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Four Essays on the Impacts of Foreign Direct Investment on the French Labor Market

Thèse

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Le temps met tout en lumière. *Thalès*

Ce qui compte ne peut pas toujours être compté, et ce qui peut être compté ne compte pas forcément. *Albert Einstein*

A mes parents
A ma soeur
Et plus particulièrement encore, à Maxime

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Introduction générale

"Un marchand n'est nécessairement citoyen d'aucun pays en particulier. Il lui est, en grande partie, indifférent en quel lieu il tienne son commerce, et il ne faut que le plus léger dégoût pour qu'il se décide à emporter son capital d'un pays dans un autre, et avec lui toute l'industrie que ce capital mettait en activité."
Adam SMITH (1723-1790)

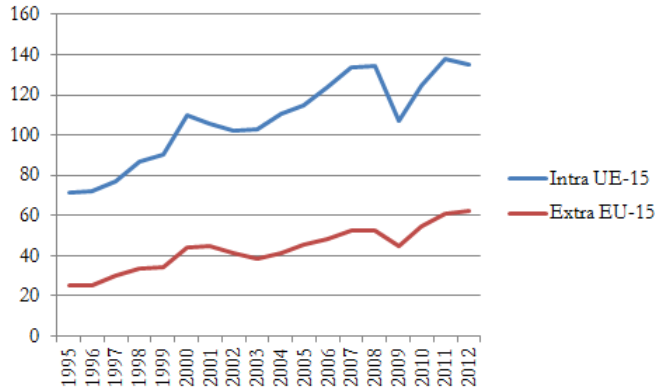
1 Panorama Général

Le partenariat de pays avec de grandes divergences dans le coût des facteurs de production, la qualification des employés et les niveaux économiques donne de grandes opportunités aux pays partenaires en termes d'échange, mais peut également provoquer des distorsions, notamment sur le marché du travail.

Déjà au 19ème siècle, sous l'impulsion fulgurante de l'amélioration des transports, la globalisation est marquée par une forte mobilité internationale de la main d'oeuvre, conduisant à un niveau d'intégration relativement élevé des marchés du travail. A cette époque, les coûts de transports étaient tels que la division du travail ne pouvait s'étendre à l'échelle mondiale. Aujourd'hui, l'amélioration des technologies de la communication et des transports constitue un vecteur de changements économiques important, à l'origine, notamment, de changements dans la façon de produire et d'échanger. La nouvelle forme du commerce international consiste désormais à fragmenter et segmenter tout ou partie des étapes nécessaires à la fabrication d'un produit. Les avancées technologiques ont, en effet, permis de diminuer les coûts de la délocalisation à l'étranger et de favoriser la segmentation des processus de production, associée au développement des investissements directs étrangers, de la sous-traitance, des zones franches, et du commerce international. La production des biens et services profite aujourd'hui des avantages de la mondialisation, en terme de compétences et de coûts de production. Désormais, les firmes les plus productives ont la possibilité de fabriquer chaque segment d'un produit là où l'avantage comparatif se trouve.

La fragmentation des processus de production à travers le monde est un phénomène en croissance continue depuis plusieurs décennies. Elle s'est traduite par une hausse fulgurante des importations et des exportations de biens intermédiaires à travers le monde. Environ 60% du commerce total, qui s'élève en 2011 à 20 trillion de dollar, correspond à du commerce de biens intermédiaires (UNCTAD, 2011). Depuis 2002, et à l'exception des années de crises financières, les importations de biens intermédiaires de la France en provenance de l'Union-Européenne n'ont cessé de croître. Selon les derniers chiffres d'Eurostat, elles sont passées d'un peu plus de 100 milliards d'euros en 2002 à plus de 140 milliards en 2012 (Figure 1).

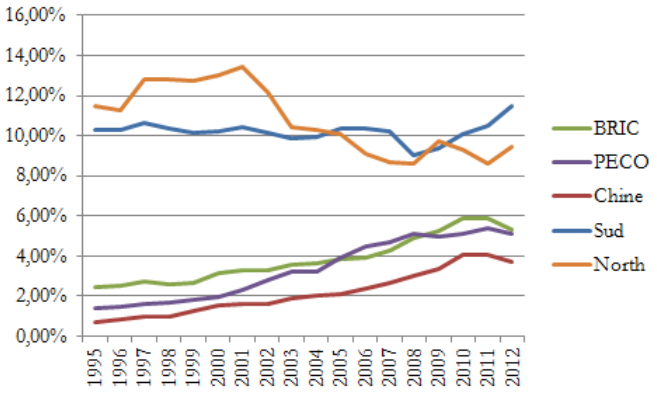
FIGURE 1 – Importation de biens intermédiaires (en valeur, Mds €)



Calcul de l'auteur - Source : comext, Eurostat - Ratio de consommations intermédiaires importées sur les importations totales. Les biens intermédiaires sont identifiés dans trois grandes catégories de la Broad Economic Classification (BEC) : "Pièces et composantes de biens d'équipement" (BEC 420), "Pièces et composantes pour équipements de transport" (BEC 530), "Autres fournitures industrielles manufacturées" (BEC 220). Cette information est mesurée à partir des informations contenues dans les tables "Entrées" et "Sorties" (TES) de la Comptabilité nationale, combinées avec des statistiques très agrégées de commerce international.

L'expansion rapide de la division internationale des processus de production est en partie dû à la montée en puissance des pays émergents, les deux étant intimement liés. Parmi ces pays figurent quatre pays particulièrement importants, de par leur taille de marché et leur potentiel de croissance : le Brésil, la Russie, l'Inde et la Chine (BRIC). L'externalisation dans ces pays est souvent motivée par l'accès à des coûts salariaux bas et par l'entrée sur de nouveaux marchés prometteurs. Cette dernière décennie a ainsi connu une intensification exponentielle des échanges commerciaux des pays développés vers les pays émergents. La France n'est pas en reste dans ce processus, puisque la part de ses importations de biens intermédiaires en provenance des BRIC a presque triplé en moins de 20 ans (Figure 2). Inversement, la part des importations de biens intermédiaires française depuis les pays du Nord a fortement chuté depuis 2001, date d'entrée de la Chine à l'Organisation Mondiale du Commerce (OMC).

Figure 2 – Importation de biens intermédiaires selon les zones de provenance (en % du total)



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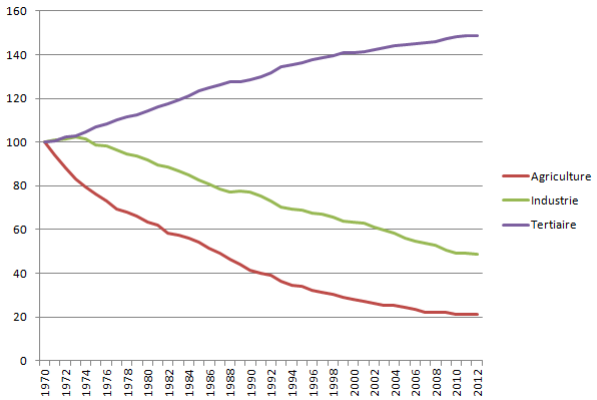
A l'instar de son commerce extérieur, le marché du travail français a connu des bouleversements importants ces dernières décennies. En particulier, l'économie française a connu un recul important de l'emploi industriel au profit de l'emploi dans le secteur des services, comme le montre la Figure 3. La diminution de l'emploi industriel atteint plus de 50% entre 1970 et 2012, contre une augmentation de 43% de l'emploi dans le secteur des services. Ce phénomène est appelé la désindustrialisation.

Figure 3 – Evolution de la part de l'emploi total par grands secteurs (base 100 en 1970)



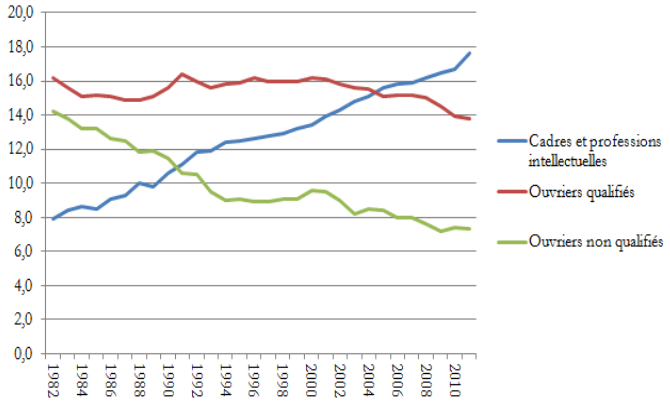
Source : Insee, Calculs de l'auteur

Il existe plusieurs explications à la désindustrialisation. D'abord, elle peut-être la conséquence d'un transfert des activités de fabrication manufacturière vers le secteur des ser-

vices. En trois décennies, environ un travailleur sur quatre a été transféré au secteur des services en France, ce qui représente 500 000 emplois. Deuxièmement, la désindustrialisation peut être liée à la hausse des gains de productivité dans l'industrie manufacturière, qui a permis de réduire les besoins de main d'oeuvre dans ce secteur. Ces gains de productivité se sont également traduits par une hausse du revenu des ménages qui ont modifié leur consommation en conséquence, au profit des services et au détriment détriment des biens industriels. Enfin, même si son impact est difficile à quantifier, la concurrence internationale a été cité comme une source de la baisse de l'emploi manufacturier (Demmou (2010)).

En plus d'une modification de la composition sectorielle de l'emploi français, un changement de la composition de l'emploi par niveau de qualification est également constaté. En effet, l'augmentation de l'emploi du secteur tertiaire s'est traduit par une plus grande part d'emploi qualifié sur le marché du travail. Ainsi, alors que les cadres et professions intellectuelles ne représentaient que 8% de la population active en 1982, ils représentaient près de 18% de la population active en 2010 (Figure 4). A l'inverse, la part des ouvriers non qualifiés dans l'emploi total passe de 14% à 8% des actifs totaux, en presque 30 ans.

FIGURE 4 – Évolution de la part des travailleurs par niveaux de qualification



Source : Insee, Calculs de l'auteur

Ces tendances soulèvent des interrogations quant aux causes à l'origine du recul de l'emploi industriel et de l'emploi non qualifié.

La première cause évoquée est celle du progrès technologique biaisé en faveur du travail qualifié. L'amélioration des technologies de communication, l'utilisation des ordinateurs au sein de l'entreprise et le développement des microprocesseurs a provoqué une augmentation de la demande de travailleurs qualifiés. En parallèle, les ordinateurs et machines ont permis de remplacer la réalisation de certaines tâches routinières effectuées par des travailleurs non qualifiés. C'est le cas par exemple des automates qui se substituent à la caissière du supermarché ou au guichetier des autoroutes ; des ordinateurs qui remplacent le traitement des fichiers papiers des secrétaires, ou encore du robot qui remplace le travail de l'ouvrier dans les usines.

La deuxième cause évoquée est celle de la mondialisation. La montée en puissance des pays émergents soulève la question d'une éventuelle substitution entre travailleurs à bas coûts à l'étranger et travailleurs non qualifiés français. Cette thèse s'intéresse plus particulièrement à cette deuxième cause et analyse l'effet des délocalisations sur le marché du travail français.

2 Les enjeux de la question de l'effet des délocalisations sur l'emploi et les salaires

La croissance des délocalisations soulève des inquiétudes récurrentes quant à son effet sur le marché du travail qui est, depuis quelques années, à nouveau sujet à interrogations de la part du corps des économistes. Cependant, pour y répondre, il est important de ne se tromper ni de défi, ni de question.

Il est d'abord important de définir la délocalisation et de la comprendre dans sa globalité. La délocalisation des activités revêt différentes formes. Elle peut se faire soit au sein de l'entreprise par l'ouverture d'une filiale, soit grâce à la sous-traitance internationale. Cependant, elle n'implique pas systématiquement de fermeture d'usine sur le territoire français [1].

Il convient également de mesurer l'ampleur de la délocalisation. A ce sujet, plusieurs mesures ont été utilisées dans la littérature. La première consiste à mesurer les importations de biens intermédiaires par rapport aux inputs totaux utlisés dans la production (Feenstra et Hanson (1999)). La deuxième mesure permet de considérer des situations plus larges que la délocalisation de biens intermédiaires (comme les délocalisations de biens finaux ou la production de biens intermédiaires à l'étranger non réimportés). Les transferts au sein des multinationales deviennent alors une variable clé. Ces transferts sont approximés dans la littérature par la part de l'emploi des filiales dans l'emploi total de la firme multinationale (FMN). Cependant, ces deux mesures ne considèrent pas, par exemple, les possibilités de fermetures d'usines, qui font le plus de tort à l'emploi local [2].

La question de l'effet des délocalisations sur l'emploi doit également être abordée d'un angle nouveau grâce à l'utilisation de données suffisamment fines, capable d'identifier les secteurs, les professions et les régions exposées aux effets de la mondialisation.

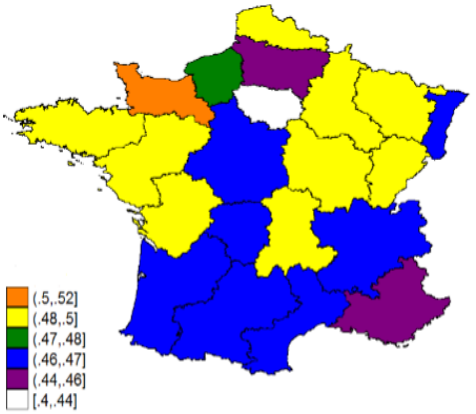
Certaines régions sont effectivement particulièrement touchées par les délocalisations, et en particulier par les fermetures d'usines, ce qui les rend sensibles à la vision du corps social et politique. D'autres innovent, exportent et importent et sont peu touchées par

1. La délocalisation absolue est le fait d'une fermeture d'une unité de production, de montage ou d'assemblage, transférée à l'étranger. La délocalisation relative est le fait d'une croissance de l'activité à l'étranger sans suppression d'unité de production dans le pays d'origine.

2. L'enquête Chaîne d'Activité Mondiales est un premier pas dans cette direction. Cette enquête est réalisée dans le cadre d'un projet européen d'amélioration des connaissances en matière de stratégies d'internationalisation des sociétés.

des destructions d'emplois manufacturiers. Les premières sont en général intensives en tâches routinières et mono-spécialisées, ce qui les rend extrêmement vulnérables face à la délocalisation.

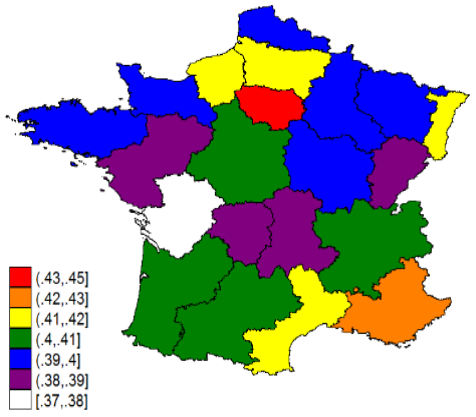
FIGURE 5 – Intensité des tâches manuelles par régions françaises



Calcul de l'auteur- Sources : DADS postes, ONET, 2007,
secteur manufacturier, entreprise de 20 salariés ou plus.

Les Figures 5 et 6 illustrent la composition de la main d'oeuvre par région, selon l'intensité des tâches réalisées. La région Ile-de-France dispose de l'indice d'interaction le plus élevé de France, reflétant le fait que cette région a une composition de la main d'oeuvre riche en travailleurs effectuant des tâches interactives (comme les cadres administratifs, hôtesses d'accueil, emplois de service). Ces emplois sont moins soumis à la pression internationale, du fait même qu'ils nécessitent une interaction physique avec le client ou avec ses collègues/supérieurs hierarchiques, ce qui les rends moins vulnérables à la délocalisation.

FIGURE 6 – Intensité des tâches interactives par régions françaises



Calcul de l'auteur - Sources : DADS postes, ONET, 2007,
secteur manufacturier, entreprise de 20 salariés ou plus.

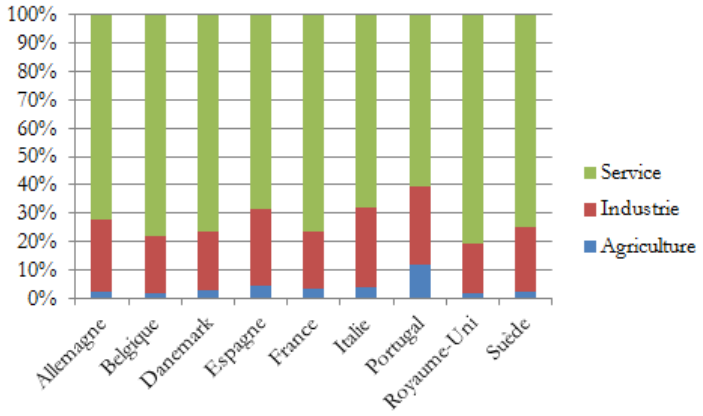
A contrario, le Nord-Pas de Calais, le Nord-Est et Nord-Ouest de la France ont une forte proportion de travailleurs effectuant des tâches manuelles (ouvriers qualifiés, non

qualifiés, contremaîtres). La réalisation de ces tâches peut être facilement codifiée et de ce fait réalisable à distance sans grande perte de qualité.

Ces différences de composition de main d'oeuvre soulignent les potentiels effets ciblés des délocalisations. Par conséquent, si la libéralisation des échanges et l'intégration économique peuvent avoir des avantages socioéconomiques au niveau macroéconomique, elles peuvent également avoir des conséquences considérables dans certaines régions, comme la mobilité des travailleurs et la désindustrialisation.

Outre la diminution des coûts, les avancées technologiques ont également permis une extension sectorielle de la division internationale des processus de production (DIPP). Elle ne concerne plus uniquement les secteurs traditionnels de l'industrie manufacturière, mais s'est désormais étendue aux services. Il est aujourd'hui possible d'opérer un patient à distance, de résoudre un problème informatique et même de surveiller, sans être géographiquement proche, grâce aux Nouvelles Technologies de l'Information et de la Communication (NTIC). Un nombre croissant de secteurs est concerné par les délocalisations. En dehors de l'industrie manufacturière, les secteurs du commerce et du BTP se sont détériorés en France, signe que la fragmentation des processus de production n'est plus propre aux industries manufacturières. En France, 8,8% des sociétés de services de l'information et de la communication, de plus de 50 salariés et exportatrices en 2009, ont délocalisé (Fontagné et D'Isanto, 2013), ce qui correspond au même niveau de délocalisation que les entreprises de l'industrie manufacturière. Blinder (2006) associe le phénomène de délocalisation des services à une troisième révolution industrielle, qui, comme les deux premières, pourrait provoquer un transfert des travailleurs d'un secteur vers un autre. La Figure 7 montre la répartition de l'emploi par grands secteurs d'activités pour neuf grands pays européens. Elle révèle que le secteur tertiaire représente la plus grande partie de la population active puisqu'il compte en France 76.6% des actifs, un des taux les plus élevés de l'Union Européenne. Ainsi, la croissance de la délocalisation dans le secteur tertiaire peut avoir des conséquences particulièrement importantes en France.

Figure 7 – Emploi total par grand secteur (en %)



Calcul de l'auteur- Sources : Source : Eurostat, Insee, année 2007.

3 Les principaux canaux de l'effet des délocalisations sur l'emploi et les salaires

3.1 L'effet sur l'emploi

L'effet sur le marché du travail peut considérablement varier selon les stratégies d'intégration commerciales et selon le degré de substituabilité des travailleurs domestiques et étrangers. Lorsque les travailleurs sont suffisamment substituables, une diminution du salaire dans le pays d'accueil augmente l'incitation d'accroître l'emploi à l'étranger pour bénéficier de coûts plus faibles. A l'inverse, lorsque les travailleurs sont complémentaires, la hausse de la délocalisation au Sud augmente l'incitation d'accroître l'emploi à domicile. La nature de la complémentarité ou de la substituabilité des travailleurs peut varier selon la forme de la délocalisation. Il semble que la substituabilité des travailleurs est plus probable lorsque la délocalisation se fait dans un pays riche (délocalisation horizontale), alors que la complémentarité des travailleurs semble l'être davantage lorsque la délocalisation a lieu dans un pays à bas salaire (délocalisation verticale) (Riker et Brainard (1997), Blomstrom et al. (1997), Slaughter (1995)).

L'effet des délocalisations sur l'emploi peut également être indirect. L'agrandissement des frontières de la firme par l'investissement direct étranger peut entraîner une restructuration du fonctionnement de la firme. Ainsi, parce que l'entreprise doit superviser et gérer une équipe de production plus large et dispersée géographiquement, la firme peut renforcer ses activités de recherche et développement, de marketing et de management sur le territoire domestique. Dans ce processus, certaines professions, notamment les professions qualifiées, peuvent être avantagées par la stratégie à l'international de la firme. De même, la compétition avec les pays du Sud peuvent induire des investissements dans des machines et des techniques de production plus sophistiquées. On parle dans ce cas d'innovation défensive qui peuvent avoir des conséquences sur le marché du travail.

Par ailleurs, il est empiriquement et théoriquement admis que seules une petite proportion de firmes peuvent exporter et délocaliser une partie de leur processus de production : celles qui sont avantagées par leur taille et leur productivité. Ainsi, les stratégies de délocalisation des grands groupes peuvent non seulement impacter la composition de la main d'oeuvre en leur sein, mais également, indirectement affecter l'emploi des autres firmes, à l'intérieur de l'industrie. Les stratégies de sous-traitance internationale peuvent en effet, déplacer la demande de production d'un sous-traitant domestique vers une firme étrangère et de ce fait nuire à l'emploi des petites entreprises domestiques, pourtant pas directement impliquées dans le processus de délocalisation.

Ces premières constatations montrent l'importance de prendre en compte l'ensemble des canaux par lesquels l'ouverture commerciale affecte l'emploi.

3.2 L'effet sur les salaires

Parce que demande de travail et salaire sont intimement liés, l'augmentation de la demande de travail qualifié et la diminution de la demande de travail non qualifié peuvent être à l'origine d'inégalités de salaire sur le marché du travail.

Dès les années 1970, les économistes observent par exemple une augmentation des inégalités de salaire et d'emploi entre travailleurs qualifiés et non qualifiés aux Etats-Unis et en Grande-Bretagne. La forte hausse des inégalités aux Etats-Unis se matérialise par un élargissement de l'éventail des salaires entre la fin des années 1970 et le début des années 1990. En effet, on observe une augmentation du ratio de salaire entre le 9ème et le 1er décile, une augmentation de 30% du salaire moyen des travailleurs diplômés de l'université par rapport aux travailleurs diplômés du lycée (Katz et Autor (1999), Bound et Johnson (1992), Acemoglu (2002a)), ainsi qu'une hausse du différentiel de salaires entre les cols blancs et cols bleus (Katz et Autor (1999) ; Murphy et Welch (1993)).

Dès la fin des années 1990, la littérature économique réalise que derrière la hausse de la demande et des salaires relatifs des travailleurs qualifiés se cachent des comportements hétérogènes. En effet, on observe un changement non monotone de la distribution des salaires par groupes de qualification aux Etats-Unis. Comme dans les années 1980, les travailleurs du haut de la distribution connaissent une croissance des salaires relativement importante par rapport à la médiane. De manière plus surprenante, on observe, depuis la fin des années 1990, une accélération de la croissance des salaires du bas de la distribution aux Etats-Unis, ce que l'on n'observait pas dans les statistiques des années 1980 (Acemoglu et Autor (2010), Autor et Dorn (2010)). Ce phénomène a été décrit comme une polarisation des salaires qui prend place du fait d'une dégradation de la situation des travailleurs du milieu de la distribution des salaires.

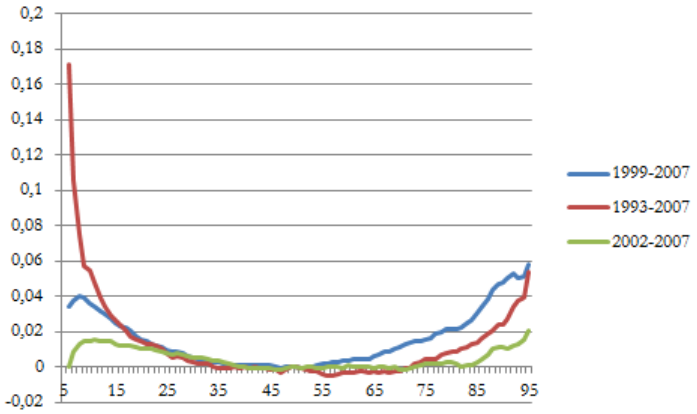
Par rapport aux marchés du travail anglo-saxons, la France dispose de plus fortes institutions, permettant de limiter les pressions à la baisse du salaire et l'accroissement des inégalités (allocations chômage, salaire minimum, aide à la mobilité). La question de l'effet des délocalisations sur les salaires français semble donc pertinente pour au moins deux raisons. La première est que son étude permettrait une comparaison de l'évolution des inégalités de salaire selon le degré de flexibilité du marché du travail ; la deuxième est que les preuves statistiques de l'occurrence d'une polarisation des salaires en France seraient encore limitées.

Pour dépasser ces limites, nous proposons de présenter sur la Figure 8 les changements à chaque percentile du salaire horaire par rapport à la médiane, pour 3 périodes de temps : 1993-2007, 1999-2007 et 2002-2007 [3]. Il apparait, sur les trois périodes, une forme en U de cette évolution. Les salaires des plus faibles percentiles connaissent une forte croissance

3. Cette figure utilise des données sur le salaire horaire des travailleurs français, employés à l'année et à temps-plein du secteur privé et publique en France (représentation au 1/12 de la population française).

relativement à la médiane. De même, les salaires des hauts percentiles présentent une croissance relativement plus forte que celle de la médiane.

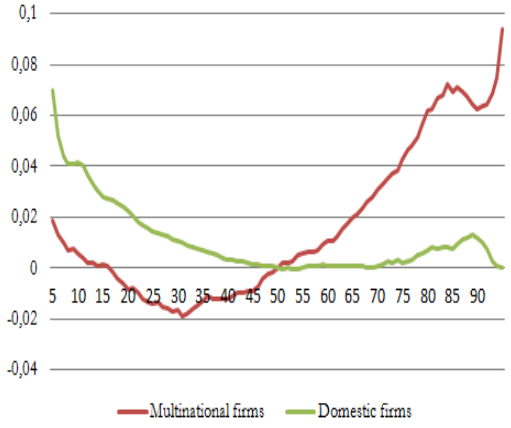
FIGURE 8 – Évolution des inégalités de salaire par percentile relativement à la médiane



Sources : Source : DADS-panel, LIFI, employés à temps-plein ayant travaillé une année complète- Calcul de l'auteur

Afin d'affiner le détail sur les inégalités relatives à la médiane, nous reportons le taux de croissance du ratio de salaire de chaque percentile par rapport à la médiane sur la période 2002-2007 pour deux groupes de travailleurs : les employés des firmes domestiques et ceux des firmes multinationales [4] (Figure 9). Les bas percentiles dans les firmes multinationales connaissent une croissance des salaires plus faible que ceux des firmes domestiques. La croissance de salaires du haut de la distribution relativement à la médiane est également plus prononcée dans les firmes multinationales que dans les firmes domestiques.

FIGURE 9 – Évolution des inégalités de salaire par percentile relativement à la médianeselon le statut de la firme (2002-2007)



Sources : Source : DADS-panel, LIFI, employés à temps-plein ayant travaillé une année complète- Calcul de l'auteur

4. Une firme multinationale est définie comme une firme ayant au moins une filiale à l'étranger

Ces statistiques montrent que la France n'est pas épargnée dans le processus de polarisation des salaires. Cette polarisation est le fait de la dégradation de la situation des travailleurs du milieu de la distribution (majoritairement composé d'ouvriers et employés non qualifiés), relativement à la situation des travailleurs du bas de la distribution (majoritairement représenté par des employés non qualifiés de service). Pour comprendre les causes à l'origine de cette polarisation, il est important de dépasser la dichotomie standard entre travailleurs qualifiés et non qualifiés. Les professions et les tâches effectuées en leur sein deviennent des variables clés pour analyser les groupes de travailleurs à risque face au progrès technologique ou à l'ouverture commerciale.

4 Motivation

Il existe différents modes d'internationalisation des firmes : investissement direct étranger (IDE), sous-traitance internationale et accès au marché par l'exportation. Dans ce travail, nous nous intéresserons plus particulièrement à l'effet des IDE sur le marché du travail. Nous pensons qu'il est important d'analyser le rôle spécifique des IDE parce que la mesure de son impact est, à ce jour, encore extrêmement limitée. En effet, la grande majorité des travaux se sont intéressés à l'effet des exportations et des importations de biens finis et intermédiaires, au détriment de l'analyse de l'effet des IDE. A ma connaissance, seules quatre études se sont intéressées à l'effet des transferts intra-firme sur la composition de la main d'oeuvre dans le pays domestique (Head et Ries (2002), Becker et al. (2012), Hansson (2005) et Oldenski (2012)).

Pourtant, les IDE représentent une partie importante des stratégies de délocalisation des firmes françaises. Un rapport récent de Fontagné et Toubal en 2010 montre en particulier que les grandes entreprises françaises ont privilégié l'IDE comme stratégie d'implantation à l'étranger, alors que entreprises allemandes semblent avoir recours plus fréquemment à des fournisseurs indépendants à l'étranger. Les filiales françaises sont également très présentes dans les pays en développement, en particulier dans les pays d'Afrique du Nord, du fait de leurs proximité géographique et de langage avec la France. Cette particularité française implique que l'effet sur le marché du travail peut être important, du fait d'une potentielle substitution entre les travailleurs non qualifiés à bas coûts dans les pays en développement et les travailleurs non qualifiés français.

Les IDE peuvent avoir un impact différencié sur le marché du travail en comparaison des autres modes d'internationalisations. Cette différence provient essentiellement de la raison d'être des IDE, qui vise principalement à protéger les actifs intangibles de la firme et à contrôler activement les activités à l'étranger.

Le choix entre l'un ou l'autre mode d'internationalisation émerge d'une littérature ancienne sur la théorie de la firme. Williamson (1970) explique les déterminants de ce choix en utilisant la théorie des coûts de transaction de Coase (1937). Dans son analyse, les

entreprises font face à un environnement incertain du fait de l'incomplétude des contrats. L'acheteur ne peut pas être certain du niveau d'effort fourni par le fournisseur. La réalisation d'un IDE peut donc être considérée comme un compromis entre le gain d'intégration (plus grande adaptation et incitation à investir), et le coût de l'intégration qui relève des coûts administratifs.

Dans Grossman et Hart (1986) et Hart et Moore (1990), les incitations à investir dépendent des droits de contrôle de l'entreprise. L'intégration verticale est préférable lorsque les investissements doivent être protégés contre des comportements opportunistes. Selon ces auteurs, l'agent qui contribue le plus à la valeur de la relation doit posséder les actifs (contrôler l'entreprise). Antràs (2003) observe que les relations de sous-traitance sont plus fréquentes dans les industries intensives en main d'oeuvre, alors que le commerce intra-firme est plus fréquent dans les industries intensives en capital. Il utilise le cadre de Grossman, Hart et Moore pour modéliser les causes à l'origine de ce fait stylisé. Il explique que le secteur intensif en travail choisit l'internationalisation via la sous-traitance parce que le travail est plus difficile à partager et nécessite des connaissances spécifiques du marché local.

Ces résultats sont importants parce qu'ils montrent que l'IDE est motivé par un avantage lié à la possession de l'actif. Le fait que l'IDE soit préféré lorsque la firme souhaite protéger ses actifs intangibles implique des transferts technologiques à l'étranger plus fréquents et des changements organisationnels sur le territoire domestique plus importants. Ces spécificités associées à l'IDE peuvent se traduire par un impact différencié sur le marché du travail, en comparaison des autres stratégies d'internationalisation des firmes (sous-traitance, exportation).

D'un côté, si l'IDE est associé à un transfert de production intensif en technologie avancée, l'effet de l'implantation à l'étranger sur le marché du travail peut être dirigé vers les travailleurs qualifiés, complémentaires aux technologies de production avancées, ayant été transférées à l'étranger.

Par ailleurs, la réalisation d'un IDE implique des changements organisationnels importants dans la mesure où la filiale à l'étranger est une entité propre au groupe. La firme peut donc avoir des incitations plus grandes à modifier l'organisation de la production. Ce changement organisationnel peut se traduire par la suppression d'établissement de production ou par la spécialisation d'établissement dans des activités connexes à la production (recherche et développement, marketing, communication). Ce changement organisationnel peut ainsi avoir des conséquences importantes sur le marché du travail en diminuant l'emploi des travailleurs associés à la production et en augmentant l'emploi des travailleurs associés aux activités qualifiées, en amont de la production.

5 Objectifs

Dans cette thèse, nous contrôlerons de l'ensemble des stratégies d'internationalisation des firmes (exportations et sous-traitance à l'international). Nous nous intéresserons particulièrement à l'effet de l'IDE sur le marché du travail et nous analyserons en détail l'effet de l'IDE sur la composition de la main d'oeuvre, sur les salaires, sur le changement organisationnel et sur la mobilité des travailleurs.

Nous répondrons à plusieurs questions motivées par les faits stylisés énoncés dans cette introduction. (i) Quelles sont les professions à risques face à la mondialisation ? (ii) Quelles stratégies d'intégration affectent davantage l'emploi français (délocalisation verticale ou horizontale) ? (iii) Comment la firme change-t-elle sa structure organisationnelle à la suite de son implantation ? (iv) Comment se répercutent ces changements sur les salaires ? (v) Existe-il des mouvements de main d'oeuvre au sein de l'entreprise à la suite d'un investissement direct étranger ?

Pour répondre à ces questions, nous avons utilisé des données microéconomiques originales dans le but de relier l'information disponible sur les employés à celle de leurs employeurs. Ces données donnent un grand avantage par rapport à la littérature dans la mesure où elles permettent de contrôler non seulement des caractéristiques des travailleurs, mais également de prendre en comptes les caractéristiques des employeurs. Seuls quelques pays ont suffisamment d'informations statistiques pour relier les informations des employés à celles de leurs employeurs [5]. Ces données permettent d'analyser différents aspects du marché du travail (mobilité, changement organisationnel, salaire et emploi) et permettent aussi d'identifier les travailleurs en fonction des tâches qu'ils effectuent.

Les trois premières questions sont traitées à l'aide de données issues des Déclarations Annuelles des Données Sociales (DADS postes). La Déclaration Annuelle de Données Sociales est une formalité déclarative, commune aux administrations sociales et fiscales, que doit remplir toute entreprise ayant employé au moins un salarié au cours de l'année. Sont concernés la majorité des employeurs, y compris les entreprises nationales, les administrations publiques et les collectivités territoriales. Ces données recensent le type de poste effectué (catégorisation PCS-ESE niveau 4), le salaire, le lieu de travail et le numéro d'établissement de l'employeur. Aux informations sur la profession de l'employé, est ajouté un indice reflétant le type de tâche effectué dans chaque profession. Cet indice est construit à partir de la base de données ONET. Pour chaque catégorie socioprofessionnelle, ONET fournit un indice sur l'importance, le niveau d'activité et sur la fréquence de 41 tâches différentes. Ainsi, la composition de la main d'oeuvre peut non seulement être analysée en terme de profession et de niveau de qualification, mais aussi en terme d'intensité de tâche effectuée. Nos résultats sur les tâches sont corroborés par deux autres indices construits à

5. A ma connaissance, ces pays sont l'Allemagne, le Danemark, la France, la Suède, la Finlande, le Japon et l'Italie.

partir d'une enquête française (enquête condition de travail) et allemande (enquête "Qualification and Career Survey").

Les informations propres aux employés sont augmentées de celles de leurs employeurs, grâce à l'utilisation de deux bases de données. La première est l'Enquête Annuelle d'Entreprise (EAE), conduite chaque année par l'INSEE. Elle recense le bilan et compte de résultat des entreprises industrielles de 20 salariés et plus. Pour ces entreprises, l'EAE fournit des informations sur leur chiffre d'affaire, leurs immobilisations corporelles, leurs profits et leur valeur ajoutée. La deuxième source d'information est celle contenue dans les Liaisons Financières (LiFi). L'enquête LiFi réalise un suivi annuel des groupes d'entreprises. Chaque observation des fichiers LiFi décrit un lien entre une société amont (qui investit) et une société aval (qui est détenue). L'enquête donne des détails sur la société aval et notamment sur son lieu d'implantation et le pourcentage des voix détenues dans les assemblées générales. Ces déclarations permettent de retracer le périmètre géographique des groupes français et de connaître leurs stratégies d'implantation à l'international. La contrainte statistique de données disponibles conduit l'étude à se concentrer sur l'effet de la délocalisation sur l'emploi et les salaires des entreprises industrielles de 20 salariés ou plus.

Nous intégrons également des informations sur les importations des firmes françaises, extraites des données douanes sur la période 2002-2007. Ces données permettent de distinguer les importations de biens intermédiaires des importations de biens finis.

Les deux dernières questions sont quant à elles analysées à l'aide de données issues du panel DADS sur la période 2002-2007. Le panel DADS est un échantillon au 1/12ème obtenu par l'extraction du fichier DADS Postes d'origine de tous les individus nés en octobre. Le panel suit chaque année ces travailleurs et permet de connaître leurs mobilités intra et inter-firmes, leurs mobilités régionales et leurs évolutions de salaires. Ces informations sont enrichies de variables sociodémographiques issues de la base de données Echantillon Démographique Permanent (EDP). l'EDP recense des informations pour un échantillon de travailleurs nés les quatre premiers jours d'octobre, ce qui permet leur appariement avec le panel DADS. Ces données sont issues du recensement des années 1968, 1975, 1982, 1990 et 1999, et du registre d'état civil. A partir de 2004, l'enrichissement de l'EDP se fait à un rythme annuel pour un individu sur sept. Les informations contenues dans l'EDP permettent de connaître le niveau de diplôme obtenu, l'âge de fin d'étude, le nombre d'enfants et le statut marital.

6 Structure de la thèse

6.1 Chapitre 1

Le premier chapitre dresse un panorama de la littérature à la recherche des causes à l'origine des inégalités d'emploi et de salaire. Il documente la littérature s'intéressant à

l'effet de l'ouverture commerciale et de son effet sur l'emploi et les salaires. Une attention particulière est portée sur la littérature récente sur données détaillées de firmes et sur l'impact combiné du progrès technique et de l'ouverture commerciale sur le marché du travail.

La revue de littérature s'attache à développer plusieurs parallèles. Un premier parallèle est mené afin de distinguer les effets de l'ouverture commerciale sur le marché du travail dans le pays de destination, au Sud et sur les pays de provenance, au Nord. Les conséquences de la délocalisation dans les pays du Sud semblent intuitivement claires lorsque la délocalisation implique principalement des segments peu qualifiés : les travailleurs peu qualifiés devraient en bénéficier. Cependant, cette conclusion n'est pas si évidente, dans la mesure où les segments peu qualifiés dans la perspective d'un pays développé pourraient être relativement qualifiés dans la perspective d'un Pays en Développement (PED). La revue de littérature recense ainsi les études propres aux PED.

En plus d'un parallèle entre pays, le chapitre dresse une comparaison entre les études menées dans les années 1990 et celles apparues à partir des années 2000. L'évolution des études sur le marché du travail est principalement le fait d'une modification de la nature des inégalités d'emploi et de salaire, puisqu'une polarisation du marché du travail est observée dès la fin des années 1990.

Enfin, un dernier parallèle dresse l'évolution des études théoriques sur la question, en distinguant les modèles théoriques des années 1990, jusqu'à leur évolution récente.

L'originalité de cette revue est double. Premièrement elle recense les études récentes de la polarisation de l'emploi et des salaires. Deuxièmement, elle cherche à mettre en lumière les hypothèses alternatives à la délocalisation matérielle en mettant l'accent sur les besoins de recherche et les pistes non encore explorées de cette thématique. En effet, la prise en compte des canaux par lesquels l'ouverture commerciale affecte le marché du travail permet d'avoir une vision nouvelle de son effet sur les inégalités. Aujourd'hui, les firmes multinationales sont considérées comme des boites noires n'ayant subi aucune transformation après leur implantation à l'étranger. Pourtant, l'ouverture commerciale peut affecter l'organisation de la firme (Caliendo et Rossi-Hansberg (2012)) et modifier l'innovation et l'investissement dans les nouvelles technologies. L'ouverture commerciale peut ainsi être à l'origine de la dynamique d'accumulation du capital et du progrès technique biaisé. Plusieurs autres hypothèses théoriques méritent également d'être testées empiriquement. La conséquence de l'amélioration de la qualité des produits, des échanges Nord-Nord ou encore des échanges du secteur tertiaire sur l'emploi demandent d'être approfondie empiriquement.

6.2 Chapitre 2

L'objectif du chapitre 2 est de mettre en évidence les professions à risque face à la mondialisation. A partir de données microéconomiques originales portant sur l'ensemble

des employés des entreprises manufacturières de plus de 20 salariés en France, ce chapitre recense l'influence du lieu d'implantation de l'IDE sur l'emploi. Nous nous attachons à déterminer si l'implantation dans un pays à bas salaire ou dans un pays émergent (BRICS) affecte davantage l'emploi que l'implantation dans un pays du Nord.

L'utilisation de données microéconomiques suffisamment fines nous permet également de souligner quels secteurs sont particulièrement affectés par les stratégies d'implantation à l'international des firmes. Nous pouvons également déterminer les régions françaises localement marquées par ce processus. En outre, nous distinguons les stratégies en marge intensive (augmentation du nombre d'IDE), des stratégies en marge extensive (primo-implantation à l'étranger).

Les professions à risque face à la mondialisation sont analysées sous différents angles. Premièrement, le chapitre analyse les professions en terme de qualification, de lien à la production et de tâches. Deuxièmement, le chapitre définit sept grandes classes de professions : ouvrier qualifié, ouvrier non qualifié, employé administratif, contremaitre, technicien, ingénieur, cadre administratif, afin de clairement identifier les professions sensibles à la stratégie d'internationalisation de la firme.

Les principaux résultats de l'analyse montrent que l'utilisation de groupes de professions agrégées ne permet pas d'identifier les gagnants et les perdants face à la mondialisation. Seule une classification en terme de profession et de tâche le peut. Ainsi, le chapitre montre l'importance de l'utilisation de données microéconomiques pour répondre à cette question.

En contrôlant par des variables propres à la firme, les résultats montrent que l'IDE vers des pays à bas salaire affecte négativement la part des ouvriers employés dans la firme française. A l'inverse, une complémentarité entre la part des cadres et l'IDE vers les BRICS et pays du Sud est observée ; particulièrement lorsque ces cadres effectuent des tâches non routinières interactives et analytiques. La délocalisation vers des pays riches est, quant à elle, associée à une part plus faible de travailleurs effectuant des tâches non routinières manuelles en France. Ces tâches sont propres aux professions techniques supérieures, tels que les ingénieurs, techniciens et contremaîtres.

En contrôlant de la stratégie d'IDE en marge intensive ou extensive, les résultats montrent également que lorsque la firme augmente son nombre d'investissements étrangers, alors que la firme est déjà implantée à l'international, elle réduit significativement son nombre d'ouvriers. En parallèle, lorsqu'il s'agit d'un premier investissement à l'étranger, la firme augmente de manière significative son nombre de cadres.

Ces résultats sont stables en agrégeant le nombre d'IDE au niveau du groupe et sont également robustes aux différentes mesures de la délocalisation (c'est-à-dire lorsque le nombre d'IDE est pondéré par la valeur bilancielle de la filiale et par le pourcentage des voix détenues dans leurs assemblées générales).

Nous vérifions également les résultats en contrôlant le potentiel biais d'endogénéité. L'endogénéité de la délocalisation est contrôlée d'une part par le niveau de PIB moyen des pays de destination et d'autre part par leur niveau d'infrastructure. Les résultats confirment la complémentarité entre la délocalisation dans les pays à bas salaire et la part des cadres dans la firme investisseuse. Toutefois, le résultat négatif obtenu à l'encontre des ouvriers n'est plus significatif en corrigeant du biais d'endogénéité.

6.3 Chapitre 3

Le chapitre 3 complète l'étude sur l'emploi en analysant l'effet des IDE sortants sur les salaires. Son objectif est double. Premièrement, il vise à mesurer les pertes ou gains de salaire liées aux IDE. Deuxièmement, il cherche à identifier quelles professions sont davantage exposées à ces changements de salaire.

De nombreux travaux se sont intéressés à l'effet du commerce international sur le salaire des travailleurs domestiques dans une industrie (Feenstra et Hanson (1996, 1999), Baumgarten et al. (2013), Geishecker et Görg (2008), Ebenstein et al. (2009)). D'autres travaux ont analysé l'effet de l'ouverture commerciale en utilisant des données de firmes (Krishna et al. (2011) sur données brésiliennes, Hummels et al. (2011) sur données danoises, Baumgarten (2013), Klein et al. (2013) analysent l'effet des exportations sur les salaires). Les travaux qui s'intéressent à l'effet spécifique des IDE sur les salaires sont en revanche moins nombreux. Ce chapitre tente de pallier à cette limite en utilisant des données françaises.

Le point de départ de ce chapitre consiste à étudier les sources de l'inégalité de salaire sur la période 2002-2007. Les résultats montrent que la plus grande composante de l'inégalité de salaire apparaît à l'intérieur des professions et des groupes de qualification. Par ailleurs, cette inégalité est majoritairement expliquée par des variances entres firmes et dans une moindre mesure à l'intérieur des firmes.

Dans ce chapitre, nous partons de l'hypothèse que les inégalités de salaires peuvent provenir des différences de statut de l'employeur : firme multinationale ou domestique. En effet, il est communément admis que seule une petite portion de firmes peuvent pénétrer le marché étranger via l'exportation ou l'IDE : celles qui sont les plus productives. Ces firmes ont un avantage comparatif, de par leur taille et pouvoir de négociation, dans la recherche de travailleurs avec de plus grandes capacités et dont les compétences correspondent mieux à leurs besoins (Helpman et al. (2010), Davidson et al. (2010)). Par ailleurs, parce que les firmes les plus grandes sont également celles qui génèrent le plus de profit, elles peuvent faire face à des pressions salariales de la part de leurs travailleurs et générer *in fine* une hausse de salaire pour que les salariés fournissent un effort optimal (Egger et Kreckemeier (2009).

De même, l'augmentation de la délocalisation peut augmenter la palette de tâches demandées aux employés. Soit parce que la firme réplique son coeur de métier dans différentes

zones géographiques, soit parce que la firme élargie ses domaines de compétences. L'augmentation des frontières d'activités et des frontières géographiques peuvent non seulement augmenter la charge de travail des employés, mais aussi élargir leurs domaines de compétences. Ces changements peuvent être à l'origine d'une hausse de salaire pour récompenser l'augmentation de travail. A l'inverse, la menace de délocalisation peut être à l'origine de pression à la baisse sur les salaires. Cette menace peut être d'autant plus crédible lorsque les salariés français et étrangers sont substituables (Choi (2001)).

Ces différentes raisons font que des travailleurs identiques *ex-ante* peuvent recevoir *ex-post* des salaires différents.

Afin de mesurer empiriquement l'effet des IDE sur les salaires nous construisons différents indicateurs de l'IDE : le nombre de filiales à l'étranger, le nombre de pays desservis par l'IDE et le statut à l'international de la firme.

Les résultats montrent que le statut à l'international de la firme explique significativement le différentiel de salaire entre les travailleurs employés dans des firmes domestiques et multinationales, pour chaque type de profession. Lorsque nous contrôlons par des effets fixes firmes et individus, les résultats montrent que l'augmentation des IDE vers des pays à bas salaires augmente significativement le salaire des cadres et diminue celui des travailleurs effectuant des tâches délocalisables. Ces résultats sont robustes quelque soit la mesure d'IDE retenue (nombre d'IDE, nombre de pays desservis via l'IDE).

Dans une dernière partie nous identifions les sources de la prime de salaire. D'un côté, cette prime peut provenir d'une faculté de l'ensemble des travailleurs à s'accaparer les surplus de profit de la firme, plus élevés dans une firme multinationale. D'un autre côté, la prime peut provenir d'une plus grande capacité de la firme multinationale pour attirer les plus grands talents. Ainsi, certains travailleurs reçoivent un salaire plus élevé du fait de leurs plus grandes capacités inobservables. Les résultats montrent que l'explication principale de la prime de salaire est liée à la capacité des travailleurs à capter les rentes de la firme.

6.4 Chapitre 4

Le chapitre 4 s'inscrit dans le prolongement des chapitres 2 et 3. Son but est de présenter les causes à l'origine de la complémentarité entre l'IDE et l'emploi et les salaires des cadres. Il s'agit de considérer l'hypothèse d'un changement organisationnel de la firme à la suite d'un investissement direct étranger. Le changement organisationnel se mesure dans ce chapitre comme (i) une plus grande autonomie des travailleurs et (ii) un transfert des activités de la firme, cédant ses activités de production au profit des activités de supervision.

Ce chapitre explore la question sous deux angles. Un premier angle théorique est abordé, en développant un cadre d'analyse d'échange de tâche *à la* Grossman et Rossi-Hansberg (2008). L'originalité du modèle réside dans le fait qu'il ouvre *la boite noire* de la

firme en analysant la structure organisationnelle de celle-ci dans un cadre *à la* Garicano (2000). Le modèle suppose une firme composée de trois couches de management : une première composée par les ouvriers, dont le rôle est de produire le bien ; une seconde regroupant les cadres employés pour superviser les ouvriers et résoudre les problèmes qu'ils rencontrent ; enfin, une troisième représentée par l'unique chef d'entreprise. La firme peut délocaliser une partie de son processus de production. Elle prend sa décision en arbitrant entre les gains de la délocalisation, liés aux salaires plus faibles versés aux ouvriers à l'étranger, et les coûts de la délocalisation, qui sont de trois types. Le premier est un coût de type administratif, commun à toutes les tâches délocalisées. Le deuxième est un coût propre à la tâche délocalisée. Enfin, le troisième est lié au fait que les cadres passent davantage de temps à résoudre les problèmes rencontrés par les ouvriers lors de la production, lorsque celle-ci est effectuée à l'étranger.

Le programme de minimisation de coût de la firme détermine le niveau de connaissance de ses employés, ainsi que leur nombre. Les résultats des simulations montrent que lorsque la firme délocalise, elle réduit le nombre d'ouvriers à domicile, et leur demande un niveau de connaissance plus faible. A contrario, la délocalisation implique une augmentation de la demande de cadres à domicile, ainsi qu'une augmentation de leur niveau de connaissance. Les simulations numériques sont menées sur la base de différentes hypothèses quant au calibrage de la fonction de coût de la délocalisation, des paramètres du nombres d'employés et du salaire étranger.

Afin de tester empiriquement les principales conclusions du modèle, nous empruntons une méthodologie propre à l'évaluation des politiques publiques. Il s'agit d'un estimateur de double différence, associé à du matching basé sur le score de propension. En d'autres termes, nous comparons le nombre de cadres avant et après l'implantation à l'étranger à celui d'une firme *jumelle* domestique. Le score de propension identifie la firme *jumelle* à la firme qui s'implante à l'étranger, en plusieurs points : son chiffre d'affaire, ses immobilisations corporelles, ses importations et exportations, sa main d'oeuvre et sa valeur ajoutée. Nous capturons le changement organisationnel de deux manières. Premièrement nous développons un indice d'autonomie des travailleurs à partir d'une enquête française sur les conditions de travail (l'enquête de la DARES). Deuxièmement, nous capturons le transfert d'activité de production vers les activités de supervision en calculant le changement du nombre de cadres et d'ouvriers dans les entreprises françaises.

Les résultats montrent qu'une firme qui s'implante à l'étranger augmente significativement son nombre de cadres, deux ans après son implantation, par rapport à sa *jumelle*. A contrario, elle diminue significativement le nombre de ses ouvriers, deux ans après son IDE. Ces résultats supportent l'hypothèse du modèle selon laquelle l'IDE change l'organisation de la firme à domicile en renforçant les activités de supervision.

Les résultats des tests de sensibilités montrent toutefois que le résultat obtenu sur les ouvriers est sensible à la technique de matching retenue et aux inobservables. Comme dans

le premier chapitre, nous sommes prudents quant à la conclusion d'un éventuel effet négatif sur l'emploi ouvrier. Cependant, la complémentarité entre les IDE et le nombre de cadres à domicile reste significatif et corrobore les résultats obtenus dans le premier chapitre.

6.5 Chapitre 5

Le Chapitre 5 s'intéresse aux déterminants des changements de salaire à l'intérieur de la firme. En particulier, il teste l'hypothèse du changement organisationnel sur les salaires.

Le Chapitre 4 a montré l'effet des IDE sur le changement de l'organisation de la firme, mesuré par l'augmentation du nombre d'employés avec un pouvoir décisionnaire (approximé par le nombre de cadres). Le chapitre 4 analyse les changements organisationnels *verticaux*, c'est-à-dire ceux qui se produisent à l'intérieur de la firme, sans se soucier des changements organisationnels *horizontaux*, c'est-à-dire ceux qui nécessitent des changements entres les établissements d'une firme. Ce chapitre tente de pallier ces limites.

Nous définissons le changement organisationnel horizontal comme la mobilité des travailleurs entre établissements au sein d'une même entreprise. Nous partons du constat que les changements organisationnels provoqués par l'ouverture commerciale peuvent conduire les firmes à renforcer l'activité de certains établissements, notamment ceux en amont de la production. La décentralisation de la décision peut prendre la forme d'un accroissement de la responsabilité manageriale des établissements décisionnaires (tels que ceux spécialisés dans l'administration, le management ou le marketing), dans le but de gagner en adaptabilité et flexibilité. Ce changement organisationnel peut provoquer une mobilité du savoir, en déplaçant les travailleurs avec une connaissance spécifique des valeurs, normes ou technologies de la firme vers certains établissements du groupe.

L'intérêt de ce chapitre est d'analyser non seulement l'effet des délocalisations sur la probabilité d'être déplacés dans un autre établissement de la firme, mais aussi de mesurer l'effet de ce déplacement sur les salaires. Les données mobilisées permettent de mettre en évidence le fait que l'augmentation des IDE de la firme augmente la probabilité pour les cadres d'être déplacé dans un autre établissement.

Les résultats des estimations économétriques indiquent également que le transfert des cadres dans d'autres établissements a un impact significatif et positif sur leurs salaires, un an après le déplacement. Ce résultat montre que cette mobilité est volontaire afin de répondre aux besoins de l'entreprise.

La méthodologie économétrique permet de contrôler non seulement de l'hétérogeneité individuelle, mais également de la sélection endogène des travailleurs ayant été déplacés.

Chapitre 1

Technical Change, Offshoring, Job tasks : How to explain rising inequality ?

1 Introduction

In the time of Adam Smith, the transportation costs were such that the division of labor could only be done to the scale of the making of pins. Today, tasks inside the same firm can be split at an international level or even be replaced by machines. Far from Adam Smith's idea though, it is the same desire for exchange, productivity and profit making which is the source of a change in the labor market structure and an increase in wage inequalities seen in Europe and in the US.

In the 1970's, economists observed an increase in wage and employment inequality between skilled and unskilled workers, more particularly marked in England and the US. Since 2000, the economic literature perceives that the rise in relative demand and wages for skilled workers stems from different behaviors. Indeed, from the mid 90s a non-monotonous change in wage distribution by qualification groups is observed. As per in the 80s, highly paid workers knew a wage increase relatively more important than the median. More surprisingly, an increase in growth rate of wages of the least paid workers has been observed since the end of the 90s, which is not found in the statistics of the 80s (Acemoglu and Autor 2011a; Autor and Handel 2013). This phenomenon has been described as a *wage polarization* in the United States, due to the erosion of middle wage workers' situation.

In Europe and in the United States, a job polarization is observed for the period 1990-2005. Demand for workers in the middle of the wage distribution decreased and the demand for workers in the top and the bottom end of the wage distribution increased. Skilled workers and unskilled workers are no longer considered as two homogeneous groups who have suffered the same impact following the adoption of new technologies or intensification

of world trade. In France, between 1993 and 2006, employment of the highest-paid workers increased by 13 %, while employment of middle-skilled workers decreased by 12 % (Goos, Manning, and Salomons 2009).

Two major trends in the literature have provided alternative explanation to the rise in labor market inequality. First, improvement in communication technology, the use of computers within the firm and the development of microprocessors can explain the rise in the demand for qualified workers, complementary to these new technologies (Acemoglu 1999; Bound and Johnson 1992; Levy and Murnane 1996). The second explanation refers to the globalization hypothesis. The increase in imports from the South led to a decrease in the demand for unskilled workers in the North, which can also explain the fall in unskilled wage in the manufacturing industry (Feenstra and Hanson 1996; Wood 1994; Leamer 1994).

During the last decade, empirical studies have shown a modest impact of trade on the labor market and have rather pointed out the effect of technological progress. The purpose of this literature review is to highlight recent theoretical and empirical advances to identify the role of globalization [1] on employment and wage inequality. This article also seeks to point out the reasons of a stronger impact of globalization on the labor market today than in the 1990s. Several arguments have been put forward.

First, the volume of international trade has increased. Krugman (2000) shows that in the 1980s, the amount of trade was too weak to explain such a significant impact on the labor market. He revised his position in 2008, given the important role of trade and more particularly the importance of imports from China in the US and in Europe. According to Krugman, trade openness seems to have played a minor role in inequality because of a statistical problem. Increasing fragmentation of production processes achieved through the rapid expansion of foreign direct investment, international subcontracting, free-zones and outward processing traffic, is not found in the statistics. When the data are aggregated, it is impossible to identify the intermediate inputs imported to produce the final good. [2] Identification of all the margins of globalization (exports, imports of intermediate inputs, intra-firm trade) allows to capture all the relevant transmission channels of globalization on the labor market.

The consequence of these stylized facts is twofold. First, theoretical understanding of trade should be reviewed by taking into account the new form of international trade. Se-

1. Globalization in the literature review takes into account both trade and offshoring. Offshoring is associated with intra-firm trade (ie imports from the foreign subsidiary) or inter-firm trade (imports from foreign subcontractors independent of the domestic firm). A detailed definition of offshoring is given in section 2.

2. Dedrick et al. (2010) illustrate this phenomenon through the fabrication of the iPod. The study highlights the limits of international trade statistics faced with international division of production processes (IDPP). This division on a global scale makes it difficult to trace intermediary components and to determine the value actually produced in any country. If the export value of an iPod in the Chinese statistics is 150 per unit, in reality its value-added is merely a few dollars. The only Chinese value added is attributable to transformation and assembly of intermediary components produced primarily in the US, in Japan or in Taiwan.

cond, empirical studies should use available microeconomic data to understand how firms are inserted into globalization (export, international outsourcing, foreign direct investment (FDI) or creation of greenfield subsidiaries) and their international strategy (vertical or horizontal investment). Indeed, most of the former research is based on data that is outdated by now. They may not have captured all relevant globalization effects since these data were almost exclusively concerned with industry, thereby neglecting potential effects on inequality within industries and within skill groups.

The use of data linking employers to their employees allows to have a better comprehension of the effect of globalization on employment, by using information on the intensity of the tasks performed in each occupation. From the early 2000s, the emergence of labor market polarization has completely changed the way workers are analyzed. While in the 1990s, studies distinguished between workers with different levels of qualification, today the skilled and unskilled workers are no longer considered as two sets of homogeneous workers. Tasks performed in each occupation become the main component of the analysis of labor market polarization. Recent literature has indeed highlighted that there is no systematic correspondence between skills and the offshorability of jobs. For instance, developing computer programs and analyzing x-ray by software engineers and doctors typically requires high-skilled workers but those tasks can easily be realized remotely ; While maintenance work does not systematically need any qualification, but cannot be relocated due to proximity requirement to the maintained facilities (Becker et al. (2013)). Thus, task characterization, such as the routine nature of tasks (Autor, Levy and Murnane (2003)), the need for proximity with the customer (Jensen and Kletzer (2010)) and the importance of face to face contact (Autor, Levy and Murnane (2003)), are more relevant to measure the offshorability of occupations than are qualifications. However, this indicator is not yet used systematically, especially because such index is developed in few countries and it does not allow the temporal analysis of task evolution within occupations.

The second argument is that international division of production processes is no longer unique to the manufacturing sector but also affects the service sector. Indeed, new technologies make possible the relocation of production inputs (Amiti and Wei 2006). Blinder (2006) associates this phenomenon with a third industrial revolution, which, like the first two will cause a reallocation of workers from one sector to another.

Globalization must also include a broader definition than just opening of goods and services to trade. Workers migration is an important component of globalization that may improve the understanding of the effect of globalization on the labor market. Immigration studies have however shown a limited effect on the labor market (Peri and Sparber 2008 ; Card 2009 ; Lewis 2005). Other studies have also emphasized the importance of considering between-industries mobility that may be caused by trade liberalization, since this type of mobility is costly for workers (Artuc, Chaudhuri, and McLaren 2010; Coşar, Guner, and Tybout 2011; Dix-Carneiro 2010).

Third, taking into account the channels through which globalization affects the la-

bor market provides a new vision of its effect on inequality. Today, multinational firms are understood as black boxes not having undergone any transformation after their implantation abroad. Yet, globalization may affect the organization of the firm (Caliendo and Rossi-Hansberg 2012) and may modify innovation and investment in new technologies. Globalization may be one of the causes of the dynamics of capital accumulation and investment in new technologies (Acemoglu 2002; Neary 2002; Thoenig and Verdier 2003) [3].

Finally, several other theoretical assumptions deserve to be tested empirically : the consequence of exports of high-quality products on the labor market and the role of North-North trade on inequality.

The present survey analyzes the impact of globalization on labor market outcomes, such as employment and wage inequality. Several articles review the literature on this issue. Chusseau et al. (2008) identify the literature on the effect of North-South trade and technological change on the labor market. They focus on the 1990s studies. Other articles review the literature on the effect of offhsoring and foreign direct investment on the labor market in developed countries (Crino (2009)) and developing countries (Goldberg and Pavcnik (2007)). However, they do not take into account the mechanisms through which trade liberalization affects inequality, nor the recent explanations of the causes behind the polarization of the labor market. Two exceptions are Pavcnik (2011) and Harrison and McMillan (2011) who identify recent literature on the effect of offshoring on labor market inequality, but they focus on wage inequality.

The originality of our review is twofold. First it focuses on the studies analyzing the effect of globalization on job and wages polarization. Second, it seeks to gain insights on the alternative hypotheses to physical relocation, by focusing on the research needs and the unexplored paths on this thematic.

The paper is organized as follows. Section 2 analyzes the origins of the debate on the role of globalization on the labor market inequality. Section 3 presents the recent literature on job polarization highlighting limitations, research needs, empirical challenges and unexplored paths of this question. Section 4 analyzes alternative hypotheses to material offshoring. Finally, section 5 lists the studies that attempt to highlight the link between technological change and relocation as well as the line of future research to pursue this reflection.

2 Increasing inequality : the origins of the debate

The strong increase in wage inequality is materialized by a widening range of wages between the end of the 1970's and the early 1990's. Statistics show an increase in the wage ratio between the 9th and the 1st decile between 1979 and 1995, partly explained

3. Technical progress is embodied in these studies by differences in firms' productivity or the upscale manufactured products.

by the increase of 30% in the average wage of college graduate workers relative to high school graduate workers (Katz and Autor 1999; Bound and Johnson 1992; Acemoglu 2003). Moreover there has been an increase of the wage gap between white and blue collar workers (Katz and Autor 1999; Murphy and Welch 1993) as well as an increase in inequality between and within groups (Juhn et al. (1993)).

Yet, the United States experienced a great period of stability in terms of wages since the late 1940s (Katz and Autor 1999; Lemieux 2008). Economists first thought of a temporary effect of the 1981-1982 recession, but it was finally clear that these changes were indeed rooted in the data. From the 1980s, many studies questioned about the root causes of inequality. The main explanation put forward is a change in the demand for skilled labor that induces an increase in the return to education, despite the increase in the relative supply of skilled workers caused by the entry of the very educated baby-boom cohort (Juhn, Murphy, and Pierce 1993; Katz and Murphy 1992; Katz and Autor 1999). The data showed indeed a stable demand over the period 1963-1979. However, this assumption was rejected in the 1980 period (Murphy and Welch 1992).

Two major trends in the literature can be distinguished to identify the principal causes of increasing inequality. First, improvement in communication technology, the use of computers within the firm and the development of microprocessors can explain the rise in the demand for qualified workers, complementary to these new technologies (Acemoglu 1999; Bound and Johnson 1992; Levy and Murnane 1996). Empirical studies find a positive correlation between technology indicators such as computer investment (Krueger (1993), Autor et al. (1998), Feenstra and Hanson (1999)), computer use (Katz and Autor 1999; Wolff 1996), R&D intensity (Allen 2001; Machin and Van Reenen 1998), and skill upgrading or wage inequality (Autor et al. (1998), Krueger (1993), Berman et al. (1994)).

From a theoretical point of view, the model originally proposed by Tinbergen (1974) shows that increasing technology, complementary to skilled workers, increases the wage premium of skilled workers, if skilled and unskilled workers are substitutes. Thus, the factor bias of technological change explains the relative wage increase of skilled workers in the United States. Leamer (1994) rejects the idea of skill biased technical change because this change can also be observed with *sector* biased technological change. If world prices are exogenous, which is the case in a small enough country, total factor productivity can lead to a price change. Thus, the increase in the wage premium for skilled workers can be observed when the skilled-intensive sector is experiencing a technological breakthrough, without a necessary bias towards one of the two factors. However, as pointed out by Krugman (1995), this result is valid in the case of a small country, but is no longer valid when world prices are determined endogenously (which is the case when the country is large enough to affect world prices). In this case only the factor biased technical change matters.

The second explanation refers to the globalization hypothesis. The increase in imports from the South led to a decrease in the demand for unskilled workers in the North, respon-

sible for the fall in unskilled workers' wage in the manufacturing industry (Feenstra and Hanson 1996; Wood 1994; Leamer 1994). However, if the impact of technological change obtained general consensus among the vast majority of economists, the importance of trade liberalization in explaining wage inequality in the United States is a widely debated question. The debate is mainly due to a lack of consensus on the empirical results obtained in the literature. The complexity of the forms of globalization makes the exercise of its measure very complicated. Firms have indeed several integration strategies, which makes the definition of globalization difficult. Firms can reach foreign markets trough exports or through offhsoring. The term offshoring may cover several situations. First, offshoring may refer to international outsourcing that implies transfer of some or all of the production to an independent supplier abroad. Second, offshoring may refer to a situation in which the company transfers its production to a foreign subsidiary. Subsidiaries may already exist (foreign acquisition) or be created (greenfield subsidiary).

There are different approaches in the literature to capture offshoring. The oldest is *the factor content of trade*. This method is a pragmatic approach defined by the accounting balance of skilled and unskilled jobs created by exports and the jobs lost by purchasing imports (Borjas et al. (1992), Sachs et al. (1994), Wood (1994)). The accounting principle consists in calculating the skilled or unskilled work content in a dollar of export or import in any sector. The factor content of trade is a controversial method because the results presented in the literature can considerably vary from one calculation method to the next [4]. In addition, even if the calculation of labor content of imports knows a success within economists for its simplicity, this method does not rely on any theoretical framework. In particular, the conclusions are valid in a partial equilibrium framework. In a general equilibrium model, this link no longer exists insofar as the cost of factors depends directly on the cost of goods (Hakura and Deardorff 1993).

This is why, in a second wave of works, the price becomes a guide to measure the impact of international trade on employment and wages. Revenga (1992) finds an important correlation between the fall in import prices and the within-industry job loss over the 1977-1987 period. Borjas and Ramey (1994) use an original econometric method by conducting cointegration tests. The only variable for which the authors reject the null hypothesis of non cointegration is the variable of net imports of durable goods as a percentage of GDP. Wage dispersion and trade deficit of durable goods share a common stochastic trend. They explain this by the fact that industries engaged in international trade have higher rents and pay higher wages to their workers, and the increase in competition from imports causes a

4. For example, Sachs (1994) considers that the job content of one dollar of import is equal to the job content of one dollar of export in the same sector. On the contrary, Wood (1994) considers that goods coming from low-wage countries are not identical to those produced in developed countries. He assumes an elasticity of substitution between workers equal to 0.5 and a price elasticity of demand equal to 0.5. These two methodologies lead to substantially different results : Wood's method overestimates losses incurred from imports and Sachs and Shatz underestimate job losses of unskilled workers, in as much as they do not consider the hypothesis of the extinction of unskilled-intensive production techniques in the North, subsequent to competition from the South.

decrease in rent and wages.

Prices are also central to articles on empirical validation of the Stolper-Samuelson theorem. First, Lawrence and Slaughter (1993) refute the theorem because they note that contrary to the hypothesis of stability of workers supply, there has been a 28% increase in skilled workers over the period 1979-1989. During this same period the relative price of skilled-intensive goods has not increased. Contrastingly, Sachs et al. (1994) note an increase in the relative price of skilled-intensive goods over the period 1978-1989 and this conclusion is supported by Leamer (1996), who notes a 30% decrease in the price of unskilled-intensive goods in the 1970's.

In light of the different results in the occurrence of these inequalities, it is very difficult to come to a consensus on the role of international trade. By the end of the 1990s the role of offshoring on labor market inequalities emerges [5] because new statistical measures of offshoring were proposed. Economists capture offshoring *via* two types of measures.

The first consists in measuring the share of imported intermediate inputs relative to total inputs used in the production. This measure of offshoring was originally proposed by Feenstra and Hanson (1999). They depart from the idea that when firms relocate a part of their production process abroad, they will have to import the intermediate good, in order to assemble it in the home country. They distinguish two different measures. The first is a broad definition that takes into account the imported intermediate inputs from all industries abroad. The second provides a more detailed definition that takes into account only imported inputs from the same industry abroad.

The second measure of offhsoring allows to consider larger situations than the relocation of intermediate goods (such as relocation of final goods or intermediate goods production abroad not being imported). Transfers within multinational firms become a key variable. These transfers are approximated by the multinational company's (MNC) share of subsidiaries' employment in total employment.

When using the imports of intermediate goods as a measure of offshoring, results mainly show that offshoring to low-wage countries can explain the bias towards qualification, while offshoring towards rich countries has an insignificant effect on employment. Anderton and Brenton (1999) analyze the effect of imports from low-wage countries on the labor market for the period 1970-1986. Their results show that imports from the South affect the demand for low skilled workers and can explain 30% of the increase in the demand for skilled labor. Hansson (2000) uses data on the manufacturing industry over the period 1970 to 1985, and notes that imports from non-OECD countries explain 5% of the increase in skilled employment growth. Helg and Tajoli (2005) propose an alternative measure as the one defined by Feenstra and Hanson (1999). They use available information on European data by calculating the ratio of imports coming from outward processing trade over the income of the industry. The outward processing trade involves goods that are temporarily exported

5. For an excellent review of the literature of this issue see Crino (2009).

from the EU to be processed abroad and eventually re-imported into the EU. This measure captures the choice of the company in terms of production sharing. They use data over the period 1988-1996 and show that offshoring affects significantly and positively the share of skilled employment in the Italian industry.

Among the studies using the second measure of offshoring, which captures intra-firm trade, it is possible to distinguish studies using individual firms' data from studies using industrial data. The results on individual firms' data show a significant and positive effect of offshoring on the demand for skilled workers when FDI are vertical, while the results on industrial data show no significant effect on employment.

Head and Ries (2002) distinguish two groups of workers, production workers and non-production workers. From a sample of 1,070 Japanese companies, they show that increasing employment in low wage subsidiaries explains the increasing demand for skilled non-production workers. A one percent change in affiliates' employment can explain 8% of the increase in the share of non-production workers in the parent company between 1970 and 1989. Hansson (2005) uses the share of employment in foreign subsidiaries as a proxy of intra-firm trade. He led the study at the industry and at the firm level on Swedish data over the period 1990-1997. He distinguishes workers with and without higher education. The study at the firm level [6] shows that MNC's transfers to non-OECD countries explain 5% of the bias towards qualification. Industrial data shows that vertical offshoring explains 15% of the rise in skilled labor demand. Slaughter (2000) uses industrial data in the United States over the period 1977-1994 and does not observe any offshoring effect on the increasing demand for skilled labor.

These studies usually take into account two types of qualification, skilled and unskilled workers. But this dichotomy does not account for the observed polarization of employment in Europe, and the wage polarization observed in the United States. Skilled and unskilled workers can no longer be considered as two sets of homogeneous individuals who have suffered the same impact as a result of globalization. Occupations then become a key component of the analysis of the polarization of employment and wages, and job content of occupations becomes a central component to analyze the labor market with a new eye.

3 Labor market inequality : Job and wage polarization

From the late 1990s, a non-monotonic change in the wage distribution has been observed. A wage polarization occurred in the United States and in Britain : wage inequality increased between the 9th and the 5th decile and reduced between the 5th and the 1st decile. Europe does not seem to have known the same evolution in wage inequalities as the US. Whereas wage inequality has not increased in Europe, contrary to what is observed in the US and England, a polarization of labor market can be noted : unemployment

6. The panel is conducted for the years 1990, 1993 and 1997 and provides information on 27 manufacturing firms.

increased for workers in the middle of the wage distribution and decreased for workers at the top and bottom end of the distribution.

Statistically, the definition of job polarization is ambiguous and varies according to studies. Some authors define it as an increase in the wage ratio between the 8th and the 5th decile of the distribution and a stability or even a decline in the ratio of the 2nd to the 5th decile (Antonczyk et al. (2010), Autor et al. (2006), Acemoglu and Autor (2011)). Others analyze polarization in terms of education, by classifying occupations according to the number of years of schooling at the beginning of the period (Autor et al. (2006), Acemoglu and Autor (2011)). Finally, occupations are classified by their average wage at the beginning of the period (Goos et al. (2009)). Job polarization is explained by a decrease in the demand for occupations located in the middle of the wage distribution (Goos et al. (2009), Kampelmann and Rycx (2011)).

This section identifies the literature going beyond the standard skilled/unskilled dichotomy of workers in order to understand the causes at the root of labor market polarization.

3.1 Theoretical Models

3.1.1 Finished goods trade

The reference model in international economics is the Heckscher-Ohlin-Samuelson, in which the relationship between wage and trade is drawn according to the hypothesis of country's comparative advantage. It is a 2 goods, 2 factors, 2 countries model (2x2x2) and assumes an identical technology in both countries. It predicts an increase in exports of labor-intensive goods in developing countries and an increase in exports of capital-intensive goods in the North, because they are relatively better endowed. Two theorems connect the effect of trade on wages : the factor price equalization theorem stipulates that when exchanges are liberated and because of free trade of commodities, the price of identical factors of production will be equalized across countries. The Stolper-Samuelson theorem indicates that an increase in the relative price of a good increases (in absolute and relative terms) the real wage of the factor used intensively in its production and decreases that of the other. This means that the decrease in the price of goods intensive in unskilled workers induces a decrease in the wage perceived by unskilled workers in the North.

This theorem is based on highly restrictive assumptions that Bagwati and Dehejia (1993) questioned in their 1993 article. The factor price equalization theorem is based on the assumption of identical technology across countries. This assumption is essential to have complementary inputs, which makes possible the arrangement of goods according to their factor intensity. But when inputs are substitutable for all relative factor prices, it is impossible to determine the factor intensity of a good. Bhagwati and Dehejia critic is not unfounded, since some segments of the textile industry remain in the country because they use capital-intensive technologies, while the same industry in the South uses labor intensive technology. Under the assumption of a possible inversion of factor intensities, the

correspondence between input prices and goods prices no longer applies. Indeed, one explanation of the Leontieff paradox (1996) is based on a possible reversal of factor intensities (Jones 1956; Robinson 1956).

Bhagwati and Dehejia are also skeptical about the assumption of constant returns to scale. Relinquishing this assumptions allows to assume imperfect competition involving higher wages in the North and South. Wood (1994) also rejects the hypothesis of incomplete specialization. In this case, if the goods are not produced in one of the two countries, the cost no longer has any implication, thereby breaking the relation between the price of good and the production factor cost. The model proposed by Wood in 1994 is fundamentally anchored in the HOS theory, but supposes that North-South trade causes a decrease in the relative wage of unskilled workers in the North due to the decrease in industrial trade barriers, but also due to the increase in the relative demand for skilled workers in the North.

3.1.2 Offshoring tasks

Traditional models of international trade continue to think in terms of production and trade of finished goods. However, the understanding of international trade reveals that countries no longer trade more wine for clothes. The advances in communication technologies, information and transportation allow increasing fragmentation of production processes (Grossman and Rossi-Hansberg 2008). It is therefore necessary to go beyond the theoretical framework in which countries exchange finished goods and services. Theoretical models of trade in tasks present the advantage of combining Smith's vision of work division and the notion of comparative advantage which we know from the Hecksher-Ohlin model.

Feenstra and Hansson (1996) are the first who introduced the possibility of fragmentation of the production process in different geographical areas. Each firm employs skilled and unskilled workers to perform a continuum of tasks. The cost of qualification determines the allocation of tasks. As rich countries are relatively well endowed with skilled workers, skill-intensive tasks are performed by workers in the North and the low-skill intensive tasks are performed by workers in the South. A decrease in the cost of offshoring (modeled by a capital movement from North to South) replaces the initial cutoff task by a new, more unskilled intensive one. The tasks reallocated are thus low skill intensive in the North but high-skill intensive in the South. This result implies that the demand for qualification increases in the North *and* in the South, which was not observed in the HOS model. This task reallocation consecutive to a fall in the offshoring cost can explain the increase in wage inequality in the North and South.

Subsequently, Grossman and Rossi-Hansberg (2008) (GRH hereafter) present a model in which the offshoring cost is heterogeneous depending on the task performed. Production requires the performance of a continuum of tasks. Each industry has the choice between performing the tasks in their home country or to relocate tasks abroad. The cost of outsourcing a task reflects the importance of whether the task must be done in the home

country and the difficulty to perform it abroad. In each industry, there exists a marginal task I such that the firm is indifferent between relocating it or keeping it in the home country because the cost of performing the task abroad equals its cost at home. This condition is given by $w = w^*\beta t(I)$ where β is an administrative cost and affects all tasks in the same way, $t(i)$ is a task specific offshoring cost function and w and w^* are the domestic and foreign wage respectively. The tasks i are ordered such that $t(i)$ is increasing. A firm that chooses α_{Lj} units of unskilled labor to perform low skilled tasks at home must use $\alpha_{Lj}\beta t(i)$ units of work abroad to produce the same output. This formulation is similar to the Samuelson iceberg cost. The idea is that a firm needs a $\beta t(i)$ extra amount of labor to make up the amount of work "lost" in offshoring process, to provide the same outcome as one unit of work at home. There exists a marginal task I such as the wage saving just balance the offshoring cost. The firm is thus willing to offshore a fraction $\int_0^I \beta t(i)di$ of workers and maintain at home a fraction $(1 - I)$ of workers.

The zero profit condition implies that the price of each good is equal to the cost of production. This implies that $P_j = w\alpha_{Lj}(1 - I) + w^*\alpha_{Lj}\int_0^I \beta t(i)di + s\alpha_{Hj}$ with α_{Hj} the amount of high skilled tasks to produce one unit of good j and w, w^* and s the wages of domestic unskilled workers, foreign unskilled workers and domestic skilled workers respectively.

Offshoring acts as an innovation that saves unskilled workers and three effects can occur from a reduction in the cost of offshoring.

The first, is the price effect [7], which according to the Stolper-Samuelson causes a wage decrease of the scarce factor. Lower offshoring costs reduce the cost of unskilled tasks performed abroad and alter the terms of trade by lowering the relative price of unskilled intensive goods. These price movements have downward implications on relative wages of unskilled workers.

The second effect comes from an increase in labor supply. This effect occurs only in an economy where there are more factors than goods. The increase in offshoring of unskilled-labor tasks provokes the absorption of unskilled workers on the labor market and causes a decrease in the relative wages of these workers.

The originality GRH model relies on the hypothesis of the occurrence of a third effect, the productivity effect. This effect comes from cost saving of the firm when offshoring increases. Two possibilities, either the firm reallocates some tasks at a cheaper cost abroad, or the firm has already begun its offshoring process, and in that case, it economizes tasks that were already done abroad. These productivity gains can reduce the price of goods, rise profits and ultimately have an impact on wages for both skilled and unskilled workers. According to this model, unskilled workers can benefit from trade if the productivity effect overtakes the price effect and the labor supply effect.

7. To understand this effect, the assumption of a small country has to be dropped so that the country can influence the world price. We assume that the foreign country is less productive than the domestic country.

Other models seek to confirm this theoretical framework by numerical simulations. Rojas Ramagosa (2010) shows that for most combinations (depending on the size of the country) wage inequality increases when the skilled-intensive country relocates unskilled tasks, because the price effect dominates the productivity effect. By expanding the GRH theoretical framework to three types of tasks : skilled, middle-skilled and unskilled, Rojas Ramagosa shows that the model can explain wage polarization.

Empirically, two major groups of empirical studies can be identified : those who consider several groups of qualification (skilled, semi-skilled, unskilled) and those who classified workers according to the tasks performed in their jobs. The following sections give more details on the empirical studies analyzing the causes at the root of the labor market polarization.

3.2 Empirical studies : The qualification at the heart of the study

The standard methodology employed to analyze the relationship between offshoring and changes in the employment structure involves estimating a translog cost function and, thanks to the Shepard's lemma, estimates the relative demand for labor :

$$\theta_{ij} = \alpha_{ij} + \sum_{s=1} \gamma_{js} \ln w_s + \phi_j \ln Q_i + \delta_j \ln K_i + \sum_{r=1} \lambda_{jr} z_{ir}$$
$$(j = 1, ...S, \mathrm{s} = 1, ...\mathrm{S}, \mathrm{r} = 1, ...\mathrm{R})$$

With $\theta_{ij} \equiv w_j L_{ij} \Big/ \sum_{s=1}^{S} w_s L_{is}$, K_i is the capital stock, Q_i is the value added or income and $z_i r$ are other variables that can affect the demand for qualification.

Ekholm and Hakkala (2005) study the effect of intermediate imports on the relative demand for different skill levels in Sweden over the period 1995-2003. They use the two offshoring proxy described above and the firm R& D investments to capture technological progress. They separate offshoring to low and high income countries. They distinguish three skill groups : (i) non-skilled workers (those with less than 9 years of schooling), (ii) medium-skilled workers (those with at least 11 to 13 years of schooling) and (iii) skilled-workers (those with a university degree). The results show that offshoring to low-wage countries is associated with a change in demand from medium-skilled workers to skilled workers. Estimating elasticities, they show that a 10% increase in intermediate imports reduces by 7% the demand for middle-skilled workers. Hijzen et al. (2005) use the same methodology on British data for the period 1982-1996. They distinguish three groups of workers. (i) Skilled workers, represented by qualified professionals such as managers, teachers, engineers and doctors, (ii) medium-skilled workers, represented by clerks, health professionals (nurses, assistant in the medical profession) and commercial employees, (iii) and low-skilled workers who are production workers in the industry or agriculture. When they use the narrow definition of offshoring (the one that takes into account the imports from the *same* industry abroad), a significant negative effect on low-skilled jobs is observed

but not on the skilled group.

Some studies use different cost functions from that discussed above. Morrison and Siegel (2001) study the United States over the period 1959-1989 and use a Leontief cost function, which has the advantage of integrating the quasi-fixity of certain variables. Thus, the assumption under which firms adjust their capital stock to price changes can be released. They distinguish workers according to their level of study : the equivalent of workers without high school degree, with high school degree, with some college and with a college degree. They add a measure of outsourcing, in addition to the ratio of import to output, which is the cost share of purchased services. They observe a negative and significant effect on the demand for workers with a bachelor's degree and without any education. Falk and Koebel (2002) use a Box-Cox cost function. They show a negative and significant effect of offshoring on the demand for unskilled labor but did not observe a significant impact on the demand for semi-skilled and skilled jobs.

All the studies presented here use industrial data. Yet, it seems that the use of individual firms' data would yield different results (Andersson and Karpaty 2007). Empirical studies lack of individual data linking firms to employees. This gap prevents to have information on the characteristics of employees, their wages and occupations. Only few countries have sufficient statistical information to be able to combine information from firms to employees [8]. Andersson and Karpaty (2007) use the same methodology as the one adopted by Hijzen et al. (2005) and Ekholm and Hakkala (2005). They use individual data from Sweden over the period 1997 to 2002, and consider three levels of qualification. The results show that service offshoring increases the relative demand for skilled labor, while the relative demand for medium skilled labor is negatively affected, regardless of the destination of foreign investment.

Hakkala and Huttunen (2010) use Finnish employer-employee data over the period 1999-2004 and distinguish three levels of education, workers with (i) 9 years of education, (ii) 12 years and (iii) more than 12 years. They use the measure developed by Feenstra and Hanson (1996) [9] and try to show how a change in offshoring affects the probability to separate from a job. They measure this by following the workers between t and $t+1$. Workers who are not attached to the same firm between the two periods are considered as excluded from the firm. [10] They show that the probability of being excluded is higher in firms intensive in intermediate goods imports and this probability is greater for workers with the lowest level of education.

It seems that results are very different depending on the data used. Studies on industrial data show a negative and significant effect on the demand for unskilled workers, while studies on individual firms' data show a positive and significant effect on the demand for

8. Denmark, France, Sweden, Finland, Japan, Italy and Germany, to my knowledge.
9. Refer to Section 3.3.1 for more details.
10. This exclusion may be due to different reasons : retirement, unemployment or parental leave. This is why the authors control for a large number of individual characteristics of the employee.

skilled-workers. However, they do not help to explain the entire process of polarization. To do so, it is necessary to go beyond a classification by qualification and put tasks at the heart of the study. Groups of workers are no longer classified according to their level of education but according to the characteristics of their occupation.

3.3 Polarization analysis : Task at the heart of the study

In this type of study, the empirical question remains the same, and studies seek to analyze the labor market effect of offshoring. However, rather than thinking in terms of qualifications, workers are identified by their tasks' characteristics. Occupations become a key variable to develop an index of offshorability. This index identifies the jobs at risk in the face of globalization.

Different criteria were used to define *offshorable* tasks. According to Autor, Levy and Murnane (2003) (ALM hereafter), the codified nature of a task determines its potential of relocation. The more a task can be determined by specific rules, the less it relies on tacit knowledge and the easier it is to explain it to someone else and to control it. Blinder (2009) constructs a measure of offshorability from the "Princeton Data Improvement Initiative". This study was conducted among 2513 participants aged 18 years and over. They are interested in the work condition and the activities performed within various occupational categories. Offshorability of a task depends on its potential to be realized in another location without loss of quality and on the importance of *face to face* contact with people other than fellow workers. These criteria differ from those developed by Autor, Levy and Murnane (2003). Wright (2010) combines ALM (2003) criteria with Blinder and Krueger (2009)'s one. He uses the ONET database in which indexes on the routine nature of tasks and the importance of physical contact are developed by occupation. By taking the average of these two measures, he assesses an index of offshorability by occupation :

$$i = \frac{(1 - \text{routine}) + \text{interaction}}{2}$$

A tasks i is more easily offshorable, the more it is routine and the less it requires physical interaction. Jensen and Kletzer (2010), develop an index of offshorability from the Helpman and Krugman (1987) original idea on geographic concentration of industries and occupations in the United States. The underlying idea is that when industries and occupations are highly concentrated, the tasks performed in these occupations may *à priori* be remotely performed from a single work site. However, to the extent that some activities may be concentrated, due to major tourist activity for example, the tasks performed in these occupations may not be offshorable (limousine drivers, for example). The authors improve their index by adding information on occupations' characteristics described in the ONET database.

On German data, the task content is calculated from the "German Qualification and Career Survey". Monitoring of this survey between 1979 and 2006 allows to analyze changes

in skill requirement within occupations (Becker et al. (2012), Baumgarten et al. (2013), Spitz-Oener (2006)). Becker et al. (2012) use two different indicators to classify offshorable task, (i) the non-routine character of a workplace tool, and (ii) the need for a physical interaction in the use of the same workplace tool. Each occupational category is assigned an index ranging from 0 to 1, measuring its intensity in non-routine and interactive tasks.

Goos et al. (2009) develop a different approach starting from jobs already relocated rather than offhsorable jobs. They use the "European Restructuring Monitor (ERM)" of the European Monitoring Centre on Change (EMCC). This database provides information on European companies that have announced offhsoring plans. Information on what type of occupation is being offshored allows them to develop an index of offhsorability. Finally, Crisculo and Garicano (2010) use a new method to measure offshorability. Occupations for which the exercise needs a license (such as lawyers or architects) limit the ability to be undertaken abroad compared to occupations without licensing requirements (e.g. consultants). The authors observe that higher penetration of service imports increases wages and employment of occupations protected by a license. They explain this result by the fact that these occupations benefit from complementarities with offshored tasks.

Studies on the polarization of the labor market have shown the importance of using detailed microeconomics data to understand the effect of offshoring in the North and the South and to take into account the characteristics of jobs. However, this information is often subject to large statistical constraints as detailed in the following section.

3.3.1 Statistical difficulties

Linking tasks to occupations has become a major challenge of polarization analysis. However, the statistical difficulties related to the lack of data and information available do not always allow for temporal and geographical comparison of changes in tasks requirements.

The main database used to connect tasks to occupations is that of the Department of Labor's Occupational Information Network (ONET) [11]. However, this database does not provide information on workers. Therefore, an analysis on intra-occupations heterogeneity is not possible (Autor and Handel 2009). It is only possible with a limited number of data sets, interrogating workers about their daily work activities.

The qualification and Career Survey conducted by the German Federal Institute for Vocational Training and Research Institute of the Federal Employment Service are part of them [12]. It is conducted among 30,000 individuals and their work activity is used to

11. This database is the Dictionary of Occupational Title's successor. It provides information on the characteristics of nearly 900 occupations in its latest version. The characteristics of occupations are identified in seven major categories : abilities, interests, knowledge, skill, work activities, work context, and work value.

12. The BIBB/AB survey includes five cross section data for years 1979, 1985-1986, 1991-1992 , 1998-1999, 2006.

analyze changes in tasks performed *within* occupations [13].

England also provides information on the task content of occupations thanks to the British Skill Survey. This database is useful insofar as it provides valuable information on the importance of each task, which can change over time (Akcomal et al. (2011)).

The statistical limit often pushes empirical studies to make the restrictive assumption of constant intra-occupations tasks content (Goos et al. (2009), Firpo et al. (2011), Acemoglu and Autor (2011)).

These limits also make international comparisons difficult. International comparisons are possible only if international occupations can be compared [14]. Surveys providing information on the task content of occupations are scarce and limited to certain countries (including Germany, England and the United States). In this case, international comparisons with a task-based approach require to make the assumption that tasks-content of occupations are the same from one country to another. However, this assumption is true only if the classification of occupations in each country refers to the same type of activity or task performed. For example, Goos, Manning, Solomon (2010) use the US ONET data to determine the task content of European occupations. Michaels et al. (2010) analyze job polarization in the United States, Japan, and nine European countries using the index developed by Autor, Levy and Murnane (2003) on US data. Both studies conclude that the decline in routine intensive jobs is mainly caused by technical progress. However, their conclusions are true only if the routinization index based on US data can be also used with European occupations. In other words, if the U.S. and European occupations have the same task-content, which has not yet been empirically proved.

Tijdens et al. (2011)'s article is a first step in this direction. It seeks to empirically confirm the hypothesis of a similar task-content of occupations in eight European countries (Netherlands, Poland, Germany, France, Belgium, Italy, Spain, Great Britain) in 160 occupations. This study is based on a survey conducted over 2468 individuals [15]. The results show that *frequency* of tasks performed is rarely identical between respondents in different countries. However, *the importance* of the tasks performed is very similar in different countries, among respondents with identical occupations [16]. This study highlights the need to develop detailed task content per occupation for each country or at least European-wide statistics.

13. This survey is used by Spitz-Oener (2006), Antonckzyk et al. (2009) , Borghans et al. (2008), Fedorets (2011), Baumgarten et al. (2010).

14. In Europe, the classification of occupations ISCO differs from the American SOC classification, even if an harmonization exercise allows a clearer reading of the correspondence tables.

15. These people are professionals with a strong knowledge of selected occupations, which include executives in human relations, staff representatives, managers etc.

16. The importance of each task is measured using a scale ranging from not important at all to major importance.

3.3.2 Empirical Results

Job polarization and tasks offshoring. Concerning the effect of offshoring on task and qualification demand, Oldenski (2010) shows that routine tasks are more likely to be undertaken by foreign subsidiaries whereas non-routine tasks are more likely to be performed in the parent company. Becker et al. (2012) use data on German multinationals and observe a statistically significant relationship between offshored employment and the proportion of non-routine jobs in the parent company in manufacturing and service sectors whatever the investment destination. They show that the probability to offshore in high-income countries is higher when the firm employs intensively white-collar workers performing non-routine tasks, whereas offhsoring to low-wage countries is more likely to arise when the firm employs blue collar jobs performing routine tasks. Hogrefe (2011) uses German data and also notes that offshoring decreases the relative demand for offshorable jobs, i.e. occupations in which the routinization index is important. But these results are significant only when investments are made to non-OECD countries.

Wage polarization and tasks offshoring. Ebenstein et al. (2010) seek to analyze the effect of offshoring on US workers' wage over the period 1983 to 2002, at the industry level and at the individual level. They first use data on the U.S. manufacturing sector between 1979 and 1990. They observe that the only significant relationship is investment in high-income countries. A 1% increase of employment in high-income countries' subsidiaries is associated with an increase of 0.01% in non-routine workers' wage. However, if the within industry impact is low, occupational changes due to between industry movement may be important. The authors calculate for each occupation exposure to international trade. They calculate an occupation-specific import penetration ratio such that $\sum_{j=1}^{J} \alpha_{kj.IMP_{jt}}$, with $\alpha_{kj} = \frac{L_{kj}}{L_k}$ the ratio of the number of workers in occupation k and industry j on the total number of workers in the profession k; and IMP_{jt} is the import penetration ratio of goods in industry j and year t. They show that a 1% increase in low-wage countries employment is associated with a decline of 0.073% in routine workers' wage. To explain the differences observed in between industry results and within-industry ones, the authors seek to understand how the wage of an excluded worker evolved. To do so, they track wage change between t and $t+1$ for a given worker on an indicator for switching industry or occupation. Workers who quit manufacturing experience a pay cut of about 3.3% and this decrease is more important for workers performing routine tasks. When workers change occupations, this further reduces wages by 5.9%.

On German data, Baumgarten et al. (2010) study the effect of offshoring on wages and try to indentify whether workers with highly interactive or non-routine occupations are more affected than routine and interactive workers. They show that increased offshoring (approximated by the narrow concept of material offshoring, i.e. imported intermediate inputs) reduces by 38 euro cents the hourly wage of medium skilled workers when performing routine tasks, and increases by 7 to 27 euro cents the hourly wage for medium-skilled

TABLE 1.1 – The effect of globalization on the labor market

	Country	Sample	Measure of offshoring	Results
Studies based on three levels of qualification				
A) Effect on employment				
Ekholm and Hakkala (2005)	Sweden	Industry level 1995-2003	Share of imported intermediates inputs	Negative on middle skilled workers Positive on skilled workers
Hijzen et al. (2005)	United-Kingdom	Industry level 1982-1996	Share of imported intermediates inputs	Negative on unskilled workers
Falk and Koebel (2002)	Germany	Industry level 1978-1990	Share of imported intermediates inputs	Negative on unskilled workers
Morrison and Siegel (2001)	USA	Industry level 1959-1989	Share of imports	Negative on unskilled and middle-skilled workers
Andersson and Karpaty (2007)	Sweden	Firm level 1997-2002	Share of imported intermediates inputs	Negative on middle skilled workers
Hakkala and Huttunen (2010)	Finland	Firm level 1999-2004	Share of imported intermediates inputs	Negative on low-skilled workers
B) Effect on wages				
Oldenski (2012)	USA	Firm level 2002-2008	Share of foreign affiliate sales in total firm's sales	Negative on workers earning the median wages
Baumgarten et al. (2010)	Germany	Industry level 1991-2006	Share of imported intermediates inputs	Negative on low-skilled and middle-skilled workers
Studies based on tasks				
A) Effect on employment				
Becker et al. (2012)	Germany	Firm level 1998-2001	Share of foreign affiliate sales in total firm's sales	Positive on non-routine interactive employment
Hogrefe (2011)	Germany	Firm level 1998-2007 1996-2005	Share of imported intermediates inputs intermediates inputs	Positive on non-routine employment
B) Effect on wages				
Ebenstein et al. (2010)	USA	Industry level 1983-2002	occupation-specific import penetration measure	Negative on routine workers' wage
Hummels et al. (2011)	Danemark	Firm level 1995-2006	Share of imported intermediates inputs	Negative on routine workers' wage

workers performing non-routine tasks. Their econometric analysis has the advantage of showing that workers are affected differently by offshoring depending on the tasks they perform. This result is also found for unskilled workers. However, wage effect of offshoring in general equilibrium i.e. when observing the movement of workers among industries, is very different. They adopt the same methodology as Ebenstein et al. (2010), by applying an occupation-specific measure of offshoring. The authors observe a more significant decrease in wages than the one observed in the partial equilibrium case.

Hummels et al. (2011) are able to follow workers and analyze the wage progression for workers who lose their jobs. They construct a measure of outsourcing based on imported intermediate inputs. Their empirical specification seeks to explain the change in wages induced by increased outsourcing. This relationship cannot be estimated if firms experience a demand or productivity shock that could affect both outsourcing and wages. To correct this endogeneity bias, they build four instruments correlated with the decision to outsource but uncorrelated with changes in the firm's ability and wage structure. They use exchange rates, tariffs, transport costs and world export supply. Then they track workers outcome after a job spell. The authors idea is to test whether wage losses for workers displaced from outsourcing are more pronounced than for workers displaced for other reasons, because their skills become obsolete and are specialized in tasks imported from abroad. They observe that workers excluded from a firm that increased its intermediate goods imports experience a larger wage decline than those excluded from another firm. They also note that both skilled and unskilled workers suffer a pay cut, but this decline is lower for skilled workers. After one year, skilled workers laid off from the firm because of rising imports have a 19% lower wage compared to their earnings before the exclusion. Unskilled workers experience a 28% wage decrease and this decline is four times greater than for unskilled workers remaining employed. Finally, they study the wage effect of outsourcing shocks conditional on occupational characteristics. They observe that wage gains are largest for social science or language skill intensive occupations.

3.4 The effect of Offhsoring in the North and in the South

The results presented in the previous section mainly analyzed the effect of globalization in the Northern home country. This section separate out the empirical literature that has focused on the impact of outward offshoring in the North and in the South. We also distinguish the literature between North-North offshoring and North-South offshoring.

3.4.1 How to distinguish vertical and horizontal FDI ?

Offshoring strategies to the North and to the South are two different types of globalization strategy. The multinational theory distinguishes two foreign direct investment (FDI) strategies (i) horizontal direct investment that takes place in order to conquer new markets and (ii) vertical FDI that intends to take advantage of the production factor costs differential (Markusen 1995). The effect on the labor market can considerably vary from one

integration strategy to another. In Harrison and McMillan (2011), vertical investments are associated with more manufacturing jobs in the United States, because in the case of vertical relocation, domestic and foreign employment are complements. [17] However, the link between the complementary nature of foreign and domestic labor and vertical integration is not clear. Several studies conclude that substitution may occur when FDI are horizontal (Braconier and Ekholm 2000; Konings and Murphy 2006; Cuyvers et al. 2005), whereas others conclude that substitution between domestic and foreign workers is more likely to arise when investments are made in low wage countries (Riker and Brainard (1997), Slaughter (2000), Blomstrom et al. (1997)). For Lipsey (2002), access to new markets or the possibility to lower factor costs can increase firms' profit and competitiveness and a positive effect on home employment can arise. Muendler and Becker (2010) show how to structurally analyze the employment effect depending on the country location. They analyze the multinational labor demand responds to wage differentials. They show that a one percent increase in German wages is responsible for an increase of 4000 manufacturing jobs abroad, at the extensive margin.

Empirically, it is very difficult to distinguish the different types of integration. Harrisson and McNillan (2011) assume that MNCs' strategies are vertical when the share of intermediate imports is strong and horizontal when it is low. Head et al. (1995) assume that when investments are held in a developing country, it reflects a vertical integration strategy, with a higher probability to invest in unskilled labor intensive activity. Hansson (2005) considers that an employment increase in non-OECD subsidiary reflects vertical foreign investment.

However, it seems important to go beyond the standard dichotomy "Southern" *versus* "Northern" countries to distinguish the different types of integration, to the extent that some developing countries are both attractive, because the demand is high, but also because the production costs are low (China, India, Russia and South Africa, for example). It is important to use a thinner decomposition in order to distinguish emerging countries, poor countries, or countries having signed a free trade agreement, for example.

The comparison between the parent company and its subsidiaries' activity may also be a good candidate to distinguish between vertical and horizontal FDI. The underlying assumption is that when the subsidiary's activity is similar to the parent's one, then the probability of horizontal strategy is strong, and when the activities of the two companies are different, the probability of vertical strategy is important. Indeed, in the case of vertical strategy, production processes are divided in different geographical areas in order to save production costs, while in the case of horizontal strategies, access to new markets requires a replication of activities in different geographical zones. However, to my knowledge, this hypothesis has not yet been used empirically.

17. They observe a slightly negative impact of horizontal investment : a reduction of 10% of affiliate wage is associated with 0.2% decrease of domestic employment. As in the 1990s, the drop in the capital and technology price and the increase in imports are both responsible for the decline in domestic employment.

3.4.2 Consequences in the North of outward North-North offshoring

The theoretical and empirical literature has mainly focused on the effects at home of North-South offshoring. Yet, offshoring between two similar countries represents an important part of international trade. Grossman and Rossi-Hansberg (2010) develop a model with two similar countries, except for their size. Production requires a continuum of tasks and the location of tasks depends on the trade-off between the benefits of concentration and the cost of relocation. The model assumes that the largest country specializes in tasks that are more expensive to offshore, whereas the smallest country specializes in tasks that are cheaper to outsource. The Grossman and Rossi-Hansberg model (2010) has not yet been the subject of any empirical study. This hypothesis is interesting though, insofar as it would explain differences in the evolution of inequalities in terms of employment, observed between similar countries. If the country is relatively large compared to its trading partners and specializes in more expensive tasks to offshore, North-North offshoring may transfer workers to sectors that are not subject to international competition because the sector is intensive in non offshorable tasks. This hypothesis joins up with the study of Askenazy (2005), where trade opening can reduce inequalities if manufacturing workers excluded from the labor market find jobs in the service sector.

Costinot and Vogel (2010) develop a model with two Northern countries that differ in their factor supply. They assume that the domestic country is more diverse. The country offers more factors than the foreign country. Trade openness implies a decrease in the demand for unskilled workers and an increase in the demand for skilled workers abroad. The opposite is observed in the domestic country. Thus, trade openness causes a wage polarization in the domestic country, since among the least skilled workers, the lowest skilled workers are favored, while among the most skilled workers, highest skilled workers are favored. Wheareas, in the foreign country, trade openness implies a greater convergence since the medium-skilled workers benefit from trade openess.

3.4.3 Consequences in the South of outward South-North offshoring

The studies presented so far have shown that the theoretical and empirical literature has largely focused on Northern economies, while very few studies have focused on the labor market effect of globalization in the destination country [18] (Peri and Poole (2013)).

The consequences of offshoring in the South may seem intuitively clear since relocation mainly involves low-skilled activities, thus low-skilled workers should benefit from inward offhsoring. Yet, this conclusion is not that obvious especially if the low-skilled segments from the perspective of a developed country is relatively skilled in the perspective of a developing country.

Khalifa and Mengova (2010) extend the Grossman and Rossi-Hansberg (2008) model by

18. Goldberg and Pavnick (2007) provide an excellent literature review on the effect of globalization on inequality in developing countries.

integrating different levels of qualification in the South. In their model, Southern countries in which the level of qualification is above a threshold level are relatively better endowed with skilled workers than countries below this threshold. They show that Northern firms prefer to outsource skilled tasks in the Southern countries that are relatively better endowed with skilled workers (countries above the threshold level) and prefer to outsource unskilled labor in Southern countries that are relatively better endowed with low-skilled workers (countries below the threshold level). This transfer of tasks involves an increase in the relative wage of skilled workers in the North and an increase in the relative wage of unskilled workers in the Southern country that is relatively well endowed with unskilled workers. They estimate their model using a panel data over the period 1982-2000 on a sample of 29 developed countries. They are able to define a threshold abundance of skilled workers below which the relationship between offshoring and inequality is negative and above which they do not observe any significant effect.

Other studies mainly focus on the home effect of offshoring that originates from the South. Ehrl (2013) uses Brazilian employer-employee data and matching technique combined with a difference in difference estimator in order to analyze the effect of increasing imports of intermediate goods on employment in Brazil. He shows that increasing imports raises the demand for routine and non-routine manual tasks. Fajnzylber et Fernandes (2009) use two World Bank database on Brazil and China. They show that Brazilian firms that offshore increase the demand for skilled workers. Conversely, they observe a negative correlation between increasing FDI and the demand for skilled workers in China.

Another part of the literature has analyzed the effect of trade openness on the labor market. The results of empirical studies give no clear consensus on this question. Trefler (2004) studies the effect of the Canada-US free trade agreement on wages. He observes that the trade agreement is associated with a decrease of 5% in manufacturing employment. However, it does not show any significant effect on wages. Amiti and Davis (2012) use Indonesian data for the period 1991-2000. Indonesia is a good framework to study this question because customs duties on imports reduced by 8 percentage points and export duties decreased by 13 percentage points. They observe that a decrease of 10% in tariffs reduces wages inside domestic firms by 3% and increases employee wages in exporting firms by 3%. They also observed that a 10% decrease in imports custom duties increases the wage of importing firms by 12%.

Pavcnik et al. (2004) use industry data on Brazil and do not observe any significant effect of tariffs' reductions on wages. Kaplan and Verhoogen (2006) use employer-employee data for the period 1993-1997 on Mexico. They show that even if the peso crisis had a positive effect on wages, skilled workers' wage in most productive firms grew more than that of unskilled workers, causing an increase in inequality. Attanasio et al. (2004) also find that tariffs reductions in Colombia increase returns to education and create wages' reduction in unskilled-intensive sectors.

3.4.4 Consequences of inward offshoring in the North and in the South

The studies presented so far have focused on the impact of outward offshoring. Some studies have also highlighted an important impact of inward offshoring on the destination country.

Hakkala et al. (2014) use employer-employee data on Sweden over the period 1996-2005. In the early estimates, they show that multinationals have a higher proportion of non-routine workers than domestic firms. In a second step, they seek to estimate the effect of a foreign acquisition on the employment structure using a matching technique to control for the endogeneity bias. Three different types of acquisition are examined : (i) the acquisition of a local firm by a Swedish multinational, (ii) the acquisition of a local firm by a foreign multinational, (iii) the acquisition of a Swedish multinational by a foreign multinational. Distinguishing between vertical and horizontal investment [19], the authors show that a 1% increase in offshoring decreases non-routine employment by 0.4 percentage points and this can be explained by the fact that only horizontal investment has a significant effect. These results suggest that imports of intermediate goods from other high-income countries appear to substitute for more advanced job tasks. Finally, their study shows that local firm acquisition by a multinational increases the share of employees performing non-routine tasks.

The literature has also analyzed the effect of inward FDI on wages. Most studies on developed and developing countries find that foreign-owned firms pay higher wages, on average, than privately owned local firms (see Girma and Gorg (2007) for the United Kingdom, Huttunen (2007) for evidence on Finland, Lipsey and Sjoholm (2010) for evidence on Indonesia, Heyman et al. (2007) for evidence on Sweden and Feenstra and Hanson (1997) for evidence on Mexico). The existence of spillovers has been indicated as one of the reasons why inward FDIs might benefit a host economy. Indeed, imitation of technological innovation and workers' mobility from foreign-owned to domestic firms may increase the productivity of other firms in the host country (Fosfuri et al. (2001)).

4 Indirect effects of globalization on the labor market

So far, the work listed in the previous section is referred to material offshoring, that is, offhsoring of production activities abroad. Yet, globalization is broader than the material aspect of offshoring. Notably, service offshoring and immigration may have a significant effect on the labor market. In addition, previous studies did not attempt to understand the channels through which globalization acts. This section will focus on reviewing the empirical studies attempting to fill these gaps and highlight research needs in this area.

19. They use the distinction between investment in OECD countries versus investment in non-OECD countries to distinguish horizontal investment versus vertical investment.

4.1 Service Offshoring

International trade takes a different form than the one known a decade earlier. The fragmentation of production processes is not unique to the manufacturing sector but also affects the service sector. Increasing international trade and foreign direct investment are mainly the result of rapid expansion of intermediate goods trade and foreign direct investment in the service sector. Blinder (2006) relates the service offshoring phenomenon to a third industrial revolution, which, like the two first may cause workers reallocation from one sector to another. New technologies make this relocation of service inputs possible (Amiti and Wei 2006). The effect of trade on service employment has not yet been the subject of numerous studies (as emphasized by Liu and Trefler (2011), only six empirical articles have examined the impact of service trade : Amiti and Wei (2006), Geishecker and Gorg (2008), Liu and Trefler (2008), Blinder and Krueger (2009), Crino (2009), Criscuolo and Garicano (2010), and Ebenstein et al. (2011)). The majority of them observe a modest impact on the labor market (Liu and Trefler 2008; Amiti and Wei 2005).

Amiti and Wei (2004) estimate a labor demand equation and incorporate a measure of offshoring similar to the one used to approximate physical offshoring : they use the share of imported service inputs on total industry imports in Britain. Between 1995 and 2001, they observe a small positive effect of services offshoring on employment. In a similar work on the U.S, with data for the period 1992-2000, Amiti and Wei (2006) do not observe any significant effect of offshoring on total employment when sectors are aggregated (data on 96 industries) and observe a slightly negative effect when data are disaggregated (data on 450 industries).

Liu and Trefler (2008) focus on offshore outsourcing in services to China and India. They observe a slightly positive overall effect on employment and wages. Their main results show that changes in occupations to less well paid occupations increased by 17% and that job losses increased by 0.9% due to offshoring of service.

Regarding the impact on skilled workers, studies show a positive effect of service offshoring on the demand for skilled workers. Crino (2010) shows on U.S. data for the period 1996-2006, that service offshoring affects negatively the demand for low and medium-skilled jobs, and the demand for routine jobs (routine cognitive jobs are those who extensively use computers and those who require less face to face contact with customers). He also shows that service offshoring increases the demand for skilled workers. Geishecker et Görg (2008) on English data for the period 1992 to 2004, show that service offshoring has had a positive effect on skilled workers' wage (even though material offshoring does not significantly affect their wages).

Also, as stated in Crino (2009), relocation of services has often been perceived as a threat to skilled workers, because service activities are on average more qualified than production activities. However, service industries employ different workers, some are unskilled (operator in call center for example), and others are skilled (project manager in advertising

or engineers). It would be interesting to understand the reasons why we did not observe any negative effect of service offshoring on skilled jobs.

Oldenski (2009)'s study makes a first step in this direction. She refutes the standard integration choice prediction of a firm in the service sector. While arbitrage between economy of scale of concentration and the benefits of producing near the final consumer exists in the manufacturing industry, this tradeoff is not a significant determinant of the export to FDI ratio in the service sector. She develops a new measure of FDI versus export relative cost through a task based approach. Industries requiring direct communication with consumers are more likely to be produced in the destination market. Production of more non-routine activities is more likely to occur at the multinational's headquarters for export, especially when the destination market has weak institutions. Thus, unskilled workers with communication skills may suffer more from service offshoring.

4.2 Workers mobility

Immigration. The increase in inequalities or the fall in employment can also be explained by taking into account the effect of immigration on native workers. The underlying assumption is that the incoming flow of less skilled workers could reduce wages paid to native workers, if both groups are perfectly substitutable (Ottaviano and Peri 2012). Language and communication skills are flawed for immigrants, but they have a comparative advantage in manual tasks. Unskilled native workers have a comparative advantage in tasks requiring communication skills. Language skills have a comparatively higher return because they are enhanced by the increased supply of manual tasks which complement them. Productivity gains due to specialization, coupled with the compensation paid for communication skills, implies that immigrants do not impact wages received by unskilled native workers (Peri and Sparber 2009). Empirical studies show that immigration does not appear to affect native workers' wage (Card 2009; Lewis 2005).

Ottaviano et al. (2013) tries to take into account this dimension to understand the simultaneous impact of immigration and offshoring on wage and employment inequality. The model is an extension of GRH model and assumes that immigration can be an alternative to offshoring. The predictions of the model are tested for the United States on 58 manufacturing industries over the period 2000-2007. The author shows that immigrant workers are competing more intensively with offshored workers than native workers. Offshoring causes a reallocation of workers in routine and manual jobs to communication intensive occupations. Empirical results reveal the existence of a productivity effect following the reduction in offshoring costs when taking into account immigration in the model. The underlying assumption is that immigration makes it possible to reduce firms' unskilled workers cost and reduces the fraction of offshored workers. This increase in productivity allows to have a positive net effect on native employment.

Mobility between sectors. More recently, a branch of the literature focuses on the between industry effect of offshoring by looking at what happens when workers change sector following the loss of their employment in the face of international pressure. This new way of understanding the effect of trade openness on wages is close to the work of Artuc et al. (2010). These authors estimate the cost endured by workers who want to move into a new industry in response to competition from imports. They observe that the cost of moving from one sector to another is important and simulations show that American workers change sectors for non-monetary reasons. This assumption is important because it shows that if trade has a negligible effect on employment and wages at the industry level, at the individual level the effect can be important due to sector reallocation.

Coşar et al. (2011) develop a two-sector model with a perfectly competitive sector and a monopolistic sector, in which the labor market is experiencing matching frictions and wage bargaining. They test their model using data from Colombia between 1981 and 1990. Their results show that trade openness leads to an increase of the average wage and occupational mobility of workers. The question address here is whether this sectoral mobility plays a role in explaining inequality in the labor market.

Hummels et al. (2012) use Danish employer-employee data between 1995 and 2006. Their results show that displaced workers from an offshoring firm have higher vocational-training take-up rates than other displaced workers. These workers also take longer to find a new job which shows that they have a higher adjustment cost. Egger et al. (2003) use Austrian data over the period 1988-2001. They show that an increase in offshoring negatively impacts the probability of remaining in the manufacturing sector and is an important determinant of occupational mobility.

Other studies on developing countries also show a non-negligible cost of inter-sectoral mobility. Dix-Carneiro (2010) performs numerical simulations on Brazilian data over the period 1995-2005. For workers currently employed in the formal sector, median costs of mobility into non-tradeables sector are equal to 1.4 times annual average wages, but costs of mobility into high-tech manufacturing are almost twice as large and equal to 2.7 conditional annual average wages.

On the contrary, other studies show that sector mobility can have a positive effect on the overall economy. Indeed, Davidson et al. (2012) on Swedish data show that trade can cause workers' mobility and creates better firms and workers matching. This better matching can *in fine* increase profits and therefore increase the overall labor demand. Krishna et al. (2011) use employer-employees data on Brazil, and show that trade openness improves the matching of the most productive workers to the most productive firms. Grossman (2013) develops a model of heterogeneous firms and workers in which trade openness increases the efficiency and productivity of an industry through better matching of workers to the most productive firms. Better matching benefits all workers in the industry, especially for skilled workers, through higher firm productivity.

4.3 Organization of the firm

The hypothesis that technical progress was able to induce a change in the internal organization of the company, supporting the demand for qualification, was the subject of empirical work in the early 1990s (Milgrom and Roberts 1990; Caroli and Van Reenen 2001). On the contrary, empirical studies on the link between offshoring and internal organization of the firm are still very limited.

Yet, opening the black box of the firm becomes a major issue in international trade theory (Antrás 2009). This hypothesis is based on the idea that change in the firm's organizational structure (decentralization of authority, increase in the number of tasks performed) benefits more skilled and experienced workers, those capable of handling various tasks (Caroli and Van Reenen 2001; Milgrom and Roberts 1990). One of the reasons that might explain the bias towards qualification comes from the fact that MNCs need more workers to oversee, coordinate and control operations scattered in different geographical areas (Castellani et al. (2008), Kokko (2006)). The need for more supervision can change the internal organization of a firm and affects the demand for specific skills and tasks.

Antràs et al. (2006a) study the effect of globalization on the formation of an international team between two countries, the North and the South. They introduce a many-to-one matching into an international trade model. The production team is composed by one manager and many production workers. The model predicts a rise in intra-group inequality in the south, as better matching between southern and northern workers induces an increase in the marginal return to skill of better southern workers. In the North however, increasing competition with southern workers leads to a decrease in their marginal return to skill. The main result for the North shows that when communication technology is good and when the time of managers is scarcer, because low skilled workers in the North are more available, northern wage inequality can go up.

Antràs et al. (2006b), base their analysis on the model above, and are interested on the reasons behind firm's locations choice in the offshoring process. They show that this choice is contingent to the presence of "middle-skilled" workers when communication technology is bad in the host country. The intuition for this result is the following. When communication technology in the south is not available, the firm needs to add a layer of *middle managers* in the host country in order to save the time needed to transmit the knowledge across international teams.

Caliendo and Rossi-Hansberg (2011) develop a model in which firm's productivity depends on how the firm is organized. They base their analysis on the hypothesis that firms need to hire managers to organize input, to planify the production and to solve problems encountered by production workers. The implication of the model is twofold. When firms enter the export market and keep the same number of layers of management before and after the entry on the export market, the wage and the number of employees in each layer grow. When firms add an additional layer of management in response to a

higher demand due to the entry on the export market, they reduce wages and raise the number of employees in each layer.

Caliendo et al. (2012) test the prediction of their theoretical model. They are concerned about the effect of being *primo-exporter* on the organization and the work composition of the firm. French firms which add a layer of management after entering the export market more than double the number of employees in each layer. They also reduce the wage of production workers by 2,5% and reduce the wage of managers in the upper layer by 26%. In contrast, the new management hired to organize the export market earns 97,5% more than the average wage of the firm before the entry on the export market.

Marin and Verdier (2007) introduce a variant of the Aghion and Tirole (1997) theory in a model of monopolistic competition according to Dixit and Stiglitz (1977) to examine how openness between two similar countries can affect the internal organization of a firm. They show that openness can influence the company to choose a structure where the principal delegates power to the middle managers of the hierarchy.

4.4 Location choices

Krugman (1991)'s view on the new economic geography helps to understand the determinants of firms' location based on the preferences of buyers and sellers. These theories have analyzed the regional choice of firms and expalined the rise of *clusters*. The agglomeration effect is an important determinant in the choice of firms' location. Head et al. (1995) show that the location of Japanese firms in the United States is correlated with the location of subsidiaries previously located in the same industry. Head and Mayer (2004) show that a 10% increase in the real European market potential implies an increase of 10.5% of the probability that this region is chosen by a Japanese investor. These stylized facts imply that if the agglomeration effect is a key determinant in the choice of firms' location (Fontagne and Mayer 2005), some regions and industries will be more affected by offhsoring strategies than others [20].

In the same spirit, Behrens and Robert-Nicoud (2009) develop a model of heterogeneous firms based on a Melitz and Ottaviano (2008) framework. They show that large cities are more productive because they attract the most productive workers and firms which raises firms' productivity. Using US data, they show that the largest cities knew greater wage inequality since the most productive workers receive a higher wage in the most productive firms, while the least productive workers are struggling to find a job in a more competitive economic environment. These inequalities are reinforced by trade liberalization, because it allows the most productive firms to enter the export market. This penetration increases firms profits and thus raises the wages of more productive workers.

20. The study of Barlet et al. (2010) on the service sector indicates that some regions in France welcome a larger share of tradable services than others (Ile-de-France, PACA).

Abdel-Rahman et Wang (1997) develop a model in which skilled workers are heterogeneous and unskilled workers are homogeneous. Unskilled workers are working in the food sector in the periphery and skilled workers in the city center. The search for the best workers create incentives for cities to agglomerate. They show that when the worker's qualifications meet the expectations of the firm, the worker earns a higher wage, which may increase wage inequality.

Hence, according to labor mobility between regions, some areas may be more affected by offshoring strategies. In this case, if the effect of trade liberalization on the labor market is weak at the macroeconomic level, offshoring may have a significant impact in some areas, where manufacturing industries are highly concentrated. The location of firms should not be ignored, because it may involve a significant local effect on labor market inequality.

The studies presented in Section 4 show that the effect of international trade on the labor market may be enhanced when one takes into account the channels through which trade globalization acts. In this sense, the effect of trade openness may be amplified if one considers that globalization is a source of technological change. This hypothesis is detailed in the following section.

5 Interaction between international trade and technical change

The hypothesis of an increased role of trade on inequality can be due to a potential interaction with technical progress. The idea that trade openness can influence the demand for labor through technology transfer was already put forward by Wood in 1994. According to him, if one underestimates the effect of international trade, it is because technical progress is addressed independently from trade. The intensification of trade with the South can push Northern firms to adopt new technologies that use less intensively unskilled workers and more intensively skilled workers. According to him, empirical studies underestimate the role of international trade because they ignore the possibility of defensive technologies' development.

Bloom et al. (2011) show that trade liberalization has influenced technical progress. They use data on twelve European countries over the period 1996-2007 and show that investment in R&D is higher in firms more exposed to Chinese imports. This result is also found in South-South trade. Bustos (2011) uses data from Argentinian firms and calculates different proxies of firm's productivity (computers, software and research and development investment). She shows that decreasing tariffs for Brazilian firms encourage Argentinian multinational firms to increase their investment in research and development.

The question we address in the following section is whether offshoring affects labor market outcomes through its effect on technological change. Has spreading new information and communication technologies increased the demand for skilled workers or has the increase in the supply of skilled workers been the source for adopting new technologies ?

TABLE 1.2 – Empirical evidences on the indirect effect of globalization

	Country	Sample	Measure of globalization	Results
Service offshoring				
A) Effect on employment				
Amiti and Wei (2004)	UK	1995-2001	Share of imported private services in total non-energy input purchases	Not significant effect on employment (on the sample of 96 sectors)
Amiti and Wei (2006)	US	1992-2000	Share of imported private services in total non-energy input purchases	Small negative effect on employment (on the sample of 450 secors)
Crino (2010)	US	1996-2006	Share of imported private services in total non-energy input purchases	increases high skilled employment and decreases medium and low skilled employment
B) Effect on wages				
Liu and Trefler	US	1996-2004	Imports of private services from China and India	Increase the probability to switch occupations. Small negative effect on employment Not significant on wages
Geishecker and Gorg (2008)	UK	1992-2004	Share of imported services over total sales	Positive on skilled workers wage. Negative on low and middle skilled workers
Immigration and globalization				
A) Effect on wages				
Peri and Sparber (2009)	US	1960-2000	immigrant share of employment	Modest consequences of immigration on less educated native born workers
Ottaviano and Peri (2012)	US	1990-2006	Share of immigrant employment over native employment	very small effect on the wages of native workers with no high school degree
B) Effect on employment				
Ottavanio et al. (2013)	US	2000-2007	imputed share of foreign-born in total employment	Positive net effect on native employment
Organization of firms				
Caliendo et al. (2012)	France	2002-2007	Entry on the export market	Positive effect of exports on the number of layers and number of employees
Upgrading of production goods				
Verhoogen (2007)	Mexico	1984-2001	ISO 9000 certification	increases within industry wage inequality

While among economists a consensus exists for the direction of technological progress towards skilled workers, the question of its endogeneity is little discussed.

5.1 Offshoring and directed technical change

Empirical studies on the combined effect of international trade and technical progress on employment are not yet abundant. Burstein and Vogel (2010) test empirically the effect of international trade on inequality through its impact on the accumulation of capital goods. They show that the decrease in the return to education is lower in countries with a comparative advantage in the production of capital goods than in countries relying on capital goods' import. Goel (2012) uses U.S data for the period 1974 to 2005 and shows that international trade and in particular import of unskilled intermediates affects the labor market by fostering innovation and skilled complementary technological capital investments. The results show that the increase in imports of intermediate goods causes an increase in equipment and research and development investment, which can ultimately increase the demand for skilled workers *and* unskilled workers.

On the theoretical side, one of the first models which takes into account endogenous technical progress and innovation is the model of Grossman and Helpman (1991). Since then, models on the link between trade openness, growth and innovation have been developed.

For Acemoglu (2002b) the increase in the proportion of skilled workers in the 70's orientated the R&D's efforts towards technologies complementary to the abundant factor. He develops a model in which technical progress is endogenous. The profit-seeking determines the amount of research and development and the direction for technical progress towards a certain production factor. Consider a final good aggregate of two intermediate goods produced from two inputs. The intermediate good in the L sector is produced with unskilled workers and a continuum of $x_L(j)$ machine. Symmetrically, the production function sector H depends on the amount of skilled workers and the number of machines available in this sector. We assume that machines are supplied by technology monopolist and profits are determined by :

$$\begin{cases} \pi_L(j) = \beta P_L^{1/\beta} L \\ \pi_H(j) = \beta P_H^{1/\beta} H \end{cases}$$

The ratio of the net present discounted value of monopolies' profits V_i with an interest rate r can be written as $\frac{V_H}{V_L} = \frac{\beta P_H^{1/\beta} H}{\beta P_L^{1/\beta} L} = \left(\frac{P_H}{P_L}\right)^{1/\beta} \left(\frac{H}{L}\right)$ with H and L the quantities of skilled and unskilled workers respectively, and P_H and P_L, the product price produced in different sectors. The ratio $\frac{V_H}{V_L}$ depends on the relative endowment of skilled workers relative to unskilled workers ($\frac{H}{L}$) and on the relative price of goods in each section ($\frac{P_H}{P_L}$). There are two distincts effects. First, a textitmarket size effect which encourages inventors to develop technologies in the largest market. Second, a *the price effect*, that creates

incentives for investment in technology complementary to the scarce factor. The elasticity of substitution between goods determines the magnitude of each effect that play in opposite direction. If the goods are sufficiently substitutable, the price decline of the abundant factor-intensive good is weak, and then market size effect dominates the price effect. Inventors are then motivated to innovate in technology complementary to the abundant factor, resulting in a faster increase in productivity. Thus, the relative wage of skilled workers may increase, even if the relative supply of skilled workers increases. The confrontation of these two forces determines the direction of technological progress towards qualification.

Naghavi and Ottaviano (2008) develop a model in which Northern firms can choose to relocate their production processes in Southern countries, maintaining R&D activity in the native country. They observe that offshoring reduces communication between the production sector and the R&D sector and can cause negative effects on growth. Glass and Saggi (2001) develop a North-South product cycle model, with the possibility for firms to outsource the basic production process to Southern countries. They include a Schumpeterian innovation possibility, allowing the firm to outsource part of its production process that uses the basic technology. The newly designed technologies remain in the home country. Outsourcing allows increasing firm's profits and, then, raises innovation. The impact in the Northern country is two-fold : a positive effect on growth due to innovation and the arrival of new products, and a negative effect on the Northern relative wages. Rodriguez-Clare (2010) notes also that offshoring has a short term negative effect on wages, but a positive productivity effect in the long term due to reallocation of resources towards research in the rich country.

Acemoglu et al. (2012) develop a Ricardian model of offshoring with technological progress. They assume two countries, a northern country with skilled and unskilled workers, and a Southern country with unskilled workers only. New technologies are present in the North and they can be transferred to the South by paying a fixed cost of relocation. Some technologies are complementary with skilled labor, while others are complementary with unskilled labor. Acemoglu et al. (2012) identify three effects that influence wages as a result of offshoring. The first is a *labor supply* effect and the second is a *relative price effect*, which act negatively on unskilled workers' wage. The third comes from the rise in unskilled intensive production Y_L, that increases the demand for unskilled workers in the North, which causes a rise in the relative wage of these workers.

In parallel, the rise of Y_L increases the relative price of the skilled intensive good. This increase supports the development of skilled intensive technology through the occurrence of *the price effect* described in Acemoglu (2002b). Conversely, the rise of Y_L also promotes the development of the unskilled intensive technology through the occurrence of the *market size effect*. The importance of the latter effect depends on the degree of substitutability between foreign and domestic unskilled workers. If the two workers are complements, this effect is maximized, since the demand for unskilled workers in the North will be even higher.

Rodriguez-Clare (2007) also develops a Ricardian model of outsourcing, in which technical progress is endogenous. In his model, there are two countries that differ in their ratio of technology to the size (T/L). Northern countries have several sectors with an absolute advantage relative to their size. The North has a T/L ratio greater than the South, involving higher wages in the North. The model includes the possibility for the North to relocate part of its production process in the South. This fragmentation implies an increase in the supply of goods produced by the North and reduces its terms of trade. Three effects appear after relocation. The first is a productivity effect, which is positive on wages in the North. The second is a terms of trade effect. The rise of production processes' fragmentation causes terms of trade's deterioration in the North and impacts negatively the equilibrium wage in the North. The third is a world-efficiency effect which causes world prices decline through the use of cheaper labor in the South. As in HOS, the decrease in commodity prices, negatively impacts the equilibrium wages in the North. In contrast, the South is not affected by the productivity effect but is affected by the terms of trade effect and the world efficiency effect, which positively affects equilibrium wages.

In the second part, the author assumes that the North has a better technology than the South. This better technology in the North is materialized by a larger stock of ideas. Countries with larger stocks of ideas pay higher wages to researchers.

Offhsoring causes a reallocation of workers from the production to the research sector in the North. This reallocation increases wages in the North and helps to counteract the adverse terms of trade effect. In the South, offshoring increases the demand for workers in the production sector and reduces the wages of researchers. This negative effect balances the positive effect of terms of trade in the South and the positive world efficiency effect.

Dinopoulos and Segerstrom (1999) study a model of growth with two northern countries who compete through their technological supremacy and their research and development efforts. In each industry the firm with the best technology becomes leader, and in each period a new firm can become leader. After trade, the country exports the goods produced by the firm leader. Export costs, supported by the firm leader, decrease the firm's profits and therefore reduces its incentive to invest in research and development. As a result, another country can, at that time, become leader by highlighting its efforts in research and development. Trade liberalization can increase growth and R&D in both countries. This R&D investment can have an impact on the labor market by increasing the demand for skilled workers.

5.2 Labor market inequality and upgrading of production goods

In line with these works, some authors have shown that specialization in high-quality production requires the use of more skilled workers. For example, Martin and Mejean (2011) shows that France's exports have increased in quality over the past decade. Their study estimates that almost 20% of the increase in France's export (in value) is explained

by quality upgrading. Amiti and Khandelwal (2013) use disaggregated data on 10,000 American products to build a quality index. They show that tariffs reduction is associated with an increase in the quality of goods produced [21]. Schott (2004) also shows that skilled-intensive countries specialize in producing highest quality product while unskilled-intensive countries specialize in the production of lower value goods.

Yeaple (2005) offers a different departure from the Melitz (2003) framework, assuming that firms are identical when they are created and decide to employ workers of the qualification of their choice as well as to use the technology they wish. Only firms that use intensively the lowest cost technology can enter the export market and pay higher wages. A decrease in transportation costs increases the incentives of firms to adopt new technology, causing a reallocation of workers from the former to the new technology and therefore can change the requirement for qualification.

As stated by Verhoogen (2007), this production reallocation in favor of high-quality goods is likely to change the balance on the labor market. The model developed by Verhoogen (2007) formalizes the rise in the range and the quality of the production of goods as described by Martin and Mejean (2011). The model is in partial equilibrium and focuses on one industry in particular, considered to be relatively small compared to the economy taken as a whole. In each country, it assumes a continuum of heterogeneous firms differentiated by their level of exogenous productivity. The quality of the products depends on (i) the quality of - high and low-skilled workers-(ii) the sophistication of the machine used to produce the goods, and (iii) the productivity of the firm. Workers are heterogeneous and differ by their level of qualification. Companies pay higher wages to attract qualified workers. It is assumed that the most productive firms produce goods of greater quality, pay higher wages, are more intensive in capital and set a higher price than the least productive firms. As in Melitz (2003) only the most productive firms are able to pay the fixed cost of entry on the export market. The econometric estimation shows that the increase in the quality of the products requires changing the composition of low-skilled workers. The highest-skilled workers would be employed in the firm. The others would be excluded from the labor market.

These different works show the importance of taking into account the combined effect of international trade and technical progress on the structure of the labor market. Many avenues of research are still open to explain the causes of inequality in the labor market.

6 Conclusion : guidelines for future research

Since Adam Smith, studies on the labor market have not ceased to evolve, and still need to be addressed to understand the different channels at the origin of its evolution. This

21. However, the direction of the effect depends on the distance of the product to the world technology frontier. When products are close to the frontier, lower tariffs increase the quality of production. The opposite is observed when the product is far from the frontier.

review identifies papers on the research of the causes of employment and wage inequality on the labor market. The dominant assumption is that of skilled biased technical progress and, more recently, that of routinization. Workers who carry out routine and codifiable tasks are replaced by computers, complementary to skilled workers performing analytical tasks.

Studies on the effect of technical progress on employment are unanimous and show a negative effect of the adoption of new technologies on low-skilled routine workers. Studies on the effect of international trade on the labor market are more nuanced. They are, because offshoring may result in a productivity effect that works in favor of employment replaced by foreign workers. The cost savings engendered by offshoring strategies can affect the profits of the companies and ultimately improve the demand and the wages of all workers. Conclusions also differ because trade has endogenous effects still not yet totally grasped. Trade openness can cause additional effect due to defensive innovations or changes in the organizational structure of the firm. Thus, international trade can have an indirect effect on employment.

The question of the effect of trade openness on labor market inequality revived in recent years. First, because the influence of trade on technological progress is still poorly understood, and second because the very nature of international trade has changed. Intra-firm trade is growing and production processes are now more and more divided in different geographical areas.

The consequence of these stylized facts is twofold. On the one hand, it is becoming increasingly important to use detailed data to statistically measure the globalization strategies of firms and to analyze workers according to the tasks they perform. On the other hand, it is increasingly important to understand the channels through which globalization acts. The organizational structure of a firm, its integration mode, its possibility to exchange services, worker mobility, and technology transfer are all parameters that need to be taken into account to understand the effect of international trade on the labor market.

In the following chapters, we control for all the margins of international trade (imports of intermediate inputs and exports). We also pay particular attention to the effect of technological change on the labor market since its effect may be enhanced by offshoring. We analyze two channels through which offshoring act on the labor market : organizational change and workers' mobility.

Chapitre 2

The Jobs at Risk from Globalization : the French Case

1 Introduction

Companies may chose between two alternative strategies when investing in a foreign country. A firm can decide to set up a foreign subsidiary by making a foreign direct investment (integration) or choose to outsource its production to an independent supplier (arm's length offshoring). Foreign direct investment is an important contributor to the internationalization of firms. In the United States, roughly one-half of US imports are transacted within the boundaries of multinational firms rather than across unaffiliated parties (Bernard et al. (2009)). In France, large multinational companies have favored internationalization through in-house overseas production, compared to German firms which have on the whole favored internationalization through arm's length production (Fontagné and Toubal (2010)). This study aims to measure the effect of outward foreign direct investment (FDI) on the work-composition of French firms.

The selection of offshoring through foreign direct investment is a deliberate choice, motivated by the advantage of ownership which acts as a protection against opportunistic behavior. This choice is often referred to as the "make-or-buy" decision. Several determinants influence the choice between integration and outsourcing : the type of industry (Antràs (2003), Antràs and Helpman (2004)) ;[1] the product life-cycle (Antràs (2005)) ; the extent of contractual incompleteness (Grossman and Helpman (2005)) ; and a firm's productivity (Antràs and Helpman (2004)). Integration can be seen as a trade-off between the gain of integration (higher adaptability and incentives to invest), and the costs of in-

1. Antràs (2003) develops a framework in which there are two inputs, one controlled by the final-goods producer, the other by the supplier. Ownership is favored concerning the party whose investment contributes most to the value of the relationship. If the final-good is capital intensive, the final producer will prefer vertical integration in capital-intensive processes and arm's length transaction in labor intensive processes.

tegration relative to administrative costs. [2] Foreign direct investment may have a specific impact on employment compared to arm's length trade, due to differences in terms of technology transfers and organizational change (Grover (2008), Antràs (2005), Grossman and Helpman (2002)).

First, technology transfers may differ depending on the mode of internationalization. Firms may prefer to integrate through foreign direct investment when the good is high-technology intensive (Feenstra and Hanson (2005)) and non-standardized (Antràs (2005)), which implies human-capital intensive inputs. Kodak for example used to produce conventional film in China through an unrelated affiliate, and when the Chinese government allowed Kodak to establish a parallel, wholly-owned plant, they started producing the latest digitized film and camera products (Moran (2001)). Similarly, Hayter (2004) showed that as the technological content of intermediate goods decreases, firms move from FDI to arm's-length contracts. Other studies have highlighted a higher speed of technological transfer and a higher investment in human capital within integrated subsidiaries compared to that of independent suppliers (Moran (2001), Mansfield and Romeo (1980)). From this literature, it seems that foreign direct investment is associated with high-technology intensive production which may hurt skilled production workers more, depending on whether foreign and domestic skilled-workers are complements or substitutes.

Second, foreign direct investment may have a specific impact on employment through its effect on the organization of work. Indeed, the make-or-buy decision is a trade-off between the cost of imperfect contracts and the search for partners, and the costs of extra-governance that come along with vertical integration (Grossman and Helpman (2002)). Vertical integration allows better monitoring, but there is no system of incentives for internal management. Hence, by undertaking FDI, a firm may want to keep full supervision and control over its subsidiary, and this may be a source of changes in the organization of the firm : first, through the streamlining of redundant production units in the home country, especially if the foreign competences are identical to home ones ; and second, through the delegation of authority to managers, which may increase a firm's incentives to hire managers in order to supervise the foreign subsidiary.

There are several theoretical models analyzing the labor market effect of international fragmentation, including Feenstra and Hanson (1996) and Grossman and Rossi-Hansberg (2008). The Grossman and Rossi-Hansberg (2008) model places tasks rather than intermediate inputs as the central unit of analysis of international fragmentation of production processes. Tasks give more information on the 'offshorability' of jobs than do occupations themselves, since there is no systematic correspondence between skills and the offshorability of jobs (Blinder and Krueger 2013; Jensen and Kletzer 2010). For instance, developing

2. Grossman and Helpman (2002) identify different types of costs and gains depending on the mode of integration. On the one hand, a vertically integrated firm may face higher production costs, because such a firm has many divisions to manage, and because the organization does not benefit from the learning that comes with specializing in a single activity. On the other hand, arm's length transaction costs stem from incomplete contracts and the search for partners.

computer programs and analyzing x-rays by software engineers and doctors typically requires high-skilled workers but those tasks can easily be carried out remotely. In contrast, maintenance work does not systematically need any qualifications, but cannot be relocated due to the requirement of proximity to the maintained facilities (Becker and Muendler (2014)). Due to a lack of available employer-employee data, only a small number of studies to date includes task characteristics to analyze the effect of offshoring on workforce composition (Becker et al. (2012), Hakkala et al. (2014)). [3]

In this study, we adopt the classification of occupations in terms of tasks, developed by Autor et al. (2003) to examine the relationship between FDI and the composition of tasks inside the firm. We use a comprehensive dataset linking detailed company and employee information. The data allow us to use all the state-of-the art approaches allowing to provide a comprehensive analysis for France over the period 2002-2007. First, we argue that the dataset permits the direction of the bias in FDI to be disentangled more carefully than does data at the industry level. Indeed, we are able to measure skill-composition in terms of occupations and tasks, which is of particular importance in its consequences on the labor market, due to the changing nature of the production process in *trade in tasks*.

Second, the data allows the effect of FDI on the labor market to be identified from different points of view. On the one hand, the data identifies the number of subsidiaries abroad and their location, making it possible to disentangle the effect of FDI in low-income countries and high-income countries on skill-composition. We include a second decomposition of FDI by distinguishing the employment effect of first-time investors from the effect of increasing the number of subsidiaries for already-established firms. On the other hand, the construction of the data allows the business group perimeter of each firm to be reconstructed, in order to examine changes in the firm's workforce composition consecutive to a shift in the offshoring strategy of the business group. [4]

Finally, we control for endogeneity that could arise due to simultaneity and/or due to omitted variable bias. Only a small number of studies in the literature address the endogeneity problem. Becker et al. (2012) use a lagged instrument variable in the spirit of Blundell and Bond's estimation (2000), while Hummels et al. (2011) use an original set of instrumental variables to control for endogeneity associated with a firm's exports and imports. In this study, we control for the omitted variable bias by using an IV-model with two instruments : (i) the mean level of GDP per capita, and (ii) the average level of infrastructure in the host countries.

3. Many countries and particularly France lack information on the task content of occupations. French studies often use Robert Reich's classification that defines occupation categories according to the type of work performed : persons with routine occupations, symbol managers, officials and farmers. The Reich classification shows that routine occupations are more sensitive to offshoring than are farmers or officials (Allain, Collobert, and Fraboul 2004). Becker et al. (2012) and Spitz-Oener (2006) used a task classification based on German data.

4. A group is composed of an independent parent company and all other entities controlled by the parent company. We include information at the group level because we argue that foreign direct investment could not only impact employment inside the investing firm but also inside all other firms belonging to the same business group.

The analysis depicts different results depending on the destination country. On the one hand, a firm's FDI to low-wage countries negatively affects the firm's share of blue-collar workers and positively impacts the firm's share of skilled workers (managers and workers performing non-routine interactive tasks). On the other hand, FDI to high-income countries is associated with a lower share of workers performing non-routine manual tasks in the home country.

When distinguishing country destinations between EU-15 countries, low-income countries, high-income countries, East European and emerging economies (BRICS), the negative effect of FDI to low-income countries on employment is mainly linked to FDI to emerging economies (BRICS). The results confirm a significant and positive impact of FDI to BRICS, both on the share of managers and non-routine occupations. The negative effect of FDI to high-income countries on the share of workers performing non-routine manual tasks is driven by offshoring to high-income countries, other than in the EU-15. Results show that FDI to high-income countries reduces significantly the share of skilled blue-collar workers inside the domestic firm. The results are stable when aggregating the foreign direct investment strategy at the level of the business group. We check for these effects on first time investors (extensive margin) and on already-established firms (intensive margin). The results highlight that firms significantly increase their share of managers at the extensive margin and reduce the share of blue-collar workers at the intensive margin. When controlling for endogeneity, the only clear and positive impact that remains significant is directed towards executives and workers performing skilled non-routine tasks.

The paper is organized as follows. Section 2 reviews the theoretical and empirical literature on the effect of offshoring on employment. Section 3 describes the data and the variables constructed. Section 4 details the methodology, Section 5 reports the results of the fixed-effect model and and the robustness tests. Finally, section 6 reports the results of the instrumental variable model, and Section 7 concludes.

2 Related Literature

During the last two decades, the impact of offshoring on the labor market has been of huge interest in academic as well as in public debate. In particular, concerns are being expressed because offshoring of production stages could affect employment in most industrialized countries (Feenstra and Hanson (1996), Anderton and Brenton (1999), Becker et al. (2012)). Until now, the literature has shown little impact of offshoring on employment and has pointed out instead the effect of technical progress (Feenstra and Hanson 1999; Hijzen, Görg, and Hine 2005; Slaughter 2000; Autor, Levy, and Murnane 2003). Recently, the consensus according to which international trade played a minor role on labor market inequality has been reconsidered due to the use of detailed information on workers. Indeed, lack of available individual employer-employee data have led previous analyses to study the effect of offshoring on employment at the industry level (Ekholm and Hak-

kala (2005), Falk and Koebel (2012), Slaughter (2000), Hijzen et al. (2005)). This data gap prevents from having detailed information on employees, in terms of tasks performed, qualifications and wages. Industry level studies use a classification of workers based on levels of skilled *versus* unskilled education (Feenstra and Hanson 1996; Feenstra and Hanson 1999; Hansson 2000). Other studies have used a more-detailed disaggregation of labor than the traditional skilled/unskilled dichotomy, by adding layers of educational categories (Ekholm and Hakkala (2005), Falk and Koebel (2002), Hijzen et al. (2005), Morrinson and Siegel (2001)), and by defining groups of occupations according to their link to production (Biscourp and Kramarz 2007; Head and Ries 2002). The underlying assumptions for making this classification is that multinational companies (MNC) may maintain their non-production *upstream* activities in the home country (such as research and development (R&D), coordination, accounting or marketing activities), while offshoring their production activities. Yet, jobs can significantly differ inside a same education group, due to different occupational characteristics. Indeed, some occupations are more manual or cognitive, even though they have the same level of education. For example, workers with a medium level of education may be administrative workers, while others are technicians. Occupation heterogeneity inside a group of education could lead to an overall effect of FDI which is insignificant.

From the seminal work of Grossman and Rossi-Hansberg (2008) tasks -rather than intermediate inputs- are a key component to understand the 'offshorability' of jobs (Blinder and Krueger (2013)). According to Blinder (2009), the offshorability of a task depends on its potential to be carried out in another location, without loss of quality and on the importance of face-to-face contact with people other than fellow workers. According to Jensen and Kletzer (2010), the potential offshorability of a task is determined by the need for proximity with the customer [5]. A few number of studies have analyzed the effect of offshoring on tasks. Hakkala et al. (2014) show a negative effect of horizontal investment on non-routine employment. Becker et al. (2012) use data on Germany for the years 1998 to 2001, and observe a statistically significant correlation between offshoring and the share of highly educated workers, and also between offshoring and the use of non-routine interactive tasks.

In this study, we analyze the effect of foreign direct investment on the skill composition of firms in terms of skills and tasks. FDI can act as a form of offshoring if the creation and/or the acquisition of a foreign company allow the value chain to be broken up, which is often referred to as vertical investment. On the other hand, FDI can be done for market-seeking reasons and does not necessarily increase the fragmentation of the production process, which is often referred to as horizontal investment. [6] The effect on the labor market

5. The underlying idea is that when industries and occupations are highly concentrated, tasks performed in these occupations may *a priori* be performed remotely from a single work site. They add information on occupational task characteristics to complement their analysis.

6. Vertical offshoring often takes place in low-income countries, whereas horizontal FDI is generally realized in high-income countries. Statistics suggest that FDI to low income countries is expanding rapidly with the development of emerging economies. In 2013, FDI flows to all major developing regions accounted

can vary considerably from one integration strategy to another. For Lipsey (2002), access to new markets (horizontal FDI) can increase firms' profits and competitiveness and a positive effect on home employment may occur. The extent to which domestic employment might benefit from firms' international expansion will depend on the share of foreign profits which are repatriated. If the parent company benefits from additional revenues from its foreign subsidiaries, domestic employment may increase. [7] Whereas vertical FDI is associated with relocation of low-skilled activities abroad, that could increase the average skill-intensity for the investing firm at home, depending on whether domestic and foreign employment are substitutes or complements. The link between the complementary nature of foreign and domestic labor is not empirically clear. Several studies conclude that substitution may occur when FDI is horizontal (Konings and Murphy 2006; Cuyvers et al. 2005), whereas others conclude that substitution between domestic and foreign workers is more likely to arise when investments are made in low-wage countries (Riker and Brainard 1997; Head and Ries 2002; Strauss-Kahn 2004a). Muendler and Becker (2010) show how to structurally analyze the employment effect depending on the country location. They analyze the multinational labor demand responds to wage differentials. They show that a one percent increase in German wages is responsible for an increase of 4000 manufacturing jobs abroad, at the extensive margin.

The literature analyzing the effect of foreign direct investment on the labor market can be separated out in two groups : (i) studies analyzing the production transfer within multinational companies on the skill-composition of domestic firms and (ii) studies analyzing the effect of FDI on overall employment.

The first group of studies capture foreign direct investment by the share of affiliate employment in total multinational firms' employment. Head and Ries (2002) observe 1,070 multinational firms in Japan, between 1965 and 1989, and show that higher employment in foreign subsidiaries is associated with greater use of non-production labor at home, relative to production labor. Hansson (2005) follow 75 multinational companies (MNC) in Sweden during the period 1990-1997 and also observe a positive association between vertical offshoring, defined as offshoring to low-income countries, and the share of skilled workers, in the parent company.

The second group of studies analyzed the effect of establishing a foreign affiliate on overall employment, starting with Glickman and Woodward (1989) who measure a net average annual loss of 274,000 US jobs as a consequence of US investment abroad. Barba Navaretti and Castellani (2004) find firms investing abroad to have no significant differences in employment growth than firms that do not invest abroad. Debaere et al. (2010) analyze the effect of investing abroad on employment in South Korea. They found that moving to less-advanced countries decreases a company's employment growth rate, while moving to more-advanced countries does not consistently affect employment growth. In

for 54 per cent of global inflows (World investment report (2013)).

7. This idea is close to the productivity effect developed in Grossman and Rossi-Hansberg (2008).

accordance with this result, Edamura et al. (2011) find a negative impact on Japanese employment associated with FDI in Asia. For the United-States, Desai et al. (2009) find FDI to be associated with higher investment and employee compensations. However, due to lack of identification of the skill-composition, the previous study did not identify the jobs at risk in the globalization process. Hijzen et al. (2011) attempted to measure the effect of foreign direct investment on the skill-composition of French firms by measuring the skill-composition as the average level of wages. They find a positive effect of FDI on the skill-intensity in the short run and a positive impact of foreign direct investment on overall employment, two years after the international settlement.

The aim of this research is to deepen the understandings of the impact of foreign direct investment on the skill-composition of firms. The objective is to give a better comprehension of the jobs at risk in the globalization process by identifying workers according to the job and the nature of tasks they perform.

3 The Data and the Construction of Variables

Our database is constructed with five micro-data sources provided by the French National Institute for Statistics and Economic Studies (INSEE). Our database allows an original employer-employee database to be constructed for France. We follow firms' characteristics through the period 2002-2007 [8].

3.1 Construction of the skill-composition of firms.

We first need to construct the skill-composition of firms, which is derived from confidential yearly social security records, processed and transmitted by the INSEE, the so-called *Déclaration Annuelles des Données Sociales* (DADS Postes). All French employers, including national companies, public administrations and local governments are required annually to declare to state social security organizations and to the tax administration information about each of their employees. Every row in the declaration corresponds to a particular employee's position (job) in a plant and reports information on the sex, age, occupation, number of worked hours, wages and the corresponding plant number. We sum each position (that corresponds to each line of the database) in groups of occupations for a given firm. [9] Hence, the final database allows changes in the workforce composition for each French firm to be tracked, during the period 2002-2007. [10]

In order to obtain the work-composition of the firm in terms of tasks, we add information on occupational tasks' content by using the ONET index. The ONET index is

8. We do not take into account information after 2007 because it could capture the labor market effect of the recent economic crisis. We do not use the data before 2002 because the occupational categories we use to define the groups of occupations (see below) changed that year.

9. These include a group of skilled/unskilled workers, a group of managers and blue-collar workers, and a group of production/non- production workers for instance. A detailed description of occupational groups is given in the following sections.

10. We only keep firms for which at least 90% of their workforce composition is referenced.

provided by the Department of Labor's Occupational Information Network. For the United States, the ONET database provides a detailed description of workers, occupations or jobs. We use information about occupation requirements that detail typical activities required across occupations to summarize the specific types of job behavior and tasks that may be performed within occupations.

The ONET index is built using a specific occupation classification based on the American SOC classification of occupations [11]. The key point has been to link the ONET occupation classification with the French PCS-ESE classification by building a mapping table detailed in appendix 2.B.

Measuring tasks. The ONET index is derived from a questionnaire completed by workers and experts [12] on the level of task needed to perform the current job. The level ranges from 0 to 7 for 41 specific tasks [13]. In order to classify the 41 tasks index, we follow the strategy of Autor, Levy, Murnane (2003) : hereafter ALM. We follow ALM to break down different tasks into five major components : non-routine analytical, non-routine interactive, non-routine manual, cognitive routine and manual routine tasks. (i) Non-routine analytical tasks are usually performed by technical or managerial occupations. They require cognitive capacity where responsiveness, creativity, decision making and problem solving is important. (ii) The second major task category is non-routine interactive tasks. These tasks require physical interaction and adaptability to certain types of situations. They are feature of skilled and unskilled service professions, such as hairdressers, gardeners or truck driver, for example. (iii) The third category identifies cognitive routine tasks that are usually carried out by administrative or clerical occupations such as secretaries and accounting officers who perform repetitive tasks using an identified procedure. These tasks are also feature of skilled managerial occupations. (iv) Finally, the last category lists manual routine and non-routine tasks performed by unskilled and skilled production operators such as handlers and machine operators.

According to ALM, the codified nature of a task determines its potential for relocation. The more a task can be determined by specific rules, the less it relies on tacit knowledge and the easier it is to explain to someone else and also to control. Table 2.14 in Annex 2.B reports the 41 work activities divided into five groups : non-routine analytical, non-routine

11. As information on the task content of an occupation is very difficult to obtain, even more so because the given data is not available in every country, we use the US database of the Department of Labor's Occupational Information Network (ONET). We assume that the task content of occupations is identical in the United States and in France, so we can use the ONET classification to analyze the job content of French occupations.

12. For occupations where it was difficult to sample workers, experts were identified and sampled from professional and/or trade association membership lists to answer to the questionnaire.

13. Three examples on the level of tasks are given at rank 2, 4 and 6 to help respondent answering to the question on the level of tasks. For instance, to the question 'what level of *getting information* is needed to perform the current job', a level of 2 corresponds to *follow a standard blueprint*, the level of 4 corresponds to *review a budget* and the level of 6 corresponds to *study international tax laws*. The index of *getting information* corresponds to the average level of all respondents in a given occupation.

cognitive, non-routine interactive, non-routine manual and routine manual. [14]

We build a score on the task intensity of the workforce within firms, by linking ONET scores to firms' workforce composition. Firms can then be identified by task vectors. We follow Oldenski (2012) in linking the ONET routine/non-routine score to the skill-composition of firms. The score importance of each group of task i in firm j is :

$$M_{ij} = \sum_{o} \gamma_{oj} l_{oi} \tag{2.1}$$

With γ_{oj} being the share of occupation o used in the production of firm j and l_{oi} being an index of the importance of task i in the occupation o. We normalize the task index by the maximum and minimum value in any firm, so that for every firm a task intensity measure varies in the range of 0 to 1 [15]. A firm having a score of non-routine interactive tasks close to one means that the largest share of the firm's workforce performs interactive tasks intensively. [16].

Table 2.1 – Workforce Composition

	Domestic Firms		Exporting Firms		Multinational Firms	
Non-routine analytical	0.555	[0.122]	0.599	[0.112]	0.659	[0.093]
Non-routine interactive	0.377	[0.125]	0.424	[0.127]	0.499	[0.115]
Routine cognitive	0.512	[0.129]	0.576	[0.130]	0.641	[0.094]
Non-routine manual	0.556	[0.119]	0.514	[0.120]	0.472	[0.121]
Routine manual	0.531	[0.155]	0.458	[0.151]	0.376	[0.125]
Skilled blue-collar	63.7%	[0.224]	62.1%	[0.208]	62.3%	[0.186]
Skilled white-collar	9.1%	[0.109]	12.4%	[0.128]	18.4%	[0.147]
Unskilled blue-collar	16.9%	[0.193]	18.1%	[0.184]	11.3%	[0.134]
Unskilled white-collar	10.2%	[0.117]	7.4%	[0.068]	7.8%	[0.063]
Managers	3.7%	[0.060]	5.3%	[0.064]	9.1%	[0.080]
Engineers	6.2%	[0.074]	7.4%	[0.091]	13.2%	[0.113]
Technicians	12.1%	[0.125]	15.5%	[0.121]	22.2%	[0.114]
Foremen	6.5%	[0.087]	4.9%	[0.046]	4.8%	[0.046]
Office workers	10.1%	[0.195]	8.6%	[0.118]	8.9%	[0.084]
Skilled blue-collar	51.6%	[0.241]	44.7%	[0.220]	37.1%	[0.197]
Unskilled blue-collar	19.3%	[0.213]	20.2%	[0.204]	12.7%	[0.149]

Source : LIFI survey, French annual census for manufacturing (EAE), French Déclaration annuelles des donnés sociales (DADS) ; balanced panel data ; year 2007. Authors' calculations.

Table 2.1 details the average workforce composition of multinational, domestic and exporting firms. MNCs are relatively more intensive in skilled white-collar workers, and

14. Table 2.15 in Annex 2.B gives examples of occupations in the metal industry, ranging from engineer to assembler. This table shows that engineers have a higher index of non-routine tasks and assemblers a higher index than manual tasks.

15. However, because the ONET database does not provide information on workers, we are unable to follow the evolution of task requirements within a given occupation. Therefore, our empirical estimations only analyze inter-occupational change by assuming that there are no intra-occupation variations. This limitation can be avoided by using data that provides for the evolution of each task within an occupation, over time. This is the case with the British Skills Survey and with the German Labor Workforce Survey, BIBB/AB.

16. Details on the importance of tasks performed within occupations are given in Appendix 2.B.

less intensive in blue-collar workers, whatever their level of qualification. [17] Interestingly, the share of skilled blue-collar workers (composed of engineers, technicians and skilled laborers) is 1.4 percentage points lower in multinational companies than in domestic firms. The decomposition by occupation shows that this result is mainly driven by a lower share of skilled blue-collar workers in MNCs. Conversely, the share of managers, engineers and technicians is higher in MNCs, compared to domestic firms.

The tasks performed inside the firm are on average less routine and less manual in multinational companies than in domestic or exporting ones. They are also more intensive in routine cognitive or non-routine analytical tasks. These preliminary results show that French multinational firms are more intensive in skilled employment not directly linked to production (such as managers) and more intensive in non-routine activities.

Robustness test. The use of ONET to build the task index requires to make the assumption that the tasks performed in a particular occupation in France and in the United-States are identical, which has not been proved statistically. In order to relax this assumption, we build two other tasks index based on French and German data. The construction of the indexes are described in the appendix 2.B.2. The conclusions of the paper derived from the ONET index are very similar when using the two other indexes as shown by the results in appendix 2.B.3. We are thus confident on the results derived from the American ONET database on tasks.

3.2 Construction of firms' controls

Firm level information comes from two confidential databases. The first is the *Liaison Financière* survey (LIFI), that collects all the links between upstream and downstream firms and allows firms having at least one FDI project to be identified (i.e., firms having 10 % or more of voting stock). We are able to identify a firm's parent company and a firm's foreign subsidiaries. [18] We have information on foreign subsidiaries' locations, on the balance sheet value of the ownership interest, and on the percentage of voting stocks at each subsidiary's general assembly. We distinguish the number of FDI holdings by country destination to BRICS, Eastern Europe, European Union countries, other high-income countries, and low-income countries [19].

Finally, we use a threshold survey from the France's manufacturing census, called

17. White-collar workers are composed of managers, accountants or sales representatives.

18. A small number of these firms are perfect joint ventures, i.e. two mother companies hold exactly 50% each of the subsidiary's voting stock. Thus, we are unable to identify a unique parent company. In order to reconstruct the group perimeter by allocating one parent company to each legal entity, we decided to drop information about joint ventures. In 2007, there were 15,006 joint ventures, representing 6% of our sample.

19. High-income countries are countries listed as high-income OECD members countries by the World Bank, excluding Slovak Republic, Slovenia, Poland, Czech Republic and Estonia that are referenced in the group of East European countries. East European countries are composed of countries which joined the European Union after 2004 ; European countries include countries which joined the EU before 2004 ; And low-income countries are composed of other Asian, African and South American countries.

the *Enquête Annuelle Entreprise* (EAE). This data source provides the detailed income statement of all French manufacturing firms employing more than 20 employees. The database allows several control variables of company characteristics to be constructed, such as : value added, tangible assets, revenue, and different technology proxies.

The panel is unbalanced, with 42% of the sample being observed during the whole period. Firms observed during the 6-year period are on average more capital intensive, have higher R&D investment, more employees and higher revenues than firms lost due to attrition. These differences might alter our results, due to a selection bias effect. Therefore, we only report results in the balanced panel data. [20]

Measuring Foreign Direct Investment. There are different degrees of commitment when investing in a foreign subsidiary. A firm can choose to engage alone and maintain full control over the foreign subsidiary (wholly owned subsidiary), or to share the ownership with one or more partners to set up a joint venture. [21] The exercise of power (i.e. the mobilization of corporate assets in a joint stock company) is a matter of control which depends on the share of voting stocks held in a foreign subsidiary (Schott (1990)).

The entry mode choice (a wholly-owned subsidiary versus a joint venture) has indeed several implications for the firm's management and technology transfer. A large number of shareholders can create an agency problem in which shareholders are passive in monitoring subsidiaries, because the benefits and costs of ownership are shared by a multitude of owners (Berle and Means (1932)). In contrast, the greater the concentration of ownership, the greater the degree of costs and benefits that are borne by any one owner (Demsetz and Lehn (1985)). Hence, owners operating under concentrated ownership have an incentive to discipline management and to supervise actively the controlled firm (Vermeulen (2013)). In addition, fear of a technology property leakage reduces technology transfer when the degree of ownership is low (Smarzynska-Javorcik and Spatareanu (2008), Abraham et al. (2010)). The employment effect of making a FDI could thus vary depending on the entry mode choice. Bircan (2011) shows that greater foreign equity participation leads to greater transfer of both tangible and intangible assets and also observed a higher wage premium, especially for skilled workers.

In order to control for the entry mode choice, our measure of FDI is calculated by summing the number of foreign subsidiaries controlled by each firm j over the period $t \in [2002, 2007]$, weighted by the firm j's equity participation [22] in subsidiary k.

$$\kappa_{jt} = \sum_{k} Equity_{kjt} \tag{2.2}$$

20. The Hausman test fails to reject the hypothesis of random attrition, still, we find similar results with the unbalanced panel data and our principal conclusions are not altered.

21. Foreign investment may be undertaken by constructing new operational facilities from the ground up (greenfield or brownfield investment), or without actually creating a new subsidiary (merger and acquisition).

22. For example, a firm having 2 subsidiaries controlled at 40% and 100% has a measure κ equals to 1.4.

Where equity is the percentage of share held in firm j's subsidiary k at time t. The data provide information on the location of subsidiaries, which we group into low-income and high-income countries (as done by Becker et al. (2012) and Hijzen et al. (2011) among others). By doing so, we aim at capturing the motivations of foreign direct investment : horizontal versus vertical FDI (See Markusen (1995)).

The literature analyzed the effect of multinational transfer on the skill-composition at home by measuring the share of foreign workers over MNCs' employment as a proxy of FDI. Our data do not allow to measure the foreign workforce composition. However, we believe equity participation (i.e. the entry mode choice) to be a good proxy of the firm's commitment in the foreign subsidiary. Indeed, change in equity participation has implications in terms of management and technology transfer, which in turns may have a specific effect on employment in the home country. This idea is also developed in Moran (2004), who argued that the failure to differentiate between FDI with minority shareholding and investments with majority ownership makes it impossible to isolate the effect of FDI in the host country. [23].

We control our results by building other proxies of outward FDI, as described in Appendix 2.A. First, we weight the number of FDI by the value of the investment, second we control for the firm's blocking minority power [24], third we use the number of foreign affiliates without any weight. We find estimation results to be similar whatever the proxy retained (see Table 2.11 and 2.12).

Table 2.2 – MNC Subsidiaries

	Average number of subsidiaries		Average conditional on presence[a]		% change[b]		% of WOS[c]	
High income countries	0.704	[1.276]	1.887	[2.958]	0.164	[0.653]	51.9%	[0.499]
Low income countries	0.755	[1.666]	2.345	[3.752]	0.112	[0.876]	28.6%	[0.452]
BRICS	0.462	[1.096]	1.962	[2.177]	0.254	[0.809]	48.1%	[0.499]
Eastern Europe	0.251	[0.727]	1.684	[1.657]	0.191	[0.693]	56.6%	[0.495]
EU-15	1.736	[2.313]	2.524	[2.442]	0.086	[0.891]	44.6%	[0.497]

a. Average number of subsidiaries at the intensive margins, that is for firms having at least one affiliate in the group of countries.
b. Measure the percentage change of subsidiaries between 2002 and 2007.
c. Measure the percentage of Wholly Owned Subsidiaries (WOS) in each region in 2007.
Lecture : The table gives the average number of subsidiaries in multinational firms by country destination for year 2007
Source : LIFI survey, French annual census for manufacturing (EAE) ;
Note : Balanced Panel ; Standard deviations under brackets. Group of countries are detailed in footnote 19.

Table 2.2 shows descriptive statistics on the number of subsidiaries by regions in which subsidiaries are located, for year 2007. French multinational firms have on average more subsidiaries in high-income countries, low-income countries and in the European Union than in other parts of the world. The large number of subsidiaries in low-income countries

23. We have tested the impact of a change in the share of voting stocks held in a foreign subsidiary on the share of employment in the investing firm. Results reveal that increases in the share of voting stock in a firm's subsidiary raises significantly the share of executives and reduces the share of blue-collar workers.

24. A firm has the possibility to veto certain decisions at general meetings of shareholders when the firm owns more than 33% of the foreign subsidiary.

is partly due to France's colonial history in North Africa and in sub-Saharan countries in the 19th century. French colonization has had an impact on language and the institutional proximity of France and the countries it colonized, by imposing French as an official language and by imposing legal and judicial institutions. Since lower geographic and cultural distance, as well as a common language have a positive impact on outward FDI (Bénassy-Quéré et al. (2007)), the number of subsidiaries in former French colonies is particularly important. In 2007, there were more than 1,500 subsidiaries established in Cameron, Côte d'Ivoire, Morocco, Tunisia and Algeria. In comparison, there were only 328 French subsidiaries in Japan in 2007, 996 in Switzerland, and 3,146 in the United States. The fourth main group of destination countries are the BRICS and which experienced the highest increase between 2002 and 2007. In 2007, in our sample, there were 2,267 French subsidiaries in the BRICS, with 1,067 of them established in China.

When looking at the average conditional on the presence in the group of countries, MNCs have on average two affiliates. In 2007, French multinational companies had on average more subsidiaries in the European Union, with an average of 2.5 affiliates. While the lowest number of subsidiaries is observed in the group of Central and Eastern Europe countries with an average of 1.7 affiliates at the intensive margin.

Roughly one half of FDI in BRICS takes the form of wholly owned subsidiaries (see the last column of Table 2.2). Emerging economies (and BRICS in particular) continue to attract knowledge-intensive and technology-intensive FDI from developed countries (Gryczka 2010), which could create incentives for French multinational firms to settle wholly owned subsidiaries in order to protect themselves against the leakage of technology, know-how and/or intangible assets. In contrast, French multinational firms seem to access low income countries by setting up a joint venture, since only 28.6% of FDI to low-income countries takes the form of wholly-owned subsidiaries. The need of a partner's experience of the foreign market is all the more important in a country where corruption and the cultural distance are high (Nunnenkamp and Andreis (2013), Brouthers and Brouthers (2001), Gatignon and Andersen (1988), Johansen and Vahlne (1977)). The predominance of joint-ventures in low-income countries suggests that FDI mainly concerns labor-intensive goods with standardized procedures and low-technology (Antràs (2005)). We also notice that internationalization in East European countries predominantly takes the form of wholly-owned subsidiaries. Firms prefer to avoid coordination with joint-venture partners in order to ensure quality standards and processes, by relying only on their own resources (Klug (2006), Stiegert et al. (2006)). In the following estimations, we take into account the equity participation in the foreign subsidiary as shown in equation (2.2).

4 Estimation Strategy

In order to observe changes in the workforce composition consecutive to foreign direct investment, we follow the existing literature by considering a reduced-form equation of a

firm's costs. We approximate the short-run cost function with a translog cost function. The Shepard's lemma yields the following conditional demand for work type i :

$$\theta_{ijt} = \alpha_{1j} W_{ijt} + \alpha_{2j} \ln K_{jt} + \alpha_{3j} \ln Y_{jt} + \alpha_{4j} \ln \kappa_{jt} + \sum_{r=1}^{R} \alpha_{rj} O_{jrt} + \alpha_t + \alpha_k + \epsilon_{ijt} \quad (2.3)$$

We denote by θ_{ijt} the share of work type i over the total number of employees in firm j at year t. The work type i refers to either occupations or tasks in order to identify more carefully the jobs at risk from FDI. The coefficient of interest is α_{4j} and captures an MNC's employment response to increasing in-house FDI, as described in equation 2.2. Here, in order to fit the economic reality, we assume that in every period $t \in [2002; 2007]$ firm j produces output Y by using capital K and different types of workers i. K_j is measured by the input of capital and Y_j by the revenue of firm j (in nominal term in thousands euros).

A source of potential bias arises from the inclusion of the variable W_{ij}. W_{ij} equals the ratio of the wage paid to work type i (w_{ijt}) out of the wage paid to the complementary work type not in i (w_{-ijt}). This wage variable captures trends in education and therefore firm j's cost share. Moreover, there could be collinearity between time dummies and wages if they are linearly dependent. We drop the wage variable by assuming that there is no exogenous variation across companies [25]. ϵ_{ijt} is the idiosyncratic error term that can be decomposed as $\epsilon_{ijt} = \eta_j + v_{ijt}$, where η_j is the constant individual-specific residual and v_{ijt} is a standard residual.

We add several control variables to the specification (captured in O_{jt}) : a technology proxy, the amount of exports and domestic insourcing.

From an already-vast literature, we know that technological change is responsible for changes in the wage-bill share (Goos et al. (2009), Autor et al. (2003), Acemoglu and Autor (2011)). We account for technological change by building a technology proxy, measured as the total factor productivity (TFP). The firm's total factor productivity is derived from the approach of Levinsohn and Petrin (2003), which allows to control for endogeneity resulting from the correlation between unobservable productivity shock and input level. We use intermediate inputs as a proxy for the productivity shock (measured as the operating expense), value-added as the dependent variable as well as the number of employees as a proxy of the labor force and the total fixed assets as a capital proxy. [26] .

25. However, we report results by including wages in Annex 2.A, and do not alter our conclusions.

26. We have used different proxies for technological change, such as investment in R&D, proximity to the sector technology frontier and software investment. The productivity frontier represents the gap between the (log) productivity of a particular firm and the highest productivity (or the highest percentile productivity) in the same industry. The productivity of the firm is measured as the value added per worker such as : $Proximity_{ikt} = P^{95} \log\left(\frac{VA}{L}\right)_{kt} - \log\left(\frac{VA}{L}\right)_{ikt}$. We use the 95 order percentile in order to have a robust measure, by excluding outliers. The lower the variable, the more productive the firm is. Whatever the variable retained, our results are not altered. However, we prefer the measure of TFP for several reasons. First, the software investment variable is not referenced for all firms. Second the R&D variable is built from the EAE survey that accounts for fixed R&D, i.e., R&D accounted as capital expenditure in the balance-sheet rather than as an expense of research and development.

We also control for the value of firms' exports (in €million). Most heterogeneous firm models treat internationalization as a progressive process : the least productive firms exit the market, low productive firms remain in the domestic market, highly productive firms export, and top-notch productive firms integrate through foreign direct investment (Helpman et al. (2004)). In practice, multinational firms continue to reach foreign markets through exports rather than only through foreign subsidiaries. Roughly 90 percent of US exports and imports flow through multinational firms (Bernard et al. (2005)). Moreover, recent empirical findings have shown that exporting is a key step prior to international settlement. 95 percent of new FDI are preceded by exports in the same country (Gazaniol (2014)). Hence, including exports in the specification would reduce a potential endogeneity problem, in which exports may not only affect the FDI decision, but also employment (See Crinò (2009) for a review of studies analyzing the effect of trade on employment).

Finally, we control for the possibility of domestic in-sourcing. A firm can choose to keep the production of an intermediate input within its boundaries by producing the intermediate input at home or abroad. Domestic in-sourcing is considered as traditional vertical integration that could affect employment within the investing firm (Antràs and Helpman (2004)). Domestic in-sourcing could also be a first step before undertaking a foreign direct investment. Indeed, Antràs and Helpman (2004) model the same pecking order as Melitz (2003), in which the least productive firms insource through domestic subsidiaries, whereas the most productive firms integrate via foreign direct investment. [27] A firm's productivity would determine whether a firm insources or integrates through foreign direct investment. In order to account for domestic in-sourcing, we build the same measure as described by equation 2.2, by summing the total number of French subsidiaries [28].

Table 2.3 – Firm's Characteristics

	Domestic Firms		Exporting Firms		Multinational Firms	
Number of Firms	1,207		4,578		767	
Apparent labor productivity (revenue/workforce) in K €	208.49	[211.48]	264.08	[777.35]	419.69	[1962.92]
Capital Intensity (Property, Plant and Equipment) in K €	2264.9	[55687.36]	2665.6	[28556.15]	45022.3	[491608.2]
Value Added	6343.6	[20967.86]	11534.7	[26839.2]	64969	[139050.2]
Revenue	22975.3	[113723.5]	42552.9	[107501.5]	242731.8	[529145.3]
Workforce	113.7	[245.935]	200.7	[354.200]	914.1	[1932.06]
Proximity to the frontier technology frontier	0.471	[0.522]	0.455	[0.529]	0.194	[0.545]

Source : LIFI survey, French annual census for manufacturing (EAE), French Déclaration annuelles des donnés sociales (DADS) ; Year 2007 ; Balanced panel data ; Standard deviation under brackets. Authors' calculations.

Table 2.3 presents some descriptive statistics of companies' characteristics, distinguishing between domestic, exporting and multinational firms. As already shown in the lite-

27. This result holds in a world with no outsourcing and if the final good is intensive in inputs brought by the final-good producer.

28. All French subsidiaries controlled by another company are considered as French subsidiary.

rature, multinational companies are on average bigger, more productive, more intensive in capital and also have higher revenue and value added. Multinational firms are also closer to their technology frontier, as shown by the last row of Table 2.3.

5 Estimation Results

In the following sections we estimate equation 2.3. We define different groups of occupations in order to account for aggregation bias as detailed in section 2. The first selects occupations by their level of qualification and defines executives, blue-collar workers, intermediate professions and employees. The second selects occupations by their link to the production process, and identifies the skilled and unskilled workers who are linked to the production process and those who are not. Finally, we look at seven specific occupations (managers, engineers, skilled and unskilled blue-collar workers, employees, foremen and technicians). A detailed description of occupational groups is provided in Annex 2.C. We also report results on task classifications and define manual versus analytical, cognitive and interactive tasks.

The Hausman test of exogeneity confirms the existence of constant unobserved variables correlated with the independent variables in all specifications. To account for individual-level heterogeneity, the constant individual-specific residual η_j is differenced out and within-firm equation estimates are provided. Time (α_t) to control for common time trends and industry-year dummies (α_k) are used to take into account all unobservable characteristics varying over time that could affect industries. Equation 2.3 is run using robust and clustered standard errors.

5.1 Changes in the share of occupations

In a first regression, we consider four groups of occupations, differentiated by their level of qualification. The first group of executives is composed of skilled workers (engineers and administrative managers) in column (1) ; the group of intermediate professions is made up of middle-skilled workers, some of whom are skilled secretaries (primary or executive secretaries), while others are skilled production workers such as technicians or foremen, in column (3). We also define two other groups of unskilled workers, the first is composed of blue-collar workers, in column (2) and the second is made up of unskilled administrative employees (operators, receptionists and unskilled secretaries) in column (4).

Controlling for unobserved firm-level heterogeneity, table 2.4 reveals a positive relationship between a firm's revenue and the share of skilled and middle skilled workers (i.e., executives and intermediate professions). In contrast, a negative correlation between the share of blue-collar workers and an increase in a firm's revenue is observed.

The results reveal a statistically significant and positive relationship between increasing FDI in low-income countries and changes in the share of executives in the home company.

Conversely, the relationship between FDI in low-income countries and the share of blue-collar worker is significantly negative, at the 10% level. This result is in line with traditional international trade theory predictions.

Table 2.4 – Changes in the Share of Occupations by Qualification Groups

	FE (1)	FE (2)	FE (3)	FE (4)
	Executives	Blue collars	Intermediate Profession	Employees
Subsidiaries in				
LI countries	0.015***	-0.010**	-0.003	-0.006
	[0.005]	[0.005]	[0.004]	[0.004]
HI countries	0.002	-0.006	0.004	0.002
	[0.007]	[0.007]	[0.007]	[0.006]
France	-0.001	-0.001	0.001	0.003
	[0.002]	[0.004]	[0.003]	[0.003]
TFP	0.000	0.004*	-0.002	-0.004*
	[0.002]	[0.002]	[0.002]	[0.002]
Export	-0.000	0.000	-0.000	0.001
	[0.000]	[0.000]	[0.000]	[0.001]
Revenue	0.007**	-0.015***	0.007**	0.008
	[0.003]	[0.004]	[0.003]	[0.005]
Capital	-0.001	0.003*	-0.001	-0.001
	[0.001]	[0.002]	[0.002]	[0.002]
Constant	0.098***	0.632***	0.192***	0.055*
	[0.018]	[0.025]	[0.020]	[0.032]
Observations	21,177	21,177	21,177	21,169
R-squared	0.098	0.193	0.047	0.016
log likelihood	44697.306	38859.694	40082.944	32049.359

Source : LIFI survey, French annual census for manufacturing (EAE), French Déclaration annuelles des données sociales (DADS) ; period 2002-2007. Authors' calculations. Note : Estimations are for firm fixed effects (FE) and variables are calculated at the level of the firm. Wage-bill shares are in percent, varying between zero and 100. Estimations are controlled for year and industry-year fixed effects. Heteroskedasticity-robust standards errors are reported in brackets. ***, **, and * indicate significance at the 1, 5 and 10 percent levels respectively.

In contrast, when identifying occupations according to their link to production [29] (as in Biscourp and Kramarz (2007), and Head and Ries (2002)), [30] we do not find any significant effect of offshoring on employment (see Table 2.20 in Appendix 2.D). We argue that the non-significant result is due to the high degree of heterogeneity in occupational categories, which could imply an aggregation bias.

29. The first two are composed of production workers. On the one hand, we define skilled production workers (i.e., engineers, technicians, foremen, skilled blue-collar workers), and on the other hand unskilled production workers (i.e., unskilled blue-collar workers). The last two are composed of non-production workers. The first are skilled (administrative managers and administrative intermediate professions, mostly composed of skilled secretaries) and the second are unskilled, mostly made up of administrative employees (i.e., receptionists, unskilled secretaries and typists).

30. Biscourp and Kramarz (2007) found a negative effect of imports of intermediate inputs on the share of unskilled production workers, while Head and Ries (2002) found a positive effect of increasing employment in low-wage subsidiaries on the share of skilled non-production workers.

TABLE 2.5 – Changes in the Share of Occupations by Occupational Groups

Model	FE (1)	FE (2)	FE (3)	FE (4)	FE (5)	FE (6)	FE (7)
Dependant variable	Managers	Engineer	Skilled blue collars	Unskilled blue collars	Employees	Technicians	Foremen
Affiliates in							
Low income countries	0.005**	0.006	-0.006	-0.013**	0.001	0.006	-0.002
	[0.002]	[0.004]	[0.009]	[0.006]	[0.001]	[0.004]	[0.003]
High income countries	-0.002	-0.000	-0.016	0.016	-0.001	0.003	0.000
	[0.004]	[0.005]	[0.012]	[0.010]	[0.001]	[0.005]	[0.003]
France	0.001	-0.002	-0.001	0.001	-0.001	0.001	0.001
	[0.002]	[0.002]	[0.005]	[0.004]	[0.001]	[0.002]	[0.001]
Exports	0.000	-0.000	-0.001	0.001**	-0.000	0.000	-0.000
	[0.000]	[0.000]	[0.001]	[0.001]	[0.000]	[0.000]	[0.000]
Revenue	0.005**	0.005*	-0.005	-0.010**	-0.001	0.005*	0.001
	[0.003]	[0.003]	[0.006]	[0.005]	[0.001]	[0.003]	[0.002]
Capital	-0.001	0.000	0.006**	-0.004**	-0.001**	-0.002	0.001
	[0.001]	[0.001]	[0.003]	[0.002]	[0.000]	[0.001]	[0.001]
TFP	-0.014*	0.016*	-0.001	0.018	0.001	-0.015	-0.006
	[0.008]	[0.010]	[0.024]	[0.021]	[0.003]	[0.010]	[0.007]
Constant	0.061***	0.028	0.461***	0.213***	0.012*	0.172***	0.055***
	[0.018]	[0.025]	[0.054]	[0.046]	[0.007]	[0.027]	[0.015]
Observations	21,222	21,222	21,222	21,222	21,222	21,222	21,222
R-squared	0.009	0.022	0.002	0.025	0.003	0.021	0.002
log likelihood	52130.455	46911.568	25703.271	27691.258	72175.682	41827.820	53075.644

Source : LIFI survey, French annual census for manufacturing (EAE), French Déclaration annuelles des donnés sociales (DADS) ; period 2002-2007. Note : Estimations are of firm fixed effects (FE) and variables are calculated at the level of the firm. The wage-bill shares are in percent, varying between zero and 100. Estimations are controlled for year and industry-year fixed effects. Heteroskedasticity-robust standards errors are reported in brackets. ***, **, and * indicate significance at the 1, 5 and 10 percent levels respectively.

When disaggregating occupational classifications into occupations, we are able to identify which occupations verify previous results. We split occupations into seven major groups : administrative managers, engineers, employees, technicians, foremen, skilled and unskilled blue-collar workers (see Table 2.21).

The negative correlation between a firm's foreign direct investment to low-income countries and the share of blue-collar workers is mainly driven by unskilled blue-collar workers, as shown by column (4) in Table 2.21. The positive correlation between FDI to low income countries and executives is only observed for skilled white collar workers (managers) and is not significant in the sample of skilled blue collar workers (engineers). Hence, results in Table 2.21 show that compensatory effects could occur when aggregating groups of occupations [31].

5.2 Changes in task intensity

The precedent results have identified the FDI bias towards occupations and have highlighted a positive correlation between FDI and executives. However, theoretical and em-

31. For instance, the coefficient associated with technicians is positive while the coefficient associated with foremen is negative, while there are both captured in the group of intermediate occupations.

pirical studies have shown that tasks may give more information to identify the offshoring bias than education and/or occupations. Indeed, some occupations might be easier to offshore because they perform offshorable tasks (Acemoglu and Autor 2011a; Grossman and Rossi-Hansberg 2008; Hummels et al. 2011; Ebenstein et al. 2009). While others, such as managers and engineers, might be less 'substituable' by offshored employees, because they perform specific tasks that can be difficult to offshore without loss of quality (such as interactive or analytical tasks). The advantage of doing the analysis at the task level is to capture the skill-composition of firms at a disaggregated level since more than 412 occupations were used to construct the task index. This section is able to clearly identify the FDI bias towards specific tasks. The results are reported in Table 2.6.

Table 2.6 shows a positive and significant complementarity between a firm's capital intensity and the use of non-routine manual, interactive and analytical tasks. This result is also observed in Becker et al. (2012), who show a positive correlation between the ratio of a firm's capital over value-added and the non-routine task index in the manufacturing sector.

Examining the results of exports on a company's task intensity, we notice that exports have a significant and negative impact on the share of workers performing non-routine manual tasks. This result mirrors the ones in Peri and Poole (2013) on Brazil, who find a rising demand for cognitive relative to manual tasks within the firm consecutive to a firm's openness.

Turning to the coefficients of the variables of interest, the results show that there is a negative effect of outward-FDI to high-income countries on the share of workers performing non-routine manual tasks. This result is driven by the capital goods industry. [32] The capital goods industry is relatively less fragmented at the top, as it requires heavy intermediate inputs which are costly to export, and requires heavy engineering, which involves skilled manual competences (see Table 2.22). Companies often choose relocation when exporting is costly in order to access foreign markets and to benefit from specific competences available in the North (Riker and Brainard (1997), Grossman et al. (2006)). In 2007, roughly 70% of FDI in capital goods industries was directed to high income countries. Production offshored to high-wage countries in capital goods industries implies the substitution of skilled production workers, resulting in a decrease in the share of workers performing non-routine manual tasks.

32. We split the data into the three main sectors composing our sample. Results are reported in Annex 2.E.

TABLE 2.6 – Changes in Task Intensity

Model	FE (1)	FE (2)	FE (3)	FE (4)	FE (5)
Dependant variable	Routine Manual	Non routine manual	Non routine interactive	Non routine analytic	Routine cognitive
Subsidiaries in					
Low income countries	-0.003	0.006	0.019**	0.011*	0.009
	[0.007]	[0.007]	[0.009]	[0.006]	[0.007]
High income countries	-0.009	-0.019**	-0.005	-0.009	-0.000
	[0.010]	[0.008]	[0.010]	[0.008]	[0.007]
France	-0.005	-0.010**	-0.002	-0.002	-0.000
	[0.005]	[0.004]	[0.004]	[0.003]	[0.004]
TFP	-0.004	-0.001	0.000	0.001	0.001
	[0.003]	[0.002]	[0.002]	[0.002]	[0.002]
Exports	-0.001*	-0.001**	0.000	-0.000	0.000
	[0.001]	[0.001]	[0.001]	[0.000]	[0.001]
Revenue	0.007	0.004	0.004	0.001	-0.001
	[0.005]	[0.004]	[0.005]	[0.003]	[0.004]
Capital	-0.002	0.005**	0.001	0.003**	0.001
	[0.002]	[0.002]	[0.002]	[0.002]	[0.002]
Constant	0.498***	0.523***	0.381***	0.555***	0.544***
	[0.037]	[0.042]	[0.034]	[0.025]	[0.027]
Observations	20,601	20,601	20,601	20,601	20,601
R-squared	0.002	0.025	0.039	0.032	0.021
log likelihood	44697.306	38859.694	40082.944	32049.359	28717.307

Source : LIFI survey, French annual census for manufacturing (EAE), French Déclaration annuelles des donnés sociales (DADS) ; period 2002-2007. Note : Estimations are for firm fixed effects (FE) and variables are calculated at the level of the firm. The wage-bill shares are in percent, varying between zero and 100. Estimations are controlled for year and industry-year fixed effects. Heteroskedasticity-robust standards errors are reported in brackets. ***, **, and * indicate significance at the 1, 5 and 10 percent levels respectively.

By contrast, we notice a positive effect of FDI to low-income countries on the intensity of interactive tasks performed in the home country. The fragmentation of production processes to low-income countries increases the need for skilled workers in *upstream* production activities and raises the average skills-intensity of the investing firm at home. The positive effect of FDI to low-income countries on the share of workers performing interactive tasks is mainly driven by FDI in the intermediate goods sectors [33] and is not observed in the consumer goods industry. One explanation may be that vertical fragmentation in the consumer goods sector is mainly realized through international arms-length production, because the cost of importing intermediate-goods and exporting final-goods is relatively small compared to that in capital goods and in the intermediate goods sector.

To conclude, these two subsections have shown the importance of having micro data to understand which occupations are exposed to FDI. There is a clear *FDI bias* toward skilled executives. More specifically, FDI to low-income countries raises the demand for skilled executives performing interactive tasks, whereas FDI to high-income countries reduces the demand for workers performing non-routine manual tasks. However, aggregate occupa-

33. See Table 2.25 in Annex 2.E.

tion classifications (such as production versus non-production workers) do not provide an understanding of which jobs are affected by the FDI strategies of French firms.

In the following subsections, we go a step further in order to understand what is driving the occupational bias : (i) the countries of destination ; (ii) first-time investors or already established multinational firms ; and (iii) the parent companies' strategies. In the following sections, we report the results on the five task categories and on only two groups of occupations -the share of executives and blue-collar workers- for which there is a significant impact of FDI.

5.3 Country of destination

In this subsection, we estimate equation 2.3 by dividing FDI into five major destination country groups : the BRICS, Eastern Europe (countries belonging to the EU prior to 2004), the European Union (countries belonging to the EU before 2004), other high-income and low-income countries.

The results show that there is a negative and significant correlation between a firm's exports and the share of workers performing non-routine and routine manual tasks. Similar to the results obtained in Table 2.6, we observe that a firm's capital intensity has a positive and significant effect on the share of workers performing tasks more intensively which are non-routine manual, interactive and analytical. These tasks are features of skilled occupations such as managers and engineers (as described in Table 2.16 in appendix 2.B).

Concerning the variable of interest here, we first notice from Table 2.7, that foreign direct investment in high-income countries does not affect the workforce composition in the domestic firm. This is true except for workers performing non-routine manual tasks intensively, which are adversely affected. These tasks are mainly performed by skilled production workers, such as engineers, technicians and skilled blue-collar workers and need specific qualifications and experience (see Table 2.16 in appendix 2.B). This result mirrors those of Hakkala and Huttunen (2014) who find a negative effect of imports of intermediate inputs on the share of non routine physical tasks in Finland.

Amongst high-income countries, it is possible to separate out the EU-15, which is traditionally one of the main area of French foreign investment. We do not observe any significant results regarding the demand for skills and tasks. This may be due to the high heterogeneity of countries inside European Union. Indeed, the reasons for offshoring to the EU-15 are more diverse than relocation to other areas (Topiol and Héricher 2013). This could explain the overall insignificant effect of FDI on employment [34].

34. Some strategies may be linked to reasons of market access : for example, in Germany, the United Kingdom and the Benelux countries. Other FDI strategies may be carried out to take advantage of factor cost differentials : for example, in Portugal, Spain and Ireland.

Table 2.7 – Changes in the Share of Occupations and tasks

VARIABLES	Executive (1)	Blue collar Workers (2)	Routine Manual (3)	Non routine Manual (4)	Non routine Interactive (5)	Non routine Analytic (6)	Routine Cognitive (7)
Subsidiaries in							
HI countries	0.002	-0.005	-0.008	-0.019**	-0.005	-0.009	-0.002
	[0.008]	[0.008]	[0.010]	[0.008]	[0.010]	[0.007]	[0.007]
Eastern Europe	0.002	0.005	0.022**	0.021*	-0.005	-0.007	-0.007
	[0.006]	[0.009]	[0.010]	[0.013]	[0.014]	[0.011]	[0.009]
BRICS	0.024**	-0.013*	-0.013	-0.003	0.032**	0.018*	0.011
	[0.011]	[0.008]	[0.011]	[0.010]	[0.014]	[0.011]	[0.009]
LI countries	0.005	-0.005	-0.011	0.003	0.015	0.012	0.011
	[0.008]	[0.008]	[0.012]	[0.011]	[0.012]	[0.011]	[0.011]
EU-15	-0.004	-0.005	-0.001	-0.004	-0.005	-0.004	0.005
	[0.004]	[0.005]	[0.007]	[0.006]	[0.007]	[0.006]	[0.005]
France	-0.001	-0.001	-0.005	-0.010***	-0.001	-0.002	0.000
	[0.002]	[0.004]	[0.005]	[0.004]	[0.004]	[0.004]	[0.004]
TFP	0.000	0.004*	-0.004	-0.001	0.000	0.001	0.001
	[0.002]	[0.002]	[0.003]	[0.002]	[0.002]	[0.002]	[0.002]
Exports	0.000	0.000	-0.001*	-0.001**	0.000	-0.000	0.000
	[0.000]	[0.000]	[0.001]	[0.001]	[0.001]	[0.001]	[0.001]
Revenue	0.007**	-0.015***	0.007	0.004	0.004	0.001	-0.001
	[0.003]	[0.004]	[0.005]	[0.004]	[0.005]	[0.004]	[0.004]
Capital	-0.001	0.003*	-0.002	0.005**	0.001	0.003	0.001
	[0.001]	[0.002]	[0.002]	[0.002]	[0.002]	[0.002]	[0.002]
Constant	0.098***	0.634***	0.499***	0.524***	0.381***	0.555***	0.542***
	[0.018]	[0.025]	[0.037]	[0.042]	[0.034]	[0.037]	[0.028]
Observations	21,177	21,177	20,601	20,601	20,601	20,601	20,601
R-squared	0.039	0.025	0.002	0.024	0.039	0.032	0.021
Log Likelihood	44700.611	38861.538	28720.732	31982.437	30738.575	32770.091	33111.482

Source : LIFI survey, French annual census for manufacturing (EAE), French Déclaration annuelles des donnés sociales (DADS) ; period 2002-2007. Note : Estimations are firm fixed effects (FE) and variables are calculated at the level of the firm. The wage-bill shares are in percent, varying between zero and 100. Estimations are controlled for year and industry-year fixed effects. Heteroskedasticity-robust standards errors are reported in brackets. ***, **, and * indicate significance at the 1, 5 and 10 percent levels respectively.

When isolating the Central and East European countries (CEECs), the effect of FDI on employment in France is clearer. Increasing FDI in CEECs raises the demand for manual workers. FDI in CEECs generally combines mixed strategies and includes both cost reductions and market access strategies. For example, car manufacturers have relocated to CEECs to benefit from low production costs, but also to be close to local markets with strong growth potential. The traditional logic of fragmenting production processes in CEECs by French and German firms consists of offshoring stages of production related to intermediate goods, by applying the logic of exploiting comparative advantages between countries. In contrast, the assembly and logistics stages in the production process are concentrated in the home country, in a region which is geographically central to accessing the EU market (Moati and Mouhoud (2005), Martinez-Zarzoso et al. (2011)). [35] Indeed,

35. In France, for example, these assembly phases are concentrated in the North Eastern region, to be close to the EU market. We have run the equation per region and the region that leads these results are Alsace and Lorraine, which are two regions close to the German border. Trade in parts and components produced in the CEEC-10 for export to the OECD countries now accounts for approximately 30% of the

when splitting our sample into different sectors, the positive significant result of FDI to the CEECs on the domestic share of manual workers is only driven by the intermediate goods industry. Therefore, FDI in the CEECs raises the demand for non-routine manual tasks, mostly carried out by skilled production workers, because firms mainly re-import intermediate goods, in order to assemble final products in France. This raises the demand for production workers performing skilled and unskilled manual tasks. This result is similar to Falk and Wolfmayr (2008) as well as to Konings and Murphy (2006).

The results are quite different when FDI is undertaken in major emerging countries. FDI inflows in developing economies increased by 68 percent between 2005 and 2007, and now surpass developed economies as recipients of FDI (World investment report, 2007, 2013). In France in 2002, the amount of imports of intermediate inputs reached €96.2 billion and rose to €197.16 billion by 2012, with the BRICS accounting for 10.6% percent of this growth. [36]. FDI to the BRICS could thus have a higher impact on employment compared to what was observed in the 1990s statistics (Krugman (2008), Autor et al. (2013)). Table 2.7 indeed reveals that the preceding results are driven by FDI to BRICS, which are favorable for executives and workers performing non-routine interactive and analytic tasks intensively (carried out by skilled workers) in France. In contrast, substitutability is observed between FDI to BRICS and the demand for blue-collar workers.

5.4 Increasing FDI and first-time investors

The preceding estimations included information on both multinational and domestic firms (composed of exporting and purely domestic firms). This section focuses on the sample of multinational firms. The sample is divided into firms that were already multinational at the beginning of the sample period and changed their number of subsidiaries abroad (we call this increasing intensive margin), and those that became multinational for the first time by undertaking at least one FDI project between 2002 and 2007 (we call this increasing extensive margin). The results are reported in Table 2.8.

First-time investors in low-income countries increase the demand for managers without reducing employment of blue-collar workers. In contrast, results indicate that, once firms are multinational, increasing FDI in low-wage countries decreases the demand for blue-collar workers.

Our results mirror those of Hijzen et al. (2011) and of Barba Navaretti et al. (2010). The study of Hijzen et al. (2011) uses French data over the period 1987-1999. They use a matching technique to measure the effect of FDI, three years after the first foreign investment. They show that investment in low-income countries has no significant effect on employment, only FDI to high-income countries does. The study of Barba Navaretti

OECD's total trade (Yeats 1998).

36. These statistics are calculated from Comext, Eurostat sources stemming from aggregate input- output tables in national accounts. Intermediate goods are identified in three broad categories with the BEC classification (BEC 420, BEC 530, BEC 220).

et al. (2010) analyze the effect of FDI on employment in France and Italy over the period 1993-2000. They show that first time investors in both developed and developing countries experience significantly higher employment relative to the control group. However, the two studies do not distinguish workers by qualification group, and are not able to observe the positive correlation between the first settlement in low-income countries and the average skill intensity of the investing firm at home.

The estimated coefficient of FDI to low-income countries on the share of executives is roughly three times the size than that of the negative coefficient associated with FDI to low-income countries on the share of blue-collar workers. Hence, as in Barba Navaretti et al. (2010), we find evidence of an overall positive effect of outward investments to cheap labor countries on total employment.

Table 2.8 – Comparaison between First-Time Investors and Multinational Firms

	Extensive Margin		Intensive Margin	
	Executives	Blue-collar workers	Executives	Blue-collar workers
Affiliates in				
LI countries	0.024***	-0.006	0.010*	-0.009*
	[0.008]	[0.007]	[0.006]	[0.005]
HI countries	0.005	0.007	0.005	-0.007
	[0.009]	[0.009]	[0.008]	[0.007]
France	-0.004	-0.010	-0.003	-0.007
	[0.007]	[0.006]	[0.004]	[0.007]
TFP	0.004	0.002	-0.009	-0.002
	[0.006]	[0.006]	[0.006]	[0.005]
Export	-0.000	0.005***	0.001	-0.001
	[0.002]	[0.002]	[0.002]	[0.003]
Revenue	0.030**	-0.026**	0.012	-0.001
	[0.012]	[0.011]	[0.011]	[0.013]
Capital	0.001	-0.001	-0.004	0.006
	[0.003]	[0.003]	[0.004]	[0.005]
Constant	-0.004	0.576***	0.198***	0.461***
	[0.064]	[0.060]	[0.060]	[0.067]
Observations	1,003	1,003	2,305	2,305
R-squared	0.092	0.070	0.102	0.084
Number of firms	1876.433	1942.302	4703.873	4583.777

Source : LIFI survey, French annual census for manufacturing (EAE), French Déclaration annuelles des donnés sociales (DADS) ; period 2002-2007. Note : Estimations are of firm fixed effects (FE) and variables are calculated at the level of the firm. The wage-bill shares are in percent, varying between zero and 100. Estimations are controlled for year and industry-year fixed effects. Heteroskedasticity-robust standards errors are reported in brackets. ***, **, and * indicate significance at the 1, 5 and 10 percent levels respectively.

Exports play a positive role in the demand for blue-collar workers. An increase in exports raises the share of blue-collar workers. But this result is only observed in the sample of first time-investors. We explain this result by the fact that export is an important determinant of the first settlement (Gazaniol 2012). International experience through exports allows a firm to collect additional information on the foreign market (legal and judicial

institutions for instance), and is a good way to gain experience from internationalization before making the first settlement (Conconi et al. (2013)). Increasing exports prior to a first investment could thus lead to an increase in domestic production, and therefore increase the proportion of blue-collar workers.

5.5 Robustness test : Parent company strategies and Foreign acquisition

In the preceding estimations, the labor effect of foreign direct investment is exactly identified for each firm. However, carrying out the study at the firm level could tend to overestimate or underestimate the coefficient associated with outward-FDI.

Firms can be either independent or be part of a business group. A group is composed of an independent parent company and all other entities controlled by the parent company. In our sample in 2007, 81% of the firms belonged to a group (as a parent company or as a subsidiary) and 82% of them were not directly engaged in outward FDI (i.e., they do not directly control any foreign subsidiary). Foreign direct investment of a particular firm belonging to a group may not only affect the investing firm, but also all other French subsidiaries belonging to the group, if foreign subsidiaries are substitutes for domestic ones. Hence, FDI at the group level can affect the work-composition of all the group's subsidiaries ; even those that are not engaged in outward FDI. For example, if a French group decides to offshore part of its production process, it can decide to restructure its whole perimeter by strengthening its tertiary functions (such as R&D, IT or sales) in the national territory inside its domestic subsidiaries (Gazaniol and Peltrault 2013). Therefore, domestic subsidiaries could go through major changes without directly investing abroad and this result would not be observed with estimation at the firm level. We follow Becker and Muendler (2008) and Becker et al. (2012) to measure the employment impact of FDI at the business-group level.

In order to control for a firm's exposure to the group's FDI activities, we attribute to each firm the κ variable at the group level [37]. The results revealed by Table 2.18 are consistent with those obtained by taking into account the relocation strategy at the firm level, as detailed in appendix 2.A. There is a negative impact of FDI to high-income countries on the share of blue-collar workers and a positive impact of FDI to low-income countries on the share of executives. However, the results at the group level are weaker. There is no significant results associated with the tasks index and the coefficients associated with the share of blue-collar workers and executives are smaller. This result highlights that the main employment adjustment happens inside the direct mother company rather than within other affiliates belonging to the business group.

In a second robustness test, we control for change in firm nationality. A recent literature has shown an impact of foreign acquisition on employment : more skilled and

37. We build the measure described in equation 2.2 by summing the number of subsidiaries of the business group. We attribute this measure to each firm belonging to the same group. All other variables are determined at the firm level. For simplicity, we only retained firms in our sample that did not change their parent company during the whole period of observation.

productive firms tend to be the targets of foreign acquisition (Bloningen et al. (2012), Almeida (2007))). Hence, the non-inclusion of foreign acquisition could result in an endogeneity problem. [38].

5.6 Control for other margins of globalization

The precedent estimations accounted for intra-firm investment but did not control for other margins of firms' internationalization such as outsourcing to independent suppliers. Material offshoring has been measured in the literature as imports of intermediate inputs (Feenstra and Hanson (1999)). The argument for doing so is as follows : imports of intermediate inputs may capture the part of the goods who needs to be shipped back to the home country in order to be assembled or sold under the brand name of the firm (Crinò (2009)). As in Biscourp and Kramarz (2007), we include both imports of intermediate inputs and imports of finished goods. Imports of finish goods may have a stronger negative impact on employment because the production abroad has been substituted to the production at home (Biscourp and Kramarz (2007)). While imports of intermediate inputs capture international fragmentation of production process with the aim of assembling the final product in the home country.

We derive information on imports from the French customs that contains, for all importing and/or exporting firms, the amount of exports and/or imports by product (CN8 nomenclature) and by destination country for each year between 2002 and 2007. We distinguish between finished and intermediate goods. Finished goods are defined as CN8 products that correspond to the same 3-digit NACE code of the main activity of the firm [39]. Other goods imported are defined as intermediate goods. Our measure of outsourcing is the share of imports of intermediate inputs and finished goods over the firm's sales : $\frac{II^c_{it}}{T_{it}}$ and $\frac{FG^c_{it}}{T_{it}}$ respectively. With II^c_{it} corresponding to firm's i imports of intermediate inputs at time t from country group c, FG^c_{it} corresponds to the firm's imports of finished goods at time t from country group c and T_{it} the firm i sales at time t. We define the same two groups of countries (low-income and high-income) as defined in the previous sections.

In the data, we are not able to separate out imports from foreign subsidiaries and imports from unrelated suppliers. Hence, one cause of concern is that collinearity problem may arise between FDI and imports since imports include intra-firm trade. We did simple checks using variance inflation factor and did not find any collinearity problem between our explanatory variables. Recent evidences have shown that whatever the type of FDI (horizontal or vertical), shipment between foreign establishment and the mother company are extremely low (see Ramondo et al. (2011) for evidences on US), which may explain the absence of collinearity between FDI and imports of intermediate inputs.

38. The inclusion of firm fixed effects considerably reduces the bias, since only 1,138 firms observed during the period changed nationality. The inclusion of the firm's nationality does not alter the conclusions (see Table 2.11 and 2.12 in Appendix 2.A).

39. Correspondence tables exist between NC8 classification and the CPA classification (classification of products by activity) for which each product is associated to a single activity (NACE code).

Table 2.9 – Control for other margins of globalization

	Executive	Blue collar Workers	Routine Manual	Non routine Manual	Non routine Interactive	Non routine Analytic	Routine Cognitive
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Import of intermediate inputs from							
HI countries	-0.015	0.004	0.030	0.013	0.003	-0.010	-0.015
	[0.010]	[0.016]	[0.022]	[0.018]	[0.020]	[0.015]	[0.020]
LI countries	-0.028	-0.003	-0.054	0.011	0.099*	0.111**	0.097*
	[0.032]	[0.039]	[0.058]	[0.050]	[0.053]	[0.045]	[0.053]
Import of finished goods from							
HI countries	0.004	-0.008	0.065	0.044	-0.014	-0.015	-0.002
	[0.031]	[0.032]	[0.039]	[0.033]	[0.029]	[0.021]	[0.031]
LI countries	-0.043	-0.047	-0.058	-0.025	0.017	0.009	0.070
	[0.043]	[0.049]	[0.056]	[0.049]	[0.052]	[0.037]	[0.047]
Subsidiaries in :							
HI countries	0.006	-0.010	-0.005	-0.020**	-0.005	-0.009	0.008
	[0.011]	[0.008]	[0.011]	[0.009]	[0.011]	[0.009]	[0.007]
France	-0.001	-0.002	-0.005	-0.013***	-0.001	-0.005	-0.001
	[0.003]	[0.004]	[0.005]	[0.004]	[0.005]	[0.004]	[0.004]
LI countries	0.017**	-0.013**	-0.006	0.008	0.026**	0.020***	0.016**
	[0.007]	[0.006]	[0.008]	[0.008]	[0.011]	[0.007]	[0.008]
Export	-0.000	0.000	-0.001**	-0.001**	0.000	-0.000	0.000
	[0.000]	[0.000]	[0.001]	[0.001]	[0.001]	[0.000]	[0.001]
Revenue	0.006*	-0.015***	0.006	0.003	0.005	0.001	-0.000
	[0.003]	[0.004]	[0.005]	[0.004]	[0.005]	[0.004]	[0.004]
Capital	0.000	0.001	-0.002	0.003*	0.003	0.004**	0.002
	[0.001]	[0.002]	[0.002]	[0.002]	[0.002]	[0.002]	[0.002]
TFP	0.006	0.009	-0.003	0.012	0.002	0.009	0.011
	[0.012]	[0.015]	[0.022]	[0.018]	[0.019]	[0.017]	[0.017]
Constant	0.059*	0.635***	0.434***	0.549***	0.424***	0.629***	0.579***
	[0.034]	[0.040]	[0.069]	[0.055]	[0.076]	[0.056]	[0.074]
Observations	19,567	19,567	19,000	19,000	19,000	19,000	19,000
R-squared	0.037	0.024	0.003	0.024	0.034	0.031	0.020
log likelihood	41177.930	35824.184	26406.859	29647.505	28404.572	30197.170	30441.075

Source : LIFI survey, French annual census for manufacturing (EAE), French Déclaration annuelles des donnés sociales (DADS) ; period 2002-2007. Note : Estimations are of firm fixed effects (FE) and variables are calculated at the level of the firm. The wage-bill shares are in percent, varying between zero and 100. Estimations are controlled for year and industry-year fixed effects. Heteroskedasticity-robust standards errors are reported in brackets. ***, **, and * indicate significance at the 1, 5 and 10 percent levels respectively.

The results are reported in Table 2.9. We observe similar results when controlling for imports of intermediate inputs. FDI to low income countries raises the share of executives and reduces the share of blue-collar workers. Similar results are observed on tasks. FDI to low-income countries raises the share of workers performing skilled non-routine tasks. While FDI to high-income countries reduces the share of workers performing non-routine manual tasks.

We find imports of intermediate inputs from low-income countries to be associated with a higher share of workers performing skilled non-routine tasks, which is in line with results observed in the literature (see Feenstra and Hanson (1999), Hansson (2000), Strauss-Kahn (2004)). The sign associated with imports of finished goods on the share of unskilled

production workers is negative but non-significant.

6 IV Results

After controlling for firm-specific heterogeneity, the main residual still contains time-varying factors that can affect the workforce's composition. A cause for concern is that simultaneity problems, measurement errors and/or omitted variable bias could affect the preceding estimations. First, simultaneity problems arise if unobserved components, such as change in the composition of shareholders, directors, head of human resources or changes in the strength of unions affect simultaneously the decision to make a foreign direct investment, and the composition of activities undertaken by the firm. In this case, the estimated coefficient of interest would be biased. Second, our estimation could suffer from measurement error bias because our proxy for in-house foreign direct investment does not reflect the offshored activity composition of the firm. In particular, we do not account for foreign employment, turnover or sales in the foreign subsidiaries. [40].

We answer these problems by using instrumental variable techniques to explain the FDI decision. [41] The first instrument is the host country's GDP per capita [42]. A high level of GDP would capture relocation motivated by reasons of market access, and conversely, a low level of GDP would capture relocation decisions in order to take advantage of less costly labor (Brainard and Riker 1997; Markusen 1995; Kohler 2002). The second instrument is the host country's level of infrastructure. The quality of institutions and infrastructure have been highlighted as important sources of comparative advantage in the recent literature of offshoring (Gamberoni et al. (2010)).

In addition, GDP per capita and the level of infrastructure are important determinants of the development of intellectual property rights, and the level of corruption in the host country. These elements may not only influence a firm's choice to settle a foreign subsidiary in a particular country, but also influence the entry mode choice, between maintaining full control over the subsidiary or sharing ownership with one or more partners (Nunnenkamp and Andreis (2013), Broughter and Broughters (2001), Javorcik and Wei (2009)).

Based on these results, we construct the average level of GDP and infrastructure in the firm's host countries. For each of these two variables, we distinguish between subsidiaries in high-income countries and low-income countries, as done previously. The two variables

40. Other studies, including Becker et al. (2012), Hanson (2005) and Head and Ries (2002) approximated transfers within multinationals by a multinational company's share of employment by subsidiaries in total employment.

41. We have assumed clustered errors, i.e., that observations for firms in two different time periods are correlated, but not observations between different firms. Hence, in order to relax the assumption that the correlation of a firm's observations within a group is constant, we run a feasible, efficient two-step GMM, as described in Baum et al. (2007) and Baum et al. (2002).

42. Desai et al. (2005) also use the GDP growth rate to predict changes in foreign direct investment.

are constructed as follows :

$$GDP_{cjt} = \frac{\sum_{k=1}^{K} GDP_{ckjt}}{K} \tag{2.4}$$

$$Infra_{cjt} = \frac{\sum_{k=1}^{K} Infra_{ckjt}}{K} \tag{2.5}$$

$c = L, H$ corresponds to high-income and low-income countries and k is a firm's subsidiary. For each subsidiary, we measure the GDP per capita and the level of infrastructure in the country. K is the total number of firm j's subsidiaries. GDP per capita and infrastructure are calculated from the World Bank database. The GDP per capita variables are gross domestic product for 220 countries, converted into international dollars using purchasing power parity rates. The proxy for infrastructure is the number of broadband Internet subscribers with a digital subscriber line, cable modem, or other high-speed technology (per 100 persons).

There are two conditions for an instrument to work well. First, it must be valid, the instrument must be uncorrelated with the error term. Second, it must be powerful, i.e., the instrument must be sufficiently correlated to the endogenous variable.

Our instruments are valid if domestic employment is not related to the instruments other than through foreign direct investment, conditional on other multinational firm's (MNC) characteristics. While we consider this assumption to be plausible, GDP per capita could still influence MNCs' employment through trade. However, the Hanson-J statistic shows that the test of over-identifying restrictions cannot reject its null hypothesis : the instruments are distributed independently of the error process and they are properly excluded from the model. [43].

We then test to ensure that our instruments are not weak, i.e., that they are sufficiently correlated with the endogenous variables included. In each case, the F statistic is sufficiently large, [44] compared to Stock and Yogo critical value with two endogenous regressors (Stock and Yogo 2002) [45].

43. Over identification tests are based on the assumption that one of the instruments is valid. We have therefore decided to report the IV results in a just-identified equation, by using GDP per capita on the one hand, and the level of infrastructure on the other hand. The results are reported in the online appendix and depict similar findings. In both cases the instruments are sufficiently strong. We prefer to report the over-identified results to prove the validity of our instruments.

44. We use the Kleibergen-Paap rk statistic F statistic, as we do not assume i.i.d errors.

45. In each case, the F statistic also exceeds the conventional 'rule of thumb' of the minimum standard of power of F=10. However, as we have multiple endogenous variables, this indicator may not be sufficiently informative (Baum et al, 2003). In this respect, the use of the Shea Partial R2 is preferable, as it accounts for the inter-correlations among the instruments. The Shea measure is always close to the partial R2. We therefore conclude that our instruments are relevant.

Table 2.10 – IV-Results

	Executives	Blue Collar Workers	Routine Manual	Non routine Manual	Non routine Interactive	Non routine Analytic	Routine Cognitive
Import of inter. inputs from							
HI countries	-0.014	0.004	0.030	0.013	0.003	-0.010	-0.016
	[0.010]	[0.016]	[0.022]	[0.018]	[0.020]	[0.019]	[0.020]
LI countries	-0.026	-0.002	-0.054	0.009	0.099*	0.110**	0.098*
	[0.032]	[0.039]	[0.058]	[0.049]	[0.053]	[0.050]	[0.053]
Import of finished goods from							
HI countries	0.005	-0.010	0.065	0.045	-0.017	-0.016	-0.004
	[0.031]	[0.032]	[0.039]	[0.033]	[0.029]	[0.023]	[0.031]
LI countries	-0.043	-0.049	-0.059	-0.026	0.018	0.008	0.069
	[0.043]	[0.049]	[0.056]	[0.049]	[0.052]	[0.050]	[0.047]
Subsidiaries in							
Low income countries	0.019**	-0.010	-0.003	0.017	0.025**	0.023***	0.019**
	[0.009]	[0.007]	[0.007]	[0.009]	[0.010]	[0.008]	[0.008]
High income countries	-0.004	0.000	-0.008	-0.014*	0.001	-0.004	0.008
	[0.005]	[0.005]	[0.008]	[0.008]	[0.009]	[0.007]	[0.007]
First Stage Estimates (low income)							
High-income GDP per capita	-0.017**	-0.017**	-0.016**	-0.016**	-0.016**	-0.016**	-0.016**
	[0.008]	[0.008]	[0.007]	[0.007]	[0.007]	[0.007]	[0.007]
Low-income GDP per capita	0.068***	0.068***	0.068***	0.068***	0.068***	0.068***	0.068***
	[0.007]	[0.007]	[0.007]	[0.007]	[0.007]	[0.007]	[0.007]
High-income infrastructure	0.026	0.026	0.031	0.031	0.031	0.031	0.031
	[0.021]	[0.021]	[0.020]	[0.020]	[0.020]	[0.020]	[0.020]
Low-income infrastructure	0.058***	0.058***	0.055***	0.055***	0.055***	0.055***	0.055***
	[0.021]	[0.021]	[0.021]	[0.021]	[0.021]	[0.021]	[0.021]
First Stage Estimates (high income)							
High-income GDP per capita	0.029**	0.029**	0.028**	0.028**	0.028**	0.028**	0.028**
	[0.012]	[0.012]	[0.012]	[0.012]	[0.012]	[0.012]	[0.012]
Low-income GDP per capita	0.011**	0.011**	0.010**	0.010**	0.010**	0.010**	0.010**
	[0.005]	[0.005]	[0.005]	[0.005]	[0.005]	[0.005]	[0.005]
High-income infrastructure	0.114***	0.114***	0.116***	0.116***	0.116***	0.116***	0.116***
	[0.034]	[0.034]	[0.034]	[0.034]	[0.034]	[0.034]	[0.034]
Low-income infrastructure	-0.020	-0.020	-0.017	-0.017	-0.017	-0.017	-0.017
	[0.018]	[0.018]	[0.017]	[0.017]	[0.017]	[0.017]	[0.017]
subsidiaries in France	-0.002	0.000	-0.005	-0.010**	-0.002	-0.002	-0.001
	[0.003]	[0.004]	[0.005]	[0.004]	[0.005]	[0.004]	[0.004]
Exports	-0.000	0.000	-0.001**	-0.001**	0.000	-0.000	0.000
	[0.000]	[0.000]	[0.001]	[0.001]	[0.001]	[0.001]	[0.001]
Revenue	0.006*	-0.015***	0.005	0.003	0.005	0.001	-0.000
	[0.003]	[0.005]	[0.005]	[0.004]	[0.005]	[0.004]	[0.004]
Capital	0.000	0.001	-0.002	0.003*	0.003	0.004**	0.002
	[0.001]	[0.002]	[0.002]	[0.002]	[0.002]	[0.002]	[0.002]
TFP	0.007	0.008	-0.003	0.013	0.003	0.009	0.011
	[0.012]	[0.015]	[0.022]	[0.018]	[0.019]	[0.018]	[0.017]
Observations	18,377	18,377	17,785	17,785	17,785	17,785	17,785
R-squared	0,036	0,024	0,002	0,022	0,034	0,031	0,020
Underidentification							
Keibergen-Paap LM stat	154,532***	154,532***	152,570***	152,570***	152,570***	152,570***	152,570***
Weak indentification							
Kleibergen-Paap rk-stat	271,652	271,652	271,281	271,281	271,281	271,281	271,281
Stock-Yogo 5% max IV bias	11.04	11.04	11.04	11.04	11.04	11.04	11.04
Over identification							
Hansen J statistic	3,012	2,315	0,633	0,983	4,145	3,603	3,164
P-value	0,221	0,314	0,728	0,612	0,126	0,165	0,206

Source : LIFI survey, French annual census for manufacturing (EAE), French Déclaration annuelles des donnés sociales (DADS) ; period 2002-2007. Note : Estimations are for firm fixed effects (FE) and variables are calculated at the level of the firm. The wage-bill shares are in percent, varying between zero and 100. Estimations are controlled for year and industry-year fixed effects. Heteroskedasticity-robust standards errors are reported in brackets. ***, **, and * indicate significance at the 1, 5 and 10 percent levels respectively.

Table 2.10 reports results of the IV-GMM estimator. It analyzes the effect of FDI to low-income and high-income countries on the share of skilled managers (column (1)) and on the share of skilled and unskilled blue-collar workers (column (2)), and on the task index (columns (3) to (7)). Results of the first stage estimates are discussed in appendix 2.F.

When controlling for endogeneity, the positive correlation between FDI to low-income countries and the share of managers in the domestic firm is stable and significant at the 5% level. Turning to the results on the composition of tasks executed inside the firm, we notice that FDI to low-income countries significantly and positively affects the share of workers performing skilled non-routine tasks. Hence, the IV-GMM results confirm our previous findings and show that investing in low-income countries raises significantly the share of managers and skilled non-routine tasks.

However, when controlling for endogeneity, the negative correlation between blue-collar workers and FDI to low-income countries is not significantly different to zero (still, the sign of the coefficient remains negative). Nonetheless, we still observe foreign direct investment to high-income countries to be associated with a lower share of non-routine manual tasks.

7 Conclusion

In this paper we use a detailed database for France in order to follow changes in the work composition of French firms in terms of skills and tasks over the period 2002-2007. Using employer-employee specific data, information on job-related tasks and detailed micro data on FDI, we show that FDI has a select effect on only few occupations and tasks. The winners of globalization are systematically the managers and more generally the workers holding non-routine tasks. We controlled for other margins of globalization by including imports of intermediate inputs, imports of finished goods and exports. Our measure of foreign direct investment is the number of foreign subsidiaries weighted by the percentage of shares held by the firm. Using such equity participation allows controlling for the firm's level of commitment to the foreign subsidiaries, which has several implications in terms of management and technology transfers. These in turn may have a specific impact on employment. In contrast to what is done in the literature analyzing this question, we do not control for turnover, foreign revenue and/or affiliates' employment. In order to control for the omitted variable bias, we use two original instruments and run an IV model. The two instruments are the level of infrastructure and GDP in the destination country.

The results indicate a clear complementarity between FDI and the demand for skilled managers in the home country, especially when FDI occurs in a low income country. When distinguishing between EU-15 countries, low-wage countries, high-wage countries, East European and emerging economies (BRICS), the positive effect of FDI on non-routine tasks is mainly driven by FDI to the BRICS. In contrast, horizontal FDI to obtain market access in developed countries reduces the share of skilled production workers who hold

non-routine manual tasks in manufacturing industry (foremen, technicians and skilled blue-collar workers). In the case of FDI into Eastern and Central European countries, we notice a positive effect on the share of routine manual tasks. This result is driven by the intermediate goods industry in Eastern and Central European countries reflecting the regional value-chain fragmentation of the French firms in Europe. For example, the Renault car company produces intermediate goods in its affiliate in Romania and assembles the final product on an assembly line in France.

Furthermore, we show that the rise of the share of managers consecutive to FDI is particularly marked in the sample of first-time investors, whereas the declining demand of blue-collar workers consecutive to FDI is observed when already-established firms raise their number of foreign subsidiaries. Hence, becoming a multinational company changes the workforce composition in favor of managers and the intensification of vertical FDI results in a decline of the share of unskilled workers and persons doing routine tasks.

The results are stable when controlling for change in the firm's nationality and the business group strategy. We conclude that the jobs at risk from globalization are workers performing non-routine manual tasks (skilled blue-collar workers, foremen and technicians), while the winners from foreign direct investment are workers performing skilled non-routine tasks (interactive and analytical), such as managers and engineers. The impact of FDI to low-income countries on workers performing manual routine tasks (unskilled blue-collar workers) is more ambiguous. When controlling for endogeneity, the negative effect on the share of blue-collar workers is no longer observed. We are thus more cautious about the interpretation of the negative effect of FDI to low-income countries on the share of blue-collar workers. However, the IV-model still shows a significant positive effect of FDI to low-income countries on the share of skilled executives and skilled non-routine tasks in the domestic firm, and a negative impact of FDI to high-income countries on the share of workers performing non-routine manual tasks.

Our results contribute to the literature on the polarization of jobs. From the mid-1990s onwards, relative employment of low-skilled and high-skilled workers increased compared to middle-skilled workers (skilled blue-collar workers, administrative workers). This phenomenon has been referred to as job polarization, which is particularly pronounced in France. Between 1993 and 2006, middle-skilled workers in France experienced an employment decline of roughly 12% (Goos, Manning and Salomon (2009)). FDI may be one channel that explains this decline in middle-skilled employment.

Appendix

2.A Robustness Tests

The following section gives results of equation 2.3 by using different measures of offshoring. We define three other measures of FDI.

The first proxy is constructed by taking into account the possibility that a firm uses its blocking minority power. [46] The underlying idea for using blocking minority as a weighted measure is to assuming increasing control over the foreign subsidiary when the firm has the possibility to veto certain decisions at extraordinary general meetings of shareholders. The investing firm could thus have incentives to actively manage employment inside the subsidiary and to transfer its intangible assets.

The measure is built as follows :

$$\rho_{jt} = \sum_{k} subsidiary_{kjt} \tag{2.6}$$

$$\text{Where} \begin{cases} subsidiary_{kjt} = 1, \text{ when } Voting_{kjt} \geq 34\% \\ subsidiary_{kjt} = Voting_{kjt}, \text{ when } Voting_{kjt} < 34\% \end{cases}$$

Here, we assume that when a firm owns more than 34% of the voting stock, then the firm has a blocking minority and can intervene in important decisions concerning its subsidiary. Therefore the firm owns the subsidiary *entirely*, and the number of FDI projects is equal to 1. If the firm does not hold a blocking minority, then we do not consider that the firm holds the *entire* subsidiary, but only holds the subsidiary weighted by the voting stock.

The ρ measure controls for the blocking minority, but has the disadvantage of overriding the existing hierarchy when votes are held.

We also control our results by using a second proxy of a firm's FDI size, by weighting the firm's number of subsidiaries by firm j's average outward investment stock. [47] The third measure is constructed as follows :

$$\varphi_{jt} = \sum_{k} Value_{kjt} \tag{2.7}$$

Where $Value_{kjt}$ is the balance sheet value of firm j's subsidiary k at time t. However, information on the gross value of investment purchased in each subsidiary is not available prior to 2004. As it is a stock value, the average over a 4-year period gives a good proxy of a firm's mean size of foreign investments. We first measure the number of foreign subsidiaries controlled by each firm j over the period $t \in [2002, 2007]$. We weight this number by the firm j's mean outward investment stock amount over the period 2004-2007.

However, the measure φ does not account for all multinational companies, since information on subsidiaries' stock amounts are not referenced for each subsidiary in the LIFI survey.

46. A blocking minority represents one quarter or one third of the shares plus one share, depending on the country and the legal form of the company.

47. This corresponds to the gross value of shares owned in the foreign subsidiary, in thousands of euros. This measure corresponds to a book value and does not reflect the market value of the firm. The amount is identified in euros. Therefore, we deflate this nominal value by using the CPI base 2005, provided by INSEE

Finally, we use the number of subsidiaries abroad without weights (we call this δ).

The measure κ is preferred for different reasons. First, it allows the effect of a change in the share of voting stock held in a foreign subsidiary to be captured, even if the firm does not change its number of foreign subsidiaries. Several studies have highlighted the impact of control over wages and employment (see Bircan (2011) for a review). Second, it allows control for multiple authority sources in a group. Indeed, if two French subsidiaries inside a domestic group control the same subsidiary abroad, it allows firm holdings with a clear majority to be distinguished.

Tables 2.11 and 2.12 report results with the different measures of FDI on the share of executives and blue-collar workers respectively. Columns (1) and (7) report the results with the measure of offshoring κ. Columns (2) and (8) report the results with the measure of offshoring ρ. Columns (3) and (9) report the results with the measure φ. Columns (4) and (10) report the result with the measure of offshoring δ. Columns (5) and (11) report the results with the measure of offshoring κ, and include the variables on the wages paid by type of work i relative to the composite wage of work type not in i. Whatever the proxy retained, the preceding conclusions are not altered.

Table 2.11 – Robustness Test with Different Measures of Offshoring (Executives)

	Executives					
	(1)	(2)	(3)	(4)	(5)	(6)
VARIABLES	κ	ρ	φ	δ	κ	κ
Affiliates in						
LI countries	0.015***	0.015***	0.003***	0.013***	0.018***	0.015***
	[0.005]	[0.005]	[0.001]	[0.005]	[0.006]	[0.005]
HI countries	0.002	-0.001	0.003	-0.001	0.001	0.002
	[0.007]	[0.004]	[0.004]	[0.003]	[0.008]	[0.007]
France	-0.001	0.001	-0.000	-0.002	-0.001	-0.001
	[0.002]	[0.003]	[0.001]	[0.002]	[0.003]	[0.002]
TFP	0.000	0.000	-0.000	0.000	-0.000	0.000
	[0.002]	[0.002]	[0.002]	[0.002]	[0.002]	[0.002]
Export	0.000	-0.000	-0.000	0.000	-0.000	0.000
	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]
Revenue	0.007**	0.007**	0.008**	0.007**	0.007**	0.006**
	[0.003]	[0.003]	[0.003]	[0.003]	[0.003]	[0.003]
Capital	-0.001	-0.001	-0.001	-0.001	-0.001	-0.000
	[0.001]	[0.001]	[0.001]	[0.001]	[0.001]	[0.001]
w_{ij}/w_{ij}					0.006***	
					[0.001]	
Nationality						0.005**
						[0.002]
Constant	0.098***	0.094***	0.093***	0.094***	0.089***	0.082***
	[0.018]	[0.016]	[0.017]	[0.016]	[0.016]	[0.027]
Observations	21,177	21,177	19,013	21,177	19,211	21,177
R-squared	0.039	0.039	0.039	0.038	0.040	0.039
Log Likelihood	44697.306	44694.877	40042.423	44691.727	41589.335	39956.032

Source : LIFI survey, French annual census for manufacturing (EAE), French Déclaration annuelles des données sociales (DADS) ; period 2002-2007. Note : Estimations are for firm fixed effects (FE), and variables are calculated at the level of the firm. The wage-bill shares are in percent, varying between zero and 100. Estimations are controlled for year and industry-year fixed effects. Heteroskedasticity-robust standards errors are reported in brackets. ***, **, and * indicate significance at the 1, 5 and 10 percent levels respectively.

Table 2.12 – Robustness Test with Different Measures of Offshoring (Blue-Collar Workers)

	Blue-collar workers					
	(1)	(2)	(3)	(4)	(5)	(6)
VARIABLES	κ	ρ	φ	δ	κ	κ
Affiliates in						
LI countries	-0.010**	-0.011**	-0.003***	-0.007*	-0.009*	-0.009**
	[0.005]	[0.005]	[0.001]	[0.004]	[0.005]	[0.005]
HI countries	-0.006	-0.003	0.000	-0.003	-0.005	-0.006
	[0.007]	[0.004]	[0.003]	[0.004]	[0.007]	[0.007]
France	-0.001	-0.001	0.000	-0.001	-0.001	-0.001
	[0.004]	[0.004]	[0.001]	[0.003]	[0.004]	[0.004]
TFP	0.004*	0.004*	0.004*	0.004*	0.003	0.004*
	[0.002]	[0.002]	[0.002]	[0.002]	[0.002]	[0.002]
Export	0.000	0.000	0.000	0.000	0.000	0.000
	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]
Revenue	-0.015***	-0.015***	-0.016***	-0.015***	-0.014***	-0.013***
	[0.004]	[0.004]	[0.005]	[0.004]	[0.004]	[0.004]
Capital	0.003*	0.003*	0.004**	0.003*	0.005**	0.002
	[0.002]	[0.002]	[0.002]	[0.002]	[0.002]	[0.001]
w_{ij}/w_{ij}					0.034***	
					[0.003]	
Nationality						-0.001
						[0.003]
Constant	0.632***	0.625***	0.628***	0.625***	0.603***	0.634***
	[0.025]	[0.021]	[0.022]	[0.021]	[0.022]	[0.032]
Observations	21,177	21,177	19,013	21,177	19,609	21,177
R-squared	0.025	0.025	0.027	0.038	0.036	0.025
Log Likelihood	38859.694	38856.275	34699.696	38853.627	36465.866	39959.054

Source : LIFI survey, French annual census for manufacturing (EAE), French Déclaration annuelles des données sociales (DADS) ; period 2002-2007. Note : Estimations are for firm fixed effects (FE), and variables are calculated at the level of the firm. The wage-bill shares are in percent, varying between zero and 100. Estimations are controlled for year and industry-year fixed effects. Heteroskedasticity-robust standards errors are reported in brackets. ***, **, and * indicate significance at the 1, 5 and 10 percent levels respectively.

Columns (6) and (12) report the results with the measure of offshoring κ, by including the variable of parent company nationality. We add a dummy that takes the value of 1 if a firm is controlled by a foreign parent company, and 0 otherwise. The coefficient associated with this dummy is identified for firms that changed nationality in the sample period. The inclusion of the firm's nationality does not alter the conclusions. FDI to low-income countries is significantly associated with a higher share of executives employees, and is associated with a lower share of blue-collar workers. [48]

Finally, we report the results when controlling for the FDI strategy at the group level (see Table 2.18). The results are consistent with those obtained by taking into account the relocation strategy at the firm level. A group's number of subsidiaries in low-income countries raises the share of executives inside domestic firms. Relocation in high-income

48. We highlight a positive coefficient associated with change in a firm's nationality on the share of executives. We interpret the positive coefficient as a positive correlation between high-skilled firms and foreign-acquisition, reflecting the fact that foreign-owned firms are on average more skills-intensive than French-owned firms. Theories of ownership have shown that acquisition can result in a reduction of employment, because takeovers are a good way for shareholders to get rid of non-value-maximizing managers (Huttunen (2007)). However, changes in employment are likely to take time, because of attendant adjustment costs.

countries does not show any significant impact on either types of jobs and tasks. However, contrary to results at the firm level, when the group raises its FDI in high-income countries, blue-collar workers are negatively affected. The reason is certainly due to an overall effect on the rationalization of production processes by eliminating unnecessary domestic capacity at the group level. Indeed, when the group increases FDI to low-income countries it may decide to reduce the employment of blue-collar workers in dedicated subsidiaries, even those that are not directly engaged in outward FDI.

Table 2.13 – International Strategies at the Group Level

VARIABLES	Executive (1)	Blue collar Workers (2)	Routine Manual (3)	Non routine Manual (4)	Non routine Interactive (5)	Non routine Analytic (6)	Routine Cognitive (7)
Affiliates in							
HI countries	0.001	-0.003	0.004	0.003	-0.005	-0.002	0.001
	[0.002]	[0.002]	[0.003]	[0.003]	[0.003]	[0.003]	[0.002]
LI countries	0.005**	-0.003*	-0.003	-0.002	0.004	0.001	0.001
	[0.002]	[0.002]	[0.003]	[0.003]	[0.003]	[0.003]	[0.003]
France	-0.003**	0.001	-0.003	-0.003*	0.002	0.001	-0.000
	[0.001]	[0.002]	[0.002]	[0.002]	[0.002]	[0.002]	[0.002]
Exports	0.000	0.000	-0.001*	-0.001**	0.000	-0.000	0.000
	[0.000]	[0.000]	[0.001]	[0.001]	[0.001]	[0.001]	[0.001]
Revenue	0.007**	-0.015***	0.008	0.004	0.004	0.001	-0.001
	[0.003]	[0.004]	[0.005]	[0.004]	[0.005]	[0.004]	[0.004]
Capital	-0.001	0.003*	-0.002	0.005**	0.001	0.003	0.001
	[0.001]	[0.002]	[0.002]	[0.002]	[0.002]	[0.002]	[0.002]
TFP	0.000	0.004*	-0.004	-0.001	0.001	0.001	0.001
	[0.002]	[0.002]	[0.003]	[0.002]	[0.002]	[0.002]	[0.002]
Constant	0.095***	0.626***	0.458***	0.497***	0.397***	0.576***	0.566***
	[0.016]	[0.021]	[0.026]	[0.021]	[0.024]	[0.020]	[0.020]
Observations	21,177	21,177	20,601	20,601	20,601	20,601	20,601
R-squared	0.039	0.025	0.001	0.024	0.039	0.032	0.021
Log Likelihood	44692.418	38862.577	28713.056	31971.250	30727.635	32762.256	33106.131

Source : LIFI survey, French annual census for manufacturing (EAE), French Déclaration annuelles des donnés sociales (DADS) ; period 2002-2007. Note : Estimations are firm fixed effects (FE) and variables are calculated at the level of the firm, except for the number of foreign subsidiaries which is calculated at the group level. The wage-bill shares are in percent, varying between zero and 100. Estimations are controlled for year and industry-year fixed effects. Heteroskedasticity-robust standards errors are reported in brackets. ***, **, and * indicate significance at the 1, 5 and 10 percent levels respectively.

2.B The Composition of Tasks within Occupations

We classified the 41 main work activities into five major categories as in ALM (2003). They distinguish between : i) non-routine analytical tasks, that are usually performed in technical or managerial occupations. They require cognitive capacity in which responsiveness, creativity, decision making and problem solving are important. ii) The second major task category includes non-routine interactive tasks. These tasks require physical interaction and adaptability to certain types of situations. iii) The third category identifies cognitive routine tasks that are usually carried out by administrative or clerical occupations, such as secretaries and accounting officers who perform repetitive tasks using an identified procedure. iv) Manual routine tasks are performed by production operators such

as handlers, machine operators, workers in packaging and transportation. These tasks can be seen as unskilled manual tasks. v) Finally, the last category lists manual tasks that require specific knowledge and are considered as skilled manual tasks. These tasks are mostly performed by technicians or foremen.

Table 2.14 – Occupational Tasks

Non-routine Analytical	Organizing, Planning, and Prioritizing Work ; Getting Information ; Analyzing Data or Information ; Making Decisions and Solving Problems ; Developing Objectives ; Judging the Qualities of Things, Services, or People ; Updating and Using Relevant Knowledge ; Interacting with Computers ; Thinking Creatively ; Estimating the Quantifiable Characteristics of Products, Events, or Information ; Evaluating Information to Determine Compliance with Standards ; Scheduling Work and Activities ; Interpreting the Meaning of Information for Others ; Processing Information and Strategies
Non-routine Interactive	Guiding, Directing, and Motivating Subordinates ; Communicating with Supervisors, Peers, or Subordinates ; Communicating with Persons Outside the Organization ; Developing and Building Teams ; Resolving Conflicts and Negotiating with Others ; Performing for or Working Directly with the Public ; Staffing Organizational Units Providing Consultation and Advice to Others ; Coordinating the Work and Activities of Others ; Selling or Influencing Others ; Training and Teaching Others ; Assisting and Caring for Others ; Coaching and Developing Others ; Establishing and Maintaining Interpersonal Relationships ; Monitoring and Controlling Resources
Routine Cognitive	Performing Administrative Activities, Documenting/Recording Information
Routine Manual	Handling and Moving Objects ; Performing General Physical Activities ; Repairing and Maintaining Mechanical Equipment ; Repairing and Maintaining Electronic Equipment
Non-routine Manual	Operating Vehicles, Mechanized Devices, or Equipment ; Inspecting Equipment, Structures, or Material ; Monitoring Processes, Materials, or Surroundings ; Drafting, Laying Out, and Specifying Technical Devices, Parts, and Equipment

Source : Constructed using data from O*NET as described in Section 3.1.2

The following table gives examples of different types of tasks performed in four main occupations in the metal industry. Here we see that engineers have a higher score in *making decision*, whereas mechanics have the lower score. In contrast, skilled assemblers have a higher score in the task of *handling and moving objects* compared to engineers.

Table 2.15 – Examples in the Metal Industry

Task Descriptions	Making decisions and solving problems	Guiding, directing and motivating subordinates	Communicating with supervisors and motivating subordinates	Performing adminisrative activities	Handling and moving objects
Engineers	0.741	0.589	0.731	0.608	0.421
Technicians	0.59	0.373	0.638	0.388	0.708
Skilled assemblers	0.558	0.306	0.362	0.176	0.857
Mechanics	0.375	0.171	0.329	0.256	0.838

Occupations in the metal industry, index values are normalized for each occupation. Sources : O*NET linked with EurOccupations.

Table 2.16 provides descriptive statistics, showing the mean intensity of each score for the seven major occupations.

TABLE 2.16 – Tasks' Intensity within Occupations

	Employees	Managers	Engineers	Technicians	Foremen	Skilled blue-collar	Non-skilled blue-collar
Non-routine analytical	0.40	0.72	0.79	0.67	0.61	0.42	0.34
Non-routine interactive	0.34	0.62	0.56	0.42	0.62	0.29	0.25
Routine manual	0.34	0.19	0.35	0.47	0.50	0.69	0.70
Non-routine manual	0.24	0.24	0.62	0.59	0.56	0.59	0.53
Routine cognitive	0.51	0.75	0.74	0.66	0.63	0.41	0.33

Source : O*NET work activity normalized measure, merged with French PCS-ESE classifications using EurOccupation correspondence tables. Authors' calculations.

It shows that skilled production workers (composed of skilled blue-collar workers, engineers, technicians and foremen) have an important index of non-routine manual, interactive and analytical tasks. Managers and engineers are the two occupations having the highest score of routine cognitive tasks, whereas skilled and unskilled blue-collar workers perform routine manual tasks more intensively.

2.B.1 Mapping the SOC classification of ONET to the French PCS-ESE.

The ONET databases provides information on 900 occupations classified according to a classification close to the American SOC classification. In order to build a task index compatible with the French classification of occupations (PCS-ESE), we need to build a mapping table from PCS-ESE to SOC 2010. We have built it thanks to the EurOccupations database. [49] The EurOccupations project aimed at building a publicly available database containing the most common occupations in multi-country data-collection. The database includes a source list of 1,594 distinct occupational titles within the ISCO-08 classification and provides a mapping table between the EurOccupation classification and the ISCO-08 classification, as well as a French translation of these occupations. We then match the 412 PCS-ESE occupational classification for which there is at least a perfect pair with occupations described in the EurOccupation database. Finally, a mapping table from the ISCO-08 to the SOC-2010 classification is used to link the PCS-ESE occupational classification with the SOC-2010. By creating this mapping table, we can use the ONET index to analyze the task content of French occupations.

2.B.2 Different measures of tasks

The construction of the task intensity derived from the ONET survey is open to criticism since surveys providing information on the task content of occupations are scarce and limited to certain countries (including Germany, England and the United States). The use of the American ONET database as we do, requires to make the assumption of identical tasks-content of occupations across countries, which has not been empirically proved for France and the United-States. Second, the use of the american SOC classification requires

49. We are very grateful to Professor Kea Tijdens for having allowed us to use this database.

to build a corresponding table obtained from the Euroccupation survey, which is also a source of measurement error.

In this subsection, we answers the two criticisms in two ways. First, we build a task index from a German survey. We use information on the activity performed in German occupations because it is likely that tasks performed in occupations in European-Union countries are similar. This hypothesis is supported by Tijdens et al. (2011) results which show a clear task similarity within occupations across 8 European-Union countries, including France and Germany [50].

Second, we use the French survey on working condition in order to derive an index on task intensity. The advantage of the French survey is that it answers the criticisms attributed to differences in the tasks intensity of jobs across countries. However, the survey does not allow to build a task index as detailed as the ONET survey.

The task index built on German survey is derived from the Qualification and Career Survey for the years 2005/2006. The survey is conducted since 1979 and is reproduced every 6 years by the German Federal Institute for Vocational Training and the research institute of the German Federal Labor Agency. We linked the ISCO-88 classification and the French PCS-ESE 2003 classification with the Euroccupation database. Hereafter, the index is named BIBB index.

In order to make the ONET and the BIBB task index comparable, we use the same methodology as the one used to construct the ONET index. The ONET index is derived from a questionnaire completed by workers and experts [51] on the level of the task needed to perform the current job. There are 41 different tasks for which workers are questioned about the intensity of tasks performed. The levels range from 0 to 7. Three examples on the level of tasks are given at rank 2, 4 and 6 to help respondent answering about the level of tasks. For instance, to the question "what level of *getting information* is needed to perform the current job", a level of 2 corresponds to *follow a standard blueprint*, the level of 4 corresponds to *review a budget* and a level of 6 corresponds to *study international tax laws*. The index of getting information corresponds to the average level of all respondents in a given occupation.

We built the BIBB index in the same spirit as the ONET index by constructing a routinization index regarding the frequency of 15 particular tasks in any 2-digit ISCO-88 occupations. Each respondent of the Qualification and Career survey has to answer on the frequency of 15 tasks. We code the answers from 1 to 3, such as "never" takes the value of 1, "sometimes" takes the value of 2 and "often" takes the value of 3. We classified tasks in 4 main categories as we did with the ONET tasks. We tried to respect the same classification to compare the results with the ONET and BIBB classification. Table 2.17

50. The use of the German survey however requires a correspondence between ISCO-88 classification and the French PCS-ESE classification.

51. For occupations where it was difficult to sample workers experts were identified and sampled from professional and/or trade association membership lists to answer the questionnaire.

details the classification of tasks.

Table 2.17 – Classificatin of tasks from the BIBB-IAB survey

Non routine Analytical	Research development ; Gathering information, investigating, documenting ; Organizing, making plans, working out operations
Non routine interactive	Consulting, advising ; Purchasing selling ; Teaching, training ; Taking care, healing ; Promoting, marketing, public relations
Routine Manual	Manufacturing of goods ; Repairing ; Transporting, storing, shipping ; Entertaining, accommodating, preparing food
Non routine Manual	Protecting, guarding, observing controlling traffic ; Operating, controlling machines ; Measuring, testing, quality control

Source : Qualification and Career survey 2005/06

For each respondent we sum the answers to each questions on the frequency of the particular task category. For instance, a worker answering "never" to all questions in the non routine analytical category would have a low index in that particular category. We then normalize the index by the maximum and minimum in any occupation, such that the index vary between zero and one across occupations. As in ONET, we map the index to occupations by measuring the average task index in a given PCS-ESE 2-digit occupation.

The following Figure reports the intensity of the groups of tasks in 9 main occupations. The x axis represents the position of each occupation. The position respects the French PCS-ESE classification in which engineers and managers are considered as skilled workers, administrative and technicians are middle skilled workers and blue-collar workers are unskilled workers [52]. The position of each point along the y axis represents the intensity of the particular task performed in each occupation.

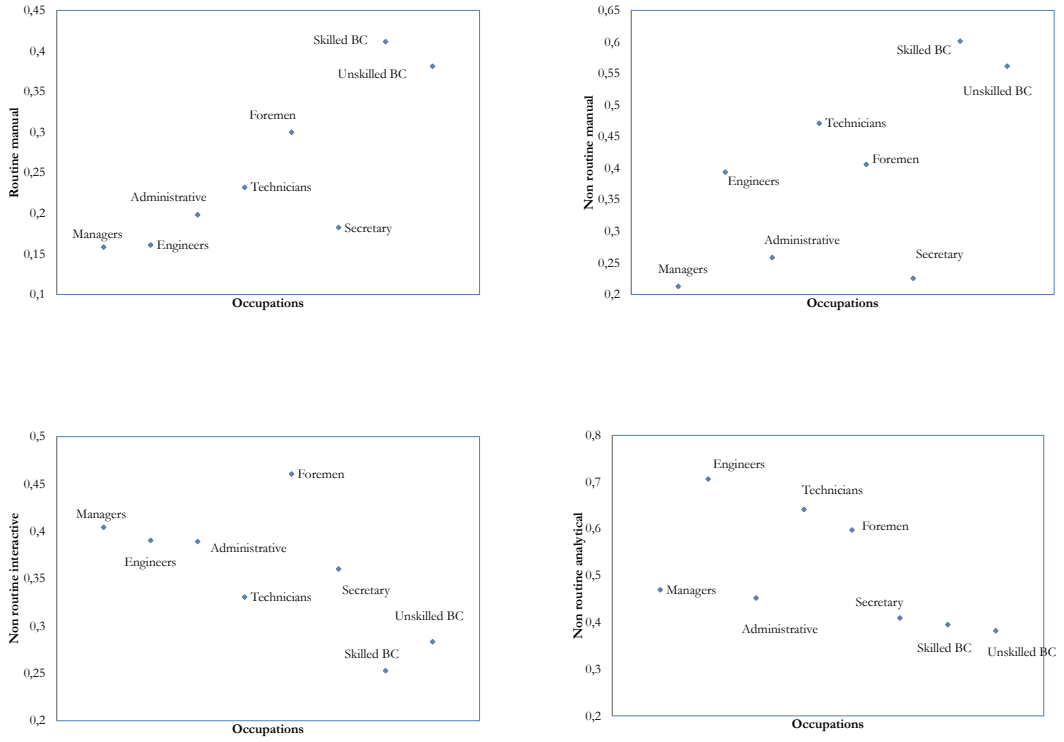
The two bottom figures report the average non routine interactive index (left-hand side) and non routine analytical index (right-hand side) derived from the BIBB index. Managers and engineers have the highest score of non-routine interactive tasks while skilled and unskilled blue-collar workers have the lowest index of interactive tasks. Engineers and technicians have the highest score of non-routine analytical tasks [53].

The two top figures report the index of non-routine manual tasks (left-hand side) and routine manual tasks (right-hand side) for different occupations. Skilled and unskilled blue-collar workers have the highest index of routine and non-routine manual tasks. Engineers and technicians have however a higher index of non-routine manual index than routine-manual index.

52. We respect the classification of the INSEE in which managers are coded 37, engineers 38, administrative workers 46, technicians 47, secretary 54, skilled blue-collar workers 62 and unskilled blue-collar workers 68.

53. This result is mainly driven by the question related to research and development.

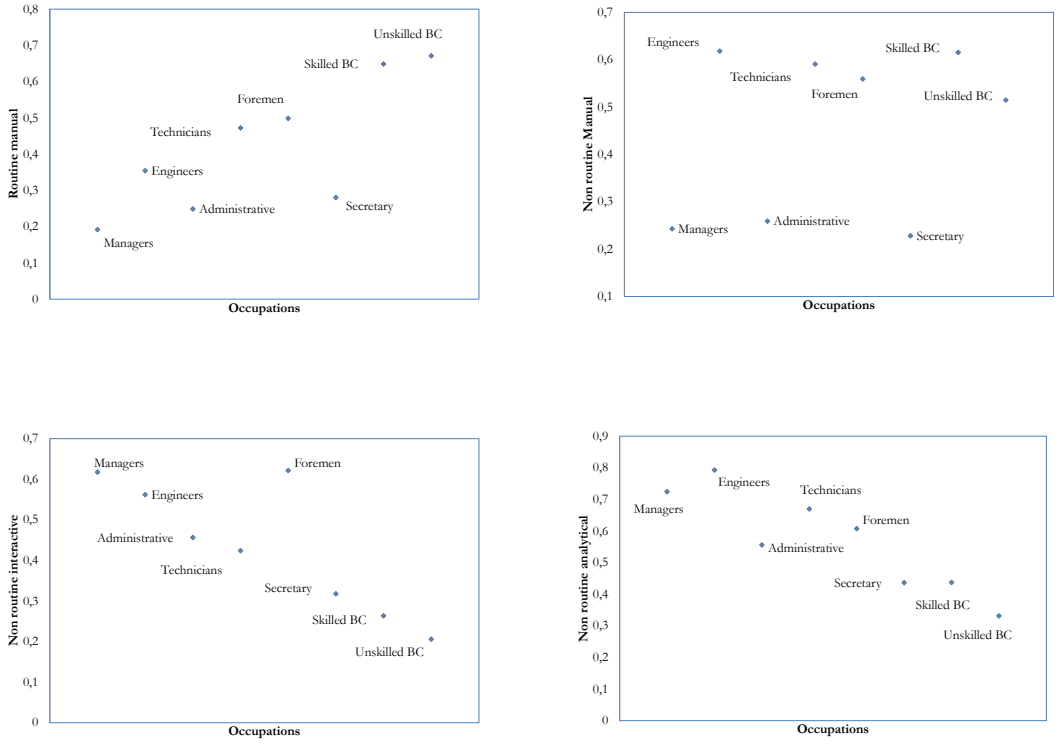
Figure 2.1 – Task index by occupations with the BIBB classification



Estimations presented in this article used the ONET index to measure the task-composition of firms. In order to compare estimation results derived from the BIBB survey with those derived from the ONET survey, we need to have similar task categories. In order to verify this assumption, we compare the task-intensity derived from the ONET to the task-intensity derived from the BIBB for the same groups of occupations. The following Figure reports the occupational task-intensity in the same way as in Figure 2.1.

There are several differences between the ONET and the BIBB task index. The non-routine interactive and routine manual tasks category derived from the ONET and the BIBB index are relatively similar. However, the main difference resides in the non-routine manual index. While the BIBB index reveals an ordering of non routine manual tasks in which skilled and unskilled blue-collar workers have the highest index, the ONET survey attributes a similar non routine manual index of around 0.6 for all type of skilled blue-collar workers (technicians, foremen, engineers and skilled blue-collar workers). The difference is mainly due to differences in the tasks reported in each category (routine manual, non-routine manual, non-routine interactive, non-routine analytical).

FIGURE 2.2 – Task index by occupations with the ONET classification



Finally, we control our results by building a routinization index derived from a French survey. We use the working condition survey produced by the French Direction de l'Animation de la Recherche, des Etudes et des Statistiques (DARES) for the year 2005. The inquiry is realized every 7 years on a sample of 19,000 workers.

The survey includes several question on work activities where respondents are asked to rate their tasks/activity on a 4-points and 5-points scale. Other questions in the questionnaire requires a yes/no answer. We build an index on the routine nature of tasks, that originates from nine relevant questions about the workers' activities. We code each answer from 1 to 5 such as 1 corresponds to a low level of routine tasks and 5 is a high level. The nine questions related to workers' taks and their according value are :

Do you directly interact with a public (always=1 ; often=2 ; sometimes=3 ; never=4)

Is your job imposed by the automatic movement of a machine ? (No=1 ; Yes=2)

Is your job imposed by the automatic movement of a product ? (No=1 ; Yes=2)

Are you an assembly-line production worker ? (No=1 ; Yes=2)

Does your job consist in repeating a series of gesture or operation ? (No=1 ; Yes=2)

Does your job involve monotonous tasks ? (Never=1 ; sometimes=2 ; often=3 ; always=4)

Does your job involve complex tasks ? (Always=1 ; often=2 ; sometimes=3 ; never=4)

Does your job involve you to read documents ? (Most of the time=1 ; half of the time=2 ; one quarter of the time=3 ; less than one quarter of the time=4 ; never=5)

Does your job involve you to write documents ? (Most of the time=1 ; half of the time=2 ; one quarter of the time=3 ; less than one quarter of the time=4 ; never=5)

For each respondent we build a routine index as the sum of the value attributed to each answer. The more the index is high the more the worker performs routine tasks. We then normalize the index by the maximum and minimum in any occupation, such that the index vary between zero and one across occupations. We map the index to occupations by measuring the average task index in a given PCS-ESE 2-digit occupation.

Figure 2.3 – Task index by occupations with the French classification

The questions selected in the French survey offers a clear lecture of routinization. Managers and Engineers have the lowest index of routinization while skilled and unskilled blue-collar workers have the highest index.

The French index have the advantage of being build on the French PCS-ESE classification but have the disadvantage to rely on a small number of tasks related to the working condition of the employee.

2.B.3 Robustness tests with different measure of tasks

The precedent section has highlighted several differences between the task categories derived from the three surveys since the value of the index strongly relies on the group of tasks included in the task category. Thus, we could not attribute different estimation results, with the BIBB index compared to the ONET index or the Frenchs survey, to divergence in terms of tasks performed in a particular occupation in the United-States, in Germany and in France.

In the present section, we estimate the effect of foreign direct investment on the task-composition of firms when the tasks index is derived from the French and the German survey. We are however unable to compare the results since the classifications do not rely on the same type of tasks but can shed more light on which tasks are at risk from globalization.

We find very similar results when using other classification of tasks. In particular, foreign direct investment to low income countries is associated with a lower share of workers performing manual tasks and a higher share of workers performing analytical tasks, as described by the BIBB index. Column (5) reports the results on the share of workers performing routine task as described by the French survey. As expected, we observe a negative and significant sign associated with foreign direct investment to low-income countries on the share of workers performing routine tasks.

Table 2.18 – Results with the BIBB and French index

	BIBB	BIBB	BIBB	BIBB	French index
Dependant variable	Routine Manual	Non routine manual	Non routine interactive	Non routine analytic	Routine index
Subsidiaries in					
Low income countries	-0.017**	-0.005	0.004	0.019***	-0.009*
	[0.007]	[0.009]	[0.003]	[0.007]	[0.005]
High income countries	0.006	0.004	-0.004	-0.008	0.008
	[0.008]	[0.011]	[0.004]	[0.009]	[0.006]
France	-0.001	-0.005	-0.000	-0.005	-0.000
	[0.005]	[0.006]	[0.002]	[0.004]	[0.003]
TFP	-0.003	-0.002	0.001	0.003	-0.003*
	[0.003]	[0.003]	[0.001]	[0.002]	[0.002]
Exports	-0.000	-0.001	0.000	-0.000	-0.000
	[0.001]	[0.001]	[0.000]	[0.000]	[0.000]
Revenue	-0.003	-0.004	0.002	0.004	-0.002
	[0.006]	[0.007]	[0.002]	[0.004]	[0.003]
Capital	0.003	0.007**	-0.002	0.003	0.001
	[0.004]	[0.004]	[0.001]	[0.002]	[0.001]
Constant	0.444***	0.539***	0.321***	0.525***	0.702***
	[0.042]	[0.049]	[0.018]	[0.028]	[0.020]
Observations	21,175	21,175	21,175	21,175	21,177
R-squared	0.007	0.002	0.003	0.009	0.014
log likelihood	27272.589	24089.101	44576.875	30869.955	37733.619

Source : LIFI survey, French annual census for manufacturing (EAE), French Déclaration annuelles des donnés sociales (DADS) ; period 2002-2007. Note : Estimations are firm fixed effects (FE), the dependent variables are the index of routinization as described in the previous section. The wage-bill shares are in percent, varying between zero and 100. Estimations are controlled for year and industry-year fixed effects. Heteroskedasticity-robust standards errors are reported in brackets. ***, **, and * indicate significance at the 1, 5 and 10 percent levels respectively.

We still prefer estimations from the ONET index since the ONET allows to have details on the task intensity over a bigger range of tasks than the BIBB index. Responses to the ONET questionnaire seem also more relevant than the responses to the BIBB questionnaire since respondents have precise example of the importance of tasks rather than a simple ranking on the frequency of tasks performed. We believe task-intensity of occupations to be very similar across developed countries and that the use of ONET does not alter the

conclusions.

2.C Description of Variables

We report a detailed description of groups of occupations, set out in Subsections 5.1 to 5.4. We also refer to their French classification (PCS-ESE 2003), available at <http ://www.insee.fr/>.

Table 2.19 – Description of the Groups of Occupations

Major Occupations	Code PCS-ESE	**Major Qualification**	Code PCS-ESE	**Detailed Occupations**	Code PCS-ESE
Executives		Skilled Production Workers			
Licensed professionals	31	Engineers	38	Technicians	47
Administrative managers	37	Technicians	47	Foremen	48
Engineers	38	Foremen	48		
IP		Skilled handling BC workers	65	Employees	
Firm's administrative IP	45	Industrial skilled BC workers	62	*Firm's administrative employees*	54
Commercial administrative IP	46	Craft skilled BC workers	63	*Commercial employees*	55
Technicians	47			Engineers	38
Foremen	48	Skilled non-production workers		Managers	37
Employees		Administrative managers	37		
Supervising officers	53	Firm's administrative IP	45	Skilled BC workers	
Firm's administrative employees	54	Commercial administrative IP	46	*Skilled handling BC workers*	65
Commercial employees	55			*Industrial skilled BC workers*	62
BC workers		Non-skilled production workers		*Craft skilled BC workers*	63
Skilled handling BC workers	65	Industrial non-skilled BC workers	67		
Industrial skilled BC workers	62	Craft non-skilled BC workers	68	Non- skilled BC workers	
Craft skilled BC workers	63			*Industrial non-skilled BC workers*	67
Industrial non-skilled BC workers	67	Non-skilled non-production workers		*Craft non-skilled BC workers*	68
Craft non-skilled BC workers	68	Supervising officers	53		
Agricultural BC workers	69	Firm's administrative employees	54		
		Commercial employees	55		

Note : The abbreviation 'IP' stems from intermediate occupations and the abbreviation 'BC' stems from blue-collar.

2.D Regression on Groups of Occupations

Table 2.20 – Changes in the Share of Occupations by Production Groups

Model	FE	FE	FE	FE
	(1)	(2)	(3)	(4)
Dependant variable	Skilled production workers	Skilled non production workers	Unskilled production workers	Unskilled non production workers
Affiliates in				
Low income countries	0.005	0.004	-0.007	-0.003
	[0.008]	[0.004]	[0.006]	[0.002]
High income countries	-0.013	-0.000	0.013	0.000
	[0.012]	[0.007]	[0.009]	[0.004]
France	-0.003	0.000	0.000	0.002
	[0.004]	[0.003]	[0.004]	[0.002]
Exports	-0.001**	0.000	0.001*	0.000
	[0.001]	[0.000]	[0.001]	[0.000]
Revenue	0.001	0.009**	-0.011**	0.001
	[0.005]	[0.004]	[0.004]	[0.002]
Capital	0.009***	-0.004**	-0.005**	-0.001
	[0.003]	[0.001]	[0.002]	[0.001]
TFP	0.001	-0.003	0.004	-0.002**
	[0.003]	[0.002]	[0.003]	[0.001]
Constant	0.600***	0.099***	0.218***	0.083***
	[0.031]	[0.019]	[0.027]	[0.014]
Observations	21,177	21,177	21,177	21,177
R-squared	0.021	0.003	0.021	0.004
log likelihood	28153.454	43982.590	30134.112	49629.168

Source : LIFI survey, French annual census for manufacturing (EAE), French Déclaration annuelles des données sociales (DADS) ; period 2002-2007. Note : Estimations are of firm fixed effects (FE), and variables are calculated at the level of the firm. The wage-bill shares are in percent, varying between zero and 100. Estimations are controlled for year and industry-year fixed effects. Heteroskedasticity-robust standards errors are reported in brackets. ***, **, and * indicate significance at the 1, 5 and 10 percent levels respectively.

Table 2.21 – Changes in the Share of Occupations by Occupational Groups

Model	FE (1)	FE (2)	FE (3)	FE (4)	FE (5)	FE (6)	FE (7)
Dependant variable	Managers	Engineer	Skilled blue collars	Unskilled blue collars	Employees	Technicians	Foremen
Affiliates in							
Low income countries	0.005**	0.006	-0.006	-0.013**	0.001	0.006	-0.002
	[0.002]	[0.004]	[0.009]	[0.006]	[0.001]	[0.004]	[0.003]
High income countries	-0.002	-0.000	-0.016	0.016	-0.001	0.003	0.000
	[0.004]	[0.005]	[0.012]	[0.010]	[0.001]	[0.005]	[0.003]
France	0.001	-0.002	-0.001	0.001	-0.001	0.002	0.001
	[0.002]	[0.002]	[0.005]	[0.004]	[0.001]	[0.002]	[0.001]
Exports	0.000	-0.000	-0.001	0.001**	-0.000	0.000	-0.000
	[0.000]	[0.000]	[0.001]	[0.001]	[0.000]	[0.000]	[0.000]
Revenue	0.006**	0.005*	-0.006	-0.012**	-0.001	0.006**	0.001
	[0.003]	[0.003]	[0.006]	[0.005]	[0.001]	[0.003]	[0.002]
Capital	-0.002**	0.001	0.008**	-0.005**	-0.001**	-0.003	0.001
	[0.001]	[0.001]	[0.003]	[0.002]	[0.000]	[0.002]	[0.001]
TFP	-0.003***	0.001	0.000	0.005*	-0.000	-0.003*	-0.001
	[0.001]	[0.001]	[0.003]	[0.003]	[0.000]	[0.001]	[0.001]
Constant	0.047***	0.050***	0.455***	0.232***	0.013**	0.156***	0.048***
	[0.014]	[0.018]	[0.037]	[0.029]	[0.006]	[0.020]	[0.010]
Observations	21,169	21,169	21,169	21,169	21,169	21,169	21,169
R-squared	0.009	0.022	0.002	0.025	0.003	0.021	0.002
log likelihood	51998.222	46784.783	25644.470	27636.996	72001.713	41710.489	52931.185

Source : LIFI survey, French annual census for manufacturing (EAE), French Déclaration annuelles des donnés sociales (DADS) ; period 2002-2007. Note : Estimations are of firm fixed effects (FE) and variables are calculated at the level of the firm. The wage-bill shares are in percent, varying between zero and 100. Estimations are controlled for year and industry-year fixed effects. Heteroskedasticity-robust standards errors are reported in brackets. ***, **, and * indicate significance at the 1, 5 and 10 percent levels respectively.

2.E Sector Decomposition

Table 2.22 presents the average wage bill share for seven broad occupations per sector. The consumer goods industries are relatively more intensive in administrative workers (managers and employees), while the capital and intermediate goods industries are more intensive in skilled production workers (engineers, skilled blue-collars and technicians). The share of unskilled blue-collar workers and foremen are relatively similar in the three sectors.

TABLE 2.22 – Decomposition of the Wage-Bill Share by Sector

VARIABLES	(1)	Workers (2)	Manual (3)	Manual (4)	Interactive (5)	Analytic (6)	Cognitive (7)
Affiliates in							
LI countries	0.003	0.005	0.002	-0.005	-0.003	-0.008	-0.000
	[0.012]	[0.015]	[0.019]	[0.016]	[0.020]	[0.018]	[0.017]
HI countries	0.005	-0.005	-0.001	0.005	0.001	0.000	-0.007
	[0.013]	[0.016]	[0.021]	[0.017]	[0.021]	[0.019]	[0.019]
France	-0.004	0.004	0.014	0.007	-0.013	-0.005	-0.005
	[0.006]	[0.007]	[0.010]	[0.008]	[0.010]	[0.009]	[0.009]
Export	0.000	0.004***	0.003***	0.001	-0.003***	-0.004***	-0.003***
	[0.001]	[0.001]	[0.001]	[0.001]	[0.001]	[0.001]	[0.001]
Revenue	0.019***	-0.035***	0.003	-0.006	0.014	0.012	0.013
	[0.006]	[0.007]	[0.009]	[0.008]	[0.009]	[0.008]	[0.008]
Capital	-0.001	0.013***	0.004	0.007	-0.004	-0.003	-0.005
	[0.003]	[0.004]	[0.005]	[0.005]	[0.006]	[0.005]	[0.005]
TFP	-0.002	0.001	-0.009*	-0.005	0.004	0.004	0.009*
	[0.003]	[0.004]	[0.005]	[0.004]	[0.005]	[0.005]	[0.005]
Constant	0.055*	0.665***	0.399***	0.495***	0.377***	0.543***	0.497***
	[0.029]	[0.035]	[0.047]	[0.039]	[0.048]	[0.043]	[0.043]
Observations	3,229	3,229	3,135	3,135	3,135	3,135	3,135
R-squared	0.041	0.038	0.009	0.020	0.043	0.036	0.048
Log Likelihood	6338.540	5759.744	4729.352	5321.430	4681.499	5033.866	5055.226

Source : LIFI survey, French annual census for manufacturing (EAE), French Déclaration annuelles des donnés sociales (DADS) ; period 2002-2007. Note : Estimations are of firm fixed effects (FE), and variables are calculated at the level of the firm. The wage-bill shares are in percent, varying between zero and 100. Estimations are controlled for year and industry-year fixed effects. Estimations are controlled for year and industry-year fixed effects. Heteroskedasticity-robust standards errors are reported in brackets. ***, **, and * indicate significance at the 1, 5 and 10 percent levels respectively.

The following tables present the results of the fixed effect model by dividing the sample into three main industry categories. Firms belonging to consumer goods industries are reported in Table 2.23. Firms belonging to intermediate goods industries are reported in Table 2.25. Finally, firms belonging to capital goods industries are reported in Table 2.24. 20.82% of our sample are in the consumer goods industries, 23.69% are in capital goods industries and 50.99% are in the intermediate goods industries.

Table 2.23 shows no clear effect of offshoring on employment. Whereas Table 2.24 shows a positive effect of offshoring to low-income countries on the share of executives, and the share of workers performing intensively cognitive and analytical tasks.

Interestingly, Table 2.24 shows that the negative bias towards manual workers when offshoring occurs in high-wage countries and is mainly driven by firms in capital goods industries, as described in Section 5.2. We also observe a positive association between offshoring in high-income countries and the share of workers performing interactive tasks. This is similar to results obtained in Becker et al. (2012).

Table 2.25 shows a clear substitution between blue-collar workers and a complementarity between skilled executives and offshored employment in low-income countries. Similar results were obtained for Sweden by Hanson (2005).

Table 2.23 – Fixed Effect Model for the Consumer Goods Industries

VARIABLES	Executive (1)	Blue-collar workers (2)	Routine manual (3)	Non-routine manual (4)	Non-routine interactive (5)	Non-routine analytic (6)	Routine cognitive (7)
Subsidiaries in							
LI countries	0.002	0.007	-0.002	-0.011	0.003	-0.005	0.004
	[0.014]	[0.015]	[0.020]	[0.016]	[0.019]	[0.017]	[0.018]
HI countries	0.005	-0.012	-0.001	0.006	-0.007	-0.004	-0.005
	[0.015]	[0.017]	[0.022]	[0.018]	[0.022]	[0.019]	[0.020]
France	-0.005	0.004	0.013	0.004	-0.012	-0.004	-0.004
	[0.007]	[0.008]	[0.010]	[0.008]	[0.010]	[0.009]	[0.009]
Export	-0.001	0.003***	0.003*	0.001	-0.004***	-0.004***	-0.003**
	[0.001]	[0.001]	[0.001]	[0.001]	[0.001]	[0.001]	[0.001]
Revenue	0.026***	-0.051***	-0.014	-0.012	0.031***	0.027***	0.015
	[0.007]	[0.008]	[0.011]	[0.009]	[0.011]	[0.010]	[0.010]
Capital	0.002	0.007*	0.005	0.005	0.004	0.003	0.003
	[0.003]	[0.004]	[0.005]	[0.004]	[0.005]	[0.004]	[0.004]
TFP	0.001	-0.001	-0.002	-0.005*	-0.000	-0.004	0.004
	[0.002]	[0.003]	[0.003]	[0.003]	[0.003]	[0.003]	[0.003]
Constant	0.011	0.748***	0.430***	0.501***	0.287***	0.470***	0.521***
	[0.040]	[0.045]	[0.059]	[0.048]	[0.057]	[0.052]	[0.053]
Observations	2,635	2,635	2,564	2,564	2,564	2,564	2,564
R-squared	0.041	0.038	0.009	0.020	0.043	0.036	0.048
Log Likelihood	5032.439	4702.799	3959.114	4472.146	4034.450	4307.433	4259.349

Source : LIFI survey, French annual census for manufacturing (EAE), French Déclaration annuelles des données sociales (DADS) ; period 2002-2007. Note : Estimations are of firm fixed effects (FE), and variables are calculated at the level of the firm. The wage-bill shares are in percent, varying between zero and 100. Estimations are controlled for year and industry-year fixed effects. Heteroskedasticity-robust standards errors are reported in brackets. ***, **, and * indicate significance at the 1, 5 and 10 percent levels respectively.

Table 2.24 – Fixed Effect Model for Capital Goods Industries

VARIABLES	Executive (1)	Blue collar Workers (2)	Routine Manual (3)	Non routine Manual (4)	Non routine Interactive (5)	Non routine Analytic (6)	Routine Cognitive (7)
Affiliates in							
LI countries	0.024***	-0.011	-0.004	0.019	0.018	0.025**	0.019*
	[0.008]	[0.010]	[0.017]	[0.014]	[0.013]	[0.012]	[0.011]
HI countries	0.002	-0.009	-0.037*	-0.052***	0.033**	-0.000	0.018
	[0.009]	[0.011]	[0.020]	[0.016]	[0.016]	[0.014]	[0.013]
France	-0.004	0.011**	0.007	-0.010	-0.015**	-0.014**	-0.010
	[0.004]	[0.005]	[0.009]	[0.008]	[0.007]	[0.007]	[0.006]
Export	0.000	-0.000	-0.003***	-0.001	0.003***	0.002**	0.002**
	[0.000]	[0.001]	[0.001]	[0.001]	[0.001]	[0.001]	[0.001]
Revenue	0.006	-0.016***	-0.006	0.007	0.009	0.010	0.012**
	[0.004]	[0.005]	[0.008]	[0.007]	[0.006]	[0.006]	[0.005]
Capital	-0.002	0.003	-0.003	-0.005	0.002	0.001	0.005
	[0.002]	[0.003]	[0.005]	[0.004]	[0.004]	[0.004]	[0.003]
TFP	0.001	0.006**	0.001	-0.003	-0.001	-0.001	-0.003
	[0.002]	[0.003]	[0.005]	[0.004]	[0.004]	[0.004]	[0.004]
Constant	0.136***	0.539***	0.529***	0.569***	0.380***	0.568***	0.526***
	[0.019]	[0.024]	[0.044]	[0.037]	[0.035]	[0.032]	[0.030]
Observations	5,195	5,195	5,039	5,039	5,039	5,039	5,039
R-squared	0.054	0.040	0.015	0.065	0.036	0.025	0.029
Log Likelihood	10896.345	9663.335	6636.798	7568.065	7776.585	8214.784	8590.982

Source : LIFI survey, French annual census for manufacturing (EAE), French Déclaration annuelles des données sociales (DADS) ; period 2002-2007. Note : Estimations are of firm fixed effects (FE), and variables are calculated at the level of the firm. The wage-bill shares are in percent, varying between zero and 100. Estimations are controlled for year and industry-year fixed effects. Heteroskedasticity-robust standards errors are reported in brackets. ***, **, and * indicate significance at the 1, 5 and 10 percent levels respectively.

Table 2.25 – Fixed Effect Model for Intermediate Goods Industries

VARIABLES	Executive (1)	Blue collar Workers (2)	Routine Manual (3)	Non routine Manual (4)	Non routine Interactive (5)	Non routine Analytic (6)	Routine Cognitive (7)
Affiliates in							
LI countries	0.011***	-0.014**	-0.006	0.001	0.028***	0.012	0.006
	[0.004]	[0.006]	[0.009]	[0.008]	[0.009]	[0.008]	[0.008]
HI countries	-0.001	-0.002	0.004	-0.007	-0.027**	-0.017	-0.002
	[0.006]	[0.008]	[0.013]	[0.011]	[0.013]	[0.011]	[0.011]
France	0.000	-0.010***	-0.012**	-0.012***	0.004	0.000	0.003
	[0.002]	[0.003]	[0.005]	[0.005]	[0.005]	[0.005]	[0.005]
Export	-0.000	-0.001	-0.002**	-0.002***	-0.000	-0.000	0.000
	[0.000]	[0.000]	[0.001]	[0.001]	[0.001]	[0.001]	[0.001]
Revenue	0.004*	-0.007**	0.015***	0.004	0.002	-0.006	-0.009*
	[0.002]	[0.003]	[0.005]	[0.005]	[0.005]	[0.005]	[0.005]
Capital	0.001	0.001	-0.001	0.008***	-0.001	0.004	0.002
	[0.001]	[0.002]	[0.003]	[0.003]	[0.003]	[0.003]	[0.003]
TFP	0.002	0.001	-0.004	-0.001	0.000	0.000	0.000
	[0.001]	[0.002]	[0.003]	[0.003]	[0.003]	[0.003]	[0.003]
Constant	0.077***	0.661***	0.429***	0.474***	0.410***	0.603***	0.597***
	[0.014]	[0.019]	[0.030]	[0.026]	[0.028]	[0.025]	[0.026]
Observations	11,713	11,713	11,404	11,404	11,404	11,404	11,404
R-squared	0.034	0.020	0.009	0.014	0.047	0.043	0.025
Log Likelihood	25785.432	22056.141	16457.706	18015.747	16997.196	18221.991	18081.223

Source : LIFI survey, French annual census for manufacturing (EAE), French Déclaration annuelles des données sociales (DADS) ; period 2002-2007. Note : Estimations are of firm fixed effects (FE), and variables are calculated at the level of the firm. The wage-bill shares are in percent, varying between zero and 100. Estimations are controlled for year and industry-year fixed effects. Heteroskedasticity-robust standards errors are reported in brackets. ***, **, and * indicate significance at the 1, 5 and 10 percent levels respectively.

2.F First Stage Estimates

Results of the first stage estimates show that there is a positive correlation between our κ measure, reflecting the number of subsidiaries, in high-income countries and the average GDP per capita in the destination country. Conversely, there is a positive correlation between GDP per capita in low-wage countries and the number of subsidiaries in low-wage countries. Overall, we observe that increasing GDP per capita raises the incentive for firms to invest, whatever the type of country (low-income or high-income).

Interestingly, we observe a positive correlation between FDI to high-income countries and the GDP per capita in low-income countries. FDI to low-income countries and more particularly in emerging economies combines strategies of market access and saving labor costs (which are often called mixed investment strategies). On the one hand, production costs are lower than in developed countries, which increasingly drive efficiency-seeking investments. On the other hand, growing demand and strong market potential increase incentives to invest in emerging economies. Mixed investment strategies represent the major share of investment, since roughly 80% of FDI to low-income countries is directed towards only ten emerging countries with strong growth potential. Large firms in European countries and French CAC 40 companies, in particular, have created more jobs and business in emerging countries than in high-income European countries in recent years. This is because a part of the global demand and growth have shifted to emerging mar-

kets (UNCTAD, 2012). Therefore, increasing low-income countries' GDP per capita would raise consumer demand without increasing production costs as much as in developed countries. A firm could gain in efficiency and profitability as a result of increasing low-income countries' GDP, and would allow it to raise FDI in high-income countries.

In contrast, we observe a negative and significant correlation between high-income countries' GDP per capita and FDI to low-income countries. These results show that, other things being equal, increasing market potential in high-income countries reduces the incentive for firms to invest in low-income countries. This corroborates the result that market access is a powerful force of attraction for companies (Fontagne and Mayer 2005).

Results for infrastructure variables are intuitive and are in line with the existing, vast literature. They show that the quality of infrastructure is an important source of comparative advantage. Increases in the level of infrastructure in low-income countries raise the incentive for firms to invest in these countries. The same conclusion holds for offshoring to high-income countries.

Chapitre 3

Does Outward Foreign Direct Investment affect domestic real wages ? An investigation using French micro-data

1 Introduction

One important issue in international economics is to understand to which extent globalization contributes to wage inequalities between- and within-demographic groups. Earlier research has found a modest impact of globalization on wages and has rather pointed out the effect of technological progress (Katz and Autor (1999), Autor et al. (1998), Krueger (1993), Berman et al. (1994)). Former studies captured wage inequality between low- and high-skilled workers through inequality between sectors. Yet, recent empirical contributions have shown that much of the overall wage inequality occurs within sectors and occupations rather than between sectors and occupations (see Helpman et al. (2012) for evidence on Brazil, Baumgarten (2013) for evidence on Germany, Faggio et al. (2010) for evidence on UK and Akerman et al. (2013) for evidence on Sweden). Previous findings may thus have neglected potential effects on wage inequality within industries and within skill groups.

As a consequence, recent theoretical models place firm and individual heterogeneity as the core transmission channel of wage inequality, through rent-sharing mechanisms and labor market frictions (Helpman et al. (2010), Davidson et al. (2010), Egger and Kreickemeier (2009)). This theoretical background has opened new areas of empirical research, requiring very detailed employer-employee data to analyze the causes of wage inequality. A recent branch of the literature has focused on the effect of trade and imports of intermediate inputs on within job-spell wages at the firm level (Hummels et al. (2011), Amiti and Davis (2011)) and at the industry level (Autor et al. (2013)). These studies suggest that

offshoring has increased wage inequality between high- and low-skilled workers (Geishecker and Görg 2008; Munch and Skaksen 2009; Hummels et al. 2011), and that low-skilled workers appear more vulnerable to import competition from low-wage countries (Autor et al. (2013)). Another part of the literature has focused on wage difference between exporting and non-exporting firms (Baumgarten (2013), Krishna et al. (2013), Helpman et al. (2013), Schank et al. (2007) and Carluccio et al. (2014) using French data). Results suggest that exports contribute to increase wage premiums of high-skilled workers because their employer's internationalization allows them to bargain over higher profits. While exports lead to higher earning losses for low- and middle-wages workers facing exposure to imports

In this paper, we use rich French firm-level panel data with matched information on workers' characteristics to study the effect of outward foreign direct investment (FDI) on job-spell wages. The case of France is particularly interesting to study wage inequality, because -compared to others industrialized countries- the rise of wage inequalities has been limited in France (Fontagné et al. (2014)). France is one of the five OECD countries where income inequality and poverty have declined over the past 20 years and this result is mainly due to labor market institutions (OECD 2008).

Evidence on the impact of outward FDI on wages is relatively scarce. Yet, foreign direct investment is an important contributor to the internationalization of firms. In the United States, roughly one-half of U.S imports are transacted within the boundaries of multinational firms rather than across unaffiliated parties (Bernard et al. (2009)). In France, several reports stress that large multinational companies have favored internationalization through in-house foreign production, compared to Germany who has favored internationalization through arm's length production (Fontagné and Toubal (2010)). According to the French office of statistics (Insee), French-owned multinational firms represented nearly 35% of total employment in French companies in 2011 (excluding the agriculture sector) and 57% of their total value-added. Therefore, outward FDI has potentially a large effect on French workers' working conditions and wages.

Different mechanisms should intervene according to the nature of FDI. First, FDI can act as a form of offshoring if the creation and/or the acquisition of a foreign company allows firms to break up the value chain in several countries, which is often referred to as vertical investment. Vertical FDI may be associated with relocation of low-skilled activities abroad, that might reduce the wage paid to unskilled workers at home, depending on whether domestic and foreign employment are substitutes or complements. Second, outward FDI can be market-seeking and does not necessarily increase the fragmentation of the production process, which is often referred to as horizontal investment. Market-seeking FDI should mostly affect domestic wages through its effects on the localization of profits and/or the bargaining process of wages. The extent to which domestic workers might benefit from their firm's international expansion will depend on two parameters. First, the share of foreign profits which are repatriated, which especially depends on tax rate and

growth prospects differentials between the home and the invested country [1]. Second, information asymmetries in the bargaining process, which may give an advantage to employers since only the employer has full information about productivity in foreign plants and/or the share of foreign profits which are repatriated. Domestic workers lacking information about the firm's profitability might lower their wage demands in order to increase the probability of acceptance, as argued by Creane and Davidson (2008) .

Finally, horizontal and vertical FDI might both affect wages through what is known as the "threat effect" (Choi, 2001). Employers' ability to resort to foreign production increases their bargaining power in the wage negotiation, since workers may fear to lose their jobs. For example, using French micro data, Kramarz (2013) shows that the implementation of the Single Market Program (at the end of the 1980s) increased the opportunities for outsourcing and led to significant employment and wage cuts in firms with strong unions. We can apply the same reasoning for multinational firms. The existence of foreign affiliates allows firms to substitute domestic workers by foreign workers more easily, since the sunk costs of FDI have already been supported [2]. A second production facility abroad improves the outside option of a multinational enterprise in its wage bargain with the domestic union.

In this article, we use a very detailed dataset for France covering the period 2002-2007. The data allows us to control for individual characteristics (sex, age, diploma, occupation) as well as firms' (exports and imports, size, productivity, sector). The use of detailed information on employees' characteristics makes it possible to disentangle the effect of foreign direct investment on wages depending on the nature of tasks performed. From the seminal work of Grossman and Rossi-Hansberg (2008), firms trade tasks rather than intermediate inputs. The job content of occupations becomes a key component to identify the winners and losers of the globalization process. Indeed, skilled and unskilled workers are no longer considered as homogeneous groups who have suffered the same impact following foreign direct investments. Following recent empirical articles, we build different classification of jobs, in terms of skill levels, tasks and occupations (Baumgarten et al. (2013), Geischecker and Gorg (2008), Ebenstein et al. (2009)).

We capture outward FDI with different proxies : the number of subsidiaries abroad, the number of countries deserved by FDI and the international status of the firm (domestic and multinational). Most importantly, we are able to control for other margins of globalization by including imports of intermediate inputs, imports of finished goods and exports. This constitutes a great advantage with respect to the existing literature, since it allows us to account for all the firms' internationalization strategies.

1. To our knowledge, no paper has investigated the impact of outward FDI on the level of profits in the home country. See Davies et al. (2014) for a recent survey of the literature interested in profit-shifting strategies.

2. In France, according to a recent survey on global value chains, firms which belong to a business group and report having offshored some part of their domestic activities between 2009 and 2011 indicate that jobs were mostly offshored either to existing foreign affiliates or to foreign subcontractors (see Fontagne and D'Isanto, 2013).

Our main results are the following. First, we observe that multinational companies pay a wage premium to their employees, even within precise skill-groups (blue-collars, intermediate profession, managers). The wage premium is increasing within the wage distribution : the wage premium of multinational firms is higher among high-paid workers than among low-paid workers.

In a second step, we control for firms and workers characteristics by using the statistical framework of Abowd, Kramarz and Margolis (1999) (AKM hereafter) where the determination of wages depends on (i) time varying observable worker and firm characteristics and (ii) firm and worker fixed effects. One crucial concern when attempting to estimate the effect of FDI on wages is that the most productive firms might also be those able to screen workers with greater abilities and skills (which are more likely to seize their employer's surplus in the wage bargaining process). If the matching process between workers and firms is determined by workers' unobservable characteristics, estimates of the effect of FDI on wages may be biased. We thus control for endogenous mobility by including firm-individual match fixed effect in our econometrical specification, following Krishna et al. (2012) and Woodcock (2007). We find this formulation to give little insight with respect to the original formulation of AKM (1999) [3].

Regardless of the model specification, we find two interesting results. First, exports raise wages in all types of occupations. Second, outward FDI explains significantly the rise of managers' wages within the firm and reduces the wages of workers performing offshorable tasks. The positive effect on managers' wage is mainly driven by the intensive margin of outward FDI, that is by large firms already established abroad. One explanation of the positive effect of outward FDI on managers' wages might come from their greater ability to capture their firm's productivity gains, or might be the counterpart of greater responsabilities (consisting in monitoring foreign affiliates for example). The negative effect of outward FDI on offshorable tasks is consistent with the existence of substituability between low-skilled workers performing offshorable tasks at home and workers in foreign affiliates.

The paper is organized as follows. The next section presents a brief review of the literature. Section 3 describes the data and the main variables. Section 4 analyzes the results of the wage gap between multinational- and domestic-workers. Section 5 estimates the wage effect of FDI within job-spells. Section 6 identifies the source of wage inequality and Section 7 concludes.

2 Related literature

There are two sets of theoretical models identifying the source of wage variation across firms. The first line of research assumes neoclassical labor markets in which workers with

3. Card et al. (2012), Davidson et al. (2014), Macis and Schivardi (2014) also find that adding a match specific component yields only a small improvement in the fit of the model.

the same characteristics are paid the same wage. Wages may differ across firms because of differences in the workforce composition. In Yeaple (2005) and Bustos (2011) for instance, a technology shock following trade liberalization results in a reallocation of workers from the old to the new technology, which increases the demand for qualification. Verhoogen (2008) also highlights the role of production reallocation in favor of high-quality goods on the demand for skills. Hence, following the same reasoning, if multinational firms engage in quality upgrading, average wages in multinational firms should increase due to changes in the skill composition.

The second line of research introduces labor market frictions, so that workers with the same characteristics can be paid different wages by different firms. The first set of labor market frictions is related to the matching process between firms and workers. Since screening workers' abitities is costly (publication of adds, search of candidates, conducting interviews), the most productive firms have a comparative advantage in screening more accurately workers' with higher abilities. The existence of screening costs implies that firms are willing to pay higher wages in order to avoid the replacement cost of higher ability workforce (Helpman et al., 2010). Hence, *ex ante* identical workers may receive different wages, depending on the employer they are matched with. Since exporters and multinationals exhibit higher levels of productivity (given that exports and FDI imply sunk costs), these firms might also have a greater ability of screening workers and attracting the best profiles.

The second set of labor market frictions concerns the wage bargaining process. First, higher profits can result in higher wages if the wage perceived to be fair increases with firms' revenue (Amiti and Davis (2012)) and if more profitable firms need to pay higher wages in order to elicit workers' full efforts. An additional source for wage inequality within skill groups comes from the use of performance-based pay, which becomes a predominant method of rewarding executive managers (Holmström and Milgrom (1987) [4]. The use of performance-based pay may increase wage inequality within precise skill groups by creating different wage agreements depending on (i) workers' ability to bargain over the firm's surplus and (ii) firms' need to elicit some workers' effort. Based on Norwegian data, Barth et al. (2009) highlight the contribution of pay schemes based on individual output to the rise of within-firm wage inequality. Increasing foreign market competition seems to increase the use of performance-related pay within companies, as suggested by Cuñat and Guadalupe (2009). They show that a higher level of product market competition increases the performance-related component of compensation schemes for executives, but not for workers.

There are three types of empirical studies analyzing the effect of globalization on wage inequality : those analyzing the effect of offshoring, those analyzing the effect of exports and those analyzing the effect of inward foreign direct investment.

4. According to Lemieux et al. (2007), an increasing fraction of jobs in the U.S. labor market explicitly pay workers for their performance, using bonus pay, commissions, or piece-rate contracts.

The first set of the literature mainly analyzes the effect of offshoring, as measured by imports of intermediate inputs on wage inequality. Ebenstein et al. (2010) seek to analyze the effect of offshoring on US workers' wage over the period 1983 to 2002, at the industry level and at the individual level. They first use data on the U.S. manufacturing sector between 1979 and 1990 and find modest effects of offshoring on wages. They argue that focusing on workers which stay within the manufacturing sector might lead to underestimate the effect of offshoring on wages. Workers' wage declines may be more important when they are pushed to search for a new job outside the manufacturing sector. The authors indeed show that the wage impact of offshoring is higher when the analysis is redefined at the occupational level.

On German data, Baumgarten et al. (2010) study the effect of offshoring on wages. They investigate to which extent workers with highly interactive or non-routine occupations are more affected by offshoring than routine occupations. They show that increased offshoring (approximated by imported intermediate inputs) reduces by 0.38 euro the hourly wage of medium skilled workers when performing routine tasks, and increases the hourly wage for medium-skilled workers performing non-routine tasks by 0.07 to 0.027 euro. They also analyze the wage effect of offshoring when workers move across industries by applying the same methodology as in Ebenstein et al. (2010). The authors observe a higher wage decline than the one observed in the partial equilibrium case.

Hummels et al. (2011) track workers outcome after a job spell. The authors' idea is to test whether wage losses for workers displaced from outsourcing are more pronounced than for workers displaced for other reasons, because their skills become obsolete and are specialized in tasks imported from abroad. They observe that workers excluded from firms that have increased their intermediate goods imports experience a larger wage decline than those excluded from other firms. They also note that both skilled and unskilled workers suffer a pay cut, but this decline is lower for skilled workers. Finally, they study the wage effect of outsourcing shocks conditional on occupational characteristics. They observe that wage gains are largest for social science or language skill intensive occupations.

The second set of literature analyzes the effect of exports on wage inequality. Klein et al. (2013) highlight a significant wage premium for high-skilled workers and a wage discount for low-skilled workers among exporting firms. They show on German data over the period 1993-2007 that export activity is associated with up to 30% of within and between skill group wage inequality. Baumgarten (2013) show that this exporter wage gap, conditional on workers' skill levels, contributed to the growth in wage inequality in Germany. Krishna et al. (2011) find a positive effect of trade liberalization in Brazil on average wages in exporting firms compared to non-exporting firms. However, this effect turns out to be insignificant when controlling for endogenous assignment of workers. Amiti and Davis (2012) use Indonesian data over the period 1991-2000 and show that a fall in output tariffs increases wages at exporting firms. Finally, Helpman et al. (2012) estimate a modified version of the model developed in Helpman et al. (2010) on Brazilian data.

They show that opening the closed economy to trade raises wage inequality by around 10 percent.

A third set of papers in the literature analyzes the effect of inward FDI on wages. Most studies on developed and developing countries find that foreign-owned firms pay higher wages, on average, than privately owned local firms (see Girma and Gorg (2007) for the United Kingdom, Huttunen (2007) for evidence on Finland, Lipsey and Sjoholm (2010) for evidence on Indonesia, Heyman et al. (2007) for evidence on Sweden and Feenstra and Hanson (1997) for evidence on Mexico). The existence of spillovers has been indicated as one of the reasons why inward FDIs might benefit a host economy. Indeed, imitation of technological innovation and workers' mobility from foreign-owned to domestic firms may increase the productivity of some firms in the host country (Fosfuri et al. (2001)).

However, little attention has been paid on the effect of outward foreign direct investment on wages. The choice to realize an outward foreign direct investment compared to international subcontracting is a deliberate choice, often realized to protect against subcontractors' opportunistic behavior and against technology leakages. Outward FDI may lead to transfers of firms' specific technological and managerial knowledge to foreign affiliates, which may hurt skilled workers depending on whether foreign and domestic skilled-workers are complements or substitutes. On the one hand, outward FDI may raise the need for specific language, communication and supervision skills in the home country, which in turn may raise wages of workers holding those particular competences. On the other hand, the transfer of skilled-intensive production may reduce wages for skilled workers if they become substitutes with workers in foreign affilliates. This article intends to shed more light on the effect of outward foreign direct investments on wages within different occupational groups.

3 Empirical Results

Our empirical analyses proceeds in two parts. First, we are interested in the raw wage differential between individuals working in domestic firms and those working in multinational firms. Second, we use the basic statistical framework of Abowd, Kramarz and Margolis (1999) (AKM hereafter) where the determination of wages depends on (i) time varying observable worker and firm characteristics and (ii) firm and worker fixed effects. We use spell of workers within a firm in a fixed effect model to analyze the effect of outward FDI on workers' wage.

3.1 Data

Our database is constructed with six micro-data sources. Three of them are employee based databases (Déclaration Annuelles des Données Sociales (DADS), Échantillon Démographique Permanent (EDP), the French survey on working conditions). These data

share a common firm identifier in order to merge them with three others firm-level databases ("Liaison Finanière" dataset (LIFI), customs data and "Enquête Annuelle Entreprise" (EAE)). [5]. Since several changes have been conducted to improve these databases, we only provide detailed descriptions of the data for our period of observation (2002-2007).

Employee Level Information. The administrative panel - Déclaration Annuelles des Données Sociales - is built from confidential yearly social-security records, treated and transmitted by the French National Institute for Statistics (INSEE). Administrative records are based on firms' mandatory report of workers subject to payroll taxes to fiscal authorities. The database covers all firms in the private and public sectors. From this administrative record, a panel of individuals born in October is built. Each observation consists of an employer-employee match and reports the sex, age, residence and workplace's region, yearly real earnings (in 2007 euros) and the number of hours and days worked each year by the individual [6].

Since wages and careers are likely to be affected by personal events such as birth or marriage, we use data enhanced by information from the Permanent Demographic Sample (échantillon démographique permanent, EDP). The Permanent Demographic Sample is augmented with variables from the annual census surveys. Currently, about 900,000 individual's social and professional trajectories are well tracked. The sample includes all the civil status and information from census surveys for individuals born one of the first four days of October each year. This data source gives details on education, marital status and number of children.

Finally, we use the French working condition survey produced by the French "Direction de l'Animation de la Recherche, des Etudes et des Statistiques" (DARES) in 2005. The inquiry is realized every 7 years on a sample of 19,000 workers and measures several aspects of working conditions based on the statements of employees. In particular, we are interested in questions related to the use of computers. We derive an index on the intensity of the use of computers at the occupation level. The index is derived from the yes/no question : "do you need to work, even occasionally, with a computer connected to a network or to other computers ?". A negative answer is coded 0 while a positive answer is coded 1. We build an index reflecting the intensity of the use of computer at the occupational level. The index is the ratio of the sum of answers over the total number of workers in a particular 2-digit occupation, such as $\frac{1}{n_{io}} \sum_i d_{io}$ where d_{io} is a dummy equal to 1 if the worker i answers 'yes' to the question on the use of computer and 0 if the answer is no. n_{io} is the total number of workers i in a particular occupation o. The more workers in a particular occupations declare using computers, the higher the index is [7].

5. We are really grateful to the CASD, the Genes (Groupes des Écoles Nationales d'Économie et de Statistiques) and the national institute of french statistic for having provided these data.

6. Workers in the DADS can be identified in several positions, we only keep the worker-firm match for which the job spell and salary is the highest.

7. Managers have an index of 0.905 (90% of respondents in the occupation of managers declared using a

We build a second task index in order to measure the routinization of occupations. We aim at providing an index that captures the routine nature of tasks, in order to classify occupations according to their offshorability. The index is built on nine specific questions about job activities, ranging according to their frequency. The questions are related to a number of tasks : routine manual tasks, non-routine interactive and analytical tasks. The higher the index is, the more the workers perform routine tasks and the easier is to relocate the occupation.

We map the index of offshorability to occupations in three steps. First, we sum the values attributed to each answers to the nine questions for each respondent. Second, we calculate the average of the index for the 412 PCS-ESE 4-digit occupations. Finally, we normalize by the maximum and minimum index value in any occupation so that the offshorability index varies between zero and one across occupations. With this standardization, each occupation is assigned a number between 0 and 1 that measures its degree of routine tasks. More details on the building of the index is given in Appendix 3.A.

We also run a robustness test by using a task index derived from the ONET, as detailed in chapter 2. The results are very similar whatever the index retained (see Appendix 3.F).

Firm level information. Firm level information comes from two confidential databases. The first is the *Liaison Finanière* survey (LIFI), which collects all financial links involving at least one French firm and allows to identify firms which own at least one FDI (i.e. firms having 10 % or more of voting stock in a foreign firm). These links also offer the possibility to reconstruct the whole business group perimeter. A business group is defined as a set of firms composed by a mother company that is not controlled by another economic entity and all other affiliates, in France or abroad, controlled by this mother company. We are able to identify both the firm's parent company and the firm's foreign subsidiaries. We sum the number of foreign subsidiaries in order to construct our FDI measure. We control our results by building a second measure of FDI as the number of countries where the firms owns at least one FDI.

Second, we use a firm survey from the French Manufacturing Census, called *"Enquête Annuelle Entreprise"* (EAE). This data source provides the detailed income statement of all French manufacturing firms employing more than 20 employees. The database allows to build several control variables of the firm's characteristics, such as tangible assets, revenue and firm's productivity. The firm's productivity is approximated by a measure of total factor productivity which is derived from the approach of Levinsohn and Petrin (2003). This approach allows to control for endogeneity resulting from the correlation between unobservable productivity shocks and the input level. We use operating expenses as the proxy variable for productivity shocks, value-added as the dependent variable, the number of employees as a proxy of the labor force and the total fixed assets as a capital proxy [8].

computer), engineers have an index of 0.931, administrative workers of 0.805, technicians of 0.799, foremen of 0.610, secretary of 0.805, skilled blue collar workers of 0.311 and unskilled blue collar of 0.206.

8. We have used different proxies for technological change, such as investment in R&D, proximity to the

Finally, the last database is derived from the French customs and contains the amount of exports and/or imports by product (CN8 nomenclature of product classification) and by destination country for each year between 2002 and 2007. We distinguish between finished or intermediate goods. Finished goods are defined as CN8 products that correspond to the same 3-digit NACE code of the main activity of the firm [9]. Other imported goods are defined as intermediate goods. Our measure of outsourcing is the share of imports of intermediate inputs and finished goods over the firm's sales : $\frac{II_{it}^c}{T_{it}}$ and $\frac{FG_{it}^c}{T_{it}}$ respectively. With II_{it}^c corresponding to firm's i imports of intermediate inputs at time t from country group c, FG_{it}^c corresponds to the firm's imports of finished goods at time t from country group c, and T_{it} the firm i sales at time t. We define two groups of countries. The group of high-income countries corresponds to high-income OECD countries (as defined by the OECD in 2007) [10] and the group of low-income countries corresponds to all other countries.

Initially, the sample of the DADS covered the private sector establishments, government owned establishments and hospitals. By merging these databases, we only keep manufacturing firms of the private sector employing more than 20 employees [11]. We give a detailed descriptive statistics of principal variables for the pooled sample (in appendix).

4 Preliminary Findings

4.1 Source of wage inequality

Recent evidences have shown that much of the overall wage inequality occurs within sectors and occupations rather than between sectors and occupations (Redding et al. (2012), Baumgarten (2013). A natural starting point for our analysis is thus to analyze trends in wage dispersion in France over the period 2002-2007.

We start by decomposing overall wage inequality into within and between-group component along different groups. We index workers by i and the different groups by k such as the overall wage variance can be decomposed as follows :

$$\sum_{i=1}^{p}\sum_{k=1}^{n}(w_{ik}-\bar{w})^2=\sum_{k=1}^{n}N_k\left(\bar{w}_k-\bar{w}\right)^2+\sum_{i=1}^{p}\sum_{k=1}^{n}\left(w_{ik}-\bar{w}_k\right)^2$$

Where overbars denote average of log hourly wages, k denotes a particular group and i the individuals. We run the analysis on the balanced-panel sample of full-time, full-year workers, working in the manufacturing sector.

sector technology frontier and software investment. The proximity to the firm's frontier represents the gap between the (log) productivity of a particular firm and the highest productivity (or the highest percentile productivity) in the same industry. The productivity of the firm is measured as the value added per worker such as : $Proximity_{ikt}=P^{95}\log\left(\frac{VA}{L}\right)_{kt}-\log\left(\frac{VA}{L}\right)_{ikt}$. We use the 95 order percentile in order to have a robust measure, by excluding outliers. The lower the variable, the more productive the firm is. Our main conclusions do not depend on the proxy which is chosen

9. Correspondence tables exist between CN8 classification and the CPA classification (classification of products by activity) for which each product is associated to a single activity (NACE code).

10. countries whose per capita Growth National Income (GNI) has been for at least two consecutive years above the World Bank graduation threshold ($6275).

11. We also keep employees observed during a full year and those having a full-time contract. We do not present results on the group of administrative employees because we do not have enough observations .

We find that most of the change in wages between 2002 and 2007 appears within occupations (93.22%) and skills (96.71%) [12] and the entire wage dispersion is explained by differences within industry rather than between industry (Table 3.1).

Table 3.1 – Variance analysis of log-wage change (2002-2007)

	2002		2007		Change	
Between-skill groups	288.597	[42.41]	303.113	[43.06]	3,606	[3.29]
Within-skill groups	391.948	[57.59]	400.849	[56.94]	105.923	[96.71]
Between-occupations	199.837	[26.27]	245.309	[31.15]	8.203	[6.78]
Within-occupations	560.769	[73.73]	542.242	[68.85]	112.848	[93.22]
Between industries	13.519	[1.62]	11.845	[1.35]	0.096	[0.07]
Within industries	823.553	[98.38]	864.293	[98.65]	133.761	[99.93]
Between firms	521.872	[62.37]	544.898	[62.19]	75.961	[56.75]
Within firms	314.841	[37.63]	331.239	[37.81]	57.896	[43.25]
Within-occupations : between firms	434.717	[62.50]	402.067	[61.53]	66.905	[57.41]
Within-occupations : within firms	260.869	[37.50]	251.402	[38.47]	49.631	[42.59]

Source : LIFI survey, French annual census for manufacturing (EAE), French Déclaration annuelles des donnés sociales (Panel DADS-EDP) ; period : 2002-2007.
Reading : The share of the different components of variance analysis is given in square brackets (in %).
Note : The between- and within- firm component of within-occupation inequality has been obtained by calculating the residuals of a linear regression of log-wages overs $age \times occupations$ dummies, and then calculating the within/between variance decomposition

At least two conclusions arise from results above. First, aggregate data at the industry level may not highlight the channels through which foreign direct investment would affect wages, since most of the change in wage is explained by within industry components. [13] Second, analyzing wage inequality between occupations is less relevant than analyzing wage dispersion within occupations, since 93.22% and 96.71% of the variance of wage change during the period sample is explained by within-skills and -occupations components.

Table 3.1 also highlights that between-firms component are much larger to account for the variance of log wages in 2002 and 2007, similarly to what is obtained in other countries [14]. In 2002, 62.50% of the variance of the real wage is explained by between-firms components and 37.50% is due to within-firms elements. The contribution of within-firm and between-firm component to the level of wage inequality is very close in 2007.

When looking at inequality within skill groups, the contribution of the between-firm component to the wage change between 2002 and 2007 is dominant and account for 57.41%, which is very similar to what is obtained with German data (Baumgarten (2013) and Faggio

12. We follow Baumgarten (2013) by defining skill and occupation groups as 40 age*education cells and 20 age*occupations cells. Education and occupations are described in appendix 3.C. We define five groups of age starting with one window of workers between 18 to 25 years, then 4 windows of 10 years each starting from 25 until 65 years old.

13. Some papers suggest though that looking at intra-industry effects leads to underestimate the effects of offshoring on wages : the most significant wage cuts would occur when displaced workers are forced to switch industries (Ebenstein et al. 2009; Baumgarten, Geishecker, and Görg 2013).

14. See Helpman et al. (2012) for evidence on Brazil, Baumgarten (2013) for evidence on Germany and Faggio and al. (2010) for evidence on UK.

et al. (2010)). [15].

The significant contribution of within-industry components to within-occupation wage dispersion might reflect the fact that there are relevant transmission channels such as profit bargaining, search and matching advantages, fair wages perceptions that may explain the between-firm component of wage inequality. While performance related-pay, organizational change and profit bargaining may explain the within-firm component of wage inequality [16].

Table 3.2 – Descriptive statistics : Gross hourly wages by occupations and firms

	Domestic	Importers	Exporters	Importers and exporter	Multinational with one subsidiary	Multinational with 2 to 4 subsidiaries	Multinational with more than 5
Managers							
Average hourly gross wage	27.708	29.403	26.995	31.533	30.285	31.846	32.526
standard deviations	[10.402]	[12.668]	[9.783]	[14.470]	[9.803]	[11.111]	[12.288]
observations	234	410	341	5031	751	1132	1728
Blue-collar workers							
Average hourly gross wage	12.889	13.056	12.537	13.319	13.831	13.924	14.575
standard deviations	[3.260]	[4.185]	[3.244]	[3.420]	[3.484]	[3.232]	[3.496]
observations	1700	2080	1651	21514	2571	3619	3005
Intermediate occupations							
Average hourly gross wage	17.417	18.059	16.854	18.384	18.547	18.808	19.612
standard deviations	[12.519]	[4.862]	[4.583]	[5.027]	[4.976]	[4.881]	[5.077]
observations	491	713	500	8862	1385	1850	2170
Administrative employee							
Average hourly gross wage	12.754	13.973	13.188	13.934	14.744	14.534	15.109
standard deviations	[3.083]	[4.478]	[3.193]	[3.364]	[3.663]	[3.702]	[3.833]
observations	150	189	187	1896	287	350	456

Source : LIFI survey, French annual census for manufacturing (EAE), French Déclaration annuelles des donnés sociales (Panel DADS-EDP) ; period : 2002-2007.
Robust standard error in brackets, *** p<0.01, ** p<0.5, * p<0.10.

Table 3.2 reports simple statistics on the wage of domestic, multinational and exporting firms. It depicts the mean raw wage according to firm's international status, within each group of occupation (managers, intermediate occupations, administrative employees, blue-collars). We observe that for each category, workers in multinational companies globally earn more than workers in all other types of firms : exporting, importing firms, domestics firms and those displaying only one form of internationalization (imports or exports). Mean wages also appear to increase with the number of foreign affiliates. The mean wage gap

15. In contrast, results on Brazil by Helpman et al. (2012) highlight the growth of wage inequality within sector-occupations to be almost entirely explained by wage inequality between firms. In our paper, in contrast, the within-firm component of wage inequality is not dominant but still accounts for 42.59% of the variance.

16. Globalization can be responsible for an increasing resort to individualized-pay setting, especially in the light of changes in firms' organization due to larger structure (multi-plants and multi-country firms) and a higher need of flexibility. Indeed, international competition might tend to urge firms to decentralize decision-making and to reduce the number of hierarchical levels, to favor horizontal communication channels rather than vertical channels and to increase workers' span of control (Guadalupe and Wulf (2007), Bloom et al. (2010), Caliendo et al. (2013)). It is likely that decentralization of decision, offshoring and delayering of managerial hierarchies translates in higher performance-pay since one way of encouraging workers to accept higher responsibilities and to provide full-effort in that sense is to create incentives by raising wages.

between workers in domestic firms and workers in multinational firms with at least 5 foreign subsidiaries goes from 13% for intermediate occupations and blue-collar workers to 17% for managers and 18% for administrative employees. This preliminary result highlights a wage premium for workers employed in large multinational companies compared to other workers. The following sections aims at identifying a causal impact between foreign direct investment and hourly gross wages.

4.2 The wage premium of workers in multinational firms

There is a wage premium within group of occupations, as shown by Figure 3.5 in appendix 3.C, which plots the evolution of real hourly wages of full-time, full-year workers employed in domestic and multinational firms. We distinguish four group of occupations : managers include engineers and executives ; employees include administrative employees and commercials ; intermediate occupations include administrative intermediates (accountants, technicians or foremen) ; and blue collar workers [17]. For each group of occupations we observe a wage-premium for being employed in a multinational firm during the period 2002-2007. The average wage premium might be due to a different skill-composition within multinational firms as illustrated by Figure 3.4. The figure depicts the differences in the workforce composition between multinational firms and domestic firms. For each occupation category, the share of workers with a professional college or university degree is higher among multinational firms, stressing their ability to attract the best workers [18]. Around 60% of managers have a high school diploma in multinational firms against only 40% of them in domestic firms. This trend is also observed in unskilled occupations, since blue collar workers in multinational firms are on average more qualified than the ones in domestic firms.

In order to analyze the wage-premium by controlling for firms and workers characteristics, we apply a year-specific regression to depict the mean raw wage difference between individuals employed in a multinational firm and those employed in a domestic firm. The regression is the following :

$$\ln w_{ij} = \beta_1 F_j + \beta_2 X_{ij} + u_{ijt} \tag{3.1}$$

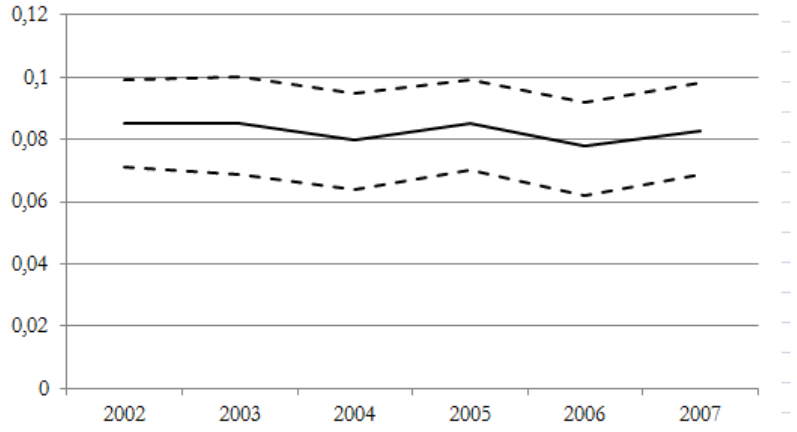
Where X_{ij} are workers and firms characteristics (age, marriage, firm's revenue, sector dummy, capital, exports, total factor productivity, imports and the constant) and F_j is a binary indicator equals to one if worker i is employed in a multinational firm and zero otherwise.

From 2002 to 2007 Figure 3.1 depicts the average wage premium for being employed in a multinational firm. The log wage premium was of around 0.08 points during the period of observation.

17. These categories are defined by INSEE and are summarized in Table 3.8 in appendix 3.C.

18. Skilled workers are defined as workers having at least 3 years of education after high-school and unskilled workers are those having less than 3 years of education after high-school.

FIGURE 3.1 – Evolution in the wage premium of multinational firms



Source : LIFI survey, French annual census for manufacturing (EAE), French Déclaration annuelles des donnés sociales (Panel DADS-EDP) ; period : 2002-2007.
Note : The figure shows the mean log-wage gap and its 95% interval associated

To gain deeper insight on wage differential between multinational and domestic firms, we apply a simple quantile regression to Mincer type equations to consider adjusted wages at different points of the wage distribution. The model used is the following [19] :

$$D_k\left(w|X_{ij}\right) = \beta_1 F_j + \beta_2 X_{ij} + u_{ijt} \tag{3.2}$$

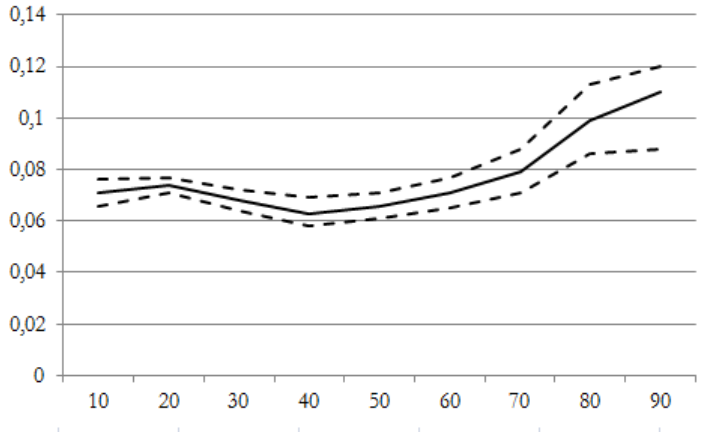
Where X_{ij} are workers and firms characteristics as detailed previously. k represents the decile's number and i and j denotes workers and firms respectively. F_j is a dummy variable equal to one if the worker is employed in a multinational firm and zero otherwise. Estimations are realized for each decile of the distribution of the conditional log hourly wage. β_2 corresponds tp the returns of the observed firm/worker characteristic at the corresponding decile. β_1 compares the k^{th} decile of the log hourly wage distribution of workers employed in multinational firms (conditional to all other variables) with the k^{th} decile of the log hourly wage distribution of workers employed in domestic firms (conditional to all other variables). We report the results for the coefficients associated with our variable of interest measuring the international status of the firm (Figure 3.2). This coefficient is always positive for each decile and is increasing along the wage distribution, suggesting that workers at the top of the distribution benefit from higher wage premium when working in a multinational firm.

Log hourly wages of *multinational-workers* are systematically higher than log hourly wage of *domestic-workers* , but those differences are higher in the upper and lower deciles of the log wage distribution, conditional on other characteristics, shaping a polarized curve. The highest wage premium corresponds to the 9th decile of the log wage distribution and equals 0.011 points, whereas the 5th and 6th decile has the lowest difference, with

19. For details on the methodology refer to appendix 3.D.

a difference of around 0.06 points. The 2nd and 3rd decile display a gap of around 0.08 points.

Figure 3.2 – Estimated FDI coefficient by quantile of wage



Source : LIFI survey, French annual census for manufacturing (EAE), French Déclaration annuelles des donnés sociales (Panel DADS-EDP) ; period : 2002-2007.
Note : The figure shows coefficients associated with the dummy variable of being employed in a MNC for 9 different hourly wage deciles. The coefficient is measured by quantile regression estimator over the pooled sample and its 95% confidence interval (dashed line).

5 The impact of outward FDI on wage dispersion within occupations

The previous section was interested in identifying the wage gap between multinational firms and domestic firms. There is a wage premium for being employed in a multinational company in each decile of the wage distribution. This section is interested in measuring the effect of within-firm outward FDI on wages for different skill groups. We pay particular attention to endogenous mobility, i.e. that worker mobility is not random conditional on observables and worker/firm fixed effects.

5.1 Methodology

Our goal is to estimate the impact of outward FDI on wages within each group of occupations. The AKM (1999) framework allows to decompose information on individual worker's wage into individual and firm heterogeneity as well as time varying firm and individual characteristics. It allows to estimate unobserved time-invariant person and firm effects. The model is as follows. Let $j(i,t)$ be a function indicating the firm at which worker i is employed at time t. The authors propose the following model for wages :

$$y_{ijt} = x_{it}\beta + x_{j(i,t)t}\tau + \theta_i + \psi_{j(i,t)} + \epsilon_{ijt} \tag{3.3}$$

Where y_{ijt} is the logarithm of real hourly gross wage of worker $i = 1, ..., N$ in firm $j = 1, ..., J$ in period $t = 1, ..., T$. θ and ψ are person and firm fixed effects respectively. Person effects are common to all of an individual's employment spells and firm effects are common to all of its employee, which can be assimilated as the firm's wage premium. We include time dummies in the vector of covariates. The heterogeneity terms θ_i and $\psi_{j(i,t)}$ are decomposed such that we are able to define observable and unobservable components $(u_i, q_{j(i,t)})$ respectively, such as

$$\theta_i = \alpha_i + u_i\eta$$
$$\psi_j = \phi_j + q_j\rho$$

One way to estimate this model is to use worker-firm specific deviations of covariates from their time average values. However, by doing so, one cannot separate the worker and firm heterogeneities. Estimating ψ and θ unobserved fixed-effects can be achieved by using least-squares dummy variable (LSDV), more precisely by adding a dummy variable for each person and firm. We can rewrite equation (3.3) to restate the model in matrix notation.

$$y = X\beta + D\theta + F\psi + \varepsilon \tag{3.4}$$

Where y is the $N^* \times 1$ vector of log hourly gross wage, X is the $N \times K$ matrix of time-varying covariates, β is a K parameter vector, D is the $N^* \times N$ design matrix of the person effects, θ is the $N \times 1$ vector of person effects, F is the $N^* \times J$ design matrix of the firm effects, ψ is the $J \times 1$ vector of firm effects and ϵ is the $N^* \times 1$ error vector. [20]

A key condition for equation 3.3 to give consistent estimate is that residual ϵ_{it} are orthogonal to time-varying individual characteristics, firm and person effects, that is

$$E\left[\varepsilon_{it}|x_{it}, x_{j(i,t)t}, u_i, q_{j(i,t)}, \alpha_i, \phi_{j(i,t)}, \mu_t\right] = 0$$

This condition implies that the unobserved component of wages does not predict worker's mobility decisions. This condition is violated when the work-firm assignment is not random, i.e when unobservable characteristics of the match between worker i and firm j are correlated with the explanatory variable, such that workers' mobility is endogenous. This hypothesis of job assignment based on unobservables has been explored theoretically. Helpman et al. (2008) assume heterogeneous firms and heterogeneous workers in their unobserved productivity. They show that the most productive workers are employed in the most productive firms and receive higher wages. Egger et Kreickemeier (2009) build a model in which workers have a bargaining power and prefer being employed in more productive firms because they pay higher wages.

20. Our datasets contains $N^* = 129,552$ observations, $N = 36,064$ employees and $j = 10,691$ firms and $K = 14$ regressors. See Appendix 3.B to estimate F with a high-dimension matrix.

The problematic issue of endogenous assignment of workers to firm can be tackled by adding worker-firm match fixed effect in equation (3.3) as in Woodcock (2007). The match effect model account for the fact that workers mobility can be endogenous since unobserved ability can cause the match between high productive workers and high productive firms. The empirical specification is similar to equation (3.3) where a term ϕ_{ij} is added and represent the returns to unobserved time-invariant characteristics of worker-firm matches, such as :

$$y_{ijt} = x_{it}\beta + x_{j(i,t)t}\tau + \theta_i + \psi_{j(i,t)} + \phi_{ij} + \epsilon_{ijt} \tag{3.5}$$

Identifying workers, firms and match effect is cumbersome, especially because differentiating by workers does not allow to give the same result as LSDV. To circumvent this problem, Woodcock (2007) estimates a mixed model specifications that rely on firm, person and match effects being orthogonal. We therefore decide to adopt Krishna et al. (2011) technique by time-demeaning covariates over the match firm-worker combination in order to compare results of the worker-firm model with the one of the match effect model. The inclusion of these effects obviates the need to separate firm and workers fixed effects, but does not allow to identify firm, workers and match heterogeneity.

If one assumes strict exogeneity assumption, estimators β, γ, ψ and ϕ are unbiased, but there still might be endogeneity bias due to reverse causality or omitted variables. Indeed, our results could be biased if the decision of engaging in outward FDI is jointly determined with wage settings, or if unobserved variables affect simultaneously outward FDI and wage determination. Following Baumgarten et al. (2013), we test the exogeneity of our FDI measure by using a methodology inspired by Blundell and Bond (2000), which consists in using lagged values as instruments. Table 3.14 in Appendix 3.E reports the results of relevant post-estimation tests when we use the lagged values of the number of FDIs as instruments (with a lag of one and two years). The Hansen-J stats indicates that our instruments are orthogonal to the error term. Orthogonality conditions are not sufficient for an instrument to be good, it also needs to be correlated with included endogenous variable. The *rk* and F-test of joint significance of instruments in the first-stage regression reveal that our instruments are sufficiently strong.

However, we are unable to reject the exogeneity assumption and the variable *FDI* may not be treated as endogenous. The use of two instruments yields the loss of two observations per individual. We have checked the robustness of this result when using one-year lagged value as an instrument and obtain similar statistics. However, we prefer to report statistics with two instruments, since it allows to check instruments' validity.

5.2 Results

We estimate various specification of equations (3.3) and (3.5) for different occupation groupings and tasks. We test the robustness of our result, by using different proxies of firms' outward FDI.

5.2.1 Results on occupations

Table 3.3 displays estimation results from equation (3.3). We control for unobserved worker heterogeneity in the form of individual fixed effects. Workers' fixed effects are collinear with education and gender variables, so these variables cannot be included in the model. Similarly, the age and tenure effects are absorbed by the time dummies, hence age squared is the only individual-level variable that can be included when controlling for unobservable and time invariant individual characteristics. We add time varying individual characteristics such as the number of children and a dummy indicating if the worker is married. We also control for unobserved firm heterogeneity in the form of fixed effects, and add firm's time-varying characteristics (sales, capital, total factor productivity, exports, imports), as described in the previous section [21].

We are interested in the impact of outward FDI on domestic wages within occupations. We divide our sample into three main occupations : managers (column (3) and (4)), blue collar workers (column (5) and (6)) and intermediate occupations (column (7) and (8)). We run the regression separately for each occupation, since each regressor might have a differentiated impact on wages depending on the type of occupation.

The first two columns of table 3.3 show the results for the whole sample. The first column presents results for the match effect model which controls for endogeneous mobility and the second column reports the results for the person-firm fixed effect model.

We first look at the coefficients of controls. Hourly wages appear to decrease when workers get maried. This result is mainly driven by blue collar workers and managers (column (3) and (5)). These results might reflect either a lower propensity of workers to consent great efforts for their careers the year of their marriage, or a lower propensity of employers to give them additional responsibilities this particular year. Changes in the number of children are not found to affect hourly wages. The age-squared variable has also a negative and significant coefficient, reflecting a decreasing impact of age on wages for the oldest workers.

21. One should note that we have also tested our regressions with a dummy for foreign-owned firms (see results in table 3.12). The most productive firms within an industry tend to be the targets of foreign acquisitions (Blonigen et al. (2012), Arnold and Javorcick (2009)). Hence, the non-inclusion of firm nationality would result in an endogeneity problem, since the most productive firms also pay higher wages. Yet, our main conclusions regarding the effect of outward FDI remain unchanged. We still prefer results without the inclusion of a firm's nationality, since collinearity problems with firm fixed effect might arise. Only 123 observations have changed nationality in the group of intermediate occupations, 73 in the group of managers and 256 in the group of blue-collar workers.

Looking at firms' controls, hourly wages increase with firm's productivity, especially for blue-collar workers [22]. Increasing tangible assets has a positive and significant effect on blue collars' wages : these workers might need to develop new skills when their company invests in new machines and tools and this might improve their bargaining power in wage negociations. The coefficient associated with the level of exports is also highly significant, and this result is obtained in each sub-sample, highlighting a wage-premium associated with exports. This result is in line with those obtained in Hummels et al. (2011) and Carluccio et al. (2014), which show a positive effect of exports within job-spell for all skill-types. Reversely, imports are not found to affect domestic wages, whether we consider imports of intermediates or imports of finished goods.

Our variable of interest is the measure of outward FDI. In our base regression, we account for outward FDI with the number of foreign affiliates. This variable has a positive and significant effect on wages, but only when we restrict the sample to managers. Considering the number of countries where the firm owns foreign affiliates, instead of the number of foreign affiliates, provides similar results (Table 3.11). As argued above, the positive effect of outward FDI on managers' wages might reflect several mechanisms. First, the creation of affiliates abroad might come with greater responsibilities for managers in the parent company, such as supervising and monitoring new entities or managing cultural and linguistic differences. These additional skills and responsibilities might translate into higher wages. Second, managers might be in a better position than other employees to capture productivity gains associated with outward FDI.

One way of identifying the productivity effect of outward FDI is to drop controls for firms' productivity in the regression and to compare the results with our actual regression. We observe that the coefficient associated with the number of FDIs increases when we drop controls for productivity, meaning that this variable captures the productivity effect of outward FDI in our base regression (see Table 3.13 in Appendix 3.E). This confirms that outward FDI affects productivity and it is possible that only managers are able to capture these productivity gains if there are information asymmetries in the wage bargaining process.

We test for a differentiated impact of outward FDI depending on the level of technology inside the industry [23]. We observe that for managers, the coefficient associated with outward FDI is nearly seven times higher when we restrict the sample to high-technology industries. Blue-collars in high-technology industries also experience a positive effect of outward FDI, while we do not observe this effect for low-technology industries.

The choice to make a foreign direct investment in high-technology intensive industry may be related to the will to maintain an ownership advantage. Firms can then transfer

22. One should note that we have used several other proxies for technological change at the firm level, such as proximity with the firm's technological frontier, investment in R&D or value added per worker. Main conclusions remain unchanged.

23. Details about the division of low-tech and high-tech industries are given in appendix 3.E.

high-technology intensive production in the foreign subsidiary without fear of technology leakages. The transfer of firm's specific technology in foreign units may increase the wage paid to some workers at home, in particular those whose competences complement the ones in the foreign subsidiary. This idea is related to the skill-biased technological change that increase the wage premium of skilled workers. Transfer of technology-intensive production may increase the wage paid to workers, whose jobs require technology and communication skills. This assumption has been validated in the United States, to explain the role of technological progress on the evolution of wage inequality (Acemoglu and Autor (2011), Goos and Manning (2007), Firpo et al. (2011) Autor et al. (2006), Autor and Handel (2013)).

We now investigate whether the positive effect of outward FDI on domestic wages is driven by the extensive margin of outward FDI (meaning domestic firms which decide to go multinational) or by the intensive margin (multinationals which change their number of foreign affiliates). In order to focus on the impact of outward FDI at the extensive margin, we change our FDI measure and use a dummy indicating if the firm has foreign affiliates or not (rather than the number of foreign affiliates). Results in table 3.15 in Appendix 3.E suggest that the effect of outward FDI at the extensive margin is low : managers experience a wage increase when their firm goes multinational, but the magnitude of the effect is smaller than in the base regression.

We now look at the effect at the intensive margin by restricting the sample to employees which always belong to a multinational firm during the whole period (measuring outward FDI with the number of foreign affiliales, as in the base regression). This time, results are very similar to results in our base regression (see table 3.15), which confirms that the effect of outward FDI is mostly driven by the intensive margin. In order to check whether our results are driven by some large multinationals which open affiliates overseas, we run our base regression on the sample restricting to firms with less than five foreign affiliates : the coefficient associated with the number of foreign affiliates is found non-significant (see Table 3.16 in appendix 3.E), suggesting that the positive effect of outward FDI on domestic wages only becomes visible in very large multinational corporations.

As argued in introduction, the nature of the underlying mechanisms should differ according to the nature of FDI (vertical *versus* horizontal). This is why we now distinguish the number of foreign affiliates according to their location : low income countries or high income countries [24]. We notice that the positive effect of outward FDI on manager's wage is mainly driven by FDI in low income countries (see Table 3.4). One potential explanation is that emerging economies offer greater growth prospects and/or constitute ideal locations for offshoring. Therefore, investments in low-income countries might allow managers to bargain on higher profits. Another explanation could be that managing affiliates

24. High income countries are composed by EU-15 countries and Norway, Japan, Switzerland, the United States, Australia, Canada, New Zealand, Liechtenstein, Monaco, Gibraltar, Iceland, Alaska and Andorra, while other countries are considered as low-income countries .

Table 3.3 – Person and firm effect model and match effect model

	All		Managers		Blue-collar workers		Intermediate Occupations	
	Match	Person/Firm	Match	Person/Firm	Match	Person/Firm	Match	Person/Firm
Number of children	-0.000	0.001	-0.001	0.003	0.003	0.003	-0.005	-0.005
	[0.003]	[0.003]	[0.007]	[0.004]	[0.004]	[0.004]	[0.004]	[0.006]
Marriage	-0.006	-0.002	-0.034**	0.012	0.013	0.012	-0.017**	-0.018**
	[0.006]	[0.006]	[0.016]	[0.009]	[0.009]	[0.009]	[0.009]	[0.009]
Number of FDI abroad	0.025	0.020	0.085**	0.078**	-0.004	-0.004	0.007	0.001
	[0.017]	[0.018]	[0.034]	[0.034]	[0.034]	[0.034]	[0.026]	[0.001]
Subsidiaries in France	0.026	0.000	-0.028	-0.000	0.072	0.001	0.002	0.001
	[0.037]	[0.000]	[0.072]	[0.001]	[0.075]	[0.001]	[0.057]	[0.001]
Revenue	0.001*	0.001**	0.001	0.001	0.002*	0.002*	0.002***	0.002**
	[0.001]	[0.001]	[0.001]	[0.001]	[0.001]	[0.001]	[0.001]	[0.001]
Capital	0.001**	0.001**	-0.000	-0.000	0.003**	0.003**	0.001	0.001
	[0.001]	[0.001]	[0.002]	[0.002]	[0.001]	[0.001]	[0.001]	[0.001]
TFP	0.000*	0.000	-0.000	-0.000	0.000*	0.000	-0.000	-0.000
	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]
Imports of II	-0.000	-0.000	-0.000	-0.000	-0.000	-0.000	-0.001	-0.001
	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.001]	[0.001]
Imports of FG	0.000	0.000	0.000	0.000	-0.000	-0.000	0.001***	0.001***
	[0.000]	[0.000]	[0.001]	[0.001]	[0.001]	[0.001]	[0.000]	[0.000]
Computer use	0.057***	0.070***	0.027	0.028	0.007	0.007	-0.039	-0.031
	[0.007]	[0.010]	[0.064]	[0.064]	[0.045]	[0.047]	[0.031]	[0.037]
Age-squared	-0.047***	-0.047***	-0.063***	-0.063***	-0.040***	-0.040***	-0.049***	-0.049***
	[0.002]	[0.002]	[0.005]	[0.007]	[0.003]	[0.003]	[0.003]	[0.004]
Exports	0.028***	0.027***	-0.005	-0.003	0.047***	0.046***	0.015**	0.015**
	[0.005]	[0.005]	[0.014]	[0.014]	[0.009]	[0.009]	[0.007]	[0.007]
Constant	3.788***	3.501***	4.400***	4.772***	3.177***	3.400***	3.970***	3.679***
	[0.037]	[0.050]	[0.106]	[0.153]	[0.045]	[0.056]	[0.066]	[0.091]
Observations	51,839	51,839	9,144	9,144	23,867	23,867	15,223	15,223
R-squared	0.106	0.106	0.120	0.120	0.076	0.076	0.131	0.131
Log Likelihood	55181.771	55181.771	9224.494	9224.494	25716.955	25716.955	18778.636	18778.636

Source : LIFI survey, French annual census for manufacturing (EAE), French Déclaration annuelles des donnés sociales (Panel DADS-EDP) ; period : 2002-2007. Fixed effect model with year, individual and firms fixed effects. Robust standard error in brackets, *** p<0.01, ** p<0.5, * p<0.10.

in low-income countries is more demanding (necessity of implementing new technologies or new managerial methods in the affiliate) and implies more complex tasks.

Table 3.4 – Person and firm effect model : discrimination on offshoring destination

	All	Managers	Blue-collar workers	Intermediate Occupations
Number of children	-0.000	-0.001	0.003	-0.005
	[0.003]	[0.007]	[0.004]	[0.004]
Marriage	-0.006	-0.033**	0.013	-0.017**
	[0.006]	[0.016]	[0.009]	[0.009]
Number of FDI to LI	0.028	0.210**	-0.084	0.019
	[0.044]	[0.091]	[0.090]	[0.066]
Number of FDI to HI	0.023	0.004	0.043	-0.001
	[0.030]	[0.065]	[0.059]	[0.047]
Subsidiaries in France	0.026	-0.058	0.088	-0.001
	[0.038]	[0.075]	[0.077]	[0.060]
Revenue	0.001*	0.001	0.002*	0.002***
	[0.001]	[0.001]	[0.001]	[0.001]
Capital	0.001**	-0.000	0.003**	0.001
	[0.001]	[0.002]	[0.001]	[0.001]
TFP	0.000*	-0.000	0.000*	-0.000
	[0.000]	[0.000]	[0.000]	[0.000]
Imports of II	-0.000	-0.000	-0.000	-0.001
	[0.000]	[0.000]	[0.000]	[0.001]
Imports of FG	0.000	-0.000	-0.000	0.001***
	[0.000]	[0.001]	[0.001]	[0.000]
Computer use	0.057***	0.027	0.007	-0.038
	[0.007]	[0.064]	[0.045]	[0.031]
Age-squared	-0.047***	-0.063***	-0.040***	-0.049***
	[0.002]	[0.005]	[0.003]	[0.003]
Exports	0.028***	-0.006	0.047***	0.015**
	[0.005]	[0.014]	[0.009]	[0.007]
Constant	3.788***	4.401***	3.177***	3.970***
	[0.037]	[0.106]	[0.045]	[0.066]
Observations	51,839	9,144	23,867	15,223
R-squared	0.106	0.120	0.076	0.131
Log Likelihood	55181.774	9225.946	25717.572	18778.665

Source : LIFI survey, French annual census for manufacturing (EAE), French Déclaration annuelles des donnés sociales (Panel DADS-EDP) ; period : 2002-2007. Fixed effect model with year, individual and firms fixed effects. Robust standard error in brackets, *** p<0.01, ** p<0.5, * p<0.10.

5.2.2 Task decomposition

Several studies have underlined a non-monotonous wage change along the wage distribution (Autor, Levy and Murnane (2003), Oldenski (2012)). Skilled workers and unskilled workers are no longer considered as two homogeneous groups who have suffered the same impact following the adoption of new technologies or intensification of world trade. Job content of occupations becomes a central component to analyze the labor market with a new eye. This section takes part to this question empirically by analyzing the wage effect of offshoring depending on the tasks carried out by workers.

Different criteria have been used to define offshorable task. According to Autor, Levy and Murnane (2003) (ALM hereafter), the degree to which one task is codified determines

its potential of relocation. The more a task is determined by specific rules, the less it relies on tacit knowledge and the easier it is to explain this task to someone else and to control it. According to Blinder and Krueger (2007,2009), the offshorability of a task depends on its potential to be realized in another location without loss of quality and also on the importance of face-to-face interactions with people other than fellow workers.

We build a task index derived from a French survey on working conditions as detailed in section 3.1. The higher the index is, the more the workers perform routine tasks and the easier it is to relocate the occupation [25].

The offshorability indexes are included in an interactive way [26], such that the effect of offshoring on wages depends on the value of the offshorability index. Equation (3.3) can include the interactive term as follows :

$$\begin{aligned} y_{ijt} = x_{it}\beta_1 + Offshorability_{it}\beta_2 + FDI_{j(i,t)t}\gamma_2 + x_{j(i,t)t}\gamma_1 + \\ (Offshorability_{it} \times FDI_{j(i,t)t})\beta_3 + \theta_i + \psi_{j(i,t)} + \epsilon_{ijt} \end{aligned} \tag{3.6}$$

The regression coefficients $Offshorability$ and FDI are a conditional relationship, i.e. they reflect the change of one coefficient when the other is set to zero. Studies often center variables in order to make the results more interpretable, by comparing the effect of one variable compared to the average level of the other. The index varies between zero and one. A value of one represents a routine-intensive occupation while a value of zero represents an interactive- and analytic-intensive occupation. We thus center our offshorability index by using individual specific-means [27]. When centering, the value of zero represents an occupation in which routine and non-routine tasks are performed with roughly the same intensity.

Table 3.5 presents the results for the whole sample. The positive and significant coefficient associated with outward FDI suggests that workers having an offshorability score of zero experience a significant wage increase while their employer increases the number of foreign affiliates. The negative and significant coefficient associated with the offshorability index is consistent with the intuition that the more workers perform offshorable tasks, the lower their wages are. The coefficient associated with the interaction term is significantly negative : the more a worker performs offshorable tasks, the more negative the effect on wages of increasing outward FDI.

When we split the results between FDI in low-income countries and high-income country, the interaction term associated with FDI in low-income countries turns out to be

25. We have also run the regression based on an index developed from the ONET databases. The results are very similar when using one or the other index. Details of the results are given in appendix 3.F.

26. The offshorability index is constant if a worker does not change occupation. However, the classification PCS-ESE is sufficiently detailed to have 41.5% of workers that change occupations and thus change offshorability index.

27. Ozer-Balli and Sorensen (2010) show that centering in panel data should be subtracted to the interaction term by using individual specific-means and not the average across all observations.

significant. Outward FDI in low-income countries is more likely to correspond to offshoring, which is more damaging for manual-intensive workers. This result is consistent with evidence that workers in routine occupations experience larger wage cuts when their industry increases offshoring (Hummels et al. 2011).

Table 3.5 – Person and firm effect model : Task offshorability index

	(1)	(2)
FDI	0.185***	
	[0.059]	
FDI to LI countries		-0.000
		[0.000]
FDI to HI countries		0.000
		[0.000]
FDI*Offshorability	-0.340***	
	[0.127]	
FDI LI*Offshorability		-0.008*
		[0.004]
FDI HI*Offshorability		-0.000
		[0.003]
Offshorability index	-0.096***	-0.095***
	[0.031]	[0.031]
Subsidiaries in France	-0.000	-0.000
	[0.000]	[0.000]
Revenue	0.001**	0.001**
	[0.001]	[0.001]
Capital	0.001**	0.001**
	[0.001]	[0.001]
Total factor productivity	0.000	0.000
	[0.000]	[0.000]
Imports of intermediate inputs	-0.001	-0.001
	[0.001]	[0.001]
Imports of finished goods	0.000	0.000
	[0.000]	[0.000]
Computer use	0.032**	0.032**
	[0.014]	[0.014]
Age squarred	-0.046***	-0.046***
	[0.002]	[0.002]
Exports	0.026***	0.026***
	[0.005]	[0.005]
Number of children	-0.003	-0.003
	[0.006]	[0.006]
Marriage	0.001	0.001
	[0.006]	[0.006]
Constant	3.845***	3.844***
	[0.044]	[0.044]
Observations	48,234	48,234
R-squared	0.104	0.104
Log Likelihood	51336.803	51335.853

Source : LIFI survey, French annual census for manufacturing (EAE), French Déclaration annuelles des donnés sociales (Panel DADS-EDP) ; period : 2002-2007.
Robust standard error in brackets, *** p<0.01, ** p<0.5, * p<0.10.

We test the robustness of our results by using an index derived from the ONET database. We follow the same methodology as described in Chapter 2 to classify work activity into five main categories : non-routine manual, routine manual, routine cognitive, non-routine interactive, non-routine analytic.

In order to obtain task-based measure of offshorability, we employ Wright (2010) stra-

tegy that takes into account the two criteria described by Blinder and Krueger (2007, 2009) and ALM (2003). We take the average of only three tasks category as detailed in Chapter 2 : manual, interactive and analytic tasks, such that :

$$i = \frac{\text{Routine Manual} - (\text{Interactive} + \text{Analytic})}{3}$$

The more manual a task is, the more it can be performed by workers abroad in foreign subsidiaries. Conversely, the more it requires physical interaction and analytical competences, the less easy is to relocate it. Since offshorability is decreasing in interactivity and analytic tasks but increasing in routine-manual tasks, most offshorable tasks are associated with high values of i.

Summing up the three tasks measures results in having an offshorability index that varies between -0.55 and 0.18. A value of -0.55 reflects individuals performing intensively interactive and analytical tasks and weakly performing manual tasks. On the contrary, individuals with an offshorability score of 0.18 are manual-intensive workers. We therefore do not center the offshorability index, in order to have a value of zero that reflects the case where a worker performs routine and non-routine tasks with the same intensity.

Results are reported in Table 3.18 in appendix. The negative and significant coefficient associated with offshorability index in the first column shows that workers performing more manual tasks are less rewarded than those performing more interactive and analytical tasks.

The first column of table 3.18 shows a non significant results associated to the interaction term even though the sign is negative. When we split the results into FDI in low-income countries and high-income country, the interaction term associated with FDI in low-income countries turns out to be significant. FDI in low-income country is more likely to correspond to vertical FDI, which is more damaging for manual-intensive workers.

6 Identification of the source of wage inequality

This section is interested in identifying the sources of the wage premium of multinational companies. In a first step, we aim at determining whether the wage premium is associated with differences in observable characteristics or whether it is associated with differences in the returns to these characteristics. We use a variant of the Blinder (1973) and Oaxaca (1973) method (OB method) to decompose mean differences in log wages between two groups of workers : those employed in a domestic firm (group d) and those employed in a multinational firm (group m). The traditional well known OB method decomposes the difference in the linear prediction at the group-specific means of the regressors into two components : a component of the wage differential attributable to group differences in the predictors and a second component attributable to unobservables, i.e. the contribution of

differences in the coefficients [28].

In a second step, we apply the methodology developed by Abowd, Kramarz Margolis (1999) (AKM, henceforth) to decompose individual wages into a component due to observable, time-varying worker and firm characteristics, a component due to unobservable worker characteristics ("worker effects") and a component due to firm-level, unobservable characteristics ("firm effects").

Indeed, there are two sets of explanation justifying the wage premium of multinational firms. On the one hand, multinational firms may be able to create higher surplus than domestic firms, which gives stronger opportunities of bargaining over the firm's profit, and thus some workers might benefit from higher rents, independently from the workers' characteristics. On the other hand, international firms may be able to screen workers with higher unobserved (to the econometrician) skills. Thus some firms may pay higher wages due to higher (unobserved) skill-composition.

6.1 Blinder-Oaxaca results

It is well established that multinational firms pay higher average wages than domestic firms in the same industry. However, it is not clear whether the multinational status *per se* explains the average wage differences between the two types of firms. We use the OB methodology to provide a detailed decomposition of the domestic/multinational workers' earnings differential and to identify the contribution of some characteristics in explaining the wage gap.

We analyze the wage regression results for the standard specification that includes a domestic firm dummy, and treat multinational firms as the omitted category. We run the analysis on the balanced panel data by excluding foreign owned firms [29].

Our explanatory variables are worker's characteristics, such as sex, age, diploma dummies, [30] marriage, number of children. We also control for firm's time-varying characteristics such as, the skill composition of the firm, the industry, the value of exports (in million €), the share of imports of intermediate inputs and finish goods over total sales, revenue

28. Details of the Blinder-Oaxaca methodology is given in appendix 3.E.2.

29. The hausman test reports significant differences between the balanced panel model and the unbalanced model, we therefore decide to report the results on the balanced model. However, in both case our principal conclusions are not altered. Furthermore, we do not include a dummy variable associated with the group nationality, as reported in Table 3.12, because there is not enough variance to estimate this variable in the two groups. To avoid capturing wages differences due to foreign-owned firms, we only focus on French groups. However, results without restricting it to french group gives very similar conclusions.

30. The assignment of the explained part of the wage gap to categorical variables is not invariant to the choice of the left-out category (Fortin (2006) Gardeazabal and Ugidos (2004) and Yun (2005)). To circumvent this problem, we follow Fortin (2006), by imposing a zero-sum restriction on the estimated coefficients of each categorical variable, where we impose $\sum_{j=1}^{k} \beta_j = 0$, where k is the number of categories for variable j, which can be implemented by restricted least squares. The shortcoming of this method is that it leaves the estimation of dichotomous variables without a simple meaningful interpretation (Fortin et al. (2010)). In our case, it is not a problematic issue, since we are not interested in the coefficients associated with the workers' and firms' characteristics.

(million K €), capital (in million €) and the firm's total factor productivity as detailed in section 3.1 [31].

Table 3.6 – Contribution of explained and unexplained component of the raw-wage gap

	All	Blue collars	Managers	Intermediate
Average log-wage of Multinational-workers	2.876***	2.656***	3.425***	2.925***
	[0.004]	[0.004]	[0.006]	[0.005]
Average log-wage of Domestic-workers	2.672***	2.548***	3.290***	2.830***
	[0.003]	[0.003]	[0.007]	[0.004]
Raw log-wage gap	0.205***	0.108***	0.135***	0.095***
	[0.005]	[0.005]	[0.010]	[0.006]
Differences in returns to characteristics	0.019***	0.021***	0.077***	0.012*
	[0.005]	[0.005]	[0.011]	[0.007]
Differences in characteristics	0.186***	0.087***	0.058***	0.082***
	[0.004]	[0.004]	[0.009]	[0.005]
Advantage of Multinational-workers	0.010	0.010	0.037	0.06
Disadvantage of Domestic-workers	0.010	0.010	0.037	0.06

Source : LIFI survey, French annual census for manufacturing (EAE), French Déclaration annuelles des donnés sociales (Panel DADS-EDP) ; period : 2002-2007.
Robust standard error in brackets, *** p<0.01, ** p<0.5, * p<0.10.

The raw log wage gaps are presented in Table 3.6. Column (1) reports results for the all sample, column (2) for the sample of blue collar workers, column (3) for the sample of managers and column (4) for the sample of intermediate occupations. Table 3.6 reports the decomposition output attributable to differences in endowments and difference in coefficient. It shows that the mean of log-hourly wages for workers employed in multinational firms is 2.876 and 2.672 euros for workers employed in domestic firms. The raw log-wage gap (0.205) is presented in the third raw. About 90% of the log-wages differences between the two groups of workers is attributable to differences in characteristics in the whole sample, meaning that *domestic workers* would have a 0.186 log wage increase if they had the same characteristics as *multinational workers*. On the contrary, differences in endowments account for 10% of the wage gap, meaning that *domestic workers* would have a mean increase of 0.019 log points if they had the same coefficient (return to characteristics) as multinational workers.

The contribution of the endowment and coefficient effect is not the same in each group of occupations. When splitting our results by defining three groups of workers according to their occupations (managers, blue-collar workers and intermediate occupations mainly composed of foremen and technicians), the unobserved (positive) discrimination of being employed in a multinational firm is 0.021 log-points in the sample of blue collar workers and 0.077 log-points in the sample of managers [32]. Contrary to what is observed in blue-collar occupations, return to characteristics, i.e. differences attributed to unobserved part of the

31. We have run several collinearity diagnostics between imports of intermediate inputs and foreign direct investment and between revenue, capital and TFP but there seems to be no multicollinearity problem in our estimations. Moreover, we do not include the variable measuring the use of computer at the worker levels since it is highly collinear to the skill-composition of the firm in the whole sample.

32. These coefficients are compatible with the coefficient associated with the dummy describing the international status of the firm (multinational or domestic firm) as defined in equation 3.9.

wage difference, account for a larger share of the wage gap in the sample of managers. Conversely, the unexplained part of the wage gap in the two groups of blue-collar workers is relatively small which highlights the strong effect of workers and firms characteristics in explaining the raw log wage gap. This indicates that return to characteristics is very different in each group of occupations. The wage differences due to return to characteristics is particularly important in the sample of managers which reflects the important role of unobserved components in explaining wage differences between managers employed in a multinational firm and managers employed a domestic firm.

The following subsection aims at identifying the source of the unobserved components of the wage premium : rent-sharing or skill-composition.

6.2 Decomposing wages into skill-composition and rent-sharing effects

In this section, we estimate the firm and the worker fixed effects as described in equation (3.3). Prior to estimation, we identify group of "connected" workers and firms. The pattern of worker mobility between firms is important because it determines whether person and firms effects can be identified [33].

One crucial concern when attempting to estimate the fixed effects is that workers' mobility decisions are independent of ϵ_{it}. If it is not the case, the firm/worker match is not random conditional on observables and time-invariant unobservables. Several authors, including Card et al.(2012), Davidson et al. (2014), Macis and Schivardi (2014) find that including match (workers-firms) fixed effects gives little insight with respect to the original formulation of AKM (1999). Adding a match specific component yields only a small improvement in the fit of the model.

We follow Card et al. (2012) to test the separability assumption in the AKM model. We find coefficients, overall R-squared and Root MSE to be very similar in the match effect and AKM model, giving high confidence that the AKM assumption is roughly met (see Table 3.3).

We follow Macis and Shivardi in identifying the rent sharing and skill-composition effects. We define a skill composition (SC) term as the average worker effect at the firm-year level such as $SC_{jt} = \frac{1}{n_{jt}} \sum_i d_{ijt}\theta_{it}$ (d_{ij} is a dummy equal to 1 if the worker i is in firm j at date t and n_{ij} is the total number of workers in firm j at date t), and a rent sharing effect as the firm-year effect such that $RS_{jt} = \psi_{jt}$. The firm fixed effect can be seen as a wage premium paid to all employees in the firm whatever their characteristics and the worker fixed effect can be seen as workers' specific abilities whatever the firm fixed effect.

Table 3.7 reports the relationship between foreign direct investments and SC and RS. The OLS results reported in columns (1) and (3) indicate that the coefficient on FDI is

33. Firm dummies are not different from any multicategory dummy, therefore, as long as workers can move from one firm to another over time, the firm dummy can be identified. Then, the person fixed effect $\hat{\theta}$ can be recovered as follows : $\hat{\theta}_i = \bar{y}_i - \bar{x}_i\hat{\beta} - \bar{x}_{j(i)}\hat{\gamma}$.

positive and significant. However, as in Frias et al. (2012) and Macis and Schivardi (2014) the coefficient associated to FDI in the estimation of rent sharing is twice the size than that of the estimation of skill-composition. This finding is also observed in the fixed effects (FE) specifications in columns (2) and (4), but the size of the coefficient in column (4) is reduced compared to estimations without fixed effects. The results indicate that the increase of outward foreign direct investment causes wages to be higher, and this effect is due to both multinational companies paying a wage premium and to changes in the market value of workers' unobservable skills.

Table 3.7 – FDI and wage component of inequality

	Skill-composition		Rent sharing	
	(1)	(2)	(3)	(4)
	OLS	FE	OLS	FE
FDI	0.088***	0.035***	0.144***	0.048***
	[0.018]	[0.012]	[0.008]	[0.004]
Observation	51,353	51,353	51,324	51,324
R-squared	0.392	0.0276	0.0958	0.125

Note : OLS denotes Ordinary Least Squares and FE represents a firm fixed effects specification in column (2) and a worker fixed effects specification in column (4). We add all other time-varying firms and workers characteristics as described in previous tables.

7 Conclusion

This article analyzes the effect of outward FDI on hourly wages within occupations, using panel data on French firms for the years 2002-2007. We use a rich French firm-level panel data with matched information on workers' characteristics. We first analyze the evolution of wage dispersion during the period 2002-2007. In line, with recent literature, we observe that most of the variance took place within occupations. This wage dispersion is mainly due to firm heterogeneity and to a lesser extent to wage dispersion within firms. Our paper focuses on the contribution of firm heterogeneity and more precisely on the role of outward FDI in explaining wage inequality within occupations.

We find evidence of a *multinational* wage premium within each skill groups, regardless of observable firm and individuals' characteristics. We isolate the impact of outward FDI on wage dispersion within occupations, using the framework developed by AKM (1999), in order to control for firm and person fixed effects. The study reveals that outward FDI in low-income countries, which is a proxy for intra-firm offshoring, has a significant and positive impact on managers' wages. Reversely, outward FDI decreases the wage of workers whose tasks are more easily offshorable. These results are robust to several firms' and individuals' controls. The positive effect of outward FDI on managers' wages might come from their greater ability to capture their firm's productivity gains, or might be the counterpart of greater responsabilities (consisting in monitoring foreign affiliates for

example). The negative effect of outward FDI on offshorable tasks is consistent with the existence of subsituability between low-skilled workers performing offshorable tasks and workers in foreign affiliates.

Our data does not allow us to identify precisely the channels through which outward FDI acts on domestic wages, especially in the case of managers. First, outward FDI might push multinational firms to increase workers' range of skills as well as their span of control and/or workload. Individualized wage settings can be a good answer to create incentives for workers to provide full effort in the decentralization process (Lemieux (2009)). Second, managers might prove to be more effective in bargaining over their employer's profits. They might consider themselves as great contributors to the success of foreign affiliates and might claim greater wage expectations compared to other workers in the firm. Finally, increased competition might push multinational firms to adopt new technologies. Following Nelson and Phelps (1966) view on human capital, skilled workers might adapt more quickly to changes in the organization of the firm and to the adoption of defensive technology. Since these changes may require additional training and efforts, skilled-workers may be rewarded for it.

In the last section, we try to identify the relative importance of skill-composition and rent sharing effects to explain the effect of foreign direct investments on wages. The results indicate that the increase of outward foreign direct investment cause wages to be higher, and this effect is due to both multinational companies paying a wage premium and to changes in the market value of workers' unobservable skills.

Appendix

3.A Task measure

We build a routinization index derived from the French survey on working conditions, produced by the French Direction de l'Animation de la Recherche, des Etudes et des Statistiques (DARES) for the year 2005. The inquiry is realized every 7 years on a sample of 19,000 workers.

We build an index derived from 9 questions on job characteristics :
Do you directly interact with a public (always=1 ; often=2 ; sometimes=3 ; never=4)

Is your job imposed by the automatic movement of a machine ? (No=1 ; Yes=2)

Is your job imposed by the automatic movement of a product ? (No=1 ; Yes=2)

Are you an assembly-line production worker ? (No=1 ; Yes=2)

Does your job consist in repeating a series of gesture or operation ? (No=1 ; Yes=2)

Does your job involve monotonous tasks ? (Never=1 ; sometimes=2 ; often=3 ; always=4)

Does your job involve complex tasks ? (Always=1 ; often=2 ; sometimes=3 ; never=4)

Does your job involve you to read documents ? (Most of the time=1 ; half of the time=2 ; one quarter of the time=3 ; less than one quarter of the time=4 ; never=5)

Does your job involve you to write documents ? (Most of the time=1 ; half of the time=2 ; one quarter of the time=3 ; less than one quarter of the time=4 ; never=5)

For each respondent we build a routine index as the sum of the value attributed to each answer. The higher the index, the more the worker performs routine tasks. We then normalize the index by the maximum and minimum of every occupation, such that the index vary between zero and one across occupations. We map the index to occupations by measuring the average task index in a given PCS-ESE 4-digit occupation ; Such that $\frac{1}{n_{io}} \sum_i d_{io}$ where d_{io} is the sum of the values attributed to the nine questions and n_{io} is the total number of workers i in a particular occupation o.

Figure 3.3 – Task index by occupations with the French classification

Note : Average routinization index in eight 2-digit occupations : managers, engineers, technicians, administrative, foremen, secretary, skilled blue-collar workers, unskilled blue-collar workers. Source : French survey on working conditions, year 2005, author's calculation.

The questions selected in the French survey offers a clear lecture of routinization. Managers and Engineers have the lowest index of routinization while skilled and unskilled blue-collar workers have the highest index.

The French index has the advantage of being build on the French PCS-ESE classification but has the disadvantage to rely on a small number of tasks related to the working condition of the employee.

3.B Details on AKM Methodology

Given equation (3.4) the least squares estimation problem is to solve the following equation

$$\begin{pmatrix} \hat{\beta} \\ \hat{\theta} \\ \hat{\psi} \end{pmatrix} = \begin{pmatrix} X'X & X'D & X'F \\ D'X & D'D & D'F \\ F'X & F'D & F'F \end{pmatrix}^{-1} \begin{pmatrix} X'y \\ D'y \\ F'y \end{pmatrix} \tag{3.7}$$

However, estimating two high dimensional fixed effects implies computing difficulties in terms of memory space [34]. Abowd et al. (2002) have shown that including N dummy variables for each unit of analysis gives the same solution as including dummy variables for the firm heterogeneity. This transformation consists in subtracting the person mean for all observations. By construction, within worker transformation eliminates firm's dummies when the worker does not change firm. Therefore, to capture the firm effect, one need to rely on workers mobility between firms, since it is the only sub-sample that does not eliminate the firm effect. Therefore, following Cornelissien (2008) we can decompose equation 3.7 such as :

$$\begin{aligned} \begin{pmatrix} X'X & X'F \\ F'X & F'F \end{pmatrix} &= \begin{pmatrix} X'X & 0 \\ 0 & 0 \end{pmatrix} + \sum_{i \in movers} \begin{pmatrix} 0 \\ F_i' y_i \end{pmatrix} \\ \begin{pmatrix} X'y \\ F'y \end{pmatrix} &= \begin{pmatrix} X'y \\ 0 \end{pmatrix} + \sum_{i \in movers} \begin{pmatrix} 0 \\ F_i' y_i \end{pmatrix} \end{aligned} \tag{3.8}$$

Equation 3.8 shows that the F matrix is null in the subsample of workers who does not change firm, therefore the F matrix is only identified for movers. Our worker-firm record gives information on both plant and firms, but, information on subsidiaries are only recorded at the firm level. Therefore, to account for the firm's foreign strategy we run our analysis at the firm level and we consider movers as workers who have changed firms during the period 2002-2007. [35]

Once equations in (3.8) are completed, we can solve equation (3.7) to obtain the coefficient vector $\hat{\beta}$ and $\hat{\psi}$. Then we can recover estimates of the person fixed effect $\hat{\theta}$ where $\hat{\theta}_i = \bar{y}_i - \bar{x}_i\hat{\beta} - \bar{x}_{j(i)}\hat{\gamma}$.

Table 3.8 – Education and occupation description

label code	Education
0	No degree reported
1	Completed elementary school
2	Completed junior high-school
3	Basic professional degree
4	Professional high school degree
5	General high school degree
6	Professional college degree
7	University degree, engineering school, Grandes écoles
	CSP
3	Managers
4	Intermediate occupations
5	Employees
6	Blue collar workers

Note : Education and occupations description for variance analysis as described in footnote 12

3.C Descriptive Statistics

Table 3.9 – Descriptive Statistics according to firm's international status

	All			Domestic Firms			Multinational Firms		
	Obs	Mean	SD	Obs	Mean	SD	Obs	Mean	SD
Diploma :									
No diploma	114,439	0.134	0.341	83,481	0.144	0.351	30,958	0.109	0.313
Completed Elementary-School	114,439	0.061	0.238	83,481	0.061	0.241	30,958	0.056	0.231
Completed Junior High-school	114,439	0.085	0.281	83,481	0.089	0.286	30,958	0.075	0.264
Basic Professional degree (CAP)	114,439	0.229	0.421	83,481	0.236	0.425	30,958	0.212	0.409
Basic Professional degree (BEP)	114,439	0.121	0.326	83,481	0.124	0.329	30,958	0.115	0.319
Professional high-school degree	114,439	0.045	0.208	83,481	0.044	0.205	30,958	0.050	0.218
General high-school degree	114,439	0.108	0.311	83,481	0.108	0.31	30,958	0.109	0.312
Professional college degree	114,439	0.121	0.326	83,481	0.114	0.318	30,958	0.139	0.346
University degree	114,439	0.093	0.291	83,481	0.078	0.269	30,958	0.132	0.339
Sex :									
Female	129,110	0.292	0.454	94,407	0.293	0.455	34,703	0.289	0.453
Male	129,110	0.708	0.454	94,407	0.707	0.455	34,703	0.711	0.453
Number of Children	126,185	0.993	1.076	92,215	0.988	1.077	33,970	1.013	1.075
Marriage	127,385	0.479	0.499	92,215	0.471	0.499	34,254	0.504	0.499
Age	129,110	39.82	9.746	94,407	39.493	9.715	34,703	40.707	9.774
Value-added per worker	128,811	71.381	264.79	94,110	68.221	286.533	34,703	79.951	196.661
Capital per worker	128,811	20.712	55.634	94,110	14.541	49.461	34,703	37.447	66.872
Revenue per worker	128,811	247.687	969.539	94,110	231.129	1085.933	34,701	292.595	537.056
Exports in euros	129,110	212,701.7	633,469.6	94,407	132,057.2	565,857	34,703	432,089.2	745,702.7
FDI	129,110	2.274	9.319	94,407	0	0	34,703	8.460	16.456
Subsidiaries in France	129,110	1.984	5.708	94,407	0.633	2.137	34,703	5.656	9.503

Source : LIFI survey, French annual census for manufacturing (EAE), French Déclaration annuelles des donnés sociales (Panel DADS-EDP) ; period : 2002-2007.

34. With our datasets, we need to invert a matrix of dimension $(K+J)\times(K+J)$ and we need to store J mean deviations for N^* observations, meaning that our data matrix is of size $N^*.(K+J).8$ bytes = 11 gigabytes

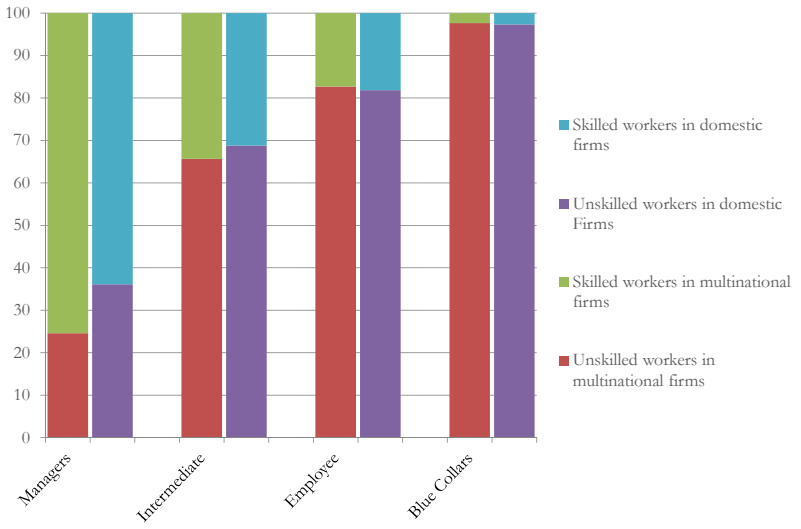
35. Our database counts 5804 movers for the period considered.

TABLE 3.10 – Descriptive Statistics by sector

		Managers	Intermediate Occupations	Employee	Blue collar Workers
Leather, clothing	Mean hourly wage	29.773	15.941	11.320	10.381
	Standard error	[12.450]	[6.829]	[3.827]	[2.714]
	Share of (in %)	7.120%	17.688%	18.953%	55.769%
Publishing, printing and reproduction	Mean hourly wage	28.225	17.529	13.044	14.322
	Standard error	[54.678]	[6.301]	[3.860]	[5.618]
	Share of (in %)	30.491%	16.341%	13.616%	39.212%
Pharmaceuticals, perfumery and personal care	Mean hourly wage	35.943	20.468	14.491	13.637
	Standard error	[18.722]	[7.149]	[4.734]	[4.340]
	Share of (in %)	21.929%	40.257%	6.505%	31.178%
Home equipment	Mean hourly wage	29.791	16.809	12.123	11.609
	Standard error	[12.282]	[5.160]	[3.181]	[3.138]
	Share of (in %)	12.098%	19.929%	8.602%	59.073%
Automobile industry	Mean hourly wage	30.062	17.957	13.914	13.337
	Standard error	[13.191]	[6.645]	[4.563]	[3.687]
	Share of (in %)	10.580%	21.185%	3.639%	64.497%
Shipbuilding, aircraft and rail construction	Mean hourly wage	30.615	18.718	16.336	14.384
	Standard error	[11.705]	[5.129]	[4.864]	[4.963]
	Share of (in %)	2.484%	24.599%	5.994%	44.474%
Machinery industry	Mean hourly wage	29.151	17.152	12.596	12.867
	Standard error	[10.698]	[5.313]	[3.600]	[11.989]
	Share of (in %)	13.715%	25.150%	6.707%	53.963%
Electrical-equipment	Mean hourly wage	30.541	17.357	13.376	12.045
	Standard error	[12.510]	[5.462]	[4.263]	[3.627]
	Share of (in %)	36.364%	26.847%	6.184%	3.034%
Mineral product	Mean hourly wage	31.307	17.858	12.551	13.088
	Standard error	[13.667]	[5.063]	[3.706]	[3.832]
	Share of (in %)	10.100%	2.046%	7.738%	61.426%
Textile	Mean hourly wage	29.044	16.063	12.286	11.052
	Standard error	[11.771]	[5.375]	[3.248]	[2.749]
	Share of (in %)	6.996%	16.340%	8.626%	67.535%
Wood and paper product	Mean hourly wage	31.036	18.829	12.773	12.880
	Standard error	[12.300]	[9.501]	[3.495]	[4.445]
	Share of (in %)	7.423%	15.640%	6.309%	70.037%
Chemicals, rubber, and plastics	Mean hourly wage	33.628	18.884	13.486	13.014
	Standard error	[18.983]	[37.423]	[4.238]	[4.246]
	Share of (in %)	11.915%	25.049%	6.122%	56.618%
Non ferrous metals mettallurgical transformation	Mean hourly wage	28.980	17.545	13.072	12.710
	Standard error	[12.248]	[5.278]	[3.755]	[3.645]
	Share of (in %)	7.673%	18.828%	5.857%	67.174%
Electrionic component	Mean hourly wage	29.810	17.392	12.400	12.575
	Standard error	[15.462]	[5.497]	[3.892]	[3.651]
	Share of (in %)	20.089%	24.915%	4.879%	50.010%

Source : LIFI survey, French annual census for manufacturing (EAE), French Déclaration annuelles des donnés sociales (Panel DADS-EDP) ; period : 2002-2007.

Figure 3.4 – Share of High-skilled and low-skilled workers in domestic and multinational firms (in %)

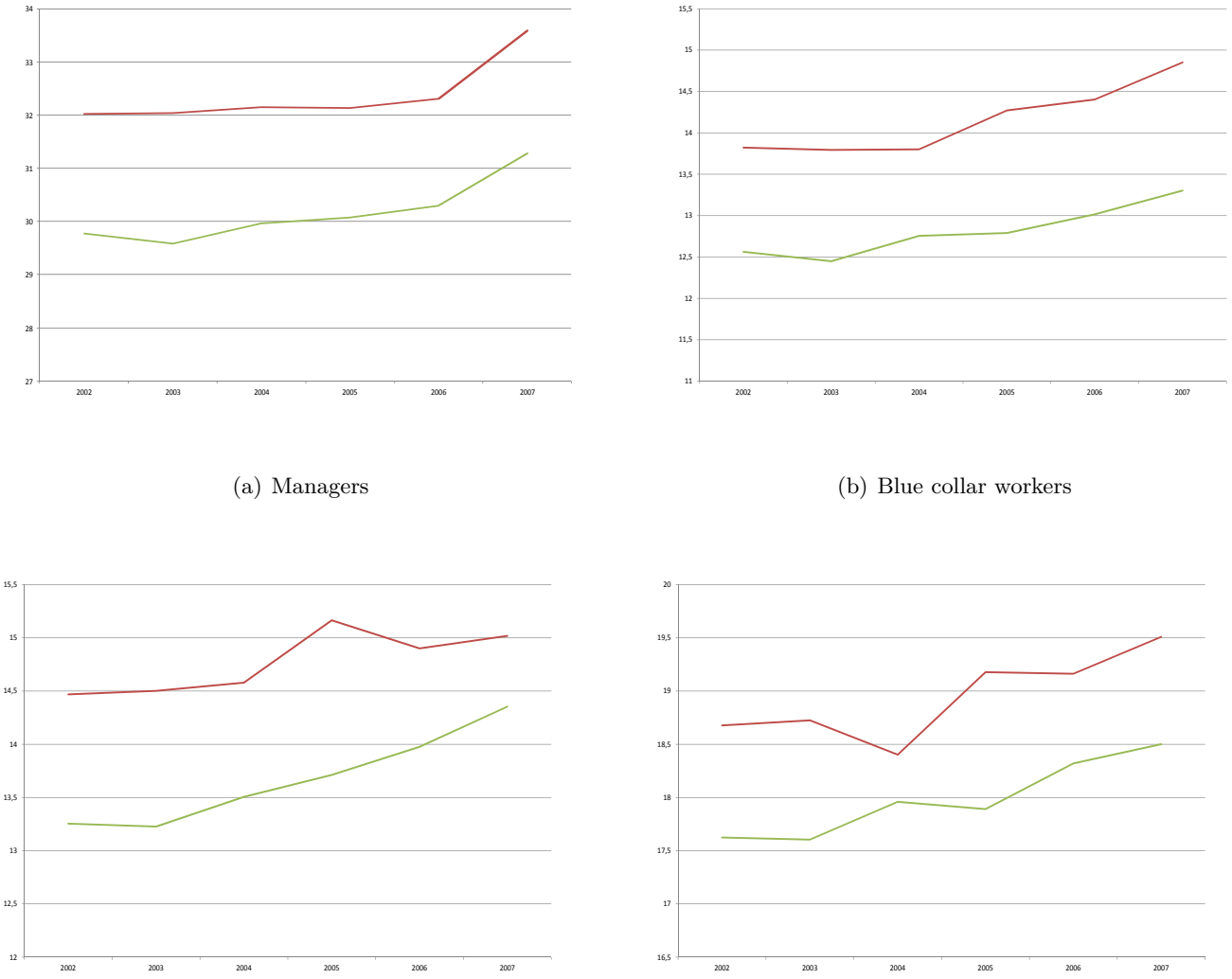


Source : LIFI survey, French annual census for manufacturing (EAE), French Déclaration annuelles des donnés sociales (Panel DADS-EDP) ; period : 2002-2007.

Note : Skilled workers are defined as those having at least level of diploma 6, as reported by table 12

Lecture : The figure represents the share of skilled and unskilled workers in multinational and domestic firms

Figure 3.5 – Evolution of wage by occupations between multinational- and domestic-workers



(a) Managers

(b) Blue collar workers

(c) Employees

(d) Intermediate Occupations

Source : LIFI survey, French annual census for manufacturing (EAE), French Déclaration annuelles des donnés sociales (Panel DADS-EDP) ; period : 2002-2007. Statistics made on balanced sample, excluding energy sector.

Note : The red curves report the average wage for workers employed in multinational firms, the green curves report the average wage for workers employed in domestic firms.

3.D Details on the quantile regression

Let Y be a random variable with cumulative function distribution $F_Y(y) = P(Y \leq y)$

The τ order quantile $\in [0;1]$ of a random variable Y is defined by $Q_\tau(u) = inf\{y|F_u(y) \geq \tau\}$

Let F_U be derivable and strictly increasing and define $\rho_\tau(u) = (\tau - \mathbb{1}_{y>0})\, y$.

A specific quantile can be found by minimizing the expected loss of $Y-u$ with respect to u and we can show that :

$$q_\tau(Y) \in \arg\min_a E\left(\rho_t\left(Y-u\right)\right)$$

Indeed, following D'haultfœuille and Givord (2012) we have :

$$E\left(\rho_t\left(Y-u\right)\right) = (\tau-1)\int_{-\infty}^{u}(y-u)f_Y(y)dy + \tau\int_{u}^{+\infty}(y-u)f_Y(y)dy$$

$$E\left(\rho_t\left(Y-u\right)\right) = \tau\left(E\left(Y\right)-u\right) - \int_{-\infty}^{u}(y-u)f_Y(y)dy$$

This function can be derived with respect to u, such as :

$$\frac{\partial E\left(\rho_t\left(Y-u\right)\right)}{\partial u} = -\tau - \left(u-u\right)f_Y(u) + \int_{-\infty}^{u} f_Y(y)dy$$

This function is convex and attains its minimum in $q_\tau(Y)$.

this approach extends easily to a conditional framework, where we assume $q_\tau(Y|X) = X^{'}\beta_\tau$ and then :

$$\beta_\tau = \arg\min_\beta E\left(\rho_t\left(Y - X^{'}\beta\right)\right)$$

The quantile regression estimator for quantile q minimizes the objective function :

$$q\left(\beta_\tau\right) = \tau\sum_{i:y_i \geq X_i^{'}\beta}^{N}(Y_i - X_i^{'}\beta) + (1-\tau)\sum_{i:y_i \leq X_i^{'}\beta}^{N}(Y_i - X_i^{'}\beta)$$

3.E Additional Results

3.E.1 Person-firm effect model

Table 3.11 – Robustness test : Number of countries deserved by Foreign Direct Investment

	All	Managers	Blue-collar workers	Intermediate Occupations
Number of children	-0.000	-0.001	0.003	-0.005
	[0.003]	[0.007]	[0.004]	[0.004]
Marriage	-0.005	-0.033**	0.013	-0.017**
	[0.006]	[0.016]	[0.009]	[0.009]
Number of countries deserved	0.038	0.139**	0.027	0.010
	[0.030]	[0.062]	[0.058]	[0.045]
Subsidiaries in France	0.035	-0.007	0.046	0.005
	[0.035]	[0.070]	[0.074]	[0.054]
Revenue	0.001*	0.001	0.002*	0.002***
	[0.001]	[0.001]	[0.001]	[0.001]
Capital	0.001**	-0.000	0.003**	0.001
	[0.001]	[0.002]	[0.001]	[0.001]
TFP	0.000*	-0.000	0.000**	-0.000
	[0.000]	[0.000]	[0.000]	[0.000]
Imports of II	-0.000	-0.000	-0.000	-0.001
	[0.000]	[0.000]	[0.000]	[0.001]
Imports of FG	0.000	0.000	-0.000	0.001***
	[0.000]	[0.001]	[0.001]	[0.000]
Computer use	0.057***	0.028	0.007	-0.039
	[0.007]	[0.065]	[0.045]	[0.031]
Age-squared	-0.047***	-0.063***	-0.040***	-0.049***
	[0.002]	[0.005]	[0.003]	[0.003]
Exports	0.028***	-0.004	0.047***	0.015**
	[0.005]	[0.014]	[0.009]	[0.007]
Constant	3.787***	4.399***	3.177***	3.970***
	[0.037]	[0.106]	[0.045]	[0.066]
Observations	51,839	9,144	23,867	15,223
R-squared	0.106	0.120	0.076	0.131
Log Likelihood	55181.374	9223.718	25717.089	18778.624

Source : LIFI survey, French annual census for manufacturing (EAE), French Déclaration annuelles des donnés sociales (Panel DADS-EDP) ; period : 2002-2007.
Robust standard error in brackets, *** p<0.01, ** p<0.5, * p<0.10.

Table 3.12 – Robustness test : Inclusion of group nationality

	All	Managers	Blue-collar workers	Intermediate Occupations
Number of children	0.001	-0.001	0.003	-0.005
	[0.003]	[0.007]	[0.004]	[0.004]
Marriage	-0.003	-0.034**	0.013	-0.017**
	[0.006]	[0.016]	[0.009]	[0.009]
Number of FDI abroad	-0.067	-0.528	-0.175	0.212
	[0.174]	[0.391]	[0.218]	[0.211]
Subsidiaries in France	0.022	0.085**	-0.002	0.007
	[0.017]	[0.034]	[0.034]	[0.026]
Nationality	-0.003	0.004	-0.008*	-0.001
	[0.003]	[0.007]	[0.004]	[0.004]
Revenue	0.001**	0.001	0.002*	0.002***
	[0.001]	[0.001]	[0.001]	[0.001]
Capital	0.001*	-0.000	0.003**	0.001
	[0.001]	[0.002]	[0.001]	[0.001]
TFP	0.000	-0.000	0.000**	-0.000
	[0.000]	[0.000]	[0.000]	[0.000]
Imports of II	-0.000	-0.000	-0.000	-0.001
	[0.000]	[0.000]	[0.000]	[0.001]
Imports of FG	0.000	0.000	-0.000	0.001***
	[0.000]	[0.001]	[0.001]	[0.000]
Computer use	0.070***	0.027	0.006	-0.039
	[0.007]	[0.064]	[0.045]	[0.031]
Age-squared	-0.046***	-0.063***	-0.040***	-0.049***
	[0.002]	[0.005]	[0.003]	[0.003]
Exports	0.026***	-0.004	0.046***	0.015**
	[0.005]	[0.014]	[0.009]	[0.007]
Constant	3.776***	4.399***	3.179***	3.971***
	[0.038]	[0.106]	[0.045]	[0.066]
Observations	51,839	7,494	21,858	13,150
R-squared	0.106	0.121	0.068	0.130
Log Likelihood	46528.915	7601.932	23569.178	16393.762

Source : LIFI survey, French annual census for manufacturing (EAE), French Déclaration annuelles des donnés sociales (Panel DADS-EDP) ; period : 2002-2007.
Robust standard error in brackets, *** p<0.01, ** p<0.5, * p<0.10.

TABLE 3.13 – Wage-regression capturing the productivity effect

	All	Manager	Blue Collar Workers	Intermediate Occupations
Number of Children	-0.002	-0.004	0.001	-0.005
	[0.002]	[0.007]	[0.003]	[0.004]
Marriage	-0.013**	-0.038**	-0.006	-0.017**
	[0.005]	[0.015]	[0.008]	[0.009]
Age-squared	0.032*	0.102***	0.011	0.005
	[0.016]	[0.033]	[0.030]	[0.025]
Number of FDI abroad	-0.048***	-0.067***	-0.041***	-0.048***
	[0.002]	[0.005]	[0.002]	[0.003]
Number of subsidiaries in France	0.000	-0.001	0.000	0.000
	[0.000]	[0.001]	[0.001]	[0.001]
Exports	0.046***	0.004	0.076***	0.031***
	[0.003]	[0.010]	[0.006]	[0.005]
Constant	3.799***	4.494***	3.402***	3.938***
	[0.033]	[0.086]	[0.045]	[0.062]
Year fixed-effects	Yes	Yes	Yes	Yes
Observations	63,421	9,317	35,060	15,389
R-squared	0.099	0.124	0.075	0.128
Number of match	13,542	2,334	7,870	4,141
Log Likelihood	64037.061	9331.250	34838.330	18931.943

Source : LIFI survey, French annual census for manufacturing (EAE), French Déclaration annuelles des donnés sociales (Panel DADS-EDP) ; period : 2002-2007.
Robust standard error in brackets, *** p<0.01, ** p<0.5, * p<0.10.

TABLE 3.14 – Exogeneity test of FDI

	All sample	Managers	Blue Collars	Intermediate occupations
F-test : First stage	F=28.58	F=13.74	F=11.56	F=21.40
	p=0.000	p=0.000	p=0.000	p=0.000
Kleibergen-Paap rk LM-stat of underidentification	Chi^2=59.051	Chi^2=25.678	Chi^2=26.051	Chi^2=20.084
	p=0.000	p=0.000	p=0.000	p=0.000
C-test of Endogeneity	Chi^2=0.239	Chi^2=1.687	Chi^2=0.721	Chi^2=1.470
	p=0.6247	p=0.194	p=0.3958	p=0.2254

Source : LIFI survey, French annual census for manufacturing (EAE), French Déclaration annuelles des donnés sociales (Panel DADS-EDP) ; period : 2002-2007. Robust standard error in brackets, *** p<0.01, ** p<0.5, * p<0.10. Exluded instruments FDI_{-1}, FDI_{-2}.

Table 3.15 – Robustness test : Extensive versus Intensive margin

	All		Managers		Blue-collar workers		Intermediate Occupations	
	Extensive	Intensive	Extensive	Intensive	Extensive	Intensive	Extensive	Intensive
Number of children	-0.007	-0.004	-0.013	-0.002	-0.005	0.004	-0.011	-0.024***
	[0.008]	[0.005]	[0.026]	[0.012]	[0.011]	[0.008]	[0.012]	[0.008]
Marriage	-0.038**	-0.007	-0.027	-0.050*	-0.059**	0.026	-0.033	0.005
	[0.017]	[0.011]	[0.051]	[0.025]	[0.026]	[0.018]	[0.022]	[0.016]
Number of FDI abroad	0.029**	0.028**	0.058*	0.071***	0.026	0.014	0.000	0.007
	[0.013]	[0.012]	[0.032]	[0.025]	[0.022]	[0.025]	[0.016]	[0.015]
Revenue	0.004***	0.001	0.010	-0.001	0.005**	0.001	0.003**	0.002**
	[0.001]	[0.001]	[0.007]	[0.002]	[0.002]	[0.001]	[0.001]	[0.001]
Subsidiaries in France	-0.101	-0.100**	-0.058	-0.080	-0.022	-0.122	-0.151	-0.107
	[0.062]	[0.044]	[0.161]	[0.088]	[0.118]	[0.099]	[0.100]	[0.066]
Capital	-0.003	0.001	-0.005	-0.001	-0.003	0.000	-0.020***	0.002
	[0.004]	[0.001]	[0.010]	[0.002]	[0.007]	[0.002]	[0.006]	[0.001]
TFP	-0.000	-0.000	-0.000	-0.000	0.000	-0.000	-0.000	-0.000
	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]
Imports of II	-0.013***	-0.002	-0.010	-0.002	-0.018***	-0.001	-0.004	-0.001
	[0.004]	[0.001]	[0.010]	[0.003]	[0.005]	[0.003]	[0.006]	[0.002]
Imports of FG	-0.001	0.001	0.001	0.001	-0.001	-0.000	-0.001	0.001**
	[0.001]	[0.000]	[0.009]	[0.002]	[0.001]	[0.001]	[0.002]	[0.000]
Computer use	0.059**	0.076***	-1.467*	0.240	-0.112	-0.022	0.158*	-0.069
	[0.023]	[0.013]	[0.814]	[0.174]	[0.177]	[0.083]	[0.081]	[0.053]
Age-squared	-0.055***	-0.049***	-0.100***	-0.066***	-0.034***	-0.034***	-0.053***	-0.054***
	[0.005]	[0.003]	[0.020]	[0.009]	[0.007]	[0.005]	[0.008]	[0.005]
Exports	-0.065**	0.035***	-0.252**	0.014	-0.042	0.083***	0.054	0.006
	[0.029]	[0.008]	[0.124]	[0.026]	[0.047]	[0.016]	[0.045]	[0.010]
Constant	3.738***	3.662***	6.961***	4.302***	3.170***	3.138***	3.643***	3.862***
	[0.092]	[0.056]	[0.883]	[0.218]	[0.123]	[0.087]	[0.146]	[0.090]
Observations	4,528	14,225	920	3,457	1,825	5,681	1,783	5,087
R-squared	0.139	0.133	0.100	0.105	0.155	0.133	0.197	0.161
Log Likelihood	5068.070	15412.108	729.005	3186.371	2510.269	6550.163	2314.615	6496.885

Source : LIFI survey, French annual census for manufacturing (EAE), French Déclaration annuelles des donnés sociales (Panel DADS-EDP) ; period : 2002-2007.
Robust standard error in brackets, *** p<0.01, ** p<0.5, * p<0.10.

TABLE 3.16 – Robustness test : Sample of firms having less than 5 subsidiaries

	All	Managers	Blue-collar workers	Intermediate Occupations
Number of children	0.002	0.001	0.002	-0.000
	[0.003]	[0.008]	[0.004]	[0.005]
Marriage	-0.001	-0.054***	0.014	-0.019**
	[0.006]	[0.018]	[0.009]	[0.009]
Number of FDI abroad	-0.067	-0.528	-0.175	0.212
	[0.174]	[0.391]	[0.218]	[0.211]
Subsidiaries in France	-0.052	0.108	0.137	0.067
	[0.061]	[0.116]	[0.093]	[0.087]
Revenue	0.002***	0.001	0.001	0.000
	[0.001]	[0.002]	[0.001]	[0.001]
Capital	0.001*	0.000	0.004***	0.001
	[0.001]	[0.002]	[0.001]	[0.001]
TFP	0.000	-0.000	0.000**	0.000
	[0.000]	[0.000]	[0.000]	[0.000]
Imports of II	-0.000	-0.000	-0.000	-0.001
	[0.000]	[0.000]	[0.000]	[0.001]
Imports of FG	0.000	0.000	-0.000	0.001***
	[0.000]	[0.001]	[0.001]	[0.000]
Computer use	0.060***	-0.000	0.018	-0.041
	[0.008]	[0.069]	[0.048]	[0.033]
Age-squared	-0.046***	-0.065***	-0.040***	-0.046***
	[0.002]	[0.006]	[0.003]	[0.003]
Exports	0.022***	0.001	0.033***	0.029***
	[0.006]	[0.016]	[0.010]	[0.009]
Constant	3.729***	4.465***	3.162***	3.881***
	[0.041]	[0.119]	[0.048]	[0.071]
Observations	43,521	7,494	21,858	13,150
R-squared	0.106	0.121	0.068	0.130
Log Likelihood	46528.915	7601.932	23569.178	16393.762

Source : LIFI survey, French annual census for manufacturing (EAE), French Déclaration annuelles des donnés sociales (Panel DADS-EDP) ; period : 2002-2007.
Robust standard error in brackets, *** p<0.01, ** p<0.5, * p<0.10.

3.E.2 Blinder-Oaxaca Methodology

We use a variant of the Blinder (1973) and Oaxaca (1973) method (OB method) to decompose mean differences in log wages between two groups of workers : those employed in a domestic firm (group d) and those employed in a multinational firm (group m). The traditional well known OB method decomposes the difference in the linear prediction at the group-specific means of the regressors into two components : a component of the wage differential attributable to group differences in the predictors and a second component attributable to the contribution of differences in the coefficients.

As pointed by Oaxaca and Ransom (1994, 1999), the group wage gap explained by differences between groups characteristics is not invariant to whether one of the group is chosen as the reference wage structure and one has to made an assumption on the direction of discrimination towards one of the group only. In this particular case, assuming that discrimination is only directed against domestic-workers and there is no positive discrimination of multinational-workers is a strong assumption. A solution, following Fortin (2006), is to use a pooled wage regression that simply includes a dummy for the disadvantaged

group. The model is the following :

$$\ln w_i = \gamma_0 + \gamma_{0m}.M_i + \gamma_{0d}.D_i + \gamma X_i + v_i \tag{3.9}$$

Where workers employed in domestic firms are indexed by d, and those employed in multinational firms by m. D_i is a dummy equals to 1 if the worker is employed in a domestic firm and $M_i = 1 - D_i$, which represents a dummy equals to 1 if the worker is employed in a multinational firm. $\psi_{j(i,t)}$ is a firm fixed effect which measures permanent differences in wages between firms and θ_i measures permanent differences between workers, conditional on measured and unmeasured characteristics. Finally, X_i is a $1 \times K$ vector of explanatory variables and β is a $K \times 1$ vector of coefficients. The model is then given by :

$$\ln \bar{w} = \begin{cases} \hat{\gamma}_0 + \hat{\gamma}_{0m} + \bar{X}_m\gamma + E\left(v_i|D_i = 0\right) \text{ if multinational workers} \\ \hat{\gamma}_0 + \hat{\gamma}_{0d} + \bar{X}_d\gamma + E\left(v_i|D_i = 1\right) \text{ if domestic workers} \end{cases} \tag{3.10}$$

Then, the raw wage differential can be written as follows :

$$\ln \bar{w}_m - \ln \bar{w}_d = (\hat{\gamma}_{0m} - \hat{\gamma}_{0d}) + \Delta X\hat{\gamma} + \left[E\left(v_i|D_i = 0\right) - E\left(v_i|D_i = 1\right)\right] \tag{3.11}$$

Where $\Delta X = \bar{X}_m - \bar{X}_d$ indicates the difference in the group's average of several observable characteristics between multinational and domestic workers. This term corresponds to the *endowment effect*, which amounts to the part of the differential that is due to group differences in the predictors. The first term in equation (3.11) is interpreted as a *coefficient effect*, which measures the contribution of differences in the coefficients, it reports the unexplained part of the log wage difference. Where $\gamma_{0m} = \left[\bar{X}_m\left(\hat{\beta}_m - \hat{\gamma}\right) + (\beta_{0m} - \hat{\gamma}_0)\right]$ and $\gamma_{0f} = \left[\bar{X}_f\left(\hat{\beta}_f - \hat{\gamma}\right) + \left(\hat{\beta}_{0f} - \hat{\gamma}_0\right)\right]$ [36].

The last term vanishes since $\left[E\left(v_i|D_i = 0\right) - E\left(v_i|D_i = 1\right)\right] = Cov(v_i, D_i) = 0$, by assumption.

The model described here assumes that the same characteristics observed on multinational workers and domestic workers receive different remunerations and, after the gap quantification, it proceeds decomposing it in the part due to the difference in the characteristics and in the part due to the different returns reserved to domestic and multinational workers.

36. Which can be easily verified by writing the decomposition in terms of Neumark-Cotton decomposition such as $\ln \bar{w}_m - \ln \bar{w}_f = \Delta X\hat{\gamma} + \Delta\theta\hat{\eta} + \Delta\psi\hat{\rho} + \left[\bar{X}_m\left(\hat{\beta}_m - \hat{\gamma}\right) + (\beta_{0m} - \hat{\gamma}_0)\right] - \left[\bar{X}_f\left(\hat{\beta}_f - \hat{\gamma}\right) + \left(\hat{\beta}_{0f} - \hat{\gamma}_0\right)\right]$.

3.E.3 Regression based on industries

We use the OECD classification to assign industries either to the low- or to the medium/high-tech sector [37]. We run separate estimations in the sample of firms belonging to the high tech and low-tech industries in order to test whether the offshoring activities had a stronger impact on wage inequalities in high tech sectors compared to low tech sectors. Results are reported in the following Table.

TABLE 3.17 – Spell fixed effects by low-tech and high-tech industries

	All		Managers		Blue-collar workers		Intermediate Occupations	
	low-tech	high-tech	low-tech	high-tech	low-tech	high-tech	low-tech	high-tech
Number of children	-0.003	0.005	-0.002	-0.006	-0.000	0.007	-0.008	0.003
	[0.004]	[0.004]	[0.008]	[0.015]	[0.006]	[0.006]	[0.006]	[0.008]
Marriage	-0.022***	0.007	-0.051***	-0.013	0.021	-0.002	-0.033***	-0.002
	[0.007]	[0.010]	[0.020]	[0.033]	[0.013]	[0.014]	[0.012]	[0.015]
Number of FDI abroad	0.016	0.101	0.074**	0.587***	0.016	-0.128	-0.014	0.220*
	[0.018]	[0.073]	[0.036]	[0.200]	[0.037]	[0.113]	[0.030]	[0.118]
Subsidiaries in France	0.033	-0.046	-0.021	-0.095	-0.017	0.062	0.044	-0.122
	[0.040]	[0.092]	[0.075]	[0.311]	[0.094]	[0.130]	[0.067]	[0.138]
Revenue	-0.002***	0.008***	0.001	0.003	-0.005***	0.010***	0.000	0.007***
	[0.001]	[0.002]	[0.002]	[0.005]	[0.001]	[0.003]	[0.001]	[0.002]
Capital	0.002***	-0.027***	-0.000	-0.047***	0.005***	-0.025***	0.002*	-0.023***
	[0.001]	[0.004]	[0.002]	[0.012]	[0.002]	[0.007]	[0.001]	[0.005]
TFP	0.000***	-0.000	-0.000	-0.000	0.000***	-0.000	0.000	-0.000
	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]
Imports of II	-0.000	-0.000	0.002	-0.000	-0.000	-0.000	-0.002	0.000
	[0.000]	[0.000]	[0.002]	[0.000]	[0.000]	[0.001]	[0.001]	[0.001]
Imports of FG	0.001	-0.000	-0.001	-0.002	0.000	-0.000	0.002***	-0.000
	[0.000]	[0.001]	[0.002]	[0.002]	[0.001]	[0.001]	[0.001]	[0.001]
Computer use	0.052***	0.061***	-0.004	0.504**	0.048	-0.057	0.018	-0.081
	[0.010]	[0.011]	[0.069]	[0.255]	[0.074]	[0.067]	[0.044]	[0.051]
Age-squared	-0.048***	-0.046***	-0.064***	-0.066***	-0.039***	-0.043***	-0.045***	-0.051***
	[0.002]	[0.003]	[0.006]	[0.010]	[0.004]	[0.004]	[0.004]	[0.005]
Exports	0.041***	0.007	0.010	-0.036	0.080***	0.040*	0.021**	-0.000
	[0.007]	[0.012]	[0.016]	[0.038]	[0.014]	[0.024]	[0.010]	[0.016]
Constant	3.592***	3.472***	4.441***	4.083***	3.150***	3.270***	3.586***	3.767***
	[0.041]	[0.050]	[0.124]	[0.311]	[0.068]	[0.070]	[0.077]	[0.092]
Observations	25,617	21,172	5,886	2,693	9,790	11,309	8,026	5,769
R-squared	0.125	21172.000	0.123	2693.000	0.093	11309.000	0.135	5769.000
Log Likelihood	28522.753	21368.429	5956.082	2654.084	11442.405	11576.699	9772.838	7190.138

Source : LIFI survey, French annual census for manufacturing (EAE), French Déclaration annuelles des donnés sociales (Panel DADS-EDP) ; period : 2002-2007.
Robust standard error in brackets, *** p<0.01, ** p<0.5, * p<0.10.

37. The classification of low-tech and high-tech industries is based on the NACE classification. Chemicals ; pharmaceuticals ; machines and equipment ; computers, electronic and optical products and transports are classified in the high-tech industries, while the others are classified in the low-tech industries.

3.F Robustness with the ONET index

Table 3.18 – Person and firm effect model : Task offshorability index with ONET

	(1)	(2)
FDI	0.021	
	[0.236]	
FDI to LI countries		-0.000
		[0.001]
FDI to HI countries		0.001
		[0.001]
FDI*Offshorability	-0.761	
	[0.057]	
FDI LI*Offshorability		-0.004**
		[0.002]
FDI HI*Offshorability		0.002
		[0.001]
Offshorability index	-0.037***	-0.037***
	[0.008]	[0.008]
Subsidiaries in France	-0.000	-0.000
	[0.000]	[0.000]
Revenue	0.002***	0.002***
	[0.001]	[0.001]
Capital	0.001**	0.001**
	[0.001]	[0.001]
Total factor productivity	0.000	0.000
	[0.000]	[0.000]
Imports of intermediate inputs	-0.001	-0.001
	[0.001]	[0.001]
Imports of finished goods	0.000	0.000
	[0.000]	[0.000]
Computer use	0.071***	0.070***
	[0.008]	[0.008]
Age squarred	-0.048***	-0.049***
	[0.002]	[0.002]
Exports	0.022***	0.022***
	[0.005]	[0.005]
Number of children	-0.003	-0.003
	[0.003]	[0.003]
Marriage	-0.000	-0.000
	[0.006]	[0.006]
Constant	3.844***	3.845***
	[0.041]	[0.041]
Observations	39,484	39,484
R-squared	0.115	0.115
Log Likelihood	52557.081	52554.115

Source : LIFI survey, French annual census for manufacturing (EAE), French Déclaration annuelles des donnés sociales (Panel DADS-EDP) ; period : 2002-2007.
Robust standard error in brackets, *** p<0.01, ** p<0.5, * p<0.10.

Chapitre 4

Offshoring and the Organization of French Firms

Introduction

Improvement in communication technology, reduction in trade barriers and transportation costs have favored internationalization of production processes. Firms are becoming increasingly integrated in the world economy and multinational firms account for a large share of world's exports and imports. Roughly one third of French exports and imports are the fact of intra-firm trade, which reflects the firm's international expansion and the increasing Foreign Direct Investment (FDI) opportunities (SESSI, 2002). French FDI flows grew rapidly and reached 7% of the GDP in 2012, which echos the increasing share of multinational companies in the firm's population. As a result, more than three out of five workers were employed in a multinational firm in France in 2013 (INSEE, 2013). Workers employed in a multinational firm are also more skilled than workers employed in a domestic firm (Davidson et al. 2014, Barba-Navaretti and Venables (2004)). Foreign direct investment has been cited as a source of the skill-upgrading, i.e. the rise of the demand of skilled-workers relative to unskilled-workers (Head and Ries (2002), Ekholm and Hakkala (2005), Becker et al. (2012) among others). However, little attention has been paid on the mechanisms through which foreign direct investment impacts the skill-composition of the firm.

This paper is an attempt to fill this gap. We underline the role of foreign direct investment as a determinant of organizational change within the firm. We define organizational change as a transfer of activities from production to supervision functions inside headquarters in the home country and as a decentralization of decision. We argue that the organizational change is responsible for the increase in the demand for skilled workers.

This hypothesis is plausible since recent evidences has shown that whatever the type of FDI, horizontal or vertical, shipment between foreign establishment and the mother

company are extremely low (see Ramondo et al. (2011)). In the case of horizontal FDI, this result is not surprising, since, according to traditional theory on horizontal FDI, the production of horizontal affiliates is intended to serve the local market. In contrast, in the case of vertical FDI, the lack of transfer between the mother company and the affiliates is unexpected regarding traditional models of vertical FDI. According to the economic theory on vertical FDI, the home country should remain the main destination market, which should predict shipment of intermediate inputs along the vertical chain between the foreign subsidiary and the parent company. This result suggests that mother companies play another role than that of reassembling the final good in the home country.

This article departs from the hypothesis that one of the main headquarters' role is to supervise the production process while the main function of foreign affiliates is to produce the output. Headquarters need to specialize in activities requiring skilled-workers in order to supervise the production processes that have been split in different geographic areas [1].

This hypothesis is supported by the business literature, that highlights the specialization of headquarters in skilled-activities in order to manage, control, develop and deploy resources through the multi-country plants. Collis et al. (2007), (2012) show that firms with multi-domestic strategies have fewer functions than multinational firms with a global strategy. They show that activities undertaken at headquarters in multinational companies complement those occurring in foreign subsidiaries and adopt a more complex organizational structure. They reference a set of activities performed at headquarters, including obligatory functions (tax and treasury, general management) that cannot be transferred to foreign affiliates ; shared services (research and development) that are best managed at the headquarters because they benefit from substantial economies of scale ; control activities (decision centers) that are kept in the headquarters to minimize the agency cost of delegating decisions ; and finally, value creating or coordination function (marketing, human resources) that are, by nature, maintained in headquarters because their main role is to allocate resources through the firm. The rise of multi-location firms can be the source of the rise of specific functions within headquarters, requiring specific skills to supervise resources through the multi-country plants. Thus, FDI may impact the work composition of headquarters in the home country through increasing skilled non-production functions.

Despite changes in the organization of work within headquarters, the study is also interested in the effect of foreign direct investments on the delegation of power inside the organization. We argue that delegation of authority is also a form of organizational change.

Indeed, product market competition has been highlighted as responsible for increasing decentralization of decisions inside the firm. The intuition for this result can be thought in terms of simple principal-agent models of delegation of authority, as in Aghion and

1. The idea of specialization of multinational headquarters in skilled activities was already present in Helpman (1984) model, in which the production was decomposed into production activities and headquarters activities. However, the model did not analyze the effect of this specialization of headquarters in supervision functions on the skill-intensity of multinational firms in the home country.

Tirole (1997). The principal has the authority to make a decision, while the agent is better informed about technology, the local markets and the firm's opportunities. Put simply, the agent, who is the plant manager, has information about the consequences of the principal's decision. The principal has the possibility to delegate the authority to the agent, however, the principal may not obtain full effort from the agent, since the manager's incentives may not be aligned with those of the principal. Delegation of authority can be summarized as a trade-off between the loss of control and the manager's incentives.

Product market competition has been cited as a channel that fosters delegation (decentralization of decision) to executive managers, since higher competition makes decisions more time-sensitive. The central head quarters or the CEO may have incentives to decentralize the decision to managers in order to gain in adaptability and flexibility (Bloom, Sadun, Reenen (2012)). Hence, workers within headquarters of multinational companies may have more responsibilities than workers in domestic firms. [2].

In order to analyze the role of FDI on organizational change, defined as delegation of authority and a transfer from production functions to supervision functions, we proceeds in two steps. First, we develop a theoretical framework to capture the mechanisms through which FDI affects the organization of the firm. Second, we test empirically the predictions of the model.

The model combines two theoretical frameworks. On the one hand, we follow a stream of theoretical models that analyzes how production is organized through a knowledge based hierarchy (Garicano (2000), Gariacano and Rossi-Hansberg (2006, 2011), Caliendo and Rossi-Hansberg (2012)). On the other hand, we adopt the Grossman and Rossi-Hansberg (2008) framework to model the firm's global production process. Analyzing firms' organization from the perspective of international trade model is not new. International production hierarchies have been studied to understand the locations of offshoring (Antràs et al. (2006b)), the formation of international teams (Antràs et al. (2006a)) and the organizational effect of exports (Caliendo and Rossi-Hansberg (2012)). The originality of our model consists in analyzing the effect of international fragmentation of production process, through foreign direct investment, on the organization of work.

The model identifies three types of workers, (i) production workers, (ii) managers and (iii) the CEO. We follow Garicano (2000) by modeling firms as a knowledge-based hierarchy, such as each type of worker is in different layer of the hierarchy. Production workers are in the first layer and are hired to produce the output. Managers are in the second layer and are hired to solve the problems encountered by production workers.

2. The agency problem of the principal has been facilitated though, by the use of performance-related pay among executives and managers. By making employee compensation dependent upon organizational performance, the principal covers against sub-optimal level of efforts by the manager (Bloom and Milkovich (1998). Similarly, product market competition encourages managerial incentives. Managerial effort is more valuable when within-market competition increases (Vives (2005), Raith (2003), Bloom and Van Reenen (2006)), which reduces the risk incurred by the principal when delegating the power of decision.

The last layer of the hierarchy is composed by the unique CEO. The agent's knowledge determines its occupation : CEO, manager or production-worker.

Each worker has one unit of time, and during this period, production-workers have to deal with one problem, occurring during the production process. If the worker's knowledge is high enough to solve the problem, then the production can occur. If not, the worker has to transmit it to an upper layer of the firm's hierarchy. We follow Garicano (2000) by showing that the optimal way to organize production is to adopt a knowledge-based hierarchy.

Our contribution to the literature consists in assuming that the firm has the possibility to offshore part of its production process. We follow Grossman and Rossi-Hansberg (2008) (GRH hereafter) framework to model the firm's global production process. As in GRH, we assume two costs of making a foreign direct investment : an administrative cost and a task-specific cost. The originality of the model lies on the hypothesis that firms bear an additional cost : a communication cost. Offshoring raises the communication cost between managers and production-workers, because managers need to spend more time to communicate with offshored production workers when solving the problem.

The main results of the model are as follows. Foreign direct investments (FDI) in low-income countries raise the managers' knowledge and reduce the production-workers' knowledge. This shift increases the demand for skilled workers and reduce the demand for unskilled production-workers in the home country. Firms need more managers in order to supervise and monitor the offshored production. Numerical experiments, calibrated on French 2007 data, show that a 1% decrease in the cost of offshoring raises the number of managers inside the investing firm by 0.08% and reduces the number of production workers by 0.15% when the firm starts offshoring. In order to test the robustness of our numerical results we propose, on the one hand, different specifications of the offhsoring function, and on the other hand, different propositions on the model's assumptions. The model manages to reproduce both the skill bias observed in the data and the rise in the demand for more autonomous workers consecutive to offshoring.

The second part empirically tests the main predictions of the model. Identifying the transfer from production activities to supervision activities is not an easy task. We follow Caliendo et al. (2013) to identify what constitutes a layer of production and a layer of management in the data. We separate out employees according to their functional characteristics. We separate out top management position (that includes chief financial officer, heads of human resources and logistic, purchasing and administrative managers) from production workers (that includes welders, assemblers, machine operators and maintenance workers). We argue that an increase in the number of managers and a decrease of production workers can be assimilated to a transfer from production activities to supervision activities.

The originality of the empirical part stems from the identification of firms according to

the autonomy of their workforce. We capture worker's autonomy by building an original index based on several questions about workers' power of decision and authority, derived from the French working conditions survey.

We exploit a detailed panel of employer-employee drawn from several micro-economic databases, over the period 2002-2009. Using such detailed databases constitute a great advantage with respect to the existing literature, since it allows to analyze the work-composition in terms of skills and tasks. Several papers have analyzed the effect of intra-firm offshoring on employment, including Head and Ries (2002) and Becker et al. (2012) but did not use detailed information on decentralization of decision. Here, we are able to measure the intensity of workers' autonomy within the investing firm and to measure the transfer from production activities to supervision activities.

We use matching techniques, in combination with difference in difference estimators, in order to compare the work-composition of multinational firm, before and after the international investment, with respect to the work-composition of the control group. Results confirm the intuition of the model. The results suggests that foreign direct investment raises the number of managers and significantly reduces the number of blue collar workers two years after the foreign investment. When controlling for hidden bias, the positive effect on the number of managers is robust, while we are more cautious about the interpretation of the negative effect of FDI on the number of blue collar workers within the firm, because the results are very vulnerable to unobservables.

The study is organized as follows. Section 1 review the literature on offshoring and its implication on workforce organization. Section 2 presents the theoretical model and its main propositions. Numerical simulations are implemented in section 3. Section 4 and 5 present the data and methodology. The econometric results are presented in section 6 and the robustness tests in section 7. Section 8 concludes.

1 Literature review

The work organization of a MNC is very different than the organization of a firm located in a unique site of production. The need for coordination is greater when organizational structures are replicated in different geographic areas (Mayrhofer 2010). Decision-making and management in foreign multinationals is decentralized (Bloom, Sadun, and Van Reenen 2010; Guadalupe and Wulf 2010), team work has become important (Görlich and Snower 2010; OECD 1999), quality circles and multitasked workers are more frequently used (Osterman 2000; Görlich and Snower 2010), hierarchies have become flatter due to international competition and environment instability (Bloom, Sadun, and Van Reenen 2010; Bloom, Draca, and Reenen 2011a; Guadalupe and Wulf 2010; Görlich and Snower 2010), and CEOs discharge their power of decision to employees in a lower layer of management, in order to have more flexibility and adaptability in transnational firms (Bloom, Draca, and Reenen 2011a; Thesmar and Thoenig 2000).

Opening the black box of the firm in international trade theory is becoming a major issue to understand how trade affects the labor market. Several papers integrate organizations inside international trade model. Antràs et al. (2006a) study the effect of globalization on the formation of an international team between two countries, the North and the South. They introduce a many-to-one matching into an international trade model. The production team is composed by one manager and many production workers. The model predicts a rise in intra-group inequality in the south, as better matching between southern and northern workers induces an increase in the marginal return to skill of better southern workers. In the North however, increasing competition with southern workers leads to a decrease in their marginal return to skill. The main result for the North shows that when communication technology is good and when the time of managers is scarcer, because low skilled workers in the North are more available, northern wage inequality can go up.

Antràs et al. (2006b), base their analysis on the model above, and are interested in the reasons behind the firms' choice of location in the offshoring process. They show that this choice is contingent to the presence of middle-skilled workers when the communication technology is bad in the host country. The intuition for this result is the following. When communication technology in the south is not available, the firm needs to add a layer of *middle managers* in the host country in order to save the time needed to transmit the knowledge across international teams.

Caliendo and Rossi-Hansberg (2011) develop a model in which firm's productivity depends on how the firm is organized. They base their analysis on the hypothesis that firms need to hire managers to organize input, to plan the production and to solve problems encountered by production workers. The implication of the model is twofold. When firms enter the export market and keep the same number of layers of management before and after entry on the export market, the wage and the number of employees in each layer grows. When firms add an additional layer of management in response to a higher demand, they reduce wages and raise the number of employees in each layer.

Caliendo et al. (2012) test the prediction of the previous theoretical model. They are concerned about the effect of being *primo-exporter* on the organization and the work composition of the firm. French firms that add a layer of management after entering the export market more than double the number of employees in each layer. They also reduce the wage of production workers by 2,5% and reduce the wage of managers in the upper layer by 26%. In contrast, the new management hired to organize the export market earns 97,5% more than the average wage of the firm before the entry on the export market.

Here, we follow the framework of Caliendo and Rossi-Hansberg (2011). However, we analyze the effect of FDI on the organizational structure, rather than the effect of exports.

The second value-added of the paper resides in the empirical analysis. We follow an already vast literature analyzing the employment effect of foreign direct investment on the work-composition of the firm. Head and Ries (2002) observed 1,070 multinational firms in

Japan, between 1965 and 1989, and show that higher employment in foreign subsidiaries is associated with greater use of non-production labor at home, relative to production labor. Hansson (2005) follow 75 multinational companies (MNC) in Sweden during the period 1990-1997 and also observes a positive association between vertical offshoring, defined as offshoring to low-income countries, and the share of skilled workers, in the parent company. Becker et al. (2012) use data on Germany for the years 1998 to 2001, and observe a statistically significant correlation between offshoring and the share of highly educated workers, and also between offshoring and the use of non-routine interactive tasks.

In this article we use a matching technique, in order to analyze the work-composition of the investing firm before and after the foreign direct investment. Other studies have used this technique to analyze the effect of foreign direct investment in France. The study of Hijzen et al. (2011) uses French data over the period 1987-1999. They use a matching technique to measure the effect of FDI, three years after the first foreign investment. They show that investment in low-income countries has no significant effect on employment, only FDI to high-income countries does. The study of Barba Navaretti et al. (2010) analyzes the effect of FDI on employment in France and Italy over the period 1993-2000. They show that first time investors in both developed and developing countries experience significantly higher employment relative to the control group. However, the two studies did not distinguish workers by qualification group. Here, we are interested in the effect of foreign direct investment on the work-composition of the firm, rather than on overall employment.

2 The Model

We follow GRH in conceptualizing the production process in terms of tasks. We assume that there are two types of tasks : routine and non-routine tasks. Routine tasks are performed in order to directly produce the output and non-routine tasks are performed to supervise the production process. Each task needs to be performed exactly once to produce the output.

There are three types of workers in the economy : production workers, managers and CEOs. Production workers are hired to directly produce the output, managers are hired to monitor production workers and CEOs are hired to supervise the entire organization. In each firm, there are n_p production workers, n_m managers, and a unique CEO. Each routine-task requires the input of production workers. Hence, n_p is the total amount of factors needed to produce q units of goods. As in GRH, we normalize to one the measure of routine-tasks, that employ a given number of production workers.

We follow Garicano (2000)'s framework by assuming that the agent's knowledge determines its occupation : CEO, managers or production-workers. Each agent has a knowledge $z > 0$ and one unit of time. For simplicity, we assume that when realizing a particular task i, an agent with a knowledge comprised in the interval $[0; z_p]$ becomes a production

worker, an agent with a knowledge comprised between $[z_p; z_m]$ becomes a manager and an agent with a knowledge comprised between $[z_m; z_{CEO}]$ becomes a CEO. The threshold levels of knowledge z_{CEO}, z_p and z_m are endogenously determined by each firm.

During the production process, problems can occur. Problems arrive in the first layer of the hierarchy, which means that only production workers face problems occurring during the production process. We assume that each production worker has to deal with one problem by unit of time. If the worker's knowledge z includes the solution of the problem, the worker can solve it and the realization of the task can occur. If the worker's knowledge does not include the solution of the problem, the worker will ask the manager to solve it. We assume that each task is independent, in the sense that the realization of a particular task i can be realized even if the task i' is not executed. However, if a particular task i is not realized, given that all the other tasks have been executed, the production of the good cannot occur.

We suppose that knowledge is cumulative, so that a worker with a knowledge $z' > z$ can solve all the problems in the interval $[0, z']$ and a worker with a knowledge $z'' > z'$ can solve all the problems that workers with a knowledge z' can solve, plus an extra one between $[z', z'']$. The distribution of knowledge is as follows :

$$\begin{cases} F(z_p) = 1 - e^{-z_p} \\ F(z_m) = 1 - e^{-z_m} \end{cases} \tag{4.1}$$

Production workers can solve a fraction $1-e^{-z_p}$ of problems and cannot solve a fraction e^{-z_p} of them. Therefore, there is a number $n_p e^{-z_p}$ of problems arriving in the layer of managers each period. Among the $n_p e^{-z_p}$ problems arriving in the managers' layer, a fraction e^{-z_m} cannot be solved neither by production workers nor by managers [3]. Thus, $n_p e^{-z_m}$ problems arrive in the CEO layer.

As in Garicano (2000), the optimal way to organize production is to adopt a *knowledge based hierarchy*. In our model, the number of layers is imposed so that each firm adopts a three layer optimal hierarchy [4]. Production workers are in the first layer of the hierarchy, managers are in the second layer and the unique CEO is in the upper layer.

2.1 Closed Economy

The managers and the CEO spend h_d units of time to treat the problems encountered by production workers, even if they do not have the solution to it. Managers and CEO cannot deal with more problems than their time constraint allows them. We assume that

3. Garicano (2000), includes λ, such that the fraction of unsolved problems are both $e^{-\lambda z_p}$ and $e^{-\lambda z_m}$. In Garicano (2000), λ is a parameter reflecting the firm's economic environment, a higher λ is preferred since the distribution of knowledge is more concentrated close to zero and the fraction of unsolved problems is then less important. Here, we assume no environment instability, such that $\lambda = 1$. This hypothesis does not alter the model's results

4. For a model with endogenous level of hierarchy refer to Caliendo and Rossi-Hansberg (2012) and Garicano (2000).

there is only one CEO in each firm. The number of managers and production workers is obtained by saturating their time constraint [5] :

$$\begin{cases} n_{CEO} = n_p e^{-z_m} h_d = 1 \\ n_m = n_p e^{-z_p} h_d \end{cases} \tag{4.2}$$

With $n_p e^{-z_p}$, the number of problems that cannot be solved by production workers and that arrive in the manager's layer. $n_p e^{-z_m}$ corresponds to the number of problems that cannot be solved neither by production workers nor by managers and arrives in the CEO's layer.

The size of the firm is constrained by the CEO's unique unit of time and is given by :

$$\begin{cases} n_p = \frac{1}{h_d e^{-z_m}} \\ n_m = \frac{e^{z_m}}{e^{z_p}} \end{cases} \tag{4.3}$$

Change in the level of knowledge modifies the number of agents in each layer. An increase in the threshold level of knowledge z_m raises the number of production workers and reduce the number of managers. An increase in the threshold level of knowledge z_m raises the number of production workers a manager can supervise.

In equilibrium all the workers are compensated with an equilibrium wage w, for the unit of time they supply. Assuming cumulative knowledge implies increasing wages, proportionally to the level of knowledge, such that :

$$\begin{cases} w_p = w\,(1 + z_p) \\ w_m = w\,(1 + z_m) \\ w_{CEO} = w\,(1 + z_{CEO}) \end{cases} \tag{4.4}$$

The production is determined by the number of solved problems. The production of the good cannot exceeds the number of solved problems that is $q \leq n_p\,(1 - e^{-z_{CEO}})$.

The organizational design of the firm involves determining the optimal level of knowledge z_m, z_p and z_{CEO} that minimizes its cost, with respect to the size of the firm and its production constraint. The cost minimization problem of a firm is given by :

$$\begin{aligned} &\min_{z_p, z_m, z_{CEO}} C = w\,(1 + z_p)\,n_p + w\,(1 + z_m)\,n_m + w\,(1 + z_{CEO}) \\ &\begin{cases} n_p = \frac{1}{h_d e^{-z_m}} \\ n_m = \frac{e^{z_m}}{e^{z_p}} \\ n_{CEO} = 1 \\ z_m > 0, z_p > 0, z_{CEO} > 0 \\ q \leq n_p\,(1 - e^{-z_{CEO}}) \end{cases} \end{aligned} \tag{4.5}$$

5. The assumption of a unique CEO allows to saturate the time constraint to one and to define an equilibrium number of production workers and managers.

An exogenous shock in the communication cost h_d has implications for the threshold levels of knowledge z_m and z_p and thus modifies the equilibrium amount of production workers and managers that minimizes the firm's cost.

A reduction in the communication cost can be assimilated with a technological progress : an increase in the speed of communication technology.

After substituting the time constraints, the first order conditions of the Lagrangian of this problem gives the optimal level of knowledge z_p, z_m and z_{CEO} with respect to h_d. It is thus possible to measure the effect of a change of h_d on the thresholds level of knowledge by calculating the first order partial derivatives. The results suggest that an improvement in the communication technology, i.e. a decrease in the communication cost, raises the managers' knowledge z_m and reduces the production workers' knowledge z_p (see proof in appendix 4.A).

This shift has implications on the workers' wage, since wages are linear in the euclidean length of the knowledge set, as described in (4.4). Hence, a decrease in the communication cost h_d reduces the wage paid to production workers and increase the wage paid to managers, through its effect on z_p and z_m respectively. The analysis of the program in (4.5) further reveals that decreasing the communication cost h_d raises the span of control of managers, that is, the share of managers over the share of production-workers (See proof in appendix 4.A). The lower the communication cost, the higher the growth of managers relative to the growth of production workers inside the firm. This result is also observed in Caliendo and Rossi-Hansberg (2011). They show that the span of control become smaller when communication costs are larger.

The model manages to reproduce the skill-bias technical change observed in the data. From the 1990s, empirical studies have shown a strong correlation between the relative demand for skilled labor and capital intensity or investment in new technology within a firm (Bartel and Lichtenberg (1987), Doms et al. (1997), Dunne and Schmitz (1995), Siegel (1998), Berman et al. (1994), Machin and Van Reenen (1998)).

2.2 Open Economy

We now consider an economy in which firms have the possibility to fragment its production process in different countries. We assume foreign wages in equilibrium to be lower than domestic wages. Thus, a firm could have incentives to offshore a part of the production abroad to benefit from lower factor costs.

We make the assumption that the firm can only offshore the work in relation with the production process, i.e. routine tasks. We assume that offshoring non-routine tasks performed by managers is prohibitively costly. This hypothesis avoids the possibility of competition between offshore and onshore managers [6]. This assumption is supported by

6. For a model in which managers can be offshored see Antràs et al. (2006).

the literature. Ambos and Schlegelmilch (2007) show that centralization of decision in head office is an important mechanism to control the group as a whole [7].

In the present model, offshoring is costly. We assume that a firm has to bear two additional costs when offshoring part of their production process : (i) an additional cost of offshoring and (ii) a higher communication cost.

We follow the framework of GRH (2008), to define the offshoring cost, which is separated into two components. The first is an administrative cost, noted β, that can be seen as the offshoring technology. We suppose that the firm uses its own technology abroad, such that the offshoring process is realized within the boundary of the firm and excludes outsourcing relationship.

The second cost is specific to the task being offshored. We index the routine tasks by $i \in [0; 1]$. The i-tasks are ordered from the cheapest to the most expensive task to offshore. The function $t(i)$ reflects the tasks-specific cost of offshoring. The ordering of the tasks implies that $t'(i) \geq 0$, such that the cost of offshoring $t(i)$, is non-decreasing.

The originality of the model consists in assuming that firms have to bear an additional cost when offshoring : a communication cost. There is a higher communication cost when offshoring because managers need to spend more time to deal with problems encountered by foreign production workers, $h_f > h_d$. This hypothesis is in line with Cremer et al. (2007) who suppose that with the distance, the number of words used to communicate with domestic workers is less important than to communicate with foreign workers.

Firms ask for the same threshold knowledge z_p for production workers performing the same routine task i abroad and domestically. However, we assume that the two workers are not exactly identical when producing the output, to the extent that firms need to offshore an extra amount $\beta t(i)$ of production workers to perform exactly the same amount of output as domestically. This can be compared to the Samulson's transportation cost, as the firm *looses* a part of the services of production workers in the offshoring process.

In each firm, the marginal task I denotes the conditions under which wage savings just balance the offshoring costs. The firm has to arbitrate between the cost of maintaining its production onshore and the offshoring cost. The cost of offshoring is determined by the wage paid to offshored production workers and the wage paid to managers who supervised offshored production workers. We suppose that the foreign wage is lower than the domestic wage such that $w^* \leq w$. Production workers are paid $w(1+z_p)$ when the production worker is in the home country and $w^*(1+z_p)$ when the production worker is abroad. Hence, when

7. Control can be done by training workers or by sending expatriates. Jaussaud et al. (2012) study how French multinational firms control their affiliates in China. Their results support the assumption of non-substitution between onshore and offshore managers. They show that multinational firms prefer to send expatriates in the case of intra-firm offshoring and do not employ local employee in key management position, in order to maintain a communication between the head office and their affiliates. Informal communication between expatriates working abroad and managers at headquarters is a central mechanism to coordinate activities. Expatriates are often sent for a short period of time, in order to transmit the firm's value, and return in the mother company.

realizing a particular task i, the fraction of problems unsolved by production workers onshore is paid $e^{-z_p}(1+z_p)w$ and $e^{-z_p}(1+z_p)w^*\beta t(i)$ when the production is realized by offshored production workers.

Managers spend h_d unit of time to deal with the fraction of problems unsolved by onshore production workers and h_f unit of time when they come from abroad. Thus, for the realization of a particular task i, the firm pays :

$$h_d((1+z_p)we^{-z_p}w(1+z_m) \tag{4.6}$$

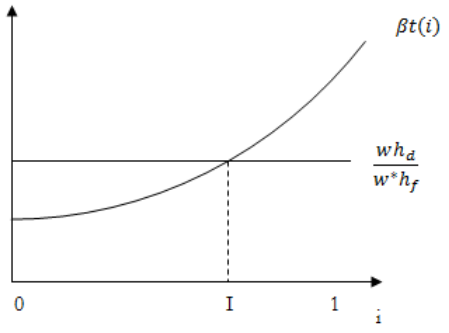
if unsolved problems come from the home country and pays :

$$h_f((1+z_p)w^*e^{-z_p}w(1+z_m)\beta t(i) \tag{4.7}$$

if unsolved problems come from abroad. As in GRH (2008), we suppose that it is profitable to realize some tasks abroad as far as $h_d w > \beta t(0)w^* h_f$. The marginal task I denotes the condition under which the wage saving just balances the offshoring cost and from equation (4.6) and (4.7) we obtain $h_d w = \beta t(I)w^* h_f$.

We illustrate this choice by the graph in Figure 4.1. The growing curve indicates the extra labor that must be employed abroad to realize the task i.

FIGURE 4.1 – Equilibrium share of onshore/offshore production workers



The tasks are ordered so that the function $t(i)$ is increasing. A higher domestic communication cost h_d (foreign communication cost h_f) raises (reduces) the marginal task I. A higher (lower) I raises (reduces) the range of tasks performed offshore and reduces (raises) the number of onshore production workers. Conversely, a lower w^* (w) raises (reduces) the gain cost of offshoring and raises (reduces) the marginal task I.

In equilibrium, a proportion $(1-I)$ of production-workers remains at home and a fraction $\int_0^I \beta t(i)di$ of workers is offshored.

We are now ready to describe the work-composition of the firm in an equilibrium with offshoring opportunities. By using equation 4.2, we are able to determine the firm's wage bill share :

$$\begin{cases} 1 = \left[(1-I)\, n_p h_d + \int_0^I \beta t(i) di . n_p h_f\right] e^{-z_m} \\ n_m = \left[(1-I)\, n_p h_d + \int_0^I \beta t(i) di . n_p h_f\right] e^{-z_p} \end{cases} \tag{4.8}$$

We denote by Ω the communication cost such as $\Omega = (1-I)h_d + \int_0^I \beta t(i) di . h_f$. Rewriting equation (4.8) gives :

$$\begin{cases} n_p = \frac{e^{z_m}}{\Omega} \\ n_m = \frac{e^{z_m}}{e^{z_p}} \end{cases} \tag{4.9}$$

A higher level of knowledge z_m increases the number of solved problems by managers. The benefit of having more autonomous managers able to solve a wider range of problems, is an increase in the number of production workers they can supervise ($\frac{\partial n_p}{\partial z_m} > 0$). On the contrary, an increase in the level of knowledge z_p raises the autonomy of production workers. They are able to solve a wider range of problems, which reduces the number of managers ($\frac{\partial n_m}{\partial z_p} < 0$).

This paper is interested in the employment effect at home of an increase in intra-firm offshoring. We materialize the increase in intra-firm offshoring through a decrease in the offshoring cost β. The effect of a change in the offshoring cost depends on its effect on z_p and z_m, which in turns shifts the optimal number of managers and production workers.

For the sake of simplicity, we first analyze the effect of offshoring for given knowledge. The decrease in the offshoring cost β implies a higher set of workers offshore ($\int_0^I \beta t(i) di$) and reduces the share of onshore production workers $(1-I)$. Increasing offshored production workers raises the time needed by managers to communicate with them, which in turns raise the communication cost $\Omega = (1-I)h_d + \int_0^I \beta t(i) di . h_f$.

Resolving the partial derivatives of n_m and n_p with respect to β implies that :

$$\begin{cases} \frac{\partial n_p}{\partial \beta} = \frac{-\frac{\partial \Omega}{\partial \beta} e^{z_m}}{\Omega} > 0 \\ \frac{\partial n_m}{\partial \beta} = \frac{\partial n_p}{\partial \beta} \Omega e^{-z_p} + \frac{\partial \Omega}{\partial \beta} n_p e^{-z_p} < 0 \end{cases}$$

A decrease in the offshoring cost β raises the number of offshored production workers and raises the number of managers because they need to spend more time to communicate with production workers.

Proposition 4.1. *For given levels of knowledge, a decrease in the cost of offshoring β raises the demand for managers and reduces the demand for production workers.* [8]

The result discussed in proposition 4.1 are given for fixed knowledge z_m and z_p. The results are in accordance with the stylized facts discussed in the introduction. However, the effect of a change in the offshoring cost β on the work composition depends on how it affects the threshold levels of knowledge z_m and z_p. In order to measure the effect of β on the firm's work composition we must determine the effect of a change in β on the optimal levels of knowledge z_m and z_p.

2.2.1 The program

The firm determines the optimal level of knowledge z_m, z_p and z_{CEO} that minimizes its cost, with respect to the size of the firm and its production constraint. . We consider a firm producing a quantity q of goods. Firms are not able to produce more than the number of solved problems encountered by production workers such as $q \leq n_p\left(1-e^{-z_{CEO}}\right)$. The cost minimization problem of a firm is given by :

$$\begin{aligned}
&\min_{z_p,z_m,z_{CEO}} C = w\left(1+z_p\right)n_p + w\left(1+z_m\right)n_m + w\left(1+z_{CEO}\right)n_p \\
&\begin{cases}
n_p = \dfrac{1}{\left[h_d(1-I)+h_f\int_0^I \beta t(i)di\right]e^{-z_m}} \\
n_m = \dfrac{e^{z_m}}{e^{z_p}} \\
n_{CEO} = 1 \\
z_m > 0, z_p > 0, z_{CEO} > 0 \\
q \leq n_p\left(1-e^{-z_{CEO}}\right)
\end{cases}
\end{aligned} \tag{4.10}$$

Each firm decides the share of production workers remained onshore, depending on parameters h_f, h_d, β, z_m and z_p. The threshold levels of knowledge z_p, z_m and z_{CEO} are chosen such that the firm minimizes its cost.

After substituting all the constraints, the Lagrangian for this problem becomes [9] :

$$\begin{aligned}
L_{z_p,z_m,z_{CEO}} &= \frac{(1-I)w(1+z_p)}{\left[(1-I)h_d+\int_0^I \beta t(i)di.h_f\right]e^{-z_m}} + \frac{\int_0^I \beta t(i)di.w^*(1+z_p)}{\left[(1-I)h_d+\int_0^I \beta t(i)di.h_f\right]e^{-z_m}} \\
&+\frac{e^{z_p}}{e^{z_m}}\left(1+z_m\right)w + \left(1+z_{CEO}\right)w + \phi\left[q - \frac{\left(1-e^{-z_{CEO}}\right)}{\left[(1-I)h_d+\int_0^I \beta t(i)di.h_f\right]e^{-z_m}}\right] \\
&+\theta_p z_p + \theta_m z_m + \theta_{CEO} z_{CEO}
\end{aligned}$$

Where ϕ and $\{\theta_k\}_{k=p,m,CEO}$ are the Lagrangian multipliers associated with the constraints. The marginal cost of a higher knowledge z_p is an increase in the wage paid to production

8. The proof of proposition 4.1 is presented in appendix 4.C.
9. See proof in appendix B.

workers. The marginal benefit is a higher share of problems solved and thus a lower number of managers needed to supervise them.

An exogenous economic choc can affect the onshore composition of a firm by directly changing the level of knowledge z_m and z_p and also through the interaction between the two levels. The former is a direct effect, whereas the latter is an indirect effect.

Indeed, the firm determines z_p and z_m simultaneously when minimizing its cost function, both levels of knowledge are determined conditionally on the level of each other. This means that when a level of knowledge changes, the optimal choice of the other one is affected. The two levels of knowledge z_p and z_m can be substitutes or complements, depending on the sign of the second order partial derivative $\frac{\partial^2 L}{\partial z_m \partial z_p}$.

In equilibrium, changes in the offshoring cost β modify the levels of knowledge z_p and z_m and can thus affect the results discussed in proposition 4.1. Now, resolving the partial derivatives of n_m and n_p with respect to β, given that β changes the optimal level of knowledge z_m and z_p gives :

$$\begin{cases} \frac{\partial n_p}{\partial \beta} = \frac{\frac{\partial z_m}{\partial \beta}\Omega - \frac{\partial \Omega}{\partial \beta}e^{z_m}}{\Omega^2} \\ \frac{\partial n_m}{\partial \beta} = \left(\frac{\partial n_p}{\partial \beta}\Omega + \frac{\partial \Omega}{\partial \beta}n_p\right)e^{-z_p} - n_p\Omega\frac{\partial z_p}{\partial \beta} \end{cases} \tag{4.11}$$

The upper equation in (4.11) can be either positive or negative, depending on the size of the numerator. The sign is likely to be positive since $\frac{\partial \Omega}{\partial \beta} < 0$ and $\frac{\partial z_m}{\partial \beta}\Omega$ is small, which implies that decreasing the offshoring cost β reduces the number of production workers. The sign of the second equation depends on the parameters value in Ω [10].

Hence, for all equilibria, opposing effects can arise with increasing offshoring, depending on the values of the parameters in Ω. The following section analyzes the alternative parametrization under which signs change under the countervailing effects.

We proceed in two steps. First, we run numerical simulations by calibrating our parameters on French data on year 2007. Second, we change the parameter values and analyze for which parametrization the equilibrium is affected.

3 Comparative Statics : Numerical simulations

In this section, we propose numerical experiments in order to test the ability of the model to reproduce the elasticities estimated in the literature.

We focus on the effect of a falling offshoring cost β on the onshore wage bill share. Two effects can arise : (i) a change in skill intensity for given wages and (ii) a change in skill intensity consecutive to change in relative wages. The first is a direct effect and the second is an indirect effect arising in a general equilibrium framework, where offshoring affects wages. We only report the outcome of computational experiments for the rigid wage case.

10. A decrease in the offshoring cost raises the number of managers if $\frac{\frac{\partial z_m}{\partial \beta}\Omega - \frac{\partial \Omega}{\partial \beta}e^{z_m}}{\frac{\partial z_p}{\partial \beta}\Omega - \frac{\partial \Omega}{\partial \beta}e^{z_p}} < e^{z_m}e^{z_p}\Omega^2$.

The parameter's calibration of the benchmark simulation are summarized in Table 4.2. The foreign wage w^* is determined as the average compensation costs in 14 main offshoring destinations. Information on wages comes from the US Bureau of Labor and statistics [11]. The 14 main destinations are chosen with the LIFI survey. Countries for which there are more than 200 French affiliates are considered as major French country destinations for offshoring. The 14 main offshoring destination are Sweden, Germany, Japan, Austria, Brazil, Czech republic, Canada, Poland, Italy, Ireland, Netherlands, Argentina, United-States and Portugal in year 2007. We normalize the French wage w to one, and the foreign wage w^* is equal to 0.71.

The offshoring cost function $t(i)$ is supposed to be non-increasing in i and strictly positive. We follow Rojas-Ramagosa (2010) to define a general functional form that can allow both linear and non-linear offshoring costs :

$$t(i) = t_1 + t_2 i^{t_3} \tag{4.12}$$

We assume in the benchmark simulation that $t_1 = t_2 = t_3 = 1$. To test the robustness of the results, we use different parameter values in equation (4.12) to obtain three different cost schedules. We define two other cost schedules to obtain a linear and a non-linear specification, such as (i) $t_1 = 1$, $t_2 = 4$, $t_3 = 1$ and (ii) $t_1 = 1$, $t_2 = 7$, $t_3 = 1.5$

Given this standard set of parameter values, we choose the domestic and foreign communication costs h_d and h_f, such that we match both the span of control, defined as the ratio between the number of managers and production workers $\frac{n_m}{n_p}$ and the wage ratio between managers and production workers $\frac{w_m}{w_p}$ in the French economy.

The number of managers and production workers and their wages are gathered from the French *Déclaration Annuelle des Données Sociales* for year 2007. This database presents confidential yearly social-security records, treated and transmitted by the French National Institute for Statistics. All French employers, including national companies, public administrations and local governments are required annually to declare to the Social-Security organism and to the tax-administration information on each of their employees (sex, age, occupation, number of worked hours and wages).

Table 4.1 reports the mean hourly gross wage [12] for different occupations and for different types of firms : domestic and multinational [13]. It also reports the average number of workers employed in domestic and multinational firms. We report seven types of occupations composed by (i) managers, (ii) engineers, (iii) technicians, (iv) foremen, (v) office workers, (vi) skilled blue collar workers and (vii) unskilled blue collar workers.

11. Wages are gross hourly compensation costs in manufacturing, in US dollar.

12. The gross wage extracted from the DADS includes all amounts paid to the employee with respect to his contract, including incentive schemes and profit sharing, company savings plan, benefits in kind before mandatory contributions (CSG, CRDS). We drop information that could bias our results, by dropping wages behind and after the first and last percentile respectively.

13. Domestic firms are firms having no affiliates abroad, but can export, whereas multinational firms are firms having at least one affiliate abroad.

Table 4.1 – Firm's employment characteristics

	Average number of workers				Average wage of workers			
	Domestic firms		Multinational firms		Domestic firms		Multinational Firms	
Manager	8.56	[33.71]	56.54	[130.48]	35.53	[13.67]	38.82	[11.41]
Engineer	13.71	[68.12]	108.01	[365.95]	29.285	[9.91]	35.01	[12.44]
Technicians	23.61	[76.53]	155.59	[403.11]	18.805	[4.47]	20.62	[4.81]
Foremen	6.46	[20.18]	37.93	[205.31]	16.37	[3.75]	18.76	[4.33]
Office workers	11.19	[30.13]	52.49	[119.03]	13.22	[2.75]	14.57	[3.01]
Skilled blue collars	55.79	[131.94]	214.83	[131.94]	13.225	[2.55]	14.44	[3.15]
Unskilled blue collars	26.27	[61.39]	58.72	[61.39]	10.72	[2.39]	11.06	[3.10]

Source : LIFI, DADS - Year 2007 - Author's calculation - wages are hourly gross wages including all amounts paid to employees in respect of their contract, including incentive schemes and profit sharing, company savings plan, benefit in kind before mandatory contributions (CSG, CRDS)- Descriptive statistics includes all firms employing more than 20 employees - Multinational firms are firms having at least one FDI abroad - Standard errors in brackets

In order to fit the theoretical model, we assume that managers are represented by the firm's administrative and technical executives (engineers and managerial executives). Production workers are represented by qualified and non-qualified blue collar workers, foremen, technicians and office workers. Of course, our two theoretical groups, managers and production workers, can be composed of different groups of occupations. In our robustness test, we check our results by defining managers and production workers by other groups of occupations.

In 2007, the span of control $\frac{n_m}{n_p}$ is equal to 0.18 when firms are domestic, i.e when $I = 0$. The wage ratio $\frac{w_m}{w_p}$ is equal to 2.24 with no offshoring. The calibrated parameters that match with these moments are presented in Table 4.2. h_d is equal to 0.48 and h_f is equal to 0.57, which means that the time needed to solve a problem encountered by a foreign production worker is about 18% higher than the time needed to solve a problem encountered by a domestic production worker.

Table 4.2 – Calibrated Parameter

h_d	h_f	w^*	w	t_1	t_2	t_3
0,48	0,57	0,71	1	1	1	1

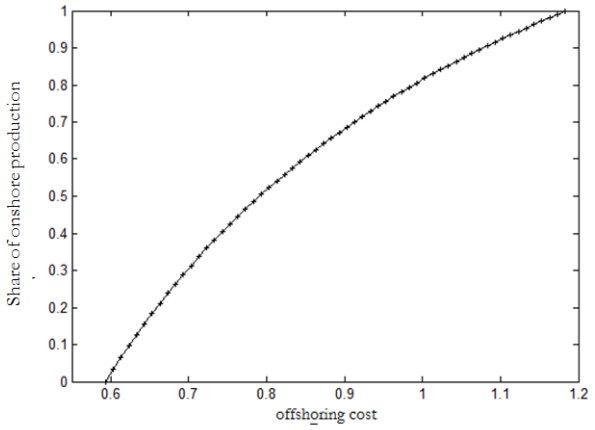
For the calibrated parameters, the offshoring cost β fluctuates between 0.59 when $I = 1$ and 1.19 when $I = 0$.

Simulation Results. This subsection analyzes the effect of a decrease in the offshoring cost β on the number of managers, production workers and their wages.

Figure 4.2 illustrates the firm's integration choice and presents the share of onshore production workers as a function of the offshoring cost β. When the cost of offshoring $\beta =$ 1.19 the gain of offshoring never offsets the cost of offshoring and no tasks are performed

offshore. All the production workers are employed onshore. Decreasing offshoring cost raises the incentive for firms to employ production workers offshore. When the offshoring cost is equal to 0.59, the firm offshores all the tasks performed by production workers and $I = 1$.

FIGURE 4.2 – change in the onshore workforce composition



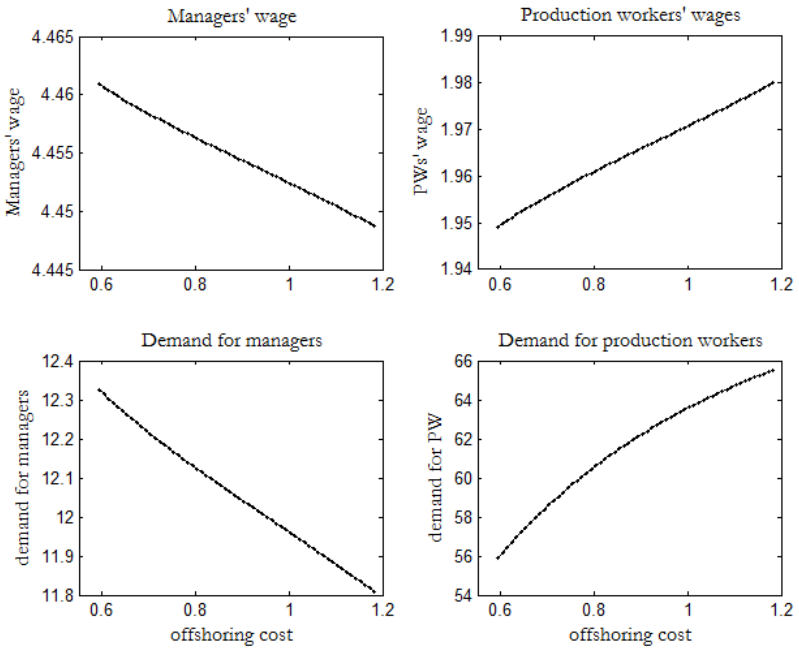
Reading : Matlab simulation showing the share of onshore production workers consecutive to a reduction in the offshoring cost β

Figure 4.3 reports changes in workers' wage consecutive to offshoring in the top figures and changes in the demand for managers and production workers in the bottom figures. Recall that wages are proportional to the workers' level of knowledge, i.e. $w_m = (1 + z_m)w$ and $w_p = (1+z_p)w$. Hence, changes in the workers' wage is due to change in the equilibrium levels of knowledge following a decrease in the offshoring cost.

The two top figures reveal that the two levels of knowledge are substitutes : an increase in the threshold knowledge z_m is compensated by a decrease in the level of knowledge z_p. As a result, the wage paid to managers shifts up and the wage paid to production workers decreases with lower offshoring cost β. On the contrary, the firm asks for less skilled production workers, as shown by the upper right panel in Figure 4.3, which results in a downsizing of production workers' wage.

This result is in line with recent literature on firm level data, which has shown a negative effect of offshoring in goods and services on the real wage of workers in the lowest skill categories, while offshoring raises the wage of skilled workers (see Hummels et al. (2011), Geishecker and Gorg (2008), Munch and Skaksen (2009) for results on Denmark and Germany).

Figure 4.3 – change in the wage bill share



Reading : Matlab simulation showing the evolution of wages and workers' autonomy consecutive to a falling offshoring cost

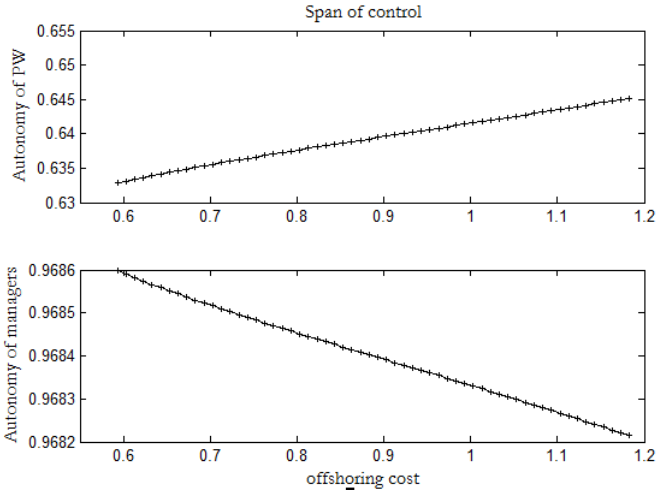
The bottom panel of Figure 4.3 report changes in the demand for both managers and production workers. The lower left-hand side panel in Figure 4.3 shows that the demand for managers rises consecutive to offshoring. A 1% decrease in the offshoring cost β increases the number of manager employed domestically by 0.08%, when the firm starts offshoring. As the share of offshore production workers increases (i.e. when β decreases), the demand for manager increases for additional reduction of β. For example, when $(1-I)$ is close to 0, i.e. when the totality of production workers are offshored, a 1% decrease in β raises the demand of managers by more than 0.15%. Conversely, when $(1-I)$ is close to 0, a 1% decrease in β reduces the demand of production workers by 0.15%. A 1% increase in β reduces the demand of production workers by 0.5%, when β is close to 0.58.

Thus, the results reveal that offshoring raise the firm's span of control $\frac{n_m}{n_p}$, i.e. the share of managers over the share of production workers. Indeed, offshoring raises the number of managers needed to supervise production workers, because supervision of workers abroad is more costly.

This result is in line with an important literature analyzing the effect of offshoring on the relative demand for skilled workers (Feenstra and Hanson (196) for US, Head and Ries (2002) for Japan, Hijzen, Gorg, and Hine (2005) for the UK and Ekholm and Hakkala (2008) for Sweden). Several studies have shown that offshoring can be responsible for

the shift in relative labor demand towards high skilled-labor. In the US, Feenstra and Hanson (1996) have shown that one-third to one-half of the rise in the wage share of non-production workers can be explained by imports of intermediate inputs. For France, Strauss-Kahn (2004) has shown that 11 to 25% of the drop of the demand of unskilled workers relative to skilled workers can be explained by offshoring.

FIGURE 4.4 – change in the workforce's autonomy



Reading : Matlab simulation showing the evolution in the demand of production workers and managers and the demand for their knowledge consecutive to a falling offshoring cost

Figure 4.4 reports change in the autonomy of production workers and managers consecutive to a change in the offshoring cost β. Autonomy is measured as the set of problems solved by agents in a given layer relative to the amount of knowledge in the upper layer. The autonomy of managers is measured by $(1 - exp(-z_m))/(1 - exp(z_{CEO}))$, and the autonomy of workers is measured by $(1 - exp(-z_p))/(1 - exp(-z_m))$. Figure 4.4 shows that firms delegate power of decision to managers in order to have more flexibility and adaptability when firms are integrated into globalization. Hierarchies become then flatter since production workers report more often to managers rather than to the CEO. These results are in line with those obtained by Caliendo and Rossi-Hansberg (2012), Bloom and al. (2010) and Guadalupe and Wulf (2010). The recent literature on firms' organization indeed revealed that international competition led to a delegation of authority from the CEO to the managers (Marin and Verdier (2003), Caliendo and Rossi-Hansberg (2012)).

Decentralization and increasing autonomy affects wages, since decentralization changes the incentives provided by earnings (Cunat and Guadalupe Globalization and the provision of incentives inside the firm : The Effect of Foreign Competition). When firms face uncertainty, due to international competition for instance, delegation of authority is more frequent and workers are better paid in order to stimulate full effort (Prendergast (2002)).

Wulf (2007) argues that decentralization of decisions combined with higher earnings to induce managers' effort are important in incentive design of the firm.

The model manages to reproduce the results observed in the empirical literature. In-house offshoring raises managers' autonomy and wage. We also observe the same results as in Chapter 2 and 3 since the firm hires less production workers and reduces their wage, in order to compensate the increase in the wage bill.

We analyze the robustness of the results by running numerical experiments with different assumptions on the workforce composition and by using different specification of the offshoring function. In a second step we define the parameters under which the signs change under the countervailing effects.

Robustness test. To fit the model, we have made the assumption of a linear function of offshoring cost defined as $t(i) = 1 + i$. To test the robustness of our result, we first use different parameter values in equation (4.12) to obtain three different cost schedules. As in Rojas-Ramagosa, we define two other cost functions t_i : (i) $t_1 = 1$, $t_2 = 4$, $t_3 = 1$ (simulation I) and (ii) $t_1 = 1$, $t_2 = 7$, $t_3 = 2.5$ (simulation II).

We have also made the assumption that *Managers* are composed by engineers and administrative managers and *Production workers* by administrative employees and unskilled blue collar workers. We compare the benchmark simulation by changing occupations constituting the two theoretical groups of managers and production workers. We first assume that *Managers* are administrative executives and *Production workers* are composed of administrative employees, qualified and non-qualified blue collar workers (simulation III). We then assume that *Managers* are engineers and *Production workers* are technicians, foremen, skilled and unskilled blue collar workers (simulation IV).

We also run robustness tests for different average foreign wage w^*. We first consider a group of high income countries composed of Germany, Ireland, Canada, Italy, United-States and Japan. Second, we consider a group of low income countries composed by Singapore, Argentina, Portugal, Brazil and Mexico. In the first case, the foreign wage is equal to 0.91 and in the second case it equals 0.39.

We report the results in appendix 4.D. Benchmark results discussed above remain robust in sign and magnitude when considering different offshoring cost schedules, different workers' category and different offshoring countries. The number of managers and their wages increase consecutive to a decrease in offshoring cost. Conversely, the number of production workers and their wages decrease consecutive to increasing offshoring.

Sensitivity Analysis. The theoretical model has shown different equilibrium configurations, depending on the sign of the parameters values w^*, h_d and h_f. This section intends to

identify the parameters values for which the equilibrium changes. We implement different computation exercises by defining numerous parameter values of h_d, h_f and w^*.

We observe that whatever the parameter values for w^*, h_d and h_f, the span of control (n_m/n_p) rises consecutive to a decline in the offshoring cost β. Nonetheless, the effect of a change in β on workers' knowledge z_m and z_p depends on the sign of the parameters. There are two equilibrium configurations depending on the values of h_d, h_f and w^*. The first equilibrium is the one described in the previous section, in which the autonomy of managers $((1 - exp(-z_m))/(1 - exp(z_{CEO})))$ increases, and the autonomy of production workers $((1 - exp(-z_p))/(1 - exp(-z_m)))$ decreases with a decline in the offshoring cost β. The second equilibrium gives the exact opposite. The autonomy of managers decreases and the autonomy of production workers increases with rising offshoring. The two equilibrium configurations can be summarized as follows :

	Span of control	Autonomy of managers	Autonomy of PW
Configuration I	+	+	-
Configuration II	+	-	+

In the precedent section h_d and h_f have been defined such as the span of control and wages are calibrated on French data, given that $w^* = 0.71$. The parameter values in section 3 give the first equilibrium configuration (configuration I).

We now turn to analyze for which value of w^* the equilibrium configuration changes, given that h_d and h_f are unchanged, i.e. $h_d = 0.48$ and $h_f = 0.57$. When $w^* < 0.84$ the first equilibrium configuration is observed : offshoring raises the span of control and the autonomy of managers in the home country. When $w^* \geq 0.84$ the second configuration is observed, in which increasing offshoring raises the span of control of managers, the autonomy of production workers and reduces the autonomy of managers. In other words, offshoring in a relatively high income country increases the firm's incentives to offshore production workers with a high level of knowledge z_p.

We now identify the value of w^* under which the equilibrium changes in the presence of a strong difference between domestic and foreign communication technology. We assume that the domestic communication cost is equal to $h_d = 0.38$ and the foreign communication cost is equal to $h_f = 0.67$. The first equilibrium configuration is observed when $w^* < 0.57$ and the second is observed when $w^* \geq 0.57$. The more communication technologies are different between the home and the foreign country, the more the *switching* level of foreign wage w^* is low. In other words, the firm has incentives to pay the extra cost of having more autonomous managers (with high z_m) in the home country if the offshoring gain is high, i.e. if the foreign wage is relatively low.

On the contrary, when domestic and foreign communication technology are close, for instance, for a parameter value of $h_d = 0.38$ and $h_f = 0.40$, the *swithwing* level of foreign

wage w^* is high. Offshoring involves the first equilibrium configuration when $w^* < 0.94$ and it provokes the second equilibrium configuration when $w^* \geq 0.94$.

To summarize, whatever the parameter values, a decrease in the offshoring cost β raises the span of control $\frac{n_m}{n_p}$. Changing the parameters values affects the effect on the level of knowledge z_m and z_p (which has implications on wages and autonomy of workers). When communication technologies are different between the home country and the foreign country, offshoring in a country where the relative wage $\frac{w}{w^*}$ is high reduces z_p and increases z_m. On the contrary, when the relative wage $\frac{w}{w^*}$ is low, a reduction in the offshoring cost raises z_p and reduces z_m.

We can illustrate the two configurations by taking the example of a developed home country, such as France, which has a good communication technology ; and two countries of destination with bad communication technology. The two countries of destination have the same technology, but differ in their average wages. We can think of countries in emerging Asia and Central and Eastern European. This scenario is realistic since countries in emerging Asia and Central and Eastern European countries (CEEC) have similar levels of communication technology but different level of wages. According to the world bank indicator of internet users, the proportion of agents with access to the worldwide network is equal to 39.5% in East Asia and Pacific and 45.9% in Europe and Central Asia in 2012.

According to the model's prediction, because wages in Eastern Europe are not as low as in emerging Asia, the firm should raise the number of skilled production workers with a high knowledge z_p in the recipient country when offshoring occurs in Central and Eastern Europe countries. On the contrary the firm should raise the number of unskilled production workers with a low level of z_p in the recipient country when offshoring occurs in Asia, since $\frac{w}{w^*}$ is relatively high. In both cases the span of control increases in the home country : the number of managers relative to the number of production workers increases.

This result is in line with the existing empirical literature. Several authors have indeed shown that offshoring to CEECs increased relative skilled labor demand in the home country (see Egger and Egger (2005) for evidence on Austria, Helg and Tajoli (2005) for evidence on Italy, Geishecker (2006) and Becker and Muendler (2006) for evidence on Germany). Offshoring to CEEC mostly concerns skilled blue-collar workers because firms mainly re-import intermediate goods, in order to assemble final products in the home country. Lorentowicz et al. (2005) who studied the effect of outsourcing to Poland on skill premium in Austria have indeed shown that Firms in Old Europe are outsourcing the more skill intensive stages of production to Eastern Europe. This result corroborates the model's conclusion : increasing offshoring in a country with a relatively high w^* raises the level of knowledge z_p asked to production workers in the foreign country.

When w^* is relatively low, which is the case when offshoring occurs in Asia, the skill intensity and the managers' wage should increase in the home country, whereas the production workers' wage should decrease. The positive effect of offshoring to emerging Asia

on the intensity of managers relative to production workers is also corroborated by the results obtained in the empirical literature (see Wright (2010) for evidences on employment and Hummels et al. (2011) for evidence on wages).

4 Empirical Strategy

This section aims at testing the model's prediction by analyzing empirically the specific role of foreign direct investment on (i) changes in the workforce composition, (ii) on delegation of authority and (iii) on increasing workers' autonomy within the headquarters. This question is empirically hard to answer since the sense of causality is difficult to identify. Decentralization may be at the source of a productivity increase (Gibbons et al. (2008), Bloom et al. (2008)), which could result in the firm's entry in the foreign market (Melitz (2003), Helpman et al. (2004)). Thus, two relations can arise. On the one hand, foreign direct investment can be a source of organizational change, and, on the other hand, managerial and organizational structure can be responsible for improvement in a firm's productivity, allowing it to realize a foreign direct investment. We are here interested in the first relation, i.e. the effect of foreign direct investment on organizational change. We use matching technique combined with a difference in difference estimator in order to control for reverse causality.

4.1 Data description

Our database is constructed with five micro-data sources provided by the French National Institute for Statistics and Economic Studies (INSEE) [14].

Employee level information. Employee level information comes from confidential yearly social-security records, treated and transmitted by the French National Institute for Statistics, the *Déclaration Annuelles des Données Sociales, Postes* (DADS). DADS gives information on wages, age, occupation, number of worked hours of all workers employed in France. Each row of the database corresponds to a particular position in a firm. The database allow to identify the work composition of each French firm. The DADS postes gives details on the occupations of the firm at the 2-digit level.

We used the French working condition survey ("enquête condition de travail"). The survey gives information on organization of work, use of computer and tasks at work for 19,000 workers employed in France. We used the survey to build an index of workers' autonomy. Measuring autonomy using survey data is challenging. The survey includes several questions on work conditions where respondents are asked to rate their autonomy on a 4-points and 3-points scale. Other questions in the questionnaire require a yes/no answer. We build an index of workers' autonomy that originates from four relevant questions about

14. We are really grateful to the CASD, the Gene (Groupes des Écoles Nationales d'Économie et de Statistique) and the National Institute of French Statistic for having furnished these data.

the firm's hierarchy. We code each answer from 1 to 4 such as 1 corresponds to a low level of autonomy and 4 is a high level. The four questions related to workers' autonomy and their according value are :

(i) When you receive orders and instructions do you : apply strictly the instructions (=1)/ In some cases, you do otherwise (=2)/ Most of the time do you otherwise (=3)/ You do not receive order and instructions (=4) ;

(ii) Are your tasks imposed by the permanent controls or monitoring exercised by the hierarchy ? (yes (=1) / no (=2)) ;

(iii) When, during your work, it happens something wrong, do you : Adjust the incident personally most of the time (=3)/ Adjusting the incident personally but in specific cases as provided in advance (=2)/ You usually ask help to a superior, a colleague, a specialized service (=1) ;

(iv) if you have trouble doing delicate, complicated work, are you helped by hierarchical superiors ? (yes (=1)/no (=2))

For each worker, we construct a variable *autonomy* as the sum of the value attributed to each answer. The higher the value, the more autonomous the worker is. We measure a given 2-digit occupation's degree of autonomy as the average of the variable autonomy per occupation. We standardize by the maximum and minimum value in any occupation so that the variable autonomy varies between zero and one across occupations. The highest the index, the more autonomous workers in a particular occupation are.

We build a score on the autonomy of the workforce within firms, by linking this index to the firm's workforce composition. Firms can then be identified by task vectors. The score importance of the index of autonomy i in firm j is :

$$M_{ij} = \sum_{o} \gamma_{oj} l_{oi} \tag{4.13}$$

With γ_{oj} being the share of occupation o used in the production of firm j and l_{oi} being an index of the importance of autonomy i in the occupation o.

Firm level information. Firm level information comes from three confidential databases. The first is the *Liaison Financière* survey (LIFI). This data source collects all the links between the upstream and downstream firms and allows to identify firms having at least one FDI (i.e. firms having 10 % or more of voting stocks). These links offer the possibility to reconstruct the whole business group perimeter. A business group is defined as a set of firms composed by a mother company that is not controlled by another economic entity and all other affiliates controlled by this mother company. We are able to identify both the firm's parent company and the firm's foreign subsidiary. We aggregate the number of foreign subsidiary at the firm level.

The second is a survey derived from the French Manufacturing Census, called *Enquête Annuelle Entreprise* (EAE). This data source provides the detailed income statement of all French manufacturing firms employing more than 20 employees. The database allows to build several control variables of the firm's characteristics, such as tangible assets, revenue and firm's productivity. The firm's productivity is approximated by a measure of total factor productivity which is derived from the approach of Levinsohn and Petrin (2003), which allows to control for endogeneity resulting from the correlation between unobservable productivity shock and input level. We use intermediate inputs as a proxy of the productivity shock (measured as operating expenses). We use value-added [15] as the dependent variable, the number of employees as a proxy of labor force and the total fixed assets as a capital proxy [16].

Finally, the last database is derived from French customs that contains, for all importing or exporting firms, the amount of exports and/or imports by product (CN8 nomenclature on products) and by destination country for each year between 2002 and 2007. We distinguish between finished and intermediate goods. Finished goods are defined as CN8 products that correspond to the same 3-digit NACE code of the main activity of the firm [17]. Other goods imported are defined as intermediate goods. The aim of this distinction is to identify the goods whose production has to be shipped back to the home country in order to be assembled in the home country. Our measure of outsourcing of intermediate inputs is : imports : $\frac{IMI^c_{it}}{T_{it}}$, with IMI^c_{it} corresponding to firm's i imports of intermediate inputs at time t from country group c and T_{it} the firm i sales at time t.

The panel is balanced and the period of observation is 2002-2009. We only keep firms that are identified in the EAE survey. The data source contains 5952 observations. In 2007, there are 744 French firms, of which 184 are engaged in outward FDI, i.e. they have at least one affiliate abroad.

4.2 Methodology

In the present section, we attempt to evaluate the causal effect of FDI on organizational change. We measure organizational change as an increase in supervision activities and a decrease in production activities. In order to capture these changes we follow Caliendo et al. (2013) by identifying the firms' layer of management and production according to the functional characteristic of their workforce. We argue that senior staffs and top

15. The value added is obtained by calculating and summing the firm's markup with the accounting year production (including services).

16. We have used different proxies for technological change, such as investment in R&D, proximity to the sector technology frontier and software investment. The proximity to the firm's frontier represents the gap between the (log) productivity of a particular firm and the highest productivity (or the highest percentile productivity) in the same industry. The productivity of the firm is measured as the value added per worker such as : $Proximity_{ikt} = P^{95} \log\left(\frac{VA}{L}\right)_{kt} - \log\left(\frac{VA}{L}\right)_{ikt}$. We use the 95 order percentile in order to have a robust measure, by excluding outliers. The lower the variable, the more productive the firm is. Whatever the variable retained, our results are not altered.

17. Correspondence tables exist between NC8 classification and the CPA classification (classification of products by activity) for which each product is associated with a single activity (NACE code).

management positions are performing supervision activities, while skilled and unskilled blue-collar workers are performing production activities. We argue that an increase in the number of production workers corresponds to a rise of production activities within the firm, whereas an increase of managers within the firm can be assimilated with a rise of supervision activities. This analysis is close to the one done by Head and Ries (2002) and Becker et al. (2012) who analyzes the effect of transfer within multinational firm on the work-composition at home.

The originality of our empirical strategy is to capture organizational change by identifying the firm's delegation of authority with an index on workers' autonomy as described in section 4.1.

We use matching techniques in combination with difference in difference estimator. The difference in difference estimator compares the number of employees before and after the foreign direct investment. We consider a panel of firms that has made at least one FDI during the period of observation, which we call switchers. Switchers can be either first time investors or multinational firms that raised their number of foreign subsidiaries [18].

The observed outcome of offshoring on a firm j is given by $y_j = y_j^0 + \sum_{k=1}^{K} \left(y_j^k - y_j^0\right) D_{jk}$, where $y_j = y_j^0$ if $D_{jk} = 0$, that is the case when the firm does not invest abroad and $y_j > y_j^0$ if the firm makes a foreign direct investment. However, the outcome that firm j would have had if not offshored is unobserved. The main challenge of matching techniques is to construct an appropriate counterfactual scenario to identify it.

We build the counterfactual scenario by matching switchers with very similar firms which did not choose to engage in FDI. We assign our observations into two groups of firms : domestic firms and switchers. In a robustness test we also match switchers with multinational firms that did not change their number of subsidiaries during the period.

Because we have panel data, we organize firms through cohorts. We define cohorts as windows of five years centered on year t^*, where t^* is the year where domestic firms may choose to invest abroad. We construct five cohorts, centered on years 2004 to 2007. Table 4.3 gives details on the composition of the cohorts.

Table 4.3 – Composition of the cohorts

	Year of Investment						
	2003	2004	2005	2006	2007	Total	Percent.
Domestic	523	528	536	541	548	2676	91.14
Switchers	39	47	39	36	45	260	8.85

Source : LiFi survey, French annual census for manufacturing (EAE), Social-security records (DADS).

18. We do not separate FDI into low-income and high-income countries because there is a too few number of switchers.

For each observation, we need to find matched firms with similar characteristics over a large number of criteria (size, value added, exports, imports, workforce, capital stock and sector). We follow Rosenbaum and Rubin (1983) and their recommendation to use propensity scores. We compute these scores with a probit model, using two-years lagged regressors [19]. We therefore estimate the probability of investing abroad in t^*, according to observable characteristics in $t^* - 2$:

$$P\left(D_{kt} = 1 | X_{j,t^*-2}\right)$$

The propensity score defines the conditional predicted probability of receiving treatment given pre-treatment characteristics X. The matching method relies on three assumptions. First the conditional independence assumption (CIA) that requires that conditional on observable characteristics, the outcomes are independent of treatment ($y_j \perp D_{jk} | X_j$). Second, the common support assumption (CS) imposes for each treated observation to have a matched control observation with similar X ($0 < prob\left(D_{jk} = 1 | X_j\right) < 1$). Third, the balancing condition (BC) requires that assignment to treatment is independent of the X characteristics, given the same propensity score ($D_{jk} \perp X_j | p(X_j)$).

If all these assumptions hold, we can measure the impact of offshoring all things being equal, by using the difference in difference estimator (DID), which measures the evolution of the gap between switchers (treated) and control firms between the period preceding offshoring (treatment) and the following period. The difference in difference estimator is given by $\Delta = E(y^{t^*+t} - y^{t^*-t}) | D = 1) - E(y^{t^*+t} - y^{t^*-t} | D = 0)$, where y^{t^*+t} and y^{t^*-t} represent the outcome t times after and before the first offshoring time, t^*.

5 Construction of the counterfactual

5.1 The boundaries of firms and definition of mother companies

There are many different firm organizations in the economic landscape. In particular, a firm can be part of a business group or be an independent firm. The emergence of a business group is very common across developed economies. For instance, the top 100 largest multinational enterprises listed by UNCTAD (2011) can be included under the category of business group (Altomonte and Rungi (2014)). In France, 65% of total French imports or exports can be attributed to firms that are part of a business group structure (Altomonte et al., 2012). A business group is composed by a mother company and at least one foreign or domestic subsidiary. When no affiliate is located in a foreign country, the group is considered as domestic, while if at least one subsidiary is settled abroad, the business group is considered as a multinational group. On the other hand, independent firms are not controlled by any mother company and can be either multinational firms

19. We follow Hijzen et al. (2011) to use two years lagged characteristics, as the decision to invest can be taken two years before the investment takes place.

(with at least one FDI abroad), exporting firms or domestic firms (without exports nor foreign subsidiaries).

Under this general definition, multinational firms can arise in the two configurations : multinational firms can be a business group's affiliate or be an independent entity [20]. In the case of an independent multinational firm, identification of the mother company is straightforward ; In contrast, in the case of a multinational firm within a business group, two parents can be identified : the parent at the top of the business group's hierarchy and the direct parent of the foreign subsidiary.

It is empirically challenging to know whether the decision to make a foreign direct investment is a global strategy taken at the business group's parent level or taken at the firm level without implications for the business group's parent [21]. This paper is interested in the organizational change arising within *direct* headquarters rather than global organizational changes at the group level. We thus do not concentrate on organizational changes arising at the top-end headquarter of the business group (head of group) but rather consider organizational change arising in every multinational firm (independent firms or business group's affiliates).

5.2 Identification strategy

We consider all firms having increased their number of foreign affiliates between the period 2002-2007. Our identification strategy relies on the comparison of similar firms that do not have any foreign subsidiary abroad (i.e. domestic firms).

There is a whole set of domestic firms in the economic landscape, some of whom present very different characteristics than multinational firms. Along the continuum of domestic firms, only a few of them have very similar characteristics to multinational firms.

The selection into offshoring status by making a foreign direct investment is a deliberate choice. There exists two type of motivations when investing in a foreign subsidiary. A company may find it cheaper or more profitable to produce abroad due to more competitive and/or advanced assets (new technology, cheaper resources, specific skills) which is often referred to as vertical investments. Second, some firms realize a foreign direct investment in order to increase their market share or to save in transportation costs by getting closer to the final consumer, which is often referred to as horizontal investments.

Whatever the motivations behind making a foreign direct investment, the internationalization process of firms is progressive. In particular, firms willing to increase their market

20. Independent firms can be considered as a special case of business groups since they are composed by a mother company in the home country and foreign subsidiaries.

21. This question is important to the extent that it could have different implications in terms of employment. On the one hand, if the foreign direct investment decision is taken at the firm level, organizational change following a FDI may only concern the local business unit. On the other hand, if the foreign direct investment decision is taken at the business group level, the mother company may centralize its international strategy by unifying production process with vertically specialized affiliates and by rationalizing shared functions (R&D, general management, human resources), which may have employment implications on the whole business group.

share often gain experience of the foreign market through exports before making horizontal investments. Whereas, firms willing to save production costs and divide the production processes into different stage may starts by outsourcing domestically or to unrelated foreign supplier. Thus, our first identification strategy relies on the comparison of firms that have no subsidiary abroad but outsource domestically (i.e. they have at least one subsidiary in France), imports intermediate inputs from abroad (with the aim to identify outsourcing from unrelated supplier) and reach the foreign market through exports.

5.2.1 Validity of the identification strategy

The present section presents the counterfactual's construction and details balance properties of the propensity scores.

We use a probit model to match switching firms with domestic firms with similar characteristics. The dependent variable is a dummy variable equal to one if the firm is a switcher and zero if the firm is domestic with the characteristics described above (imports of intermediate inputs, domestic subsidiaries and exports). Switchers are either firms that are already multinational and raise their number of foreign subsidiaries and primo-investors, i.e. firms that set up a foreign subsidiary for the first time [22].

We control for a large number of variables such as the total employment, the share of managers and blue-collar workers. We add firms' controls related to the international status of the firm : exports, imports of intermediate inputs and the number of French affiliates. Finally, we control for firms' characteristics such as the firm's total factor productivity (TFP), the revenue and tangible assets. As done by Hijzen et al. (2011), we build the propensity score by using firms' characteristics two years before the investment takes place, since the decision to invest abroad may occur long time before the year of the investment, which allows to control for anticipatory effects. In a robustness test we have calculated the propensity score by using one year lag firm's characteristics. Changing the number of lags does not alter the conclusion.

Table 4.4 presents the results of the probit model. Results reveal that the work-composition of the firm is an important predictor of the probability to switch. The larger the firm's size in terms of employment, the higher the probability to make a foreign direct investment. In particular, the share of managers within the firm is positively associated with the probability to switch. On the contrary, the share of blue-collar workers is negatively associated with the probability to switch, but the result is not significant. The coefficients associated with firms characteristics are largely not significant, except for the variable associated with total factor productivity and capital. Capital intensity reduces the propensity to set up a foreign subsidiary. A firm that has strongly invested in capital at the home company may not have incentives to raise funds to buy the capital of a foreign

22. The results are very similar when keeping first-time investors in the sample.

subsidiary. However, the coefficient associated with capital is extremely small and does not contribute much to explain the probability to switch.

Table 4.4 – PSM Probit Estimation

Propensity score Probability to increase FDI	coefficients	Standard errors
Total employment	0.001***	[0.000]
Share of Managers	2.983***	[0.727]
Share of Blue-collar workers	-0.412	[0.401]
Capital	-0.000**	[0.000]
Revenue	-0.001	[0.000]
Total Factor Productivity	0,156**	[0,078]
Exports	0.002	[0.001]
Subsidiaries in France	0.011	[0.022]
Imports of Intermediate inputs	0.237	[0.399]
Constant	-1.408***	[0.435]
Sector fixed effects	Yes	
Cohort fixed effects	Yes	
Observations	2,264	
Pseudo R-squared	0.1648	

Note : Standard-errors in brackets are robust ; *, **, ***, statistically significant at 10%, 5% and 1%.

On the contrary, the more productive a firm is, the higher the probability to make a foreign direct investment. The coefficient associated with exports is also significant, as expected. Firms often gain experience of the foreign market through exports before making a foreign direct investment. Gazaniol (2012) shows that roughly 95% of new foreign direct investment are preceded by exports in the destination country.

We then retrieve the propensity scores for each firm in order to match switchers with comparable domestic firms. We use the nearest neighbor matching technique and only keep one control per switcher. Treated firms differ significantly from domestic firms in most respects, we test if there is any remaining significant difference between the group of switchers and the group of control. The balancing tests is reported in Table 4.5. For each variable we report the t-test and the Hotelling test. In each row is conducted the checks for balance based on individual t-tests for each covariate. We perform the Hotelling test at the bottom of Table 4.5 which is a joint test for the equality of means in all the covariates, rather than a test for balance in each of the covariates individually.

Before matching, there are large differences in the covariates between the treatment and comparison groups. In particular, switchers are on average larger and have more managers and less blue-collar workers than the control group. They are relatively close regarding their subsidiaries in France and imports of intermediate inputs. Results show that the means of the treated and untreated are not significantly different in the matched sample and yields reasonable bias reductions. We assume as in Hijzen et al. (2011) that a standardized bias in excess of 20% is large.

TABLE 4.5 – Balance of covariates in match sample

		Mean		% bias	t-test	
		Treated	Control		t	p>|t|
Total employment	Unmatched	546.65	279.81	67.7	9.62	0.000
	Matched	546.65	514.01	8.3	0.65	0.515
Number of French subsdiaries	Unmatched	1.941	1.853	3.7	0.54	0.613
	Matched	1.941	2.081	-6.0	-0.46	0.643
Share of Managers	Unmatched	0.193	0.111	75.8	10.84	0.000
	Matched	0.193	0.199	-6.4	-0.55	0.582
Share of Blue-collar workers	Unmatched	0.461	0.586	-64.3	-8.24	0.000
	Matched	0.461	0.449	6.1	0.57	0.570
Capital	Unmatched	101.44	104.34	-2.1	-0.23	0.819
	Matched	101.44	114.65	-9.6	-0.98	0.328
Total Factor Productivity	Unmatched	1.478	1.174	36.9	5.07	0.000
	Matched	1.478	1.476	0.4	0.03	0.977
Revenue	Unmatched	110000	50139	61.1	8.82	0.000
	Matched	110000	99317	9.4	0.78	0.438
Exports	Unmatched	49503	17945	58.0	8.32	0.000
	Matched	49503	48077	2.6	0.20	0.843
Imports of Intermediate inputs	Unmatched	0.122	0.115	4.9	0.60	0.547
	Matched	0.122	0.116	3.9	0.39	0.699
	Hoteling test				F-test	p>|F|
All Covariates	Treated	-	-		7.994	0.000
	Control	-	-		0.000	0.999

Note : t-test and F-test are conducted after nearest neighbor matching

The Hotelling test also shows that the null of joint equality of means in the two groups is not rejected indicating balance in covariates between the control and treated groups. We are thus confident that our matching strategy permits to compare firms with very similar characteristics.

6 Results

Using the matched sample, we analyze the causal effect of establishing an affiliate abroad. We follow cohorts in time to summarize the evolution of treatment effect from one year before making the foreign direct investment to two years after it. Figure 4.5 presents the treatment results for employment outcomes from $t^* - 1$ to $t^* + 3$. Firms are matched in $t^* - 2$ and the difference in difference estimator corresponds to the difference between switchers and controls between $t^* - 2$ up to $t^* + 2$. The outcomes of interest in this section are the total number of managers, the total number of blue-collar workers and the changes in the autonomy of workers. We do not report the results on the share of managers and blue-collar workers since these rates may change without any employment differences [23].

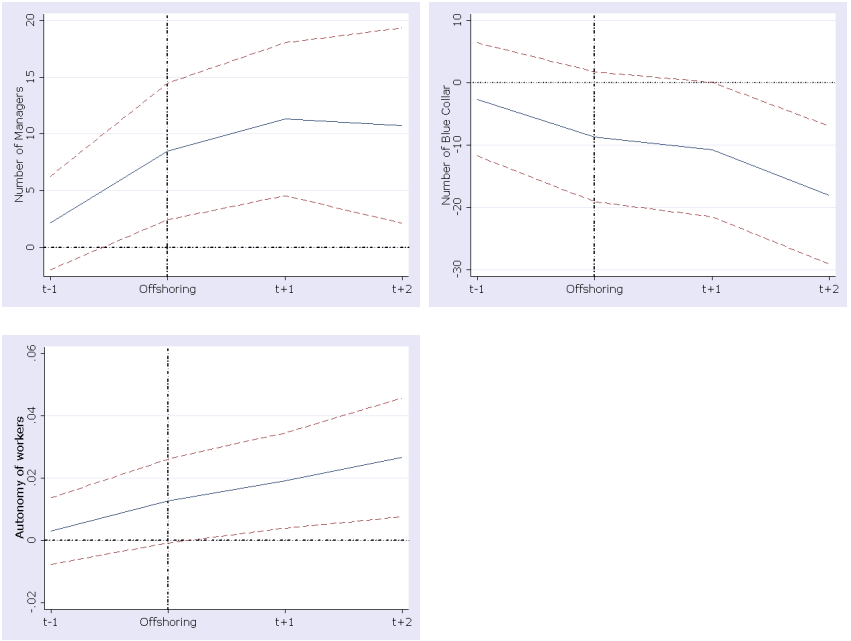
Results of the difference in difference estimates are reported in the following figures. The difference in difference estimates are materialized by the blue line and the confidence

23. Indeed, if the number of production workers decreases, the share of managers may increase without any changes in the number of managers.

intervals are materialized by the red lines. The two top panels in Figure 4.5, present the evolution of managers' and blue-collar workers' employment respectively. Increasing the number of foreign direct investment has a positive and significant impact on the employment of managers one to two years before the foreign settlement. Multinational firms have on average ten more managers than their domestic counterparts two years after the FDI took place.

Conversely, FDI is associated with a significant and lower employment of blue-collar workers. Two years after switching, multinational firms have on average 20 production workers less than their domestic counterparts. Unsurprisingly, since the skill-composition of the firms changes following a foreign direct investment, the index of autonomy is significantly higher two years after the firm's makes a FDI. These results indicate that the skill-composition of the firm shifts towards more autonomous workers (see the bottom panel in Figure 4.5). There is an important reorganization of workers following a foreign direct investment, which changes the workforce-composition towards a skilled and more autonomous workforce.

Figure 4.5 – DID Estimator



Note : Results of the outcome variable (number of blue-collar workers, managers, autonomy) of the difference-in-difference estimator from $t^* - 1$ to $t^* + 2$. Switchers and domestic firms have been matched using nearest neighbor matching.

Interestingly, we find that the change in the skill-composition and autonomy of workers is already observed the year of the switch. One possible explanation is firms' anticipation of the foreign direct investment. Firms prepare for FDI one to two years before the first foreign investment and starts hiring skilled production workers in order to accompany the foreign direct investment (strengthening of supervising and management functions

for instance). This result is less pronounced for blue-collar workers' employment. The employment decrease following FDI is only significant two years after the switch. It might be less immediate to reduce the number of workers, through lay-off or the non-replacement of retirees than to create skilled jobs.

Sensitivity Analysis. Assuming balancing covariates increases the likelihood of obtaining unbiased treatment effects, but it does not prevent unobserved variables to affect simultaneously the outcome variable and assignment to treatment, creating biased estimator. Rosenbaum (2002) developed a sensitivity analysis to the robustness of DID estimates. Rosenbaum (2002) shows that a match pair of individuals can differ in their odds ratio of receiving treatment by a factor Γ, that involves their unobserved characteristic. An odds of one implies that both individuals have the same probability to participate in the treatment and conversely, when $\Gamma = 2$ implies that individuals with similar X differ in their probability of receiving the treatment by a factor of 2.

We use results from the nearest neighbor matching estimates of definition 2, to calculate the Hodges-Lehmann estimates of the impact of the treatment on employment for unobserved confounding variables with different values of Γ. A value of Γ giving estimates confidence interval that crosses zero gives the level at which the impact is non significant. The higher Γ is, the more unlikely a variable with this level of odds relative to controls should be unobserved [24].

Table 4.10 in Appendix 4.E reports sensitivity analysis for the demand of managers in $t^* + 2$, when $\Gamma \in [1; 3]$. In a study free of hidden bias, the Hodges-Lehmann estimates is equal to 5.25, which suggests that the number of managers is significantly higher two years after the first settlement in offshoring firms. The estimates become insignificant at the 5% level when $\Gamma = 2.5$. We therefore conclude that the statistically significant relation between offshoring and the rise in the number of managers is not affected by hidden bias.

Table 4.11 in Appendix 4.E analyzes sensitivity to hidden bias for the demand of production workers in $t^* + 2$, when $\Gamma \in [1; 2]$. It shows that when $\Gamma = 1.4$, the confidence interval of the estimated impact encompasses zero. A critical value of $\Gamma = 1.4$ does not mean that unobserved heterogeneity exists and that there is no effect of treatment on the outcome variable, but means that the results are sensitive to possible deviations from the identifying unconfoundedness assumption and we therefore must be caution in the interpretation of the results (Becker and Caliendo 2007).

The results of the sensitivity analysis show a statistical positive and significant relation between offshoring and the number of managers employed in the offshoring firm two years after offshoring. However, we are more cautious about interpretation of the negative effect

24. In the medical and natural science literature they are confident of invulnerability to hidden bias when $\Gamma > 1.5$ and above and refer to $\Gamma < 1.5$ as vulnerable to hidden bias (Duvendack and Palmer-Jones (2011)).

of offshoring on the demand for blue collar workers, observed two years after offshoring, because these results are very vulnerable to unobservables.

7 Robustness Test

7.1 Different matching methods

The choice of making a foreign direct investment is a deliberate choice that might be related to unobserved characteristics such as different firms' culture, a will to protect firms' intangible assets (specific technology, norms and routines) and/or unobserved workforce ability. In order to compare firms with similar characteristics, we implement several robustness tests by defining two other types of matching : (i) First, a match between multinational firms that have increased their FDI with other multinational firms that did not change their foreign boundaries during the period (definition 1), (ii) second, a match between first time investors with domestic firms (definition 2). Domestic firms are defined as in the previous section, i.e. firms having at least one domestic subsidiary and is either an exporter or an importer of intermediate inputs.

The first row in Table 4.6 is the benchmark result detailed in the previous section. It gives the results of the DID estimator when matching occurs between multinational firms that have increased FDI during the period and domestic firms. The second row gives results when matching concerns multinational firms that made at least one FDI with other multinational firms that didn't (definition 1). Finally, the third raw presents the results when matching occurs between primo-investors and domestic firms (definition 2). Primo-investors are firms that realize for the first time a foreign direct investment and keep the investment for at least two years.

We observe very similar results whatever the matching techniques. Two years after foreign direct investment, the firm increases the number of managers (column (1)) and reduces the number of blue-collar workers (column (2)), which results in a more autonomous workforce (column (3)).

Table 4.6 – Robustness test : Different Matches

		Managers	Blue-collar workers	Autonomy	Nb of treated
(1)	Match MNC with similar domestic	10.611*** [4.329]	-19.892*** [7.570]	0.024** [0.012]	186
(2)	Match MNC with MNC	13.328*** [8.053]	-30.876*** [9.582]	0.036*** [0.012]	186
(3)	Match Primo with domestic	7.408* [5.118]	-17.176* [12.328]	0.037* [0.023]	39

Note : The Table represents the outcome variable in $t + 2$ of the difference-in-difference estimator after nearest neighbor matching for different matches.

7.2 Different counterfactuals

In this section, we report the results of the first match (MNC with similar domestic firms) for different matching techniques. In a robustness test we report Kernel and stratification matching. The first row corresponds to the nearest neighbor matching reported as the benchmark. The second is the Kernel matching, in which all the control firms are used (i.e. domestic firms) and are weighted by the distance from the score of the treated. The third row is the stratification matching, which compares the outcome within blocks of the propensity scores.

Results of the robustness test are reported in Table 4.7. Whatever the matching method retained, results are very similar : FDI raises significantly the number of managers and reduces the number of blue-collar workers two years after switching.

TABLE 4.7 – Robustness test : Different Matching Methods

	Managers	Blue-collar workers	Autonomy
Nearest Neighbor matching	10.611***	-19.892***	0.024**
	[4.329]	[7.570]	[0.012]
Kernel matching	11.263***	-26.823***	0.033***
	[4.568]	[7.491]	[0.010]
Stratification matching	11.355***	-26.474***	0.035***
	[4.881]	[9.254]	[0.009]

Note : The control group are domestic and exporting firms, the treatment group are first time investor. Standard errors are bootstrapped with 100 replications. t represent the year of first settlement for the treatment group.

8 Conclusion

This study seeks to gain insight on how firms change their organizational structure after establishing a foreign affiliate abroad.

The first part of the study proposes a theoretical framework to explain how in-house offshoring creates changes in the firm's workforce organization. We develop a framework where the firm adopts an optimal three layer hierarchy composed by managers, production workers and one CEO. In each period, production workers face problems during the production process and managers are hired to solve them. The firm is willing to offshore part of the production process if the gain of offshoring outweighs the offshoring cost. The offshoring gain is materialized by a lower wage paid to production workers abroad. The offshoring cost is materialized by three distinct components. The first is specific to the particular task being offshored. The second is common to all tasks being offshored since the firm has to pay an administrative cost when offshoring. The third is specific to managers since the firm has to pay an additional communication cost because managers have to solve problems encountered by offshored workers.

The model focuses on the effect of a falling offshoring cost on the workforce organization

and the skill-composition of the firm. Numerical simulations, calibrated on French data, show that offshoring reduces the demand for production workers and increases the need for managers. A 1% decrease in the cost of offshoring raises the number of managers inside the domestic firm by 0.08% and reduces the number of production workers by nearly 0.15%, when the firm starts offshoring. Furthermore, results show that firms delegate power of decision to managers. They become more autonomous as firms ask for more skilled managers, flattening the hierarchy of the firm.

The second part of the study aims at empirically testing the predictions of the theoretical model. We use a panel of microeconomic data for France over the period 2002-2009. An important contribution of the study is to inform the exact workforce composition of firms.

To evaluate the causal impact of offshoring on employment, we use a difference-in-difference estimator. In order to solve the problem of missing counterfactual, we adopt propensity score matching on domestic firms and first time investors. We also add sensitivity analysis to explore the robustness of matching estimates to selection on unobservables. Results of the difference-in-difference estimators show that offshoring significantly increases the number of managers compared to domestic firms with similar characteristics. Conversely, DID estimates show that two years after offshoring, first time investors significantly reduce the number of blue collar workers. Sensitivity analysis show though that this result is very sensitive to unobservables. On the contrary, the positive relation between offshoring and managers is very slightly sensitive to hidden bias.

We also report the results associated with an index of firms' autonomy. The results suggest that the workforce is more autonomous two years after increasing the number of subsidiaries abroad. The results of the empirical part thus corroborates the intuition of the model : there is an increasing need of supervision when the production is geographically spread.

Appendix

4.A The Firm's Program in Closed Economy

In this appendix we derive the first order conditions of the representative firm's program.

$$\begin{min}_{z_p,z_m,z_{CEO}} C = w\left(1+z_p\right)n_p + w\left(1+z_m\right)n_m + w\left(1+z_{CEO}\right)\end{min}$$
$$\begin{cases} n_p = \frac{1}{h_d e^{-z_m}} \\ n_m = \frac{e^{z_m}}{e^{z_p}} \\ n_{CEO} = 1 \\ z_m > 0, z_p > 0, z_{CEO} > 0 \\ q \leq n_p\left(1 - e^{-z_{CEO}}\right) \end{cases} \tag{4.14}$$

After substituting all the constraints the Lagrangian for this problem becomes :

$$L_{z_p,z_m,z_{CEO}} = (1+z_p)w\frac{e^{z_m}}{h_d} + (1+z_m)w\frac{e^{z_m}}{e^{z_p}} + (1+z_{CEO})w + \phi\left[q - \frac{(1-e^{-z_{CEO}})e^{z_m}}{h_d}\right] + \theta_p z_p + \theta_m z_m + \theta_{CEO} z_{CEO} \tag{4.15}$$

Where ϕ and $\theta_{k k=p,m,CEO}$ are the Lagrangian multipliers associated with the constraints. The first-order condition for the knowledge z_p is :

$$\frac{\partial L}{\partial z_p} = 0 \Leftrightarrow z_p = ln\left[(1+z_m)h_d\right]$$

$$\frac{\partial L}{\partial z_p} = 0 \Leftrightarrow \frac{e^{z_m}}{e^{z_p}} - \phi\left[\frac{(1-e^{-zCEO})e^{z_m}}{h_d}\right] = 0$$

$$\frac{\partial L}{\partial z_{CEO}} = 0 \Leftrightarrow 1 - \phi\left[\frac{e^{-z_{CEO}}e^{-z_m}}{h_d}\right] = 0 \Leftrightarrow \phi = \frac{h_d}{e^{-z_{CEO}}e^{-z_m}}$$

$$\frac{\partial L}{\partial \phi} = 0 \Leftrightarrow q = \frac{(1-e^{-z_{CEO}})e^{-z_m}}{h_d}$$

We are able to derive the value of z_m and z_p with respect to h_d

$$\begin{cases} z_p = ln\left[(1+z_m)h_d\right] \\ z_m = \frac{e^{-z_{CEO}}}{(1-e^{-z_{CEO}})h_d} - 1 \end{cases} \tag{4.16}$$

We can thus derive equation (4.16) with respect to h_d in order to analyze the effect of an increase in communication technology on managers' and production workers' wages.

Since $\frac{\partial z_m}{\partial h_d} = \frac{-e^{-z_{CEO}}}{\left[(1-e^{-z_{CEO}})h_d\right]^2} < 0$, an increase in the communication technology reduces the communication cost h_d, which increases the managers' knowledge z_m such as the wage paid to managers rises.

In addition, since $\frac{\partial z_p}{\partial h_d} = \frac{1}{h_d} > 0$, a reduction in the communication cost h_d, which can be assimilated with improvement in ICT, reduces the wage paid to production workers.

We now turn to analyze the effect of an improvement in communication technologies on the firm's span of control. The span of control is defined such as $S = \frac{n_m}{n_p}$, with $n_m = n_p e^{-z_p} h_d$ and $n_p = \frac{e^{z_m}}{h_d}$.

Thus, $S = \frac{n_p h_d^2}{e^{z_m} e z_p}$

The first order partial derivative of S with respect to h_d gives

$$\frac{\partial S}{\partial h_d} = \left(\frac{\partial n_p}{\partial h_d} h_d^2 + 2h_d n_p\right) e^{z_m} e^{z_p} - \left[n_p h_d^2 \left(e^{z_m} e^{z_p} \left(\frac{\partial z_m}{\partial h_d} + \frac{\partial z_p}{\partial h_d}\right)\right)\right] \tag{4.17}$$

By rewriting equation 4.17 we can show that $\frac{\partial S}{\partial h_d} < 0$ since :

$$\frac{\partial z_m}{\partial h_d} h_d - e^{z_m} - 2e^{z_m} < n_p h_d^2 \left[\frac{1}{h_d} - \frac{e^{-z_{CEO}}}{\left((1-e^{-z_{CEO}})h_d\right)^2}\right] \tag{4.18}$$

The left hand side equation is always negative, whereas the right hand side is positive when the knowledge of the CEO is high enough.

When $z_{CEO} \to \infty$, $lim \left[\frac{e^{-z_{CEO}}}{\left((1-e^{-z_{CEO}})h_d\right)^2}\right] \to 0$ and the right hand side of equation 4.18 is positive.

To conclude, this section has shown that an improvement in communication technology, materialized by a decrease in the communication cost h_d raises managers' wage and managers' span of control and reduces the production workers' wage.

4.B The Firm's Program in Open Economy

In this appendix are reported the first order conditions of the representative firm's program.

$$\frac{\partial L}{\partial z_p} = 0 \Leftrightarrow \frac{w(1-I)}{\Omega e^{-z_m}} + \frac{w^* \int_0^I \beta t(i) di}{\Omega e^{-z_m}} - \frac{e^{z_m}\left(w\left(1+z_m\right)\right)}{e^{z_p}} + \theta_p \tag{4.19}$$

With $\Omega = h_d(1-I) + h_f \int_0^I \beta t(i) di$

$$\begin{aligned} &\frac{\partial L}{\partial z_m} = 0 \Leftrightarrow \frac{((1+z_p))\left(w(1-I) + w^* \int\limits_0^I \beta t(i) di\right)}{\Omega e^{-z_m}} + \frac{((we^{z_m})(1+z_m))}{e^{z_p}} \\ &-\phi\left[\frac{\left(1-e^{-z_{CEO}}\right)}{\Omega e^{-z_m}}\right] + \theta_m \end{aligned} \tag{4.20}$$

$$\frac{\partial L}{\partial z_{CEO}} = 0 \Leftrightarrow w - \phi \left[\frac{e^{-z_{CEO}}}{e^{-z_m}\Omega} \right] + \theta_{CEO} \tag{4.21}$$

The second order conditions are given by :

$$\begin{array}{l} \frac{\partial^2 L}{\partial z_m^2} = \frac{(1+z_p)\left[(1-I)w + w^* \int_0^I \beta t(i) di\right]}{\Omega e^{-z_m}} \\ + \frac{e^{z_m}[w(1+z_m)+2w]}{e^{z_p}} - \phi \left[\frac{(1-e^{-z_{CEO}})}{\Omega e^{-z_m}} \right] \end{array} \tag{4.22}$$

$$\frac{\partial^2 L}{\partial z_p^2} = \frac{^2 e^{z_m} w\,(1+z_m)}{e^{z_p}} \tag{4.23}$$

$$\frac{\partial^2 L}{\partial z_m \partial z_p} = \frac{\left[(1-I)\,w + w^* \int_0^I \beta t(i) di\right]}{\Omega e^{-z_m}} - \frac{e^{z_m}\left[w\,(1+z_m)+w\right]}{e^{z_p}} \tag{4.24}$$

$$\frac{\partial^2 L}{\partial z_{CEO}^2} = \phi \left[\frac{e^{-z_{CEO}}}{e^{-z_m}\Omega} \right] \tag{4.25}$$

$$\frac{\partial^2 L}{\partial z_m \partial z_{CEO}} = -\phi \left[\frac{e^{-z_{CEO}}}{e^{-a z_m}\Omega} \right] \tag{4.26}$$

$$\frac{\partial^2 L}{\partial z_p \partial z_{CEO}} = 0 \tag{4.27}$$

In order to have a minimum, the determinant of the Jacobian has to verify :

with $J = \left| \begin{pmatrix} 0 & \frac{\partial \phi}{\partial z_p} & \frac{\partial \phi}{\partial z_m} & \frac{\partial \phi}{\partial z_{CEO}} \\ \frac{\partial \phi}{\partial z_p} & \frac{\partial^2 L}{\partial z_p^2} & \frac{\partial^2 L}{\partial z_p \partial z_m} & \frac{\partial^2 L}{\partial z_p \partial zCEO} \\ \frac{\partial \phi}{\partial z_m} & \frac{\partial^2 L}{\partial z_m \partial z_p} & \frac{\partial^2 L}{\partial z_m^2} & \frac{\partial^2 L}{\partial z_m \partial zCEO} \\ \frac{\partial \phi}{\partial z_{CEO}} & \frac{\partial^2 L}{\partial z_{CEO} \partial z_p} & \frac{\partial^2 L}{\partial z_{CEO} \partial z_m} & \frac{\partial^2 L}{\partial z_m^2} \end{pmatrix} \right| < 0$ with ϕ the functions of constraints.

The effect of a change in z_m and z_p on n_m and n_p depend both on the size of the first layer and on the indirect effect through the interaction between z_m and z_p.

The following equations derives the first order partial derivatives with respect to z_m and z_p.

$$\frac{\partial n_p}{\partial z_p} = \left[\frac{\partial n_m}{\partial z_p} + n_m \right] \Big/ \left(\Omega e^{-z_p} \right) \tag{4.28}$$

$$\frac{\partial n_p}{\partial z_m} = \left[\frac{\partial n_m}{\partial z_m} + \frac{\partial z_p}{\partial z_m} \right] \Big/ \left(\Omega e^{-z_p} \right) \tag{4.29}$$

$$\frac{\partial n_m}{\partial z_p} = \left[\frac{\partial n_p}{\partial z_p} - n_p \right] \left(\Omega e^{-z_p} \right) \tag{4.30}$$

$$\frac{\partial n_m}{\partial z_m} = \left[\frac{\partial n_p}{\partial z_m} - n_p \frac{\partial z_p}{\partial z_m}\right] (\Omega e^{-z_p}) \tag{4.31}$$

Equation (26) and (28) can be both positive or negative depending on the size of the first layer.

Indeed if $\frac{\partial n_p}{\partial z_p} < n_p$, equation (28) is positive and an increase in the production worker's knowledge raises the number of production workers inside the firm. Conversely, if the size of the first layer is relatively small, then $\frac{\partial n_p}{\partial z_p} < n_p$ is negative and equation (28) is negative

Now, the sign of equation (26) depends on the sign of $\frac{\partial n_m}{\partial z_p} + n_m$. By rewriting this equation we obtain

$$\left[\frac{\partial n_p}{\partial z_m} - n_p\right] \Omega e^{-z_p} + hke^{-z_p} n_p$$

Which gives $\frac{\partial n_p}{\partial z_p}$. Therefore, the sign of equation (26) is positive if the first layer is large enough, i.e if $n_p > \frac{\partial n_p}{\partial z_p}$.

The sign of equation (29) depends on the size of the first layer and on the interaction between z_p and z_m. By rewriting equation (29) we obtain :

$$\frac{\partial n_m}{\partial z_m} = \left[\frac{\partial n_p}{\partial z_p}\frac{\partial z_p}{\partial z_m} - n_p \frac{\partial z_p}{\partial z_m}\right] \Omega e^{-z_p}$$

$$\frac{\partial z_p}{\partial z_m}\left[\frac{\partial n_p}{\partial z_p} - n_p\right]$$

If the size of the first layer is large enough : $\frac{\partial n_p}{\partial z_p} - n_p < 0$, then $\frac{\partial n_m}{\partial z_m}$ is positive if both levels are substitutes ($\frac{\partial z_m}{\partial z_p} < 0$) and negative if both levels are complements ($\frac{\partial z_m}{\partial z_p} > 0$).

The sign of equation (27) is more subtle and depends both on the interaction between z_p and z_m ($\frac{\partial z_m}{\partial z_p}$) and on the sign of $\left[\frac{\partial n_m}{\partial z_p} + 1\right]$. By rewriting equation (27) we obtain :

$$\frac{\partial n_p}{\partial z_m} = \frac{\partial z_p}{\partial z_m}\left[\frac{\partial n_m}{\partial z_p} + 1\right] \Big/ \Omega e^{-z_p}$$

We transform $\frac{\partial n_m}{\partial z_p} + 1 < 0$ to obtain the condition under which this equation is positive or negative. We obtain that :

1. $\frac{\partial n_m}{\partial z_p} + 1 < 0$ if $\frac{\partial n_p}{\partial z_p} < \frac{n_p - 1}{\Omega e^{-z_p}}$, i.e if the size of the first layer is relatively big.
2. $\frac{\partial n_m}{\partial z_p} + 1 > 0$ if $\frac{\partial n_p}{\partial z_p} > \frac{n_p - 1}{\Omega e^{-z_p}}$, i.e if the size of the first layer is relatively small.

We can summarize the effect of an increase in manager's knowledge on the share of production workers as :

1. If the size of the first layer is large enough and both level are substitutes, i.e if $\frac{\partial z_p}{\partial z_m} < 0$, then $\frac{\partial n_m}{\partial z_m} > 0$ and $\frac{\partial n_p}{\partial z_m} > 0$
2. If the size of the first layer is low enough and both level are substitutes, i.e if $\frac{\partial z_p}{\partial z_m} < 0$, then $\frac{\partial n_m}{\partial z_m} < 0$ and $\frac{\partial n_p}{\partial z_m} < 0$
3. If the size of the first layer is large enough and both level are complements, i.e if $\frac{\partial z_p}{\partial z_m} > 0$, then $\frac{\partial n_m}{\partial z_m} < 0$ and $\frac{\partial n_p}{\partial z_m} < 0$
4. If the size of the first layer is low enough and both level are complements, i.e if $\frac{\partial z_p}{\partial z_m} > 0$, then $\frac{\partial n_m}{\partial z_m} > 0$ and $\frac{\partial n_p}{\partial z_m} > 0$

4.C Proof of proposition 4.1

Since $\frac{\partial n_p}{\partial \beta} = \frac{\partial n_p}{\partial \Omega}\frac{\partial \Omega}{\partial \beta}$ and $\frac{\partial n_m}{\partial \beta} = \frac{\partial n_p}{\partial \Omega}\frac{\partial \Omega}{\partial \beta}$, it is easy to calculate the effect of a falling offshoring cost β for given knowledge[25]. The first part of the derivatives gives :

$$\frac{\partial n_p}{\partial \Omega} = \frac{-n_m e^{-z_p}}{(\Omega e^{-z_p})^2} \tag{4.32}$$

and

$$\frac{\partial n_m}{\partial \Omega} = \frac{\partial n_p}{\partial \Omega}\Omega e^{-z_p} + n_p e^{-z_p} \tag{4.33}$$

As $\frac{\partial \Omega}{\partial \beta} < 0$, a falling offshoring cost raises the demand for managers and reduces the demand for production workers, for a given knowledge.

4.D Robustness Test

For given parameters, a change in β impacts differently the share of offshored production workers, depending on the offshoring functional form, which is illustrated by the Figure 5.3. It represents the cost of offshoring $\beta t(i)$ as a function of tasks i performed by production workers. The tasks i are ordered from the least to the most expensive task to offshore, such as the cost of offshoring is increasing in i.

25. However the threshold knowledge chosen by the firm, z_p and z_m can be modified following a change in the amount of production workers being offshored. To follow the dynamics demand for knowledge and workers consecutive to a falling cost of offshoring refer to the section 4.

Figure 4.6 – Equilibrium share of onshore/offshore production workers

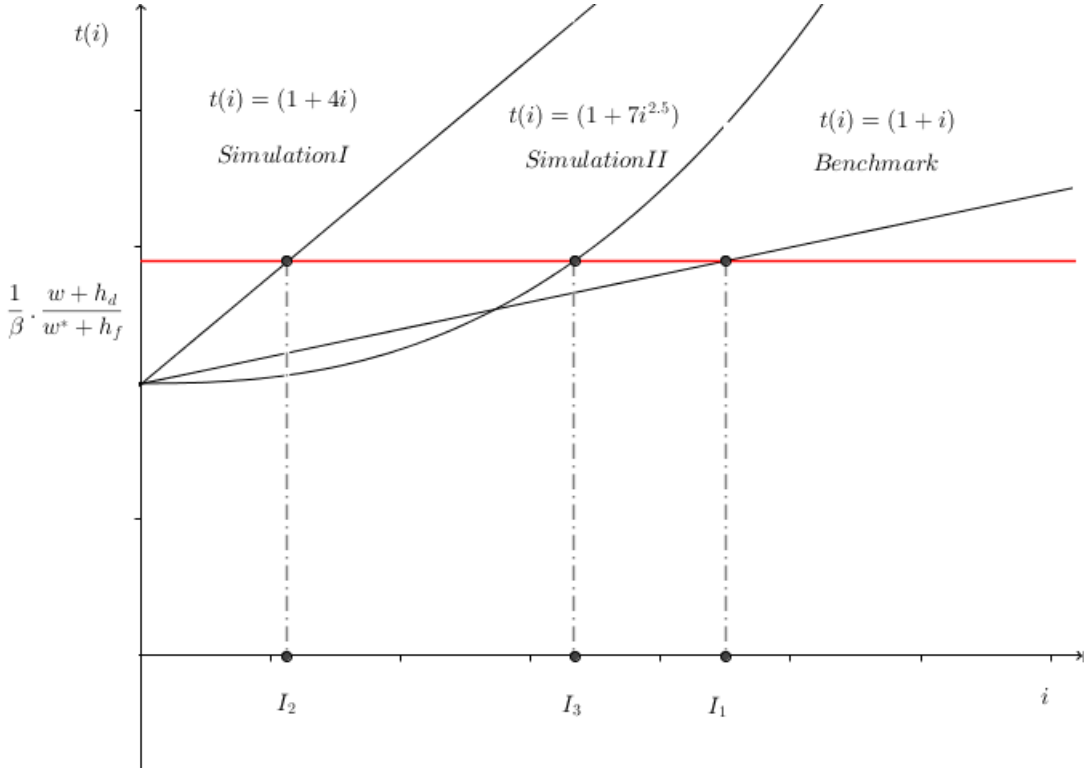


Figure 5.3 represents the functional form of offshoring cost associated to the benchmark, simulations I and II. Changes in the slope from the Benchmark function to simulation I function imply that the firm is less sensitive to changes in β. The function employed in simulation II assumes a non linear cost schedule, where initially the firm is very sensitive to changes in β, and later on, the firm becomes relatively inelastic to changes in β.

The functional form of $t(i)$ also affects the sensitivity of changes in β on the threshold tasks I. Indeed, as $\frac{\partial I}{\partial \beta} = -\frac{\Omega}{t_2 t_3 \beta}$, with $\Omega = \frac{w+h_d}{w^*+h_f}$, the size of the effect of a change in β on the share of onshore/offshore production workers depends on t_2 and t_3. An increase in β implies a decrease in the horizontal line $\frac{1}{\beta}\frac{w+h_d}{w^*+h_f}$ in Figure 5.3. The steeper the slope of $t(i)$, the more important the effect of a change in β on I.

Therefore, to check the robustness of our results, we propose different numerical experiment by changing assumptions made on t_1, t_2 and t_3 as discussed in section 3.

Table 4.8 – Parameters for Robustness test

	Moments		Parameters								
	Span of control	Wage ratio	B (I=1)	B (I=0)	h_d	h_f	w^*	w	t_1	t_2	t_3
Benchmark	0.18	2.22	0.58	1.16	0.48	0.57	0.71	1	1	1	1
Simulation I	0.18	2.22	0.23	1.18	0.47	0.54	0.71	1	1	4	1
Simulation II	0.18	2.22	0.14	1.16	0.47	0.54	0.71	1	1	7	1.5
Simulation III	0.09	2.86	0.64	1.29	0.20	0.22	0.71	1	1	1	1
Simulation IV	0.20	2.32	0.57	1.15	0.61	0.69	0.71	1	1	1	1

Table 4.8 presents parameter values for different scenarii. Recall that scenarii I and II change the assumption made on the offshoring cost's functional form $t(i)$ and scenarii III and IV change assumption made on the type of occupations contained in the group of managers and production workers.

TABLE 4.9 – Robustness Results

% change between I=0 and I=1	Number of Production Workers	Number of Managers	Production workers' knowledge	Managers' knowledge
Benchmark	-15.59%	5.37%	-4.54%	0.26%
Simulation I	-2.84%	5.84%	-5.06%	0.29%
Simulation II	-3.50%	6.35%	-5.32%	0.31%
Simulation III	-5.43%	23.88%	-21.17%	1.16%
Simulation IV	-11.4%	5.3%	-3.9%	0.19%

The first two columns of Table 4.9 report the percentage change of managers and production workers between the situation where there is no offshoring ($I = 0$) and the situation where all the production workers are offshored ($I = 1$). The last two columns report changes in the threshold levels of knowledge z_m and z_p.

Results of simulation I to IV reveal similar results to the one obtained in the benchmark experiment. An increase in offshoring raises the demand for managers and reduces the demand for production workers because both threshold knowledge are substitutes. Indeed, a decrease in the offshoring cost raises managers knowledge z_m and reduces the production workers' threshold knowledge, z_p. This results implies that the CEO delegates power of decision and autonomy to managers and reduces the ability and wages of production workers.

4.E DID and Matching Results

Table 4.10 – Sensitivity Analysis : Number of Managers

	Significance Level (Wilcoxon signed-rank test)		Hodges-Lehman point estimates		95% Confidence Intervals	
Gamma	Lower	Upper	Lower	Upper	Lower	Upper
1	0	0	5,760	5,760	5,188	6,354
1.1	0	0	5,125	6,423	4,573	7,044
1.2	0	0	4,565	7,053	4,029	7,703
1.3	0	0	4,067	7,654	3,545	8,337
1.4	0	0	3,621	8,237	3,102	8,954
1.5	0	0	3,211	8,798	2,699	9,544
1.6	0	0	2,836	9,339	2,325	10,114
1.7	0	0	2,485	9,865	1,982	10,664
1.8	0	4,40E-16	2,163	10,371	1,659	11,198
1.9	0	2,10E-12	1,861	10,859	1,355	11,719
2	0	2,20E-09	1,576	11,339	1,068	12,229
2.1	0	5,80E-07	1,306	11,803	0,795	12,726
2.2	0	0,000045	1,502	12,261	0,535	13,214
2.3	0	0,001359	0,806	12,704	0,286	13,689
2.4	0	0,016682	0,573	13,142	0,046	14,155
2.5	0	0,097866	0,349	13,569	-0,184	14,611
2.6	0	0,310351	0,133	13,986	-0,407	15,059
2.7	0	0,609146	-0,075	14,392	-0,623	15,499
2.8	0	0,845999	-0,277	14,797	-0,832	15,929
2.9	0	0,958719	-0,472	15,191	-1,036	16,351
3	0	0,992426	-0,661	15,579	-1,233	16,763

Note : Sensitivity analysis conducted after nearest neighbor matching. Hodges-Lehmann point estimates provides median shifts between treatment groups.

Table 4.11 – Sensitivity Analysis : Number of Blue collar workers

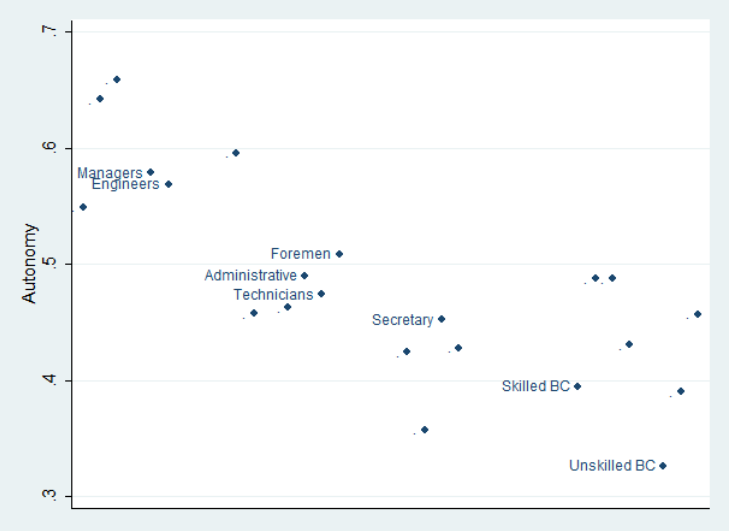
	Significance Level (Wilcoxon signed-rank test)		Hodges-Lehman point estimates		95% Confidence Intervals	
Gamma	Lower	Upper	Lower	Upper	Lower	Upper
1	8.90E-16	8.90E-16	-2.5	-2.5	-3.5	-2
1.1	0	3.90E-09	-3.5	-2	-4	-1
1.2	0	0.000074	-4	-1	-5	-0.5
1.3	0	0.023796	-5	-0.5	-6	-0.00000038
1.4	0	0.380021	-5.5	-0.00000038	-6.5	0.5
1.5	0	0.895092	-6.5	0.5	-7.5	1
1.6	0	0.996678	-7	1	-8	1.5
1.7	0	0.999978	-8	1.5	-9	2
1.8	0	1	-8.5	2	-9.5	2.5
1.9	0	1	-9	2	-10	3
2	0	1	-9.5	2.5	-11	3.5

Note : Sensitivity analysis conducted after nearest neighbor matching. Hodges-Lehmann point estimates provides median shifts between treatment groups.

4.F Autonomy measure

Figure 4.7 illustrates workers' autonomy by occupations. It reveals that managers and engineers have a high autonomy index, close to 0.6. On the contrary, skilled and unskilled blue-collar workers have the smallest index of about 0.4 and 0.3 respectively. Hence, headquarters having a higher share of managers and engineers are more likely to be an important decision-making center, in which the mother company has delegated power of decision to workers.

FIGURE 4.7 – Autonomy index by occupations



Note : The autonomy index varies within the range of zero and one. The higher the index is, the more autonomous the workers are. Autonomous workers are workers that do not rely on superiors' authority when making decisions and are not subject to superiors' systematic control.

Chapitre 5

The effect of foreign direct investments on job-mobility and its consequence on wages

1 Introduction

Although the allocation of resources across economic activities has been a core issue in international trade, little is known on the effect of foreign direct investments (FDI) on the reallocation of labor within the firm [1]. This is an important question from a policy point of view since the need for a mobile workforce is extremely important in a changing environment.

Transfer between plants can be voluntary or involuntary, for promotional opportunities or threatened of layoff, but is often realized to suit the purposes of the company. Transfers may stem from plant closings or relocation, transfers of operations, or the opening of new plants (Andrews et al. (1981)). This article intends to identify the particular role of foreign direct investments in explaining labor mobility between plants belonging to the same firm. In a second step, we identify the wage effect of mobility, in order to separate out the cost and gains supported by individuals to satisfy the firms needs of flexibility.

Firms might go through important reorganization following a foreign direct investment, especially if it involves vertically specialized affiliates. Organizational change following a foreign direct investment can be materialized by a streamlining of redundant business units in the home country or by the strengthening of some activities in a particular plant. This hypothesis is supported by evidence on the specialization of plants in multi-location firms. Following Defever's (2005) analysis on plants' specialization, establishments in the home country are likely to specialize in management functions, while plants in the foreign

1. Several studies have analyzed the effect of foreign direct investments and outsourcing on employment (Hansson (2005), Head and Ries (2002), Becker et al. (2012)), on wages (Hummels et al. (2012), Autor, Dorn and Hanson (2013)) and on firms' productivity (Arita and Tanaka (2014)), but little attention has been paid to the effect of foreign direct investment on labor mobility within the firm.

country are likely to specialize in production activities [2]. Plants are no longer supervised as a stand-alone independent units, but are rather supervised as a network of plants having specific functions (Maritan et al. (2004)). Hence, following a foreign direct investment, a firm might want to bring together competences in a same plant to benefit from economy of scale or to save communication costs (Eriksson (2009), Neffke et al. (2012)).

Worker mobility is a way to bring together different sources of information within plants, since it is one of the key mechanisms through which knowledge is spread (Boschma et al. (2009), Boschma et al. (2012), Hausmann and Hidalgo (2010), Eriksson (2009), Breschi and Lissoni (2003)). Labor mobility can indeed facilitate knowledge creation and knowledge flows between plants because face to face and personal contact contributes the most to the transmission of tacit and codified knowledge (Breschi and Lissoni (2001), Agrawal et al. (2006), Sonn and Storper (2008)). It is also the best way to transmit firm's culture and routines to different establishments, since plants are highly dependent upon the closest geographical origin of such information.

Only a small number of workers may be directly involved in in-house mobility. On the one hand, workers with higher skills and abilities and those whose knowledge complements the existing knowledge of the plant may be good candidates for the move (Boschma et al. (2009)). In particular, workers with strong abilities to manage international teams (adaptability, language and communication skills) and workers with a firm specific knowledge of technology, management practices and firm's culture may be directly concerned by the reorganization of the firm. On the other hand, if the decision to transfer workers is taken because of a plant closure following a foreign direct investment, mobility may concern workers whose competences are obsolete in the light of fragmentation of production processes. Indeed, the firm might have incentives to displace workers in other plants if the dismissal cost is higher than the transfer cost. This is particularly true in France since economic layoffs are allowed only if it is proved that workers cannot be transferred to any other establishment of the business group [3].

Hence, worker mobility can be either positive if the aim is to generate knowledge spillover or negative if transfers concern workers' reclassification following a plant closure. The positive or negative effect of mobility on workers' well-being can be analyzed through a study of its impact on wages one year after the move. Therefore, in a second part of the paper, we analyze the wage consequences of between-plant mobility one year after the move. On the one hand, the response to job mobility can be an increase in the wage paid to mobile workers. At least two reasons explain the positive effect of mobility on wages. First, because moving to a new establishment is costly, the firm may want to create incentives to move to another plant by increasing the migrant workers' wage. Second, because mobility

2. Defever and Puga (2005) have shown that the function of each plant is a key determinant of its location. The location of production plants is determined by wage costs, while the location of management and administrative functions highly depends on a country's governance (Defever (2005), Defever and Mucchielli (2005)).

3. From the article L.1233-4 of the labor code.

is intended to increase the transmission of knowledge to the plant, it is likely that the plant benefits from knowledge spillover and the migrant might be rewarded for it. On the other hand, the impact on wages can be negative if the movement is involuntary, following a plant closure for instance.

As far as we know, this question has not been addressed in the literature [4]. Most of the literature has focused on vertical mobility within the firm [5], i.e. in terms of job-to-job mobility, or on the wage effect of organizational change. A part of the literature has analyzed job-to-job mobility as any movement up in the occupational scale (Robin, Postel-Vinay, Kramarz (2014), Baker et al. (1994)), while another part of the literature has studied promotion as the individual's own perception (Pergamit and Veum (1999), Francesconi (2001)). Empirical results have highlighted within-firm mobility, defined as promotion, to be an important source of earning growth (Belzil and Bognanno (2008), Booth, Francesconi and Frank (2003), Frederiksen et al. (2010)).

Another bulk of the literature has focused on the wage effect of organizational change, which might be close to what we want to capture in this article. Cappelli and Neumark (2001) find organizational change, defined as decentralization and flattening hierarchy, to be associated with higher labor costs due to increasing wages. Osterman (2006) finds that companies having implemented organizational changes pay higher wages to core blue-collar workers and managers. Bertschek and Spitz-Oener (2004) find similar results with German data. However, the foregoing studies do not identify the wage effect of workers directly engaged in organizational change, i.e. workers moving from one establishment to another.

In order to conduct this analysis, we exploit a detailed employer-employee database for France over the period 2002-2007, which gives a great advantage with respect to the existing literature because it allows to identify intra-firm mobility and to identify the workforce by level of occupation (blue-collar workers, managers). We first use a conditional fixed effect logit model to analyze the effect of increasing foreign direct investment on the probability to change plants. In a second step, we analyze the effect of changing plants on wage. We apply a two-step procedure of the Heckman type to control for selection bias, since it is likely that better workers are self selected to ensure the transmission of knowledge and may thus have a higher wage prior to the move.

Our paper contributes to the existing literature in different ways. To our knowledge, we are the first to implement an estimation of the impact of foreign direct investment on between-plants mobility. We are also the first to analyze the wage effect of horizontal mobility, i.e. mobility between-plants of the firm. Most of the literature has focused on the

4. The characteristics of same-employer migrant workers has been analyzed actually. Hunt (2004) shows that within-firms migrants have higher education and pre-move wages than non-migrant workers.

5. The literature has focus on wage effect of mobility depending on the characteristics of promoted workers (Pergamit and Veum (1999), Francesconi (2001)), on seniority in promotions decisions (Bell and Freeman (2001)) and differences between gender (Lazear and Rosen (1990), Booth et al. (2003)). See Ferreira (2009) for a detail of related literature. Results generally show that intra-firm mobility cause larger wage growth than inter-firm mobility if it is associated with occupational changes (Zimmermann (1998)).

wage effect of within-firm mobility, defined as promotion, without looking at horizontal mobility. Second, using a Wooldridge (1995) model, we are able to identify the causal impact of between-plants mobility on wages. We use an original instrument to control for selection bias : the distance between the place of work and the place of living. The instrument is strongly correlated with the probability to change plant since workers have incentives to reduce the time needed to go to work, but the distance has no reason to be correlated with wages.

Results show that foreign direct investments to low-income countries explain significantly managers' mobility between plants. This result strongly supports the assumption of Chapter 4, stating that reorganization of work may be more important when affiliates are vertically specialized. The second part of the results show that workers mobility is associated with higher wages one year after the move. However, the positive effect is only observed in the sample of managers.

The Chapter is organized as follows. Section 2 gives a brief review of the literature. Section 3 describes the data and the construction of the main variables. Section 4 provides descriptive statistics on wage inequality in France. Section 5 details the two methodologies used to analyze the role of FDI in explaining organization change. Section 6 provides the results and Section 7 concludes.

2 Mechanisms and Related Literature

Foreign direct investment is an important source of organizational change. Globalization provokes expansion in terms of geography, activity and products, involving cost in transmission of information which favors decentralization of decision (Guadalupe and Wulf (2010), Caliendo et al. (2012), Marin and Verdier (2003), Aghion and Tirole (1997), Antràs et al. (2006), Caliendo and Rossi-Hansberg (2012)). [6]

Multi-location is the consequence of the separation of the firm's management and production into specialized plants in upstream and downstream activities. The localization of each plant is highly dependent on their functions (administration, management, accounting, R&D, production or logistic activities). For instance, the location of production plants is highly determined by wage costs, whereas the location of management and administrative functions strongly depends on a country's governance (Defever (2005), Defever and

6. Technical progress has also been underlined as a potential source of organizational change. Technological change has considerably facilitated the transmission of information and knowledge, giving responsibilities and autonomy to workers (Garicano (2000), Bloom et al. (2009)). Thus, the diffusion of new technologies has encouraged decentralization of decision making (Caroli and Van Reenen (2001), Bresnahan, Brynjolfsson, and Hitt (2002), Acemoglu et al. (2007).

In practice, international competition and technological progress are intricately linked. Imports from low-wage countries provide greater incentive to innovate and strengthen R&D activities (Bloom et al. (2011), Glass et Saggi (2001), Naghavi et Ottaviano (2010)). Reversely, reduction in transportation and communication costs have fostered foreign direct investment and trade in tasks (Grossman and Rossi-Hansberg (2008)). A decrease in communication costs has allowed to better understand and face firms' problems from a distance, which has fostered the creation of multi-location firms (Gori (2013)).

Mucchielli (2005)). R&D and logistic activities tend to locate near production activities whereas sales, marketing, accounting and administration activities are not attracted by production activities (Defever (2005)). In light of increasing vertical fragmentation of production process, a multinational firm may maintain in the home country specialized plants in pre-production activities such as marketing, management and administration activities and offshore downstream stages to make production-oriented and/or distribution-oriented investments, such as direct sales to the consumer and production activities (Hanson et al. (2001)).

Worker mobility may be the consequence of organizational change following a FDI. Indeed, a firm can adapt to environmental change by two mechanisms. On the one hand, it can hire new workers if there is no need for firm-specific skills or if the new worker is a better match (Gabarro (2010), Acosta (2010)). On the other hand, it can transfer existing workers towards a specific plant, resulting in worker mobility. A firm may want to bring together competences in a same plant to benefit from economy of scale and to save communication cost. In particular, recent studies have shown that multi-plant firms adopt a cluster-based approach by having knowledge based within a plant, firm or region in order to increase their performance and flexibility (Eriksson, 2009), Boschma and Iammarino (2008), Boschma et al. (2009) and Neffke et al. (2012)). Changes in a firm's boundaries due to an increased number of subsidiaries abroad can create (i) a need of specific knowledge (in terms of knowledge of the foreign language, the culture, foreign laws) and (ii) a need to strengthen *upstream* functions when a firm is vertically specialized which may result in different allocation of labor across plants. The same reasoning holds following a change in the firm's technological environment. Implementation of technological progress may need specific knowledge, which may imply the transfer of key people associated with the implementation of technological progress. Ettlie (1990) has shown that innovation is associated with workers' mobility. In particular, it appears that managers move between plants during initiation of the innovation process.

To the best of our knowledge, no study has analyzed the wage effect of job change between establishments belonging to the same firm. Studies have focused on the link between wage growth and workers' mobility between firms. The job-search model of Mortensen (1986) predicts that workers' productivity depends on their employer. Workers are assumed to search for firms that will raise their productivity. Hence, job mobility can affect their wage positively. According to human capital theory (Becker, 1962), the positive effect of mobility depends on the transferability of specific-human capital across firms. The more it is transferable, the more the wage growth will be important.

Wage mobility between plants without changing employer is a specific type of mobility for several reasons. First, within-firm mobility reduces asymmetric information, since the workers' skills are likely to be known and information on the conditions of the new job is likely to be easily available. Second, within-firm mobility can be a low cost move, since moving cost are likely to be paid. Third, if mobility is associated with higher responsibilities

in the new plants, skills are likely to be fully rewarded in the new job. In the second part of the chapter, we analyze the wage effect of within-firm mobility.

3 The Data

Our database is constructed with five micro-data sources. Two of them are employee based databases (Déclaration Annuelles des Données Sociales (DADS), Échantillon Démographique Permanent (EDP)). These data share a common firm identifier which allows a merge with three others firm-level databases (Liaison Finanière (LIFI) and Enquête annuelle entreprise (EAE) and customs data). [7]. Since several changes have been conducted to improve these databases, we only provide detailed descriptions of the data for our period of observation (2002-2007).

Employee Level Information. The administrative panel - Déclaration annuelles des données sociales - is built from confidential yearly social-security records, treated and transmitted by the French National Institute for Statistics (INSEE). These administrative records are based on firms' mandatory report of workers subject to payroll taxes to fiscal authorities. The database covers all firms in the private and public sector. From this administrative record, a panel of individuals born in October is built. Each observation consists of an employer-employee match and reports their sex, age, residence and workplace's region, yearly real earnings (in 2007 euros), the number of hours and days worked each year. [8].

Since wages and careers are likely to be affected by personal events such as child birth or marriage, we use data enhanced by information from the Permanent Demographic Sample (échantillon démographique permanent, EDP). The Permanent Demographic Sample is enriched annually from the annual census surveys. Currently, about 900,000 individual's demographic and social stories are well tracked. The sample includes all the civil status and information from census surveys for individuals born one of the first four days of October each year. This data source gives details on education, marital status and number of children.

Finally, we use the French working condition survey produced by the French "Direction de l'Animation de la Recherche, des Etudes et des Statistiques" (DARES) in 2005. The inquiry is realized every 7 years on a sample of 19,000 workers and measures several aspects of working conditions based on the statements of employees. In particular, we are interested in questions related to the use of computers. We derive an index on the intensity of the use of computers at the occupation level. The index is derived from the yes/no question : "do you need to work, even occasionally, with a computer connected to a network or to other

7. We are really grateful to the CASD, the Gene (Groupes des Écoles Nationales d'Économie et de Statistiques) and the national institute of french statistic for having furnished these data.

8. Workers in the DADS can be identified in several position, we only keep the worker-firm match for which the job spell and salary is the highest.

computers ?". A negative answer is coded 0 while a positive answer is coded 1. We build an index reflecting the intensity of the use of computer at the occupational level. The index is the ratio of the sum of answers over the total number of workers in a particular 2-digit occupation, such as $\frac{1}{n_{io}} \sum_i d_{io}$ where d_{io} is a dummy equal to 1 if the worker i answers 'yes' to the question on the use of computer and 0 if the answer is no. n_{io} is the total number of workers i in a particular occupation o. The more workers in a particular occupations declare using computers, the higher the index is [9].

Firm level information. Firm level information comes from two confidential databases. The first is the *Liaison Finanière* survey (LIFI), which collects all the links between the upstream and downstream firm and allows to identify firms having at least one FDI (i.e. firms having 10 % or more of voting stock in a subsidiary). We are able to identify both the firm's parent company and the firm's foreign subsidiaries. Our measure of globalization corresponds to the number of foreign subsidiaries abroad at the firm level.

We also derive information on imports from French customs. This base contains, for all importing and/or exporting firms, the amount of exports and/or imports by product (CN8 nomenclature) and by destination country for each year between 2002 and 2007. We distinguish between finished and intermediate goods. Finished goods are defined as CN8 products that correspond to the same 3-digit NACE code of the main activity of the firm [10]. Other goods imported are defined as intermediate goods. Our measure of outsourcing corresponds to the share of imports of intermediate inputs and finished goods over the firm's sales : $\frac{II_{it}^c}{T_{it}}$ and $\frac{FG_{it}^c}{T_{it}}$ respectively. With II_{it}^c corresponding to firm's i imports of intermediate inputs at time t from country group c, FG_{it}^c corresponds to the firm's imports of finished goods at time t from country group c and T_{it} the firm i sales at time t. We define the same two groups of countries (low-income and high-income) as defined in the previous chapters.

Finally, we use a survey from the French manufacturing census, called *Enquête annuelle entreprise* (EAE). This data source provides the detailed income statement of all french manufacturing firms employing more than 20 employees. This database allow to build several control variables of the firm's characteristics, such as value added, tangible assets and revenue [11].

Initially, the sample of the DADS covered the private sector establishments, government owned establishments and hospitals. By merging these databases, we only keep manufacturing firms in the private sector, excluding firms of the energy sector, employing more

9. Managers have an index of 0.905 (90% of respondents in the occupation of managers declared using a computer), engineers have an index of 0.931, administrative workers of 0.805, technicians of 0.799, foremen of 0.610, secretary of 0.805, skilled blue collar workers of 0.311 and unskilled blue collar of 0.206.

10. Correspondence tables exist between NC8 classification and the CPA classification (classification of products by activity) for which each product is associated with a single activity (NACE code).

11. The value added is obtained by calculating and summing the firm's markup with the accounting year production (including services).

than 20 employees. Our database contains information on 26,115 employees and 9,833 employers. We provide a detailed descriptive statistics of principal variables for the pooled sample (in appendix).

4 Descriptive Statistics

Large firms are composed by many plants- or establishments- with different roles in the firm. Plants may be located in one country- which is the case for domestic firms- or be located in at least two countries- which is the case for multinational firms (Caves (2007), Antràs and Yeaple (2013)). Multinational firms are on average more productive and bigger.

Table 5.1 reports descriptive statistics to illustrate main differences between multinational firms and domestic firms. We split the sample into multinational firms, that are firms having at least one foreign subsidiary ; exporting firms, that are firms that do not have any subsidiary but have positive exports ; and domestic firms, that have no subsidiaries nor foreign affiliates and do not export. In our sample, multinational firms have more internal movers [12] than purely domestic firms as shown by the first raw of Table 5.1. Around 5% of the sample of workers employed in multinational firms are movers over the period 2002-2007, against 3% of workers in domestic and exporting firms. Several factors may explain why there is nearly two times more movers in multinational firms than in domestic firms. On the one hand, the size of multinational firms allows to have an important internal job markets. On average, multinational firms have more than 900 employees against around 100 in domestic firms, as shown by the third line of Table 5.1. Transferring employees in another site permits employers to be well informed about the productivity of employees, which reduces uncertainty faced by employers when hiring new candidates. On the other hand, multinational firms have a higher number of plants than their domestic counterparts (63 plants on average against 3 for domestic firms), which permit employees to benefit from possible opportunities at other sites and to be well informed about it (Hunt (2004)).

Multinational firm are also more diversified than their domestic counterpart. We report the firm's degree of diversification, defined by the ratio between the number of plants operating in a different two-digit industry than the mother company and the total number of plants. On average, more than 22% of plants operate in a distinct sector, against 6% in domestic firms. Diversified firms benefit from the real option to redeploy workers across their line of business, from declining to expanding industries (Tate and Yang (2013)), which can explain the importance of movers within multinational firms. Tate and Yang (2013) analyze the effect of diversification on workers' mobility within the firm. They show that diversified firms are more able to respond to local economic shock by shifting labor internally to industries with good opportunities and away from declining industries. They

12. Movers are defined as workers who switch establishments within the same firm at least once during the period 2002-2007.

find a more active internal labor markets in diversified firms.

Table 5.1 – Descriptive statistics : Firms characteristics

	Domestic Firms		Exporting firms		Multinational firms	
Share of movers	3.02%	[0.171]	3.08%	[0.173]	5.22% [0.222]	
Diversification ratio	0.059	[0.206]	0.114	[0.255]	0.219	[0.269]
Internal labor market	113.7	[245.935]	200.7	[354.200]	914.1	[1932.06]
Number of plants	2.96	[8.074]	13.45	[93.34]	63.83	[204.92]

Source : LIFI survey, French annual census for manufacturing (EAE), French Déclaration annuelles des donnés sociales (Panel DADS-EDP) ; period : 2002-2007. Internal labor market is the total number of workers employed in domestic, multinational and exporting firms, it is derived from the DADS postes. Diversification is the ratio of the number of plants operating in a different two-digit industry (NAF classification) over the total number of plants.

Difference between movers and stayers at the occupational level. Table 5.2 splits the sample of workers into four different occupational categories : managers that are composed by engineers and white-collar managers ; intermediate occupations, that include foremen and technicians ; employees that cover unskilled white-collar workers (secretary, administrative employees) and blue-collar workers. The share of workers moving across establishments increases with the level of skills. 5.14% of managers in multinational firms have moved to other establishment belonging to the same firm, whereas only 3.19% of managers have experience an establishment change without changing employer in domestic firms. This gap is reduced for other occupations. The share of between-plants blue-collar migrants is quasi similar in multinational firms and domestic firms. 1.66% of blue collar workers employed in multinational firms has experienced a within-firm mobility, against 1.19% in the group of domestic firms. The gap reduction between the two groups highlights a skill-bias of within-firm mobility.

Table 5.2 – Descriptive statistics : Between-plant mobility by occupations

Occupation	All firms		Multinational firms		Domestic Firms	
	Mean	SD	Mean	SD	Mean	SD
Managers	3,91%	0,193	5,14%	0,221	3,19%	0,176
Intermediate occupations	3,00%	0,171	4,16%	0,200	2,36%	0,152
Employees	2,33%	0,151	3,04%	0,172	2,03%	0,141
Blue-collar workers	1,30%	0,113	1,66%	0,128	1,19%	0,109

Source : LIFI survey, French annual census for manufacturing (EAE), French Déclaration annuelles des donnés sociales (Panel DADS-EDP) ; period : 2002-2007. Domestic firms are composed by exporting and non-exporting domestic companies.

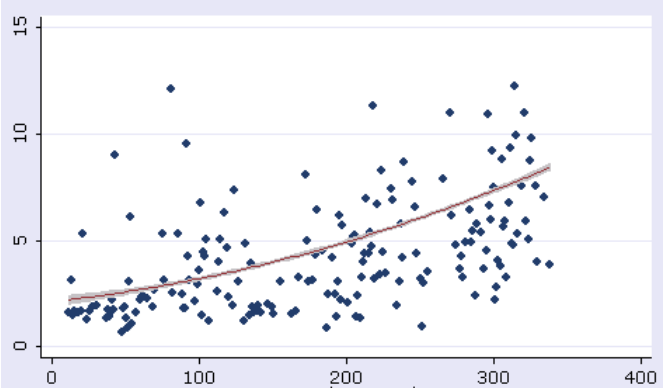
We provide first evidence on the type of workers concerned by internal mobility. It has been underscored that the probability of within firm mobility, in terms of promotion, is a function of schooling, ability and job experience (Sicherman and Galor (1990)). The more workers are educated, the more likely they will move up in the hierarchy. Yet, the effect of education is stronger to explain within-firm career mobility (in terms of promotion) than to explain inter-firms mobility (Sicherman and Galor (1990)). A stylized fact, described in table 5.2 on within-firm and between-plant mobility highlights an educational bias in the process of within-firm mobility. 3.91% of managers in the sample have moved to another

establishment of the firm against 3.00% of intermediate occupations, 2.33% of employees and 1.30% of blue-collar workers.

Knowledge spillovers can increase with the worker's level of skills since the speed of adjustment to technological change or to foreign direct investment depends on how transferable specific skills are across establishment. Therefore, a firm might want to transfer high-skilled workers, with firm-specific skills and high abilities, in order to increase knowledge spillovers in its plants.

Figure 5.1 illustrates the skill-bias of within-firm mobility. It depicts percentage of job change over the level of wage in different groups of occupations. To capture these developments, we first ranged groups of occupations by their average hourly wage over the period 2002-2007. The X axis sorts the 338 groups of occupations in an increasing order, where the first group defines the lowest paying occupations and the last group defines the group of highest payed occupation [13]. The first group has an average hourly gross wage of 9.78 euros and the last group of 67.64 euros.

Figure 5.1 – Share of workers changing plants by occupations



Source : LIFI survey, French annual census for manufacturing (EAE), French Déclaration annuelles des donnés sociales (Panel DADS-EDP) ; period : 2002-2007.

We then calculate the share of mobile workers in each of the 338 groups of occupations. Mobile workers are defined as workers having changed establishment at least once during the period of observation. More specifically, we define this share as

$$\kappa = \frac{\text{Total number of workers changing establishment in group of occupation j}}{\text{Total number of workers in group of occupation j}} \tag{5.1}$$

κ ranges from 0.68% to 12.25%. The highest share is associated with occupation coded 373b in the french PCS-ESE classification, which corresponds to administrative and commercial managers in firms of 500 employees or more. 12.25% of administrative managers have changed establishment inside the same firm at least once during the period 2002-2007.

13. For confidentiality reasons we do not report the type of occupation associated with the highest and the lowest paid group.

The lowest share is associated with occupations coded 675*c* in the french PCS-ESE classification, which corresponds to unskilled blue-collar workers in the printing and publishing industry. 0.68% of them have changed establishment between 2002 and 2007. The Y axis reports the share of movers in each group of occupations.

Figure 5.1 highlights a positive slope of the trend line, which illustrates the skill-biased of within-firm mobility. The higher the average hourly wage of a group of occupations, the higher the share of workers changing establishment. In other words, the more workers are skilled, the more they are likely to be displaced in other plants of the firm. This result is similar to the ones obtained by Hunt (2004). She shows that same-employer migrants have higher education and pre-move wages than non-migrants.

The wage effect of inhouse mobility. Table 5.3 shows that movers have a higher wage compared to stayers in different occupations. Movers are defined as workers who have changed establishment, without changing employer, at least once during the period of observation (2002-2007). Stayers are workers who stay in the same plant they were employed at the beginning of the period. Within-occupations, movers have on average a higher hourly wage than non-movers. For instance, managers who have changed establishment at least once during the period of observation, earn on average 2 euros more than immobile managers. This gap is observed for all group of occupations (employees, intermediate occupations, blue-collar workers) and for all type of firms (multinational or domestic firms).

Table 5.3 – Descriptive statistics : average wage of movers

Variable :	Multinational firms				Domestic Firms			
Hourly wage	Movers		Stayers		Movers		Stayers	
	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Managers	34,437	[14,882]	32,257	[31,985]	31,742	[20,633]	30,089	[14,532]
Intermediate Occupations	19,509	[5,749]	18,809	[23,357]	19,306	[10,049]	17,779	[5,997]
Employees	14,701	[4,896]	13,738	[4,429]	13,416	[3,667]	12,823	[3,936]
Blue-collar workers	15,046	[6,536]	13,866	[4,399]	12,793	[4,101]	12,601	[6,223]

Source : LIFI survey, French annual census for manufacturing (EAE), French Déclaration annuelles des donnés sociales (Panel DADS-EDP) ; period : 2002-2007.

Two rationales can explain the wage gap between movers and stayers : differences observed *prior* and *post* establishment mobility.

Explanation due to *ex-ante* different characteristics of movers comes from migration theory. Workers take the decision to migrate from the source to the destination region by comparing earning gains and mobility costs. If the cost of migration (foregone earnings, direct cost of migration and adjustment costs in terms of consumption and activities) is the same for all migrants, then the return to migration is higher for high-paid, high-skilled workers. Thus, economic migrants would be self-selected and would tend to be more able, ambitious, aggressive, entrepreneurial than similar individuals whose cost of migration is

too high compared to their gain (Chiswick, 2000).

Furthermore, a firm may want to transfer workers with firm-specific skills and high abilities to the destination establishment so as to increase knowledge spillovers (Hunt (2004)). Hence, mobile workers are likely to be *ex-ante* high-skilled and receive high-wage prior to the change.

Explanation due to *ex-post* different characteristics of movers comes from human capital theory. Worker's mobility may be seen as an investment in human capital which can increase worker's wage *after* plant change (Becker, 1964). Mobility can induce knowledge spillovers which could increase plant's productivity and result in an increase in wages consecutive to the move. In particular, Timmermans and Boschma (2013) highlight a positive effect of skills flow on productivity at the plant level, especially if the inflow of skills is related to the existing skills. Moreover, the firm may want to increase the wage paid to migrant-workers to create incentives for high-skilled workers to move towards another plant because moving to a new establishment is costly.

Table 5.4 provides evidence of a wage change before and after the move. We focus on the sample of full-time full-year workers having a permanent contract. We report the wage increase of the gross monthly wage. Movers have a higher wage increase one year after the move than non movers, whatever the type of occupations. Managers earn 1.6 euros per hour more one year after the move, while the average wage increase for stayers is the half, on average. The positive effect of mobility is observed for all four occupations. Table 5.4 reveals no significant differences between the wage increase of movers in multinational firms and domestic firms.

Table 5.4 – Descriptive statistics : wage change before and after the move

Variable :	Multinational firms				Domestic firms			
$w_{t+1} - w_t$	Movers		Stayers		Movers		Stayers	
	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Managers	1.640	[8.000]	0.836	[5.797]	1.565	[8.678]	0.769	[7.112]
Intermediate occupations	0.848	[3.837]	0.341	[2.273]	0.844	[2.823]	0.329	[2.494]
Employees	0.231	[1.795]	0.003	[1.274]	0.438	[2.156]	0.226	[1.670]
Blue-collar workers	0.680	[2.759]	0.169	[1.757]	0.174	[1.804]	0.312	[1.850]

Source : LIFI survey, French annual census for manufacturing (EAE), French Déclaration annuelles des donnés sociales (Panel DADS-EDP) ; period : 2002-2007.

The following section is interested in measuring the wage effect of mobility between-plants by controlling for individual characteristics prior to the move. We also evaluate this effect in different segments of the wage distribution, since mobility may concern a small fraction of workers.

5 Methodology

The model seeks to estimate the effect of job mobility between plants at home on wages. Equation (5.2) describes a model for wages, where w_{it} is the logarithm of real hourly gross wage of worker $i = 1, ..., N$ employed in firm $j = 1, ..., J$ in period $t = 1, ..., T$. x_{it} and k_{jt} are vectors of variables of worker and firm characteristics respectively. a_i and d_j are time invariant individual worker and firm fixed effect, that can be correlated with independent variables. ε_{it} are unobserved error components independent in i and t. The parameter of interest to be estimated is θ. r_{it} is a dummy variable which represents between plants mobility. r_{it} takes the value of 1 if the worker changes establishment and 0 otherwise. This variable is observed for both situations and we estimate the influence of each regime on the wage equation.

$$w_{it} = x_{it}\beta + k_{jt}\gamma + \theta r_{it} + a_i + d_j + \varepsilon_{it} \tag{5.2}$$

However, it is likely that individual with higher wages, given x_{it} and k_{jt} are also more likely to change establishment. To deal with this endogeneity problem due to selection on unobservables, we adopt a two stage procedure in the spirit of Heckman, as suggested by Wooldridge (1995).

$$\begin{cases} w_{it} = x_{it}\beta + k_{jt}\gamma + \theta r_{it} + a_i + d_j + \varepsilon_{it} \\ r_{it} = z_{it}\Gamma_1 + y_{jt}\Gamma_2 + \eta_i + m_j + v_{it} \end{cases} \tag{5.3}$$

The second equation in (5.3) describes a binary selection rule (moving *vs* not moving between establishments). The equation depends on two linear vectors of workers' and firms' characteristics respectively (z_{it} and y_{it}) composed by similar variables as in vector x_{it} and k_{jt}. The second equation has also assigned invariant unobserved individual and firm effects, η_i and m_j that can be correlated with independent variables.

We sketch Wooldridge's (1995) sample selection model and review Wooldridge (1995) main assumptions to ensure convergent estimators. Similar to Chamberlain (1980), Wooldridge (1995) assumes that fixed effects in the equation (5.3) display the following linear relationship between η_i and z_i and between m_j and y_j.

$$\begin{aligned} \eta_i &= z_{i.}\delta_1 + c_i \\ m_j &= y_{j.}\delta_2 + b_j \end{aligned} \tag{5.4}$$

Where c_i and b_j are random components. Wooldridge (1995) adopts a specification *à la* Chamberlain (1980) to avoid introduction of present, past and future values of z_i and y_j by adding time average of $z_{i.}$ and $y_{j.}$ rather than the totality of them.

Wooldridge (1995) assumes that the error term in the selection equation $v_{it} = c_i + b_j + u_{it}$ is distributed independently of z_{it}, y_{jt}, $z_{i.}$ and $y_{j.}$, and it is normally distributed with zero mean and σ^2 variance.

This equation allows to estimate the selection equation but other hypothesis need to be precised in order to estimate the quantitative wage equation.

In the spirit of hypothesis made in the selection equation, Wooldridge (1995) assumes that the regression function of a_i on $x_i t$ and $v_i t$ is linear and the regression function of d_j on k_j and v_{it} is linear. Accordingly the relation between a_i and d_j with x_{it}, k_{jt} and v_{it} is linear, such as :

$$\begin{aligned} E\left(a_i|x_i, v_{it}\right) &= x_{i.}\varphi_1 + \Phi_1 v_{it} \\ E\left(d_j|k_j, v_{it}\right) &= k_{j.}\varphi_2 + \Phi_2 v_{it} \end{aligned} \tag{5.5}$$

Rather than taking the past, present and future values of x_{it} and k_{jt}, we adopt a formulation *à la* Chamberlain (1980) by using time average values of x_{it} and k_{jt}.

Finally, Wooldridge (1995) assumes that ϵ_{it} is mean independent of x_i, k_j and its conditional mean is linear on v_{it} :

$$E\left(\varepsilon_{it}|x_i, k_j, v_{it}\right) = E\left(\varepsilon_{it}|v_{it}\right) = \rho_t v_{it}$$

Thus, by the Law of Iterated Expectation, and by combining the last two hypothesis, we obtain :

$E\left(\varepsilon_{it} + a_i + d_j|x_i, z_i, r_{it} = 1\right) = x_{i.}\varphi_1 + k_{j.}\varphi_2 + \left(\Phi_1 + \Phi_2 + \rho_t\right) E\left(v_{it}|x_i, z_i, w_j, y_j\right)$

Which is equal to $E\left(\varepsilon_{it} + a_i + d_j|x_i, z_i, r_{it} = 1\right) = x_{i.}\varphi_1 + k_{j.}\varphi_2 + \left(\Phi_1 + \Phi_2 + \rho_t\right)\lambda_{ijt}$, where $\lambda_{ijt} = E\left(\varepsilon_{it} + a_i + d_j|x_i, z_i, r_{it} = 1\right)$ and λ_{ijt} is the Inverse Mills Ratio obtained from the selection equation such as :

$$\lambda_{ijt} = \frac{\Psi\left[z_{it}\Gamma_1 + y_{jt}\Gamma_2 + z_{i.}\delta_1 + y_{j.}\delta_2|\sigma_v\right]}{\Phi\left[z_{it}\Gamma_1 + y_{jt}\Gamma_2 + z_{i.}\delta_1 + y_{j.}\delta_2|\sigma_v\right]} \tag{5.6}$$

Where Ψ is the density function of the normal distribution and Φ is the cumulative density function of the normal distribution.

So, for each period, Wooldridge suggests to estimate a cross-sectional probit model for participation and compute the Inverse Mills Ratio (IMR), then, estimate the structural equation :

$$w_{it} = x_{it}\beta + k_{jt}\gamma + r_{it}\theta + \left(\Phi_1 + \Phi_2 + \rho_t\right)\lambda_{ijt} + \varepsilon_{it} \tag{5.7}$$

To estimate Wooldridge (1995)'s model, we need exclusion restrictions, that is an instrumental variable that affects the selection process but not the wage equation. If no exclusion variables are retained, equation (5.7) is only identified through the non linearity of the inverse Mills ratio, and in that case collinearity problems are likely to prevail as IMR is an approximately linear function over a wide range of its argument (Puhani (2000)).

The whole issue is then to find a variable that explains worker mobility without explaining log hourly wage other than through mobility. One possible candidate is the distance

between the place of work and the place of living, with the assumption that workers living far from their work are more likely to change establishment within the firm to get closer to their home.

In the following sections, appropriate standard errors and t-statistics of the Wooldridge's model are obtained using the standard cluster-bootstrapping approach because of the two step nature of the model, as suggested in Wooldridge (1995).

6 Job mobility

This section aims to identify the causes of job mobility. The literature has identified two major sources of organizational change that can be responsible for job mobility : technical progress and globalization (see Guadalupe and Wulf (2010), Antràs et al. (2006) for evidence on the impact of globalization on organizational change and Caroli and Van Reenen (2001) and Acemoglu et al. (2007) for evidence on the impact of technological progress on organizational change). In this section, we need to capture empirically technological progress and globalization.

Globalization is captured in different ways in the literature. Caliendo et al. (2012) analyze globalization in terms of bilateral trade liberalization. They show that firms that export increase the number of layers of management and decentralize decisions. Bloom et al. (2010) analyze the effect of globalization, as measured by the share of total imports over domestic production, on decentralization of decision. They show that competition is associated with a greater degree of delegation.

We are interested in measuring the impact of foreign direct investment on job mobility. Our variable of FDI corresponds to the number of subsidiaries abroad at the firm level. We also control for other margins of globalization such as imports and exports [14].

Technological progress is also captured in different ways in the literature. Caroli and Van Reenen (2001) measure technological progress through the proportion of workers using computers or other micro-electronic technologies. Acemoglu et al. (2007) capture technological advancement as a measure of *proximity to the frontier*, which represents the gap between the productivity of a particular firm and the highest productivity (or the highest percentile productivity) in the same industry.

We measure technological change by the firm's total factor productivity (TFP). The firm's total factor productivity is derived using the approach of Levinsohn and Petrin (2003), which allows us to control for the endogeneity problem resulting from the correlation between unobservable productivity shock and input level. We use intermediate inputs to proxy the unobservable productivity term (measured as the operating expense),

14. Exports are measured in €million. Imports are separate out between imports of finished and intermediate goods as detailed in section 3.

value-added as the dependent variable, the number of employees as the proxy of the labor force, and the total fixed assets as the capital proxy. [15]

Organizational change is measured in different ways in the literature. Some studies use surveys on organizational change [16] in order to have information on delayering (i.e. removal of an intermediate hierarchical level) [17] and on increase in decision making (Caroli and Van Reenen (2001), Acemoglu et al. (2007), Bloom et al. (2009), Caliendo et al. (2012)). In the present article, we define organizational change as job mobility within a same firm.

We aim at measuring the effect of FDI on the probability to change plant within the firm. The hausman test rejects exogeneity of the random effects : there is endogeneity of covariates with respect to individual heterogeneity. Since estimators are estimated with maximum likelihood methods, we are confronted with the difficulty associated with the asymptotic properties of estimators, which allows unbiased coefficient only when N and T tend to infinity. Fixed effect estimators with small number of periods are only possible with a logit distribution function [18]. We therefore perform a conditional fixed effect logit model over a different sample of occupations : managers, intermediate occupations, and blue-collar workers (Table 5.5).

FDI to low-income countries significantly raise the probability to change plants within the firm in the sample of managers. Increasing a firm's boundary through FDI leads to many changes. First, socio-cultural changes such as language and culture. Second, changes in legal dimensions, such as patents and intellectual recognition. Third, changes in political dimensions, such as differences in currency controls or national rules. Changes in a firm's boundaries due to an increased number of subsidiaries abroad can create (i) a need for specific knowledge (in terms of knowledge of the foreign language, the culture, foreign laws) and (ii) a need to strengthen skilled functions when a firm is vertically specialized, which may imply worker mobility to transfer specific knowledge in some plants.

On the contrary, raising FDI in low-income countries significantly reduces the probability to change plants in the sample of blue-collar workers. FDI in low-income countries seek to take advantage of international price-factor differences, and is a good proxy for vertical fragmentation of production processes. When price-factors differ across countries, firms become multinational by locating production in countries where manual-labor costs are low

15. We used different proxies for technological change, such as investment in R&D, proximity to the sector technology frontier and software investment. Whatever the variable retained, our results are not altered. We prefer the measure of TFP for several reasons. First, the software investment variable is not referenced for all firms. Second the R&D variable is built from the EAE survey that accounts for fixed R&D, i.e., R&D accounted as capital expenditure in the balance-sheet rather than as an expense of research and development.

16. Such as French REPONSE survey (Relation professionnelle et Négociation d'Entreprise, the British Workplace Industrial Relations Survey (WIRS), or data collected by Bloom et al. (2009) on almost 4,000 medium sized (100 to 5,000 employees) manufacturing firms

17. Caliendo et al. (2012) measure organizational change by defining layers in the organizations based on group of occupations (as we did in Chapter 3) : Managers, intermediate occupations, blue-collar workers, employees.

18. See explanation in appendix 5.B

(Hanson et al. (2001)). Vertical specialization through FDI in low-income countries may imply substitution between French and foreign subsidiaries, reducing the need for production workers in domestic production-oriented plants and thus reducing production-workers probability to move between-plants.

Table 5.5 – Between-plant mobility by occupations

Dependant variable	(1)	(2)	(3)
Probability to change plant within firm	Managers	Intermediate Occupations	Blue collar workers
Foreign Subsidiaries			
In low-income countries	6.871**	-7.258	-4.760
	[3.073]	[4.624]	[10.782]
In high-income countries	-5.863*	2.746	7.267
	[3.496]	[2.715]	[8.097]
Number of plants	-0.086**	-0.027	-0.073
	[2.847]	[6.018]	[10.191]
Computer use	2.404	0.358	5.262
	[2.960]	[3.036]	[3.384]
TFP	0.086***	-0.001	-0.013
	[0.028]	[0.013]	[0.099]
Revenue	-1.335	3.354***	-0.643
	[0.943]	[1.226]	[1.956]
Capital	-2.113	2.917	5.927
	[3.390]	[3.779]	[11.899]
Marriage	-1.184	-0.149	1.134
	[1.194]	[0.872]	[0.971]
Number of children	0.059	0.818*	-0.218
	[0.356]	[0.453]	[0.509]
Age-squared	0.419	0.065	0.155
	[0.301]	[0.315]	[0.333]
Exports	-1.002	-2.004***	4.534
	[0.636]	[0.728]	[2.745]
Imports of inter. Inputs	-0.097	0.357	0.024
	[0.082]	[0.238]	[0.261]
Imports of finish goods	0.187**	0.095	0.135
	[0.082]	[0.122]	[0.479]
Year fixed effect	Yes	Yes	Yes
Observations	1,445	1,351	1,040
Log Likelihood	-398.907	-361.391	-292.086

Source : LIFI survey, French annual census for manufacturing (EAE), French Déclaration annuelles des donnés sociales (Panel DADS-EDP) ; period : 2002-2007.
Robust standard error in brackets, *** p<0.01, ** p<0.5, * p<0.10.

There is also a positive correlation between technological progress (as measured by total factor productivity) and the managers' probability to change plants. The same reasoning may hold. Implementation of technological progress may require specific skills that imply the transfer of key people associated with the implementation of the new technology. The firm's revenue significantly raises also the probability to change establishments in the sample of intermediate occupations.

A higher number of firms' establishment should theoretically increase opportunities in other sites and therefore raises the probability to switch plants. This coefficient is however not significant in all groups of occupations. The probability to change plant does not depend on the size of the firm in terms of number of establishments, but rather depends

on external shocks such as FDI and technological progress.

We observe that increased imports of finish goods raise significantly the probability to change establishments in the case of blue-collar workers. The positive effect can be due to an effect of the rationalization of production processes in France, by eliminating unnecessary domestic capacity at the firm level and bringing together production activities within a particular plant.

On the contrary, we observe a negative coefficient associated with exports in the sample of managers and intermediate occupations (technicians and foremen). This result is in line with those obtained on French data in Caliendo et al. (2012). They show that new exporters that went through an organizational change (as measured by an increase in the firm's layers of hierarchy) decrease average wages in existing layers, while exporters that do not add layers increase them. [19]. Given that labor market institutions and regulations make reducing the wage of a particular employee complicated, they explain that the wage decrease is possible if the firm hires new workers who earn less, while keeping wages of existing workers essentially unchanged. We also observe this trend : increasing exports reduce the incentives for the firm to displace workers in other establishments. The firm might hire new workers consecutive to increasing exports, in order to benefit from new skills and knowledge.

7 Wage returns to job mobility

Results above suggest that job mobility is likely to have different sources depending on occupations. The following section focuses on the effects of between-plant mobility on wages in different segments of the wage distribution.

7.1 Selection Bias

We analyze the effect of job change by estimating equation (5.2). It involves a continuous dependent variable (log hourly wages) and a categorical endogenous predictor (change establishment within firm). The choice variable (moving or staying), is likely to be correlated with unobservables relegated to the error term, since it has been proved that workers with higher abilities and firm-specific knowledge are more likely to change plants. Our approach to correct for endogeneity is to use the two-step procedure of Heckman. We first model the probability to change plants and we estimate a wage equation that includes the correction terms for endogeneity that are derived from the first step.

Consistent estimates of θ and β are obtained as long as at least one explanatory variable in the selection equation is not in the equation of interest. This variable is called exclusion restriction, and avoids collinearity problem, due to the fact that $\lambda(.)$ is an approximately

19. They define layers as groups of occupations inside the firm. The upper layer is the layer of the CEO, the second layer is the layer of managers, the third layer is composed by intermediate occupations and the last layer is the layer composed by blue-collar workers and employees.

linear function over a wide range of its arguments (Puhani (2006)). An exclusion restriction must influence the selection variable without influencing the subsequent outcome of interest.

Our exclusive variable is defined as the distance between the worker's place of work and the worker's place of living. We have information on both districts where the worker lives and works. Metropolitan France counts 36,552 different districts. The distance is calculated as the shortest distance between two districts as defined by the great-circle formula. It is obtained using longitude and latitude coordinates of each french district.

A worker might want to change establishment within its firm for different reasons. First, he/she may want to reduce the time needed to go to work (transportation time by car or by public transportation). Second, if the worker has moved house during the period, he or she may wants to get closer to his/her workplace. Distance from the workplace is likely to be a good exclusion restriction since it may not a priori affect the dependent variable.

Yet, there still may be some reasons explaining a link between the distance and wages. First, workers far from their workplace may leave their work earlier reducing the time spent at work, which can artificially raise the hourly wage if the gross wage does not vary. Second, workers closer to their workplace may be able to perform better on the jobs or to stay longer at work which can result in an increase of the monthly gross wage. To probe the hypothesis that the distance from work is exogenous with respect to wages, we regress the wage gap ($w_{t+1} - w_t$) on the distance between the workers' home and the workplace. We use a person fixed effect model, including year dummies. We include firms and workers control in the regression. The results are reported in Table 5.8 in appendix 5.C. The coefficient associated with the distance is never significant in any specification. This result is also true when dropping firm's and worker's controls (see table 5.9).

The methodology proposed by Wooldridge (1995) is to estimate, period by period, and with the maximum likelihood method the selection equation described in (5.3), where the dependent variable is dichotomous taking the value of one if workers change establishment year t and 0 otherwise. Results are reported in Table 5.10 in appendix 5.C.

We add regions control to the analysis, since it is now recognized that activities are grouped together in certain regions to form *cluster of activities*. Clusters in some region contribute to the emergence of a pool of specialized workers, the development of supporting local institutions and the establishment of trustful relations between local firms (Eriksson (2009)). Hence, certain regions may attract workers with regional cluster specific-skills. We also add industry fixed effects, since some industries pay higher wage due to higher productivity, and we add time-invariant workers' control such as sex and level of diploma. Finally, we control for common shocks by adding time fixed effects. For each year the coefficient associated with the distance variable is positive and significant. Increasing the distance from workplace to home increases the probability to change plant within the firm.

7.2 Wage effect

Table 5.6 reports results of equation (5.7). It is likely that the wage effect of a job change between plants depends on the position along the wage distribution. To test for a differentiated effect of in-house mobility relative to the type of occupation of the worker, we report in Table 5.6 the Wooldridge estimators for different groups of occupations : managers (column (1)), intermediate occupations (column (3)) and blue-collar workers (column (5)). [20].

The Hausman test rejects exogeneity of the random effects, so we include workers fixed effect in the regression [21]. The coefficients associated with the inverse mills ratios are not significantly different from zero. Results do not support the assumption of endogeneous selection of workers changing plants. Pavlopoulos et al. (2007) also find on German and British data that evidence on sample selection disappears once the model controls for the workers' position in the wage distribution. Hence, we are more confident about the results of the fixed effect model without controlling for sample selection. Results are reported in column (2) for the sample of managers, column (4) for the sample of intermediate occupations and column (6) for the sample of blue-collar workers.

The only group of occupations for which there is a positive and significant wage effect associated with job mobility is the group of managers. For the other groups of occupations there is no statistically significant coefficient associated with the variable capturing in-house mobility.

There is thus no significant negative effect of within-firm mobility on wages. This result highlights that intra-firm mobility in France is not involuntary but is rather a good way to ensure a wage increase, especially for skilled-workers.

The literature on intra-firm mobility find similar results. Kauhanen and Napari (2009) find that high-educated workers are both more mobile and experience a stronger wage growth than their less educated colleagues, especially for women. On the contrary, Pavlopoulos et al. (2007) highlight that low-paid workers choose a reservation wage that is relatively higher than the current wage (as proposed by Van Den Berg (1992)), hence, if workers accept to move, their wage should be close to their reservation wage and thus the wage gains from a job change should be relatively higher for low-paid workers than for high-paid-workers. However, their results show that within-firm job-to-job mobility does not seem to produce any significant gains or losses, whatever the level of education. The wage growth of the German low-paid in-house mover does not differ significantly from the wage growth of a colleague who stays in the same job (Pavlopoulos et al. (2007)).

20. Because of the two-step nature of the estimation, standard errors are adjusted for the selection process and are bootstrapped using 100 replicates.

21. We have also estimated the equation with Hausman-Taylor estimator by using the variable of changing plants as the time-variant endogenous regressor (i.e. correlated with the individual fixed effect) and the level of diploma as the time-invariant endogenous regressor. However, the Hausman test fails to reject exogeneity of the random effects, even with Hausman-Taylor estimates.

Table 5.6 – Wage effect of changing plants by occupations

	Managers		Intermediate occupations		Blue collar workers	
	Wooldridge	Within	Wooldridge	Within	Wooldridge	Within
	(1)	(2)	(3)	(4)	(5)	(6)
Change plant within firm	0.372***	0.304***	0.080	0.044	0.026	0.008
	[0.077]	[0.066]	[0.070]	[0.063]	[0.076]	[0.071]
Computer use	-0.734	-1.226	-0.275	-0.650	0.366	-0.018
	[0.825]	[0.788]	[0.631]	[0.429]	[0.465]	[0.395]
Number of children	0.024	0.076	0.082	0.166***	-0.008	0.005
	[0.084]	[0.066]	[0.072]	[0.052]	[0.046]	[0.039]
Marriage	-0.245*	-0.095	0.076	0.010	0.077	0.120
	[0.132]	[0.121]	[0.101]	[0.080]	[0.076]	[0.081]
Age-squared	0.001*	0.001**	0.001***	0.001***	0.001***	0.001***
	[0.001]	[0.001]	[0.000]	[0.000]	[0.000]	[0.000]
FDI	0.420	0.419*	0.047	-0.065	-0.307	0.068
	[0.282]	[0.243]	[0.222]	[0.191]	[0.238]	[0.180]
Subsidiaries in France	1.321**	-0.011**	-0.389	-0.002	-0.232	-0.002
	[0.659]	[0.006]	[0.521]	[0.004]	[0.331]	[0.003]
TFP	0.018***	0.013***	0.007	0.004	0.010**	0.011***
	[0.006]	[0.005]	[0.004]	[0.003]	[0.005]	[0.004]
Revenue	0.000	0.000**	0.000	0.000	0.000**	0.000***
	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]
Capital	0.000	-0.000	0.000	0.000	0.001	0.001
	[0.001]	[0.001]	[0.000]	[0.000]	[0.001]	[0.001]
Imports of inter. Inputs	-0.015	0.002	0.010	0.015*	0.002	0.002
	[0.014]	[0.008]	[0.022]	[0.008]	[0.002]	[0.002]
Imports of finish goods	0.047**	0.017	-0.005	-0.005	0.001	0.005
	[0.020]	[0.011]	[0.004]	[0.003]	[0.001]	[0.005]
Exports	-0.384***	-0.147	0.294***	0.166***	0.053	0.046
	[0.098]	[0.101]	[0.057]	[0.052]	[0.059]	[0.056]
Mills ratio	0.041	-	-0.025	-	0.006	-
	[0.039]	-	[0.024]	-	[0.009]	-
Constant	-1.133	-1.077	-2.487***	-1.460**	-1.533***	-1.273**
	[1.619]	[1.337]	[0.930]	[0.640]	[0.481]	[0.524]
Observations	4,408	6,522	7,791	11,379	20,103	26,180
R-squared	0.025	0.016	0.016	0.010	0.007	0.006
Log Likelihood	-4673.113	-7252.447	-6637.081	-10361.932	-17703.746	-23537.785

Source : LIFI survey, French annual census for manufacturing (EAE), French Déclaration annuelles des donnés sociales (Panel DADS-EDP) ; period : 2002-2007.
Robust standard error in brackets, *** p<0.01, ** p<0.5, * p<0.10.

8 Conclusion

Evidence on the wage effect of worker's mobility within-firms and between-plants is still extremely scarce. Within-firm mobility has been studied in terms of promotion, i.e. in terms of vertical mobility, which is an important source of earning growth (Belzil and Bognanno (2008), Booth, Francesconi and Frank (2003), Frederiksen et al. (2010)).

This study analyzes the effect of mobility between-plants within a given firm on wages. We first analyze the cause of mobility between-establishments within a firm. One possible source is increasing international competition and technological progress. We conduct a conditional fixed effect panel logit model to test whether globalization (measured by the number of subsidiaries abroad) and technological progress (measured by total factor productivity) increase the worker's probability to change establishment within the firm. Re-

sults show that foreign direct investment and technological progress significantly raise the probability to change plants, but only in the sample of managers. Technological progress is not significant in any other group of occupations. Increasing outward FDI significantly reduces the probability to switch plant in the sample of blue-collar workers.

In a second step, we are interested in the wage effect of changing establishment without changing employer. A firm might want to increase span of control and strengthen specific-knowledge in some plants, in order to gain in adaptability and flexibility. In that sense, worker mobility can be biased due to selectivity of better workers. To control for the endogeneity problem, we use a two-step procedure *à la* Heckman, adapted by Wooldridge (1995) on panel data. Our instrumental variable is the distance between the place of living and the place of work. Distance is positively associated with mobility but not with wages.

Results show that changing plants increases the wage growth of mobile workers, but is only significant in the group of managers. Firms' create incentives to change plants, by increasing wages, in order to attract specific workers with a better match. This result is robust whatever the model used (fixed effect model and Heckman-type selection model).

The limitation of the study stems from the use of data reflecting mobility in the home country without taking into account expatriates and mobility to foreign affiliates. In particular, Jaussaud et al. (2012) show that multinational firms prefer to send expatriates in the case of intra-firm offshoring and do not employ local employee in key management position, in order to maintain a communication between the head office and their affiliates. Informal communication between expatriates working abroad and managers at headquarters is a central mechanism to coordinate activities. However, expatriates are often sent for a short period of time, in order to transmit the firm's value, and return back in the home company. We thus believe to capture a large part of the mobility within the firm since we account for a six year period, which may account for expatriates' return.

An interesting remaining improvement to be made is to analyze mobility within business group, rather than focusing on within-firm mobility. Delarre and Duhautois (1999) have shown that more than 40% of workers in France were employed in a business group. When measuring the share of movers within a business group, we observe that the share of movers in domestic and exporting business groups is twice the size of the share of movers in multinational groups (around 12% in domestic and exporting groups against 5% in multinational groups). This specificity deserves to be analyzed to identify the causes of mobility between plants of a business group. This result highlights once again that the size of the firms in terms of number of establishments is not a good predictor of within-firm mobility. Other variables such as FDI and technological progress can explain intra-firm mobility.

Appendix

5.A Complementary descriptive statistics

Table 5.7 – Descriptive statistics : between plant mobility by occupations

		Multinational firms				Domestic Firms			
		Movers		Stayers		Movers		Stayers	
Occupations	Variables	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Managers	Wages	34,437	[14,882]	32,257	[31,985]	31,742	[20,633]	30,089	[14,532]
	Age	41,124	[8,951]	40,525	[8,961]	40,816	[8,865]	40,391	[9,097]
	Routine manual tasks	0,253	[0,137]	0,266	[0,145]	0,277	[0,144]	0,295	[0,149]
	Non routine analytical	0,779	[0,113]	0,761	[0,131]	0,738	[0,128]	0,744	[0,135]
	Non routine interactive	0,592	[0,164]	0,561	[0,167]	0,587	[0,169]	0,549	[0,166]
	Non routine manual	0,455	[0,229]	0,464	[0,232]	0,438	[0,227]	0,481	[0,226]
	Routine cognitive	0,746	[0,095]	0,736	[0,092]	0,744	[0,103]	0,741	[0,100]
	Level of diploma	6,891	[1,744]	6,848	[1,811]	6,241	[2,167]	6,337	[2,075]
Intermediate occupations	Wages	19,509	[5,749]	18,809	[23,357]	19,306	[10,049]	17,779	[5,997]
	Age	40,957	[9,581]	41,188	[9,749]	39,345	[9,267]	39,382	[9,731]
	Routine manual tasks	0,347	[0,263]	0,388	[0,236]	0,364	[0,251]	0,401	[0,249]
	Non routine analytical	0,592	[0,149]	0,601	[0,147]	0,585	[0,152]	0,587	[0,156]
	Non routine interactive	0,407	[0,156]	0,417	[0,165]	0,423	[0,162]	0,415	[0,159]
	Non routine manual	0,423	[0,251]	0,466	[0,165]	0,432	[0,236]	0,472	[0,226]
	Routine cognitive	0,656	[0,142]	0,646	[0,145]	0,636	[0,154]	0,629	[0,150]
	Level of diploma	4,885	[2,089]	4,852	[2,171]	4,802	[2,205]	4,755	[2,206]
Employees	Wages	14,701	[4,896]	13,738	[4,429]	13,416	[3,667]	12,823	[3,936]
	Age	38,271	[11,276]	38,171	[11,449]	39,485	[10,529]	36,553	[10,802]
	Routine manual tasks	0,281	[0,122]	0,271	[0,139]	0,277	[0,140]	0,267	[0,144]
	Non routine analytical	0,464	[0,087]	0,487	[0,141]	0,489	[0,126]	0,481	[0,121]
	Non routine interactive	0,361	[0,107]	0,355	[0,118]	0,349	[0,101]	0,339	[0,103]
	Non routine manual	0,229	[0,051]	0,243	[0,098]	0,251	[0,124]	0,245	[0,108]
	Routine cognitive	0,634	[0,118]	0,641	[0,141]	0,646	[0,134]	0,643	[0,134]
	Level of diploma	3,893	[2,362]	3,957	[2,206]	3,783	[2,109]	4,088	[2,253]
Blue-collar workers	Wages	15,046	[6,536]	13,866	[4,399]	12,793	[4,101]	12,601	[6,223]
	Age	37,054	[10,191]	39,564	[10,491]	38,353	[10,128]	38,014	[10,386]
	Routine manual tasks	0,644	[0,185]	0,662	[0,178]	0,675	[0,173]	0,674	[0,155]
	Non routine analytical	0,381	[0,138]	0,411	[0,141]	0,408	[0,126]	0,403	[0,129]
	Non routine interactive	0,252	[0,121]	0,264	[0,151]	0,265	[0,135]	0,245	[0,136]
	Non routine manual	0,574	[0,188]	0,572	[0,173]	0,581	[0,163]	0,577	[0,148]
	Routine cognitive	0,399	[0,128]	0,397	[0,155]	0,388	[0,144]	0,375	[0,146]
	Level of diploma	3,241	[2,179]	2,711	[1,929]	2,501	[1,933]	2,511	[1,929]

Source : LIFI survey, French annual census for manufacturing (EAE), French Déclaration annuelles des donnés sociales (Panel DADS-EDP) ; period : 2002-2007.

5.B The conditional logit approach

The advantage of conditional logit model is to eliminate individual unobserved time-invariant components. The limitation of this model is that one cannot estimate time-invariant covariates.

Suppose a sample of N individuals followed during T periods. The model can be written as :

$$P(y_{it} = 1|x_{i1}, \ldots, x_{iT}; u_i) = F(x_{it}\beta + u_i)$$

where $F(z) = \frac{exp(z)}{1+exp(z)} = \frac{1}{1+exp(z)}$ represents the cumulative distribution function of the logistic function.

The model is identified for workers having changed establishment at least once during the period. Where $P(y_{it} = 1) = \frac{exp(x_{it})\beta+u_i)}{1+exp(x_{it}\beta+u_i)}$ and $P(y_{it} = 0) = \frac{1}{1+exp(x_{it}\beta+u_i)}$.

With $T = 3$ and a switch in the first period we have :

$$P(y_{i1} = 1; y_{i2} = 0; y_{i3} = 0 | y_{i1} + y_{i2} + y_{i3} = 1) = \frac{exp(x_{i1}\beta)}{exp(x_{i1}\beta) + exp(x_{i2}\beta) + exp(x_{i3}\beta)}$$

More generally, we can right :

$$P(y_{i1} = 1; y_{i\tau} = 0, \tau = 1, \ldots, T, \tau \neq t | y_{i1} + y_{i2} + y_{i3} = 1) = \frac{exp(x_{i1}\beta)}{\sum_{\tau=1}^{3} \exp(x_{i\tau}\beta)}$$

5.C Selection-Bias : Heckman correction

Table 5.8 – Validity of the exclusion variable

Dependent variable : $w_{t+1} - w_t$	All	Managers	Blue-collar workers	Intermediate occupations
	(1)	(2)	(3)	(4)
Distance from work	0.001	0.001	-0.006	0.001
	[0.002]	[0.005]	[0.008]	[0.003]
Number of children	0.036	0.000	0.002	0.119**
	[0.023]	[0.061]	[0.031]	[0.050]
TFP	0.000***	0.000***	0.000***	0.000
	[0.000]	[0.000]	[0.000]	[0.000]
Foreign subsidiaries	0.059	0.480*	0.014	-0.021
	[0.099]	[0.250]	[0.156]	[0.192]
Marriage	-0.046	-0.189	0.003	-0.050
	[0.042]	[0.122]	[0.063]	[0.079]
Imports of finish goods	0.001	0.021*	0.001	-0.004
	[0.001]	[0.011]	[0.001]	[0.003]
Imports of inter. Inputs	0.004**	0.001	0.002	0.014*
	[0.002]	[0.008]	[0.002]	[0.008]
Revenue	0.000***	0.000**	0.000**	0.000
	[0.000]	[0.000]	[0.000]	[0.000]
Capital	0.000	-0.000	0.001	0.000
	[0.000]	[0.001]	[0.000]	[0.000]
Age squared	0.000***	0.000	0.000***	0.000**
	[0.000]	[0.000]	[0.000]	[0.000]
Exports	0.030	-0.154	-0.001	0.152***
	[0.024]	[0.104]	[0.051]	[0.052]
Constant	-0.296***	0.494**	-0.415***	-0.252**
	[0.058]	[0.205]	[0.074]	[0.124]
Observations	46,426	6,488	25,938	11,284
R-squared	0.005	0.006	0.006	0.008
Log Likelihood	-44730.051	-7237.268	-23322.472	-10297.613

Source : LIFI survey, French annual census for manufacturing (EAE), French Déclaration annuelles des donnés sociales (Panel DADS-EDP) ; period : 2002-2007. Robust standard error in brackets, *** p<0.01, ** p<0.5, * p<0.10.

Table 5.9 – Validity of the exclusion variable without control variables

Dependent variable : $w_{t+1} - w_t$	All	Managers	Blue collar workers	Intermediate occupations
Distance from work	0.001	-0.002	-0.003	-0.011
	[0.002]	[0.005]	[0.007]	[0.007]
Constant	0.268***	0.585***	0.181***	0.218***
	[0.005]	[0.019]	[0.009]	[0.009]
Observations	48,291	6,810	26,915	11,768
R-squared	0.000	0.000	0.000	0.001
Log-likelihood	-47060.079	-7697.283	-24479.534	-10907.659

Source : LIFI survey, French annual census for manufacturing (EAE), French Déclaration annuelles des donnés sociales (Panel DADS-EDP) ; period : 2002-2007. Robust standard error in brackets, *** p<0.01, ** p<0.5, * p<0.10.

Table 5.10 – Heckman procedure

Dependant variable	2003	2004	2005	2006	2007
Change plant within firm	(1)	(2)	(3)	(4)	(5)
Distance from work	0.005***	0.008***	0.006***	0.001*	0.006***
	[0.002]	[0.001]	[0.001]	[0.001]	[0.002]
Number of Children	-0.369	0.155	0.052	-0.025	-0.274
	[0.321]	[0.153]	[0.116]	[0.052]	[0.177]
TFP	-0.269***	-0.263***	-0.125	-0.210**	-0.277***
	[0.087]	[0.083]	[0.085]	[0.082]	[0.089]
High-school diploma	Ref.	Ref.	Ref.	Ref.	Ref.
Completed Elementary school	-0.255*	-0.361**	0.047	-0.173	-0.325**
	[0.147]	[0.147]	[0.140]	[0.136]	[0.149]
Completed Junior high school	-0.213	-0.094	0.145	-0.189	-0.304
	[0.185]	[0.169]	[0.176]	[0.184]	[0.188]
Basic professional Degree (CAP)	-0.277	-0.134	-0.442*	-0.050	-0.191
	[0.175]	[0.152]	[0.230]	[0.154]	[0.167]
Basic professional Degree (BEP)	-0.118	-0.134	-0.118	-0.282**	-0.546***
	[0.119]	[0.114]	[0.126]	[0.125]	[0.135]
Professional high-school degree	-0.161	-0.253*	0.033	-0.328**	-0.249*
	[0.132]	[0.137]	[0.137]	[0.145]	[0.139]
General high school degree	0.142	-0.147	-0.224	0.099	-0.457*
	[0.162]	[0.167]	[0.207]	[0.172]	[0.257]
Professional college degree	-0.181	-0.460***	0.019	-0.141	-0.460***
	[0.137]	[0.150]	[0.139]	[0.138]	[0.164]
Male	Ref.	Ref.	Ref.	Ref.	Ref.
Female	0.040	-0.064	-0.054	-0.047	-0.009
	[0.046]	[0.045]	[0.045]	[0.046]	[0.045]
Marriage	0.049	-0.039	0.022	0.011	0.014
	[0.053]	[0.051]	[0.051]	[0.050]	[0.050]
Subsidiaries abroad	-0.056	0.515*	0.335	0.443**	-0.343
	[0.238]	[0.308]	[0.222]	[0.180]	[0.230]
Subsidiaries in France	0.972**	-0.493	1.231***	2.007***	2.343***
	[0.425]	[0.552]	[0.386]	[0.338]	[0.382]
Revenue	0.043	-0.025	0.037	0.013	0.076***
	[0.042]	[0.069]	[0.047]	[0.011]	[0.021]
Capital	-0.471	-0.823	-0.747	-0.725	-1.267***

	[0.446]	[0.558]	[0.611]	[0.533]	[0.439]
Age	0.020	0.016	0.004	0.035*	-0.003
	[0.018]	[0.018]	[0.016]	[0.019]	[0.017]
Age-squared	-0.000	-0.000	-0.000	-0.000*	0.000
	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]
Exports	0.006	0.000	-0.085	-0.092**	-0.053*
	[0.048]	[0.047]	[0.062]	[0.042]	[0.027]
Average covariates :					
Number of children	0.123	0.140	-0.151	0.078	-0.033
	[0.168]	[0.225]	[0.235]	[0.190]	[0.142]
Technology Frontier	-0.083	-0.082	-0.116	-0.066	-0.140
	[0.126]	[0.166]	[0.147]	[0.137]	[0.132]
Marriage	0.476	0.102	-0.818	0.452	-0.363
	[0.333]	[0.578]	[0.492]	[0.449]	[0.289]
Foreign subsidiairies	0.000	0.004	0.008	0.029***	0.025**
	[0.010]	[0.007]	[0.016]	[0.009]	[0.012]
French subsidiaries	-0.006	0.035	-0.005	-0.000	-0.002
	[0.025]	[0.029]	[0.025]	[0.019]	[0.021]
Revenue	0.000**	-0.000	0.000	-0.000	-0.000
	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]
Capital	-0.000	-0.001	-0.003**	0.003**	-0.000
	[0.000]	[0.002]	[0.001]	[0.001]	[0.001]
Constant	-2.471***	-1.267*	-2.410***	-1.876*	-1.163
	[0.705]	[0.689]	[0.657]	[0.754]	[0.850]
Time, industry, region fixed effect	Yes	Yes	Yes	Yes	Yes
Observations	8,994	9,182	9,071	9,808	9,121
Log Likelihood	-1903.636	-2244.511	-2125.163	-1971.290	-2189.719

Source : LIFI survey, French annual census for manufacturing (EAE), French Déclaration annuelles des donnés sociales (Panel DADS-EDP) ; period : 2002-2007.

Robust standard error in brackets, *** p<0.01, ** p<0.5, * p<0.10.

General conclusion

Does globalization increase labor market inequality ? In public debates, globalization raises many fears. Plant closures, tougher working conditions, wage inequality and unemployment. Yet, in the 1990s, the labor market impact of globalization appeared to be very limited because trade mainly concerned countries with comparable levels of development. In the last decade, the impressive growth of emerging economies has changed the consensus according to which globalization benefits all workers and employers.

Today, several emerging economies are important actors of globalization. Differences in their level of development give strong opportunities to French firms in terms of increasing profits and saving labor cost, but can also be a source of distortions, especially in the labor market. These distortions require rethinking the French industrial landscape in order to face competition from emerging economies.

Adjustment costs implied by these transformations are often supported by a fraction of workers, those whose competences substitutes for foreign ones. Hence, identifying the jobs at risk from globalization is a major issue for policy makers in order to define policies promoting workers mobility towards sectors with a comparative advantage.

These concerns motivate the present dissertation. In particular, I intend to analyze the consequences of globalization and to identify jobs at risk from globalization. I am particularly interested in measuring the impact of Foreign Direct Investment (FDI) on French labor market. I analyze several aspects of this issue. First, I measure empirically the impact of FDI on employment and wages within group of occupations (chapters 2 and 3). Second, I investigate theoretically how firms respond to FDI in terms of organizational change (chapter 4). Finally, I examine the role of FDI on workers' mobility within the firm's plants (chapter 5).

In the literature, little attention has been paid to the effect of outward FDI on the labor market. Studies have mainly focused on the impact of imports and/or exports on wages and employment. Yet, FDI is an important contributor to the internationalization of firms. In the United-States, roughly one-half of U.S imports are transacted within the firm boundaries. This result is particularly true for France, as stressed by several reports. France has favored internationalization through FDI, compared to German firms who have favored internationalization through arm's length production.

Implementing an outward FDI is a deliberate choice to protect against subcontractors' opportunistic behavior and against technology leakages. FDI may thus result in a particular impact on the labor market compared to other internationalization strategies (arm's length trade, exports). The following sections analyze the firm's motivations to implement a FDI in order to identify the specific impact of FDI on the labor market.

I then explain the principal results of the thesis and link the microeconomic results to macroeconomic considerations. In particular, I analyze whether FDI is responsible for the job polarization observed in France. Finally, I describe the specificity of the French labor market compared to other economies. More particularly, I analyze the role of labor market institutions and French colonial history to determine whether French labor market adjusts differently to FDI with respect to other developed economies.

Is there a specific choice between FDI and arm's length transactions ? Several reasons explain firms' international investments. Put simply, a company may find it cheaper or more profitable to produce abroad due to more competitive and/or advanced assets (new technology, new buyers, cheaper resources, specific skills). The choice of locating production at home or abroad is actually contingent to the firm's level of productivity, as explained by new trade theories : only the most productive firms can self-select into globalization.

Companies have several alternatives schemes when investing in a foreign country. A firm can choose integration by setting up a foreign subsidiary (vertical integration) or choose to outsource the production to an independent supplier (arm's length offshoring). This choice is often referred to the "make-or-buy" decision. Grossman and Helpman (2002) identify different types of costs and gains depending on the mode of integration. On the one hand, a vertically integrated firm may face a higher cost of producing components and services, because such a firm has many divisions to manage, and because the organization does not benefit from learning that arises when specializing in a single activity. On the other hand, arm's length transaction costs stem from incomplete contracts and the search for partners.

The literature [22] suggests that FDI, compared to outsourcing, is motivated by an ownership advantage : the firm is willing to protect against opportunistic behavior. Indeed, the reason for being of foreign affiliates compared to independent supplier is mainly related to the transfer of knowledge, specific technology and/or managerial ability within the company (Ramondo et al. (2011), Hortacsu and Syverson (2009)). A firm choose vertical integration rather than arm's length relation to protect its intangible assets (Antràs (2005), Antràs and Helpman (2002)) and/or to keep full control over the management (Grossman and Helpman (2004)). Of course, this conclusion cannot be generalized to all firms and industries. In particular, the capital-intensive industry chooses vertical FDI to

22. See Williamson (1970), Grossman and Hart (1986), Hart and Moore (1990), Antràs (2003), Antràs and Helpman (2004), Grossman et al. (2005) or Antràs and Helpman (2006).

reduce the hold-up cost but not necessarily to protect its intangible assets (see Antràs (2003) for more details).

From this starting point, one could wonder whether the decision to realize an intra-firm investment led to a distinct labor market effect compared to international subcontracting. However, due to data scarcity, the differentiated impact of FDI and arm's length offshoring on the labor market has received little attention in the literature. There are two ways to analyze this issue. The first is to study the internationalization choice depending on the country of destination's labor standards. The second is to consider the main factors behind the firm's choice to become a multinational company and how it affects management and technology transfer. By answering these two questions, we will be more likely to draw some conclusions on the differentiated effect of FDI and subcontracting on the labor market.

The distance between the country of origin and the country of destination is a major determinant of the entry mode choice (arm's length offshoring vs. FDI). The empirical literature has shown that the proportion of vertical FDI decreases with the distance to the host country (see Shatz and Venables (2001), Carr, Markusen and Maskus (2000), Hanson et al. (2002)). While in the case case of horizontal FDI proximity to the market is the most important determinant : distance may thus have a positive effect (Brainard (1997).

The specificity of the destination country when firms integrate through a foreign affiliate can be a source of a particular effect on the labor market compared to that of arm's length trade. This effect needs though further research to be identified. Still, we can discuss the intuition behind the role of the destination country in affecting home employment. First, since trade costs are iceberg-type and increasing with distance, it is likely that a large part of FDI in close European countries are of vertical type, especially FDI in Central and Eastern Europe countries which represents an important part of French FDI. Moreover, vertical FDI may be more frequent in France than in any other developed country due to its geographic, cultural and language proximity with many countries in North Africa.

Second, since contractual incompleteness is an important determinant of FDI, a firm may prefer to setup a foreign subsidiary rather than subcontracting its production process in countries where contracting institutions are bad (see Ottaviano and Turrini (2002)). Hence, offshoring in a low-income country may mainly take the form of a FDI rather than the form of international subcontracting. As a consequence, FDI may have a more important impact on the labor market since vertical FDI is often associated with a relocation of low-skilled activities abroad.

An alternative way of analyzing the specific effect of FDI compared to arm's length production is to focus on the main factors determining the firm's choice to integrate. One can argue that a firm's outward FDI has a specific impact on employment compared to international subcontracting, due to differences in technology transfers and organizational change. On the one hand, technology transfers may be higher in the case of outward FDI,

since several studies have highlighted that firms prefer to integrate through FDI when the good is high-technology intensive (Feenstra and Hanson (2005)) and non-standardized (Antràs (2005)). Hence, if FDI implies transfer of high-technology production, it can hurt skilled-production workers that are complementary with respect to high-technologies (see Chusseau et al. (2008) for a review on the employment effects of technological change).

On the other hand, FDI could have a specific impact on employment through its effect on the workplace organization. A firm may implement a FDI to keep full control over the foreign subsidiary in order to supervise and monitor actively the controlled firm (see Vermeulen (2013)). Since vertical integration allows better monitoring, the firm might have higher incentives to change the workplace organization by streamlining unnecessary production units in the home country.

Hence, on the one hand, FDI may hurt skilled production workers due to technology transfer, while it may benefit skilled non-production workers due to changes in the workplace organization. On the other hand, if outward FDI are preferred to subcontracting in a distant country with bad contractibility environment, low-skilled workers at home might suffer from FDI if foreign and domestic workers are substitutes.

In this thesis, I have accounted for all the margins of offshoring (outsourcing and FDI). The results reveal that FDI has a stronger impact on employment and wages than outsourcing.

How did we analyze the question and what are the main results ? I now present chapter by chapter the main findings of the PhD thesis. In the first chapter, I identify the literature on the labor market effect of globalization. The analysis depicts the importance of using detailed data linking employers to their employees. Detailed data allow to have a better comprehension of the effect of globalization on the labor market since recent literature has highlighted that there is no systematic correspondence between skills and the offshorability of jobs. Tasks are the main component to identify the offshorability of jobs.

The originality of the literature review is to focus on studies analyzing the effect of globalization on employment and wages at a disaggregated level, allowing to have information on tasks and employers' characteristics at the firm level. The literature gains insights on the alternative hypotheses to physical relocation, by focusing on the research needs and the unexplored paths on this topic. The Chapter underlines the fact that alternative channels through which globalization affects the labor market must be considered. Today, multinational firms are understood as black boxes not having gone through any transformation. Yet, globalization is likely to influence employment through different channels : the organization of the firm (Caliendo and Rossi-Hansberg 2012) and changes in innovation and investment in new technologies.

I build the other chapters of the thesis by taking into account conclusions drawn from

the literature review. I start by providing a comprehensive analysis on the effect of FDI on the demand for skills and tasks (chapter 2) and on workers' hourly gross wages (chapter 3). Results highlight a selective effect of FDI on the French labor market. I observe a positive effect of FDI on employment and wages, mostly concentrated among high-skilled workers and managerial occupations. Those effects mainly come from FDI to low-income countries.

One explanation of the selective impact of FDI on skilled white-collar workers may come from its effect on organizational change. Hence, in a second step, I open the black box of the firm by analyzing the effect of FDI on organizational change within headquarters. Organizational change is analyzed in two ways : decentralization of decision making and worker's mobility. Chapter 4 analyzes organizational changes as a transfer of activity from production functions to supervision functions and as an increase in the autonomy of skilled-workers. Chapter 5 defines organizational changes as worker mobility between plants of an organization.

I argue in Chapter 4 that the rise of multi-location firms increases the need for specific functions within headquarters, requiring specific skills to manage, control, develop and deploy resources through the multi-country plants. I analyze this question theoretically and empirically. I measure the transfer from production functions to supervision functions by calculating the number of managers and blue-collar. I identify delegation of authority by building an index on workers' autonomy. Two consequences of organizational change arise. First, firms delegate decision power to skilled-workers inside headquarters and ask for a more autonomous workforce. Second, firms reorganize their headquarters by strengthening their supervision activities. Results show that FDI raises the demand for skilled non-production workers and reduces the demand for unskilled production workers.

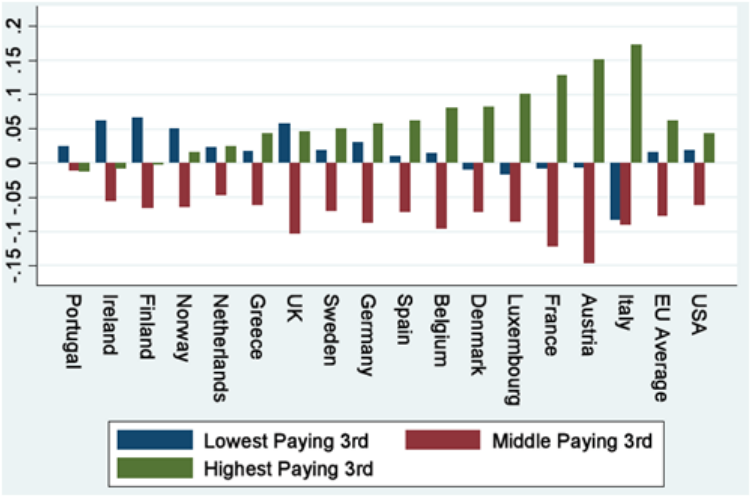
Chapter 5 identifies the impact of FDI on workers' mobility between plants within the firm. I argue that organizational changes may result in a transfer of specific knowledge in some plants of the firm. I test whether the transfer of workers is voluntary or involuntary by measuring the wage effect of mobility one year after the move. Results reveal that FDI raises the probability to change plant in the sample of managers. The transfer seems to be voluntary in order to suit the purpose of the firm since managers' hourly gross wage increases one year after the move.

The analysis draws conclusions on the effect of FDI at the micro level, by analyzing the consequences of a change in the firm's internationalization decision on workers within the firm. One could wonder how FDI affects employment at the macroeconomic level and how FDI contributes to explain the inequality on the labor market.

From microeconomic results to macroeconomic considerations From the late 1990s, a non-monotonic change in the wage distribution by skill group has been observed. A wage polarization occurred in the United States and in Britain : wage inequality increased between the 9th and the 5th decile and reduced between the 5th and the 1st decile. Other

countries in continental Europe does not seem to have experienced the same evolution in wage inequalities as in the US. However, a job polarization has been observed in most European Union countries. Unemployment increased for workers in the middle of the wage distribution and decreased for workers at the top and bottom end of the distribution.

FIGURE 5.2 – Change in Employment Shares by Occupation 1993-2006 grouped by wage terciles : low, midium, high



Source : Figure extracted from Goos, Manning and Salomons (2009). Data on EU employment for years 1993-2006. Occupations are grouped into three categories according to their wage level

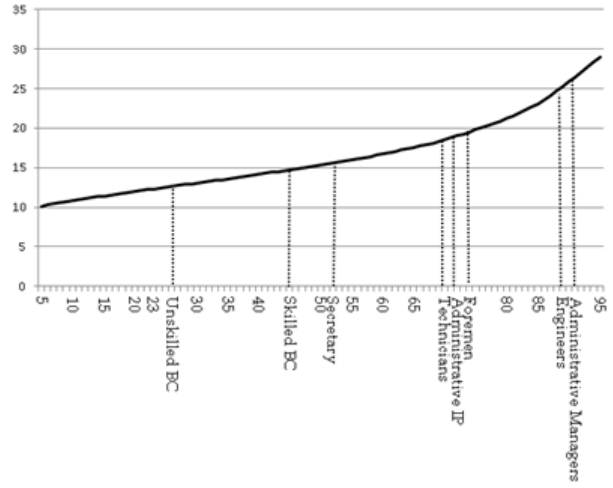
The pattern of job polarization is not identical in all countries. Figure 5.2 is taken from Goos, Manning and Salomons (2009) and depicts the change in the share of employment of low, medium and high paid occupations over total employment during the period 1993 through 2006. Some countries (Norway, Netherlands, Greece, UK, Sweden, USA, Germany, Spain and Belgium) went through a clear job polarization of their labor market : the employment of middle-paid workers decreased, while the employment of high-paid and low-paid workers increased. In France the situation is less clear. The employment of middle-paid workers has declined by 12% during the period and the employment of high-paid workers has increased by 14%. Contrary to what is observed in some other European countries, the employment of low-paid workers has slightly decreased in France.

Results derived from this thesis isolate the effects of technology and globalization on the production function at the firm and worker levels, but does not allow to measure the contribution of each factor to the variation in the total employment of some groups of occupations. Still, from our estimations, I can draw some basic conclusions on the role of FDI at the macro level.

Figure 5.3 plots the average position of nine main groups of occupations along the wage distribution. Skilled blue-collar workers and administrative workers (mainly composed of secretaries) are in the middle of the wage distribution, while managers and engineers are

at the top-end of the wage distribution. Estimates in chapter 2 highlight the negative impact of FDI on the share of blue-collar workers. On the contrary, there is a positive effect of FDI on the share of executives. Our estimation results are in line with the pattern of job polarization since blue-collar workers are in the middle of the wage distribution and executives are in the top-end of the wage distribution. Furthermore, from Figure 4 in the General Introduction, we know that skilled blue-collar workers and managers represent, in 2007, 15% and 16% of the workforce respectively. Hence, the results at the microeconomic level may have an important macroeconomic impact since these two particular groups of workers, which are affected by FDI, represent one third of the workforce.

Figure 5.3 – Position of eight groups of occupations along the wage distribution



Source : DADS postes, year 2007, author's calculation.
Note : Average wage of eight groups of occupations along the distribution of hourly gross wages for full-time, full-year workers.

However, we cannot conclude that globalization has a higher employment impact than technological progress, since the thesis' results do not take into account general equilibrium effects, that may be very important. Still, the results in the thesis find no important effect associated with firm's technological change (as measured by the distance to the technology frontier and total factor productivity). Two explanations may justify the small impact of technological progress on inequality. First, our measure of technological progress may not well capture investment in new technologies, which is known to be biased towards skilled workers. Second, technological progress may have played a smaller role on inequality compared to what was observed in the 1990s. The ICT revolution mainly happened in the 1990s with the development of computers, internet and robots. Today, new technologies are embedded in the production process. In France, a large fraction of workers has access to a computer and internet. For instance, more than 90% of managers responding to the French Survey on Working Conditions declare using a computer. Hence, analyzing the labor market effect of globalization in the recent period (2002-2007) may have a different

impact than what was observed in the 1990s. Moreover, results showing a modest impact of trade mainly use data before the rise of China in the 2000s. Analysis in the recent period may highlight a higher impact of globalization due to the impressive growth of emerging economies.

TABLE 5.11 – Evolution of technological progress and trade over two periods

	Technological progress	Trade
1995-2001	110.464%	10.146%
2002-2007	35.592%	68.701%

Source : Growth in ICT services derived from EUKLEMS. Growth of Exports in US constant 2005 dollar in France derived from World Trade Organization. Author's calculations.

This idea is confirmed by results in Table 5.11, which reports the growth in ICT capital services per hour worked. Information is derived from the EUKLEMS database for France. The growth in ICT services is particularly important during the 1990s and becomes less important in our period of observation (2002-2007). We also report the growth rate in the flow of exports from France (in US constant dollar) as detailed by the World Trade Organization database. As observed, the growth of trade is much more important in the recent period (2002-2007) which is in part explained by the boom of emerging economies. I thus argue that the role of globalization may be much more important in the recent period than what was observed in the 1990s. A similar conclusion was also reached by Chusseau and Dumont (2012), who claim that the two causes are valid but their weight may differ across countries and period of time.

The French labor market may also have several specificities that explain the important impact of globalization on the labor market.

Is there a specificity of the French labor market The French labor market has three salient features that place it apart from the UK or the US markets : a high minimum wage, a rigid labor market (high lay-off costs [23]) and a generous welfare state (important unemployment allowances).

As a result, the rise of wage inequalities has been limited in France (Fontagné et al. (2014)). Charnoz et al. (2011) have shown that the overall wage inequality was stable from 1976 to 1992 and slightly decreased from 1995 to 2004 in France. They show that both within and between education-group inequality decreased during the period 1995-2004. In

23. The OECD employment outlook 2004 presents the overall summary index of employment protection that relies on three main components : (i) the protection of regular workers against dismissal, (ii) the requirements for collective dismissals and (iii) the regulation of temporary forms of employment. On a scale from 0 to 6 France has an employment protection index of 2.9, the sixth highest index on a sample of 28 countries. For comparison, the US has an index of 0.6.

particular, France is one of the five OECD countries where income inequality and poverty have declined over the past 20 years and this is mainly due to labor market institutions (OECD 2008).

Strong labor market institutions in France may however have implications on FDI, since high level of employment protection tends to discourage outward FDI because high lay-off costs makes firms reluctant to relocate abroad (Dewit et al. (2009)). Yet, the number of French foreign subsidiaries is important and French companies are important investors in low-income countries. FDI to low income countries is the second destination country for France, after FDI to EU-15. Hence, the effect of FDI on the French labor market may be important despite the strong labor market institution. Two main conclusions can be derived from these two seemingly oppositional French specificities (large number of subsidiaries in low-income countries and strong labor market institutions).

First, since labor market institutions anchored firms at home, it is likely that firms willing to pay the extra costs of workforce reorganization are on average bigger and more productive. Hence, the labor market effect of FDI on the French labor market may be driven by large French multinational firms. Chapters 3 confirm this intuition. Results show that the positive effect of FDI on wages in the sample of managers is mainly driven by the intensive margin by large firms having at least 5 foreign subsidiaries abroad. Second, the adjustment variable to FDI in France may be employment. Our findings support the idea that employment has been the main adjustment variable for French firms at the extensive margin (see chapter 2), while wages are the adjustment variable at the intensive margin (see chapter 3). Hence, due to wage rigidity, it seems that firms adjust by declining employment, through a decrease of hiring and the non-replacement of retirees, when starting their offshoring process, while firms adjust wages at the intensive margin.

To summarize and conclude, the thesis contributes to quantify the role of international competition in recent labor market transformations by focusing on the effect of outward FDI. I analyze the impact of FDI on employment, wages, organizational changes inside firms and workers' mobility. I conclude that FDI is associated with higher employment and wages, but this positive effect of FDI is very selective. FDI gains are only directed towards skilled-workers and are only observed when FDI is vertical. This result reflects the firm's need to maintain skilled activities at home to coordinate international division of production processes.

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Résumé

Cette thèse a pour objectif d'analyser et d'identifier les effets des investissements directs étrangers (IDE) sur le marché du travail français. Le premier chapitre dresse un état des lieux de la littérature récente sur cette question. Les autres chapitres analysent empiriquement et théoriquement l'effet des IDE sur le marché du travail. A l'aide de données récentes et détaillées sur les firmes et les employés français, plusieurs aspects du marché du travail sont abordés. Dans un premier temps, la thèse analyse l'effet des IDE sur l'emploi (chapitre 2), puis s'intéresse à leurs effets sur les salaires des travailleurs français (chapitre 3). Le chapitre 4 quant à lui, identifie un des canaux par lequel l'IDE affecte le marché du travail. Ce canal est celui du changement organisationnel au sein de la maison mère. Enfin, le chapitre 5 identifie les conséquences du changement organisationnel en terme de mobilité de la main d'oeuvre au sein des firmes multinationales. Les résultats montrent un effet sélectif de l'IDE sur l'emploi et les salaires. Seuls les IDE vers des pays à bas salaires affectent le marché du travail et seuls les cadres sont impactés positivement par les stratégies d'implantation à l'étranger des firmes. L'emploi semble être la variable d'ajustement en marge extensive, alors que le salaire est la variable d'ajustement en marge intensive. Les IDE sont également responsables du changement organisationnel au sein de la maison-mère. Ce changement provoque d'une part, un déplacement de l'autorité du chef d'entreprise vers les cadres et d'autre part, une augmentation de la mobilité des travailleurs qualifiés au sein de la firme.

Mots clés : IDE, Salaire, Emploi, Changement Organisationnel, Inégalité, Tâches, Mobilité des Travailleurs

JEL classification : J21, J23, J24, F16, F66, J31

Abstract

This thesis aims to identify the effects of outward foreign direct investment (FDI) on the French labor market. The first chapter provides an overview of the recent literature on this topic. The other chapters of the thesis analyze empirically and theoretically the effects of FDI on the labor market. Thanks to recent and detailed data on French firms and employees, the thesis looks at several aspects of the labor market. First, the study starts by analyzing the effect of FDI on employment (chapter 2) and then looks at the effects on hourly gross wages (chapter 3). Chapter 4 identifies a possible channel through which FDI affects the labor market. This channel is organizational change. Finally, Chapter 5 identifies the impact of organizational change on labor mobility within multinational companies. The results show a selective effect of FDI on employment and wages. Only FDI to low-wage countries affect the labor market and only managers' employment is positively affected by offshoring strategies of their firm. Results also show that employment is the main adjustment variable at the extensive margin, while wage is the main adjustment variable at the intensive margin. Results of chapter 4 and 5 highlight the role of FDI on organizational change within the mother company. Organizational change is materialized on the one hand, by a decentralization of authority from the CEO to the managers and, on the other hand, by an increase of inhouse labor-mobility of skilled workers.

Keywords : FDI, Employment, Wage, Inequality, Tasks, Organizational Change, Labor Mobility

JEL classification : J21, J23, J24, F16, F66, J31