AIX-MARSEILLE UNIVERSITÉ

Faculté de Sciences Economiques et de Gestion

École Doctorale de Sciences Economiques et de Gestion d'Aix-Marseille n° 372

Année 2013 Numéro attribué par la bibliothèque

| | | | | | | | | | | | |

Thèse pour le Doctorat ès Sciences Economiques

Présentée et soutenue publiquement le 13 Décembre 2013 par

Sarra Ben Yahmed

Inégalité entre hommes et femmes sur le marché du travail, les rôles du commerce international et du secteur informel

Directeurs de Thèse

M. Alain Trannoy	Directeur d'Etudes à l'EHESS et AMSE
Mme Cecilia García-Peñalosa	Directrice de Recherche CNRS au GREQAM, AMSE

Jury

Rapporteurs

M. Peter Neary	Professeur à l'Université d'Oxford
M. Mathieu Crozet	Professeur à l'Université Paris Sud

Examinatrice

Mme Dominique Meurs	Professeur à l'Université Paris Ouest

Remerciements

C'est à mes directeurs de thèse, Alain Trannoy et Cecilia García-Peñalosa, que mes remerciements s'adressent en premier lieu, pour leur soutien constant, la rigueur de leurs commentaires et leurs conseils.

Peter Neary, avant d'accepter d'être rapporteur de cette thèse, avait soutenu ce travail par des explications, des commentaires et des discussions ; travail qui a aussi grandement bénéficié d'un séjour au département d'économie de l'Université d'Oxford. Pour tout cela, je lui suis très reconnaissante.

Matthieu Crozet et Dominique Meurs ont également accepté d'être rapporteur et examinatrice de cette thèse, et leurs commentaires ont fait et feront progresser cette recherche ; je les en remercie.

Je souhaite remercier aussi tous les chercheurs à qui j'ai présenté mes travaux, et qui ont aidé et encouragé leur progression. Comme la liste est longue, ces précieuses rencontres ne seront pas nommées.

Pour leur aide et leur présence porteuse, c'est avec une grande joie que je remercie, Anne-Sarah, Bilel, Clément, Daria, Kalila, Marion, Maty, Morgane, Zakaria, Jean-Christophe, Julie, Tanguy, Clément et Qays, tous rencontrés à Marseille ; Francis, German, Rebecca et Silja, rencontrés à Oxford ; Ysaline, Sean, Xavier, Maxime, Adrien, Sarah et Michalis, collègues et amis parisiens ; Claudine, Dominique, Catherine et Anissa, des belles contrées montagneuses.

Avertissement

Mis à part l'introduction et la conclusion générale, les chapitres de cette thèse sont issus d'articles de recherche rédigés en anglais et dont la structure est autonome. Ceci explique la présence des termes "paper" ou "article" ainsi que l'éventuelle répétition de certaines informations.

Notice

Except for the general introduction and the general conclusion, the chapters of this dissertation are self-standing research articles. Consequently, the terms "paper" and "article" are frequently used. This also explains that some information is provided in multiple parts of the thesis.

Résumé

Cette thèse, composée de trois essais, traite deux questions relatives aux inégalités salariales entre hommes et femmes. Le premier et le deuxième chapitres analysent l'impact du commerce international sur les écarts de salaire entre hommes et femmes, tandis que le troisième chapitre se pose la question de l'influence du secteur informel sur ces écarts.

Le premier chapitre montre que le commerce international peut avoir des effets opposés sur l'écart de salaire entre hommes et femmes via le canal de la concurrence. Si les entreprises étrangères ont un avantage compétitif, l'ouverture commerciale concourt à la baisse des écarts de salaire. En revanche, si les entreprises domestiques détiennent un avantage compétitif fort, l'intégration commerciale des marchés permet aux entreprises domestiques, même discriminantes, d'augmenter leurs profits et de ce fait, conduit à un accroissement de l'écart de salaire. Les prédictions du modèle théorique sont confirmées par une analyse empirique des écarts de salaire en Uruguay sur une période incluant la création du Mercosur.

En unissant la théorie de la discrimination statistique et les théories du commerce international avec des entreprises hétérogènes, le deuxième chapitre montre que l'intégration commerciale peut modifier les écarts de salaire entre hommes et femmes différemment en fonction des qualifications. Le modèle montre que l'intégration commerciale augmente les inégalités entre les femmes, et entre les hommes, lorsque les qualifications et le progrès technologique sont complémentaires. Si les femmes sont discriminées à cause d'une plus grande incertitude quant à leur engagement au travail, l'intégration commerciale accroît les inégalités entre hommes et femmes qualifiés lorsque l'engagement au travail et le progrès technologique sont complémentaires.

Le troisième chapitre conduit une analyse empirique des écarts de salaire entre hommes et femmes dans les emplois formels et informels au Brésil. Alors que l'écart brut de salaire est plus élevé dans le secteur informel que dans le secteur formel, les résultats indiquent que cette différence est un artefact de la composition de l'emploi dans les deux secteurs. Tout d'abord, les femmes qui participent au marché du travail ont de meilleures caractéristiques observables que les hommes, et cet avantage féminin est plus fort parmi les salariés du secteur formel. Ensuite, la sélection dans les différentes catégories d'activité, dont l'emploi formel et l'emploi informel, diffère entre les hommes et les femmes. Dans le secteur informel, la correction du biais de sélection réduit le différentiel de salaire qui n'est plus significatif. Dans le secteur formel, en revanche, l'écart de salaire, corrigé de la sélection, demeure élevé et fortement significatif.

Mots clés: Inégalité de genre, écart de salaire, discrimination, commerce international, emploi informel.

Abstract

This dissertation consists of three essays on gender wage inequality and covers two different topics. The two first chapters explore the impact of international trade on the gender wage gap, while the third chapter deals with the role of the informal sector in shaping the gender wage gap.

By integrating the taste-based theory of discrimination and the oligopolistic trade literature, the first chapter shows that international trade can have two opposite effects on the gender wage gap through the channel of competition. When foreign firms have a competitive advantage over domestic discriminatory firms, international trade reduces domestic firms' profits leading to a reduction in the gender wage gap. When domestic firms have a competitive advantage, however, trade integration creates new export opportunities that can increase firms' profits in such a way that the gender wage gap increases. The predictions of the models are confirmed by an empirical analysis of gender wage gaps in Uruguay following the Mercosur trade agreement.

The second chapter investigates how international trade impacts the gender wage gap at different points of the skill distribution, by incorporating statistical discrimination into a model of trade with heterogeneous firms and workers. The model shows that trade integration increases inequality within gender groups when skills and technology upgrading are complements; trade induces a skill-biased technological change. If employers discriminate against women because of a higher risk of low job commitment, trade integration increases inequality between high-skilled men and women when job commitment and technology upgrading are complements; trade induces a gender-biased technological change.

The third chapter investigates whether the gender wage gap differs in the formal and the informal segments of the labour market in Brazil. It shows that the higher raw wage gap in the informal sector is an artificial effect of the different sorting of men and women into formal and informal jobs. Two reasons explain this finding. First, women have better observable productive characteristics than men and the female advantage is stronger among formal employees. Second, selection into work status is not random and differs between men and women. In the informal sector, the selection-corrected gender wage gap is reduced and not significant anymore. In the formal sector, however, the selection-corrected gender wage gap is large and highly significant.

Keywords: Gender inequality, wage gaps, discrimination, international trade, informal employment.

Contents

List of Tables

List of Figures

Introduction générale

1. Les inégalités entre hommes et femmes sur le marché du travail

La participation des femmes au marché du travail a beaucoup progressé durant les dernières décennies. Cependant l'écart des taux de participation entre hommes et femmes reste fort dans les années 2000. Si parmi les pays de l'OCDE, l'écart des taux d'activité est en moyenne de 20%, cet écart est encore plus grand et plus hétérogène dans les autres régions du monde. En Amérique Latine, cet écart est d'environ 40% [1]. Ces écarts de taux de participation cachent d'autres différences sur le marché du travail. Dans tous les pays, le taux de chômage est plus élevé pour les femmes. Lorsque les femmes et les hommes travaillent, leurs activités sont souvent différentes. Le pourcentage de femmes dans l'emploi sectoriel est différent en fonction des secteurs. Les femmes sont très largement représentées dans les services, notamment dans les fonctions administratives, l'éducation et la santé. Elles sont moins présentes dans l'industrie manufacturière, sauf dans l'industrie du textile et de l'habillement, et sont presque absentes du secteur de la construction. A l'intérieur des secteurs, les femmes sont très largement présentes dans certaines catégories d'emplois, mais presque absentes d'autres catégories. A l'intérieur de chaque catégorie d'emploi, il existe des différences hiérarchiques entre les hommes et les femmes [2]. De plus, les hommes et les femmes n'ont pas toujours accès au même type de contrat de travail. Dans un rapport de juin 2011 portant sur 44 pays d'Afrique, d'Amérique Latine, d'Asie et du Moyen Orient, l'Organisation Internationale du Travail (OIT) note que, dans plus de la moitié des pays étudiés, les femmes sont plus souvent en emploi informel que les hommes dans les services

1. World Bank. 2011. World Development Report 2012 : Gender Equality and Development. World Bank, Washington D.C.
2. Blau et al. (2006) présentent une analyse chiffrée de ces différences pour les États-Unis.

et l'industrie manufacturière [3]. Enfin, les revenus du travail perçus par les femmes sont globalement plus faibles que ceux perçus par les hommes [4].

Cette thèse se concentre sur les différences de rémunération entre hommes et femmes dans l'emploi salarié. Elle étudie, d'un point de vue théorique d'une part, et dans une perspective empirique d'autre part, l'impact du commerce international et celui du secteur informel sur les écarts de salaire. Les analyses empiriques sont conduites sur des pays d'Amérique Latine, pays où l'ouverture commerciale et le secteur informel sont deux aspects marquants de l'environnement économique des dernières décennies. Nous présentons dans les sections suivantes des éléments importants pour l'appréhension de l'objectif de cette thèse et de sa contribution à l'étude ces différences.

1.1. Inégalité et discrimination, deux notions à distinguer

Une différence ne suppose pas forcément un traitement discriminatoire. C'est lorsque la différence est désignée comme illégitime qu'il y a discrimination. La discrimination sur le marché du travail implique que la différence de traitement n'est pas justifiée par une différence de compétence mais par l'appartenance à un groupe.

L'analyse des données montre que les femmes gagnent en moyenne de plus faibles salaires que les hommes. Quelle est la partie du différentiel de salaire qui est causée par des traitements discriminatoires sur le marché du travail ? Un autre fait majeur constaté sur la longue période est celui de la baisse des écarts bruts de salaire entre hommes et femmes (Weichselbaumer and Winter-Ebmer, 2005), malgré la récente stagnation de cet écart depuis les années 1990 pour certains pays développés (Blau et Kahn (2006) et Gupta et al. (2006) pour les États-Unis, Meurs et Ponthieux (2006) pour la France). Comment explique-t-on la convergence du salaire moyen des femmes avec celui des hommes ? Deux explications potentielles sont à explorer : une augmentation de la productivité des femmes suite à un investissement dans l'éducation et la formation, et/ou une baisse de la discrimi-

3. "Statistical update on employment in the informal economy", ILO Department of Statistics, June 2011.

4. Blau et Kahn (2000) et Eckstein et Nagypál (2004) documentent l'évolution des écarts de revenus pour les États-Unis ; Arulampalam et al. (2007) présentent les écarts de salaire pour onze pays européens ; Nopo et al. (2010) pour l'Amérique Latine ; Weichselbaumer et Winter-Ebmer (2005) proposent une méta-analyse des études sur les écarts de salaire entre les sexes qui couvre toutes les régions du monde.

nation. Pour répondre à cette question, nous avons besoin d'une définition et d'une mesure de la discrimination.

En 1951, l'OIT adopte la convention sur "l'égalité des rémunérations entre la main-d'oeuvre masculine et la main-d'oeuvre féminine pour un travail de valeur égale", convention qui stipule que le taux de rémunération doit être fixé sans discrimination de sexe. La discrimination est plus amplement définie dans la convention de 1958 comme l'inégalité d'accès à l'emploi, et aux promotions, l'inégalité de salaire et/ou de conditions de travail, qui ne sont pas dues aux différences de qualification.

La section suivante présente une décomposition du différentiel total de salaire largement utilisée dans la littérature empirique sur les inégalités. Cette décomposition aboutit à une proposition de mesure statistique des écarts de salaire dus à la discrimination.

1.1.1. Écarts de salaire entre hommes et femmes : de quoi parle-t-on ?

L'écart brut de salaire est la différence entre la moyenne des salaires perçus par les hommes et la moyenne des salaires perçus par les femmes. Cet écart brut peut se réduire à deux composantes, un effet de composition - qui sont les hommes et les femmes que nous comparons ?- et un effet de discrimination. La méthode d'Oaxaca (1973) et de Blinder (1973) [5] propose une décomposition de l'écart total de salaire en deux parties : l'écart dû aux différences de caractéristiques productives et l'écart dû aux différences de rémunération associée à ces caractéristiques.

L'effet de composition, ou effet des dotations, réfère à la partie de l'écart expliquée par les différences de productivité entre les hommes et les femmes en emploi salarié. La productivité dépend du capital humain, c'est à dire d'un ensemble de variables qui incluent notamment le niveau d'éducation, les formations, l'expérience. Ces différences de productivité expliquent légitimement les différences de salaires.

La partie de l'écart due aux différences de traitement des hommes et des femmes, malgré la similarité de capital humain, est parfois appelée l'effet des prix associés aux caractéristiques, ou encore l'effet des coefficients. Cette partie de l'écart de salaire est attribuée à la discrimination.

5. De nombreux développements ont permis d'améliorer la méthode initiale. Fortin et al. (2011) présentent une revue des méthodes de décomposition des écarts de salaire, notamment des méthodes alternatives à celle d'Oaxaca (1973) et de Blinder (1973)

1.1.2. Les biais dans la mesure de la discrimination salariale.

Il existe plusieurs sources de biais dans la mesure des différences de traitement des hommes et des femmes. Tout d'abord, pour que l'économètre puisse mesurer des écarts de salaire à compétence égale, et ainsi quantifier l'impact de la discrimination salariale, il lui faut une mesure des caractéristiques productives observables par l'employeur. Des erreurs de mesures ou l'absence de variables quantifiant certaines compétences observables peuvent conduire à surestimer ou à sous-estimer l'écart non expliqué par les compétences. L'enjeu ici est d'isoler ce qui est causé par les différences de traitement et non par les différences de capital humain. Les erreurs de mesures et l'omission de certaines variables peuvent conduire à surestimer l'écart dû à la productivité. La source principale de surestimation de la discrimination de genre est la mesure de l'expérience. Souvent l'expérience réelle n'est pas disponible dans les données, ce qui oblige l'économètre à construire une variable d'expérience potentielle, égale à l'âge actuel moins le nombre d'années d'études ; puisque les femmes s'absentent plus souvent du marché du travail, leur expérience potentielle s'en trouve surestimée.

Ensuite l'économètre doit se poser la question du choix des variables qu'il est pertinent d'inclure dans les déterminants du salaire car certaines variables sont elles-mêmes la conséquence de la discrimination ; les inclure peut conduire à sous-estimer la discrimination. Ainsi lorsqu'on prend en compte les caractéristiques précises de l'emploi dans l'équation de salaire, il est possible d'ignorer l'impact de la discrimination dans l'accès aux emplois (ségrégation occupationnelle, temps partiel subi), aux promotions et aux professions de direction les plus qualifiées (le "plafond de verre"). De même, lorsqu'on inclut certaines caractéristiques des entreprises (taille, productivité), on risque d'ignorer l'impact de la discrimination à l'embauche, les femmes ayant plus de difficultés à entrer dans les entreprises les plus porteuses, à secteur et poste équivalents (la "porte de verre").

Enfin, l'effet de sélection dans l'emploi peut fausser la mesure de l'écart de salaire dû à la discrimination. L'écart de salaire observé dans les données est celui des individus qui non seulement ont décidé de participer au marché du travail, mais ont obtenu un emploi et accepté l'offre de salaire. Or c'est l'écart d'offres de salaire potentiellement faites aux hommes et aux femmes qui nous intéresse. Si la répartition des hommes et des femmes dans les différents types d'activité n'est pas aléatoire, la distribution des salaires observés dans les activités salariées ne reflète pas la distribution des offres de salaire potentiellement faites aux femmes et aux hommes. Les salaires observés peuvent surestimer les offres de salaire ; le biais est alors positif ; c'est le cas lorsque seules les personnes pouvant obtenir les salaires les plus élevés exercent une activité salariée. Inversement, les salaires observés peuvent sous-estimer les offres de salaire ; le biais est alors négatif ; dans ce cas, les personnes qui ont un travail salarié ont des salaires en moyenne plus faibles que les salaires potentiellement perçus par les personnes qui décident de ne pas travailler ou qui choisissent une activité non salariée. Si le biais de sélection des hommes et des femmes diffère, l'écart de salaire est faussé. L'écart moyen calculé à partir des salaires observés ne reflète pas l'écart d'offres de salaire. L'estimation de la part de l'écart due à la discrimination est donc biaisée. Aussi, est-il pour donner une mesure exacte de la discrimination salariale, de tenir compte de la sélection des femmes et des hommes dans les différents types d'activités [6].

1.2. Comment comprendre les différences entre hommes et femmes sur le marché du travail ?

1.2.1. La répartition des rôles, la maternité et les différences de capital humain entre hommes et femmes n'expliquent pas tout.

Notons pour commencer que la décision de participer au marché du travail et l'évolution de la carrière sont intrinsèquement reliées aux différences de genre dans la sphère privée, dans l'accomplissement des tâches domestiques et dans les soins et l'éducation apportés aux enfants. C'est sur ce point que la littérature a d'abord insisté. Comme le rappellent Blau et al. (2006), la question de la division des tâches au sein du ménage a déjà été abordée dans les années 1930 et 1940 par Margaret G. Reid ; mais ce n'est qu'à partir des années 1960, période à laquelle les femmes accèdent massivement au travail rémunéré, que la "New Home Economics" se développe. L'article de Becker (1965), "A theory of the allocation of time", ouvre véritablement la recherche dans ce domaine. Si les modèles néoclassiques de la famille présentent les avantages de la spécialisation au sein du couple, la division traditionnelle

6. Neuman et Oaxaca (2004) et Yun (2007) présentent des extensions de la méthode d'Oaxaca (1973) et de Blinder (1973) lorsque la sélection dans l'emploi est endogène et doit être prise en compte dans l'équation de salaire.

des tâches implique des renoncements qui peuvent s'avérer désavantageux en termes de participation au marché du travail.

Les responsabilités familiales dévolues aux femmes ont des conséquences sur les inégalités professionnelles entre les sexes pour plusieurs raisons. Elles peuvent influencer les décisions de participation et l'acquisition de capital humain, c'est à dire l'acquisition d'une expérience professionnelle et l'investissement dans des formations. Les femmes se retirent plus souvent du marché du travail à la suite d'une naissance ou bien optent pour une participation plus discontinue, pour des emplois plus flexibles ou à temps partiel, moins rémunérés. Les travaux de Gauthier et al. (2002) décrivent les différences de répartition du temps entre conjoints. Les auteurs montrent qu'avec l'arrivée du premier enfant, ce sont surtout les jeunes mères qui modifient le partage de leur temps entre leurs différentes activités. Angelov et al. (2013) montrent que la naissance d'un enfant est associée à un creusement de l'écart des revenus du travail au sein même du couple.

Les normes et habitudes sociales ne confèrent pas les mêmes responsabilités aux hommes et aux femmes dans la sphère domestique. Ils ne peuvent généralement pas dégager le même temps pour leurs activités professionnelles ou extra-domestiques. En 1981, la convention de l'OIT sur les travailleurs des deux sexes ayant des responsabilités familiales reconnait cette réalité et l'intègre dans son plan d'action en vue de promouvoir l'égalité des chances et de traitement entre les hommes et les femmes. L'objectif de cette convention est d'inciter les pouvoirs publics à reconnaître que certains aspects de la vie privée, et en particulier les responsabilités familiales, peuvent limiter les possibilités d'acquérir les compétences valorisées sur le marché du travail, d'accéder à certaines professions, et de progresser dans une carrière.

Si les hommes et les femmes *choisissent* volontairement des trajectoires différentes, les différences de genre sont des différences observables légitimes (résultant du libre choix des individus). Cela étant, les différences de genre peuvent aussi *modifier les motivations et comportements* des hommes et femmes (choix de participation au marché du travail contraints ou influencés) ainsi que des employeurs, générant de ce fait sur le marché du travail des inégalités qui ne sont pas justifiables par des différences de compétence individuelle. Plusieurs modèles montrent que même lorsqu'il n'y a pas de différence de genre au départ (pas d'avantage comparatif dans la sphère domestique par exemple), il peut tout de même exister un équilibre "genré" sur le marché du travail où des écarts de salaire entre les sexes existent du fait de la discrimination statistique. Même lorsqu'on neutralise l'effet des différences de compétences et d'engagement observables (qualification, formation, temps de travail), il demeure des inégalités d'opportunités qui pénalisent les femmes même si elles souhaitent maintenir une vie professionnelle continue. Budig et England (2001) montrent qu'aux États-Unis, les mères reçoivent des salaires plus faibles que les femmes sans enfant, même compte tenu des caractéristiques observables telles que l'expérience réelle dans l'emploi et le type d'emploi ainsi que des caractéristiques constantes dans le temps, observées ou non par l'économètre, qui sont capturées par un effet fixe individu. Les auteurs n'excluent pas l'existence de différences de productivité entre les mères et les femmes sans enfant qui ne soient pas renseignées par la base de données et qui varient dans le temps ; ces différences, qui ne peuvent pas être prises en compte par l'économètre, peuvent expliquer tout ou partie de l'écart restant. La deuxième explication de l'écart de salaire non rapportable aux caractéristiques productives réside dans une discrimination de statut à l'encontre des mères.

Les théories de la discrimination proposent différents mécanismes pour expliquer la formation et la persistance des différences de traitement entre des individus ayant des caractéristiques productives identiques. Les deux principales théories de la discrimination sont présentées dans la section suivante.

1.2.2. Théories de la discrimination

Les théories de la discrimination peuvent être classées en deux courants principaux. La théorie de la discrimination par les goûts [7] développée par Becker (1957) explique les différences de traitement par les préférences des individus. Le second courant comprend les théories de la discrimination statistique, dont les premiers développements sont dus à Phelps (1972) et Arrow (1973) [8]. Dans ce cas, ce sont des problèmes d'acquisition d'information qui causent les différences de traitement.

7. *Taste-based discrimination* en anglais.

8. Altonji et Blank (1999) présentent une revue de la littérature des théories de la discrimination. Fang et Moro (2011) se concentrent sur la discrimination statistique et les résultats escomptés de la discrimination positive, et présentent les développements de modèles récents. Havet et Sofer (2002) proposent également une revue de la littérature sur les théories de la discrimination en français.

Discrimination en information parfaite : l'antipathie ou les préférences discriminatoires

Becker propose un modèle où la discrimination est due à l'antipathie de l'employeur, des collègues ou des clients pour un groupe ethnique ou démographique. Les implications de ces trois sources de discrimination sont proches et nous présentons ici la discrimination par les employeurs, version utilisée dans le chapitre 1 de cette thèse.

Selon cette théorie, certains employeurs voient leur satisfaction diminuer lorsqu'ils embauchent une femme plutôt qu'un homme dans l'entreprise qu'ils dirigent. La baisse de satisfaction a ici un équivalent monétaire, le coefficient de discrimination. Becker émet l'hypothèse que les employeurs maximisent leur propre satisfaction et non les profits de l'entreprise. Il s'en suit que tout employeur misogyne [9] ne trouve avantageux d'embaucher une femme que s'il obtient une compensation financière. En d'autres termes, un employeur misogyne n'embauche des femmes que si leur salaire est inférieur à celui des hommes d'un montant au moins égal à son coefficient de discrimination. Dans la première version de cette théorie, les entreprises orientent leur recrutement vers un seul genre. Il en résulte une ségrégation des hommes et des femmes au niveau des entreprises [10].

Une implication importante de la discrimination par les préférences est que l'intensification de la concurrence réduit les écarts de salaire entre les deux groupes. Lorsque la misogynie des employeurs les conduit à proposer des salaires plus élevés aux hommes qu'aux femmes alors que leur productivité est identique, les entreprises discriminantes augmentent par là même leurs coûts salariaux, à productivité donnée. Selon cette théorie, une entreprise discriminante aura des profits plus faibles qu'une entreprise concurrente qui accepte d'embaucher des femmes. Une hausse de la concurrence, consécutive à l'entrée de nouvelles entreprises sur le marché, oblige les entreprises discriminantes à réduire leurs prix, c'est à dire leurs coûts de production, pour ne pas perdre leur part de marché. Les employeurs les plus misogynes, qui ne sont pas prêts à accepter des femmes au salaire du

9. L'usage du terme de misogynie nous semble le plus approprié pour décrire l'attitude des employeurs dans ce cadre théorique. Le *Dictionnaire de philosophie* de C. Gaudin définit ce mot comme la "détestation des femmes qui va de l'aversion pour leur corps au mépris pour leur comportement et leur personnalité". Il est aussi parfois défini comme "hostilité envers les femmes" (*Dictionnaire historique de la langue française*, sous la direction d'Alain Rey). Nous le préférons au terme plus général de sexisme, "attitude de discrimination à l'encontre des femmes", qui peut regrouper différents types de comportements discriminatoires.

10. Arrow (1973) propose une autre version du modèle, où la baisse de satisfaction d'un employeur misogyne n'est pas causée par l'embauche d'une femme, mais dépend du ratio hommes/femmes parmi les employés de l'entreprise. Cette version permet d'obtenir de la mixité dans les entreprises, ce qui est plus réaliste.

marché, n'ont d'autre choix que d'arrêter leur production. Les entreprises discriminantes sont inévitablement évincées du marché par les entreprises non-discriminantes, qui ont des coûts de production plus faibles. Une intensification de la concurrence implique ainsi une baisse de la demande de travail masculin et une hausse de la demande de travail féminin. Si la concurrence des entreprises non-discriminantes est assez forte, les salaires des hommes et des femmes s'égalisent.

Une critique, une réponse

La discrimination par les goûts de Becker a été critiquée ; car, comme l'écrit Arrow dans son article de 1972, le modèle de la discrimination par les employeurs "prédit l'absence du phénomène qu'il devait expliquer" : l'entrée de nouvelles entreprises sur le marché doit éliminer les écarts de salaire entre les sexes ; or les écarts persistent ! Cette critique ne remet pas en cause la validité de la théorie lorsque le marché des biens ou le marché du travail ne sont pas concurrentiels. Concernant le marché des biens, remarquons que la concurrence entre les entreprises n'est pas toujours forte ; certains secteurs restent de fait concentrés. Pas plus que le marché des biens, le marché du travail n'est souvent pas en situation de concurrence parfaite. Il est alors possible que des entrepreneurs misogynes demeurent sur le marché et participent à la persistance des écarts. Cette théorie permet donc de comprendre l'évolution des écarts de salaire dans les secteurs où des chocs de concurrence peuvent modifier les rentes de certaines entreprises, c'est à dire dans les secteurs peu concurrentiels, là où des entreprises discriminantes ont pu maintenir leurs parts de marché. Et si Gary Becker écrit : "évidemment, l'évaluation définitive de toute approche dépend de son utilité"[11], il s'avère que plusieurs articles et le premier chapitre de cette thèse ont trouvé dans la théorie de la discrimination par les préférences une approche utile pour comprendre l'effet de certains changements de l'environnement économique sur les écarts de salaire entre hommes et femmes.

Ainsi les recherches de Black et Strahan (2001) ainsi que celles de Black et Brainerd (2004) montrent qu'aux États-Unis les écarts de salaire entre hommes et femmes ont baissé dans certains secteurs où la concurrence s'est intensifiée. Black et Strahan (2001) utilisent la dérégulation du secteur bancaire tandis que Black et Brainerd (2004) exploitent les changements de taux d'importation par secteur. Une autre force du marché doit réduire

11. "Of course, the final evaluation of any approach depends on its usefulness" Michael and Becker (1973).

les écarts de salaire dus à la discrimination : c'est le rachat d'entreprises, puisqu'il doit améliorer la productivité de l'entreprise, notamment par une meilleure gestion du personnel. Suite à une analyse empirique menée sur des données suédoises, Heyman et al. (2013) trouvent que le rachat d'entreprises est en effet associé à une baisse des écarts de salaire non expliqués. Weber et Zulehner (à paraître) montrent que les entreprises ayant un pourcentage de femmes très faible par rapport à la moyenne sectorielle, identifiées comme des entreprises discriminantes, ont une durée d'existence plus faible. Une plus forte concurrence au niveau du secteur fragilise davantage ces entreprises ; seules celles qui augmentent la part de leur emploi féminin ne voient pas leur risque de faillite augmenter. Le modèle de discrimination par les préférences implique aussi que lorsque les entreprises augmentent leurs profits, les écarts de salaire augmentent. Le premier chapitre de cette thèse porte son attention sur la façon dont évoluent les écarts de salaires lorsque les opportunités de profits augmente à la suite de l'ouverture commerciale des marchés étrangers. Les articles susmentionnés montrent qu'une hausse du degré de concurrence réduit l'incidence de la discrimination sur les écarts de salaire, et inversement. Ces résultats empiriques vont dans le sens de la théorie des préférences discriminatoires.

Toutefois, certains peuvent objecter à la théorie de Becker que la concurrence ne réduit pas totalement les écarts ; des différences de salaire non justifiables par les compétences persistent dans des secteurs où la concurrence entre les entreprises est extrêmement forte. Rosén (2003) montre que lorsqu'il existe des frictions sur le marché du travail, les forces du marché (entrée de nouvelles entreprises, rachat d'entreprises) n'impliquent plus la disparition des écarts de salaire dus à la discrimination des employeurs. Flabbi (2010) propose un autre modèle, comportant lui aussi un marché du travail imparfaitement compétitif et des écarts de salaire générés par les préférences discriminatoires des employeurs, dans lequel il est possible de distinguer deux sources de différentiel de salaire : la discrimination et les différences de productivité, même inobservables. Il teste les prédictions du modèle sur les données du *Current Population Survey* des États-Unis, et trouve que la moitié des employeurs ont des préjugés à l'encontre des femmes, et que la misogynie des employeurs peut expliquer deux tiers de l'écart de salaire entre hommes et femmes.

Cela étant, la théorie de la discrimination par les préférences des employeurs ne prend pas en compte le caractère inobservable de certaines caractéristiques productives des employés. Becker fait l'hypothèse que l'employeur est capable de prédire parfaitement la productivité des candidats qui se présentent pour un poste ; or la lecture d'un curriculum vitae et le temps consacré à un entretien d'embauche ne permettent pas d'évaluer toutes les compétences d'une personne. Une large part des compétences qui seront à mettre en oeuvre dans l'emploi demeure inconnue. Les théories de la discrimination statistique, elles, prennent cet aspect en considération.

Discrimination en information imparfaite : la discrimination statistique.

Les articles majeurs de Phelps (1972) et Arrow (1973) sont à l'origine du développement des théories de la discrimination statistique. Dans ces modèles, la discrimination se manifeste à cause d'un problème d'extraction de l'information. L'employeur ne peut pas prédire exactement la productivité des candidats à l'embauche ; et pour réduire cette incertitude, il regroupe les candidats en fonction d'un signe visible, par exemple le sexe, et utilise la moyenne (ou un autre moment de la distribution) des caractéristiques productives de chaque groupe pour prendre ses décisions. Chez Phelps, et dans les modèles qui s'en inspirent, les différences non apparentes entre les groupes sont exogènes. Si les employeurs pensent, à juste titre, que les femmes passent *en moyenne* moins de temps au travail que les hommes, l'attitude rationnelle de l'employeur qui maximise ses profits est de traiter différemment les hommes et les femmes. Pour compenser le risque d'un moindre engagement professionnel des femmes, les employeurs leur proposent des salaires plus faibles à poste équivalent, financent moins de formations pour les femmes (Kuhn, 1993) et exigent davantage de résultats pour leur accorder une promotion (Lazear et Rosen, 1990). Il y a bien une discrimination : car si certaines femmes sont en effet moins disponibles à cause du temps passé à la maison, avec les enfants ou avec les personnes âgées de la famille (sans que cela soit la conséquence d'un découragement lui-même dû à la discrimination), d'autres femmes sont (ou étaient) prêtes à investir autant voire plus de temps et d'énergie dans leur travail que leurs homologues masculins.

Arrow (1973) développe la première version des modèles de discrimination statistique où les différences entre les groupes se forment de manière endogène. Cette littérature ne fixe pas les différences de productivité ; celles-ci se forment du fait même de la discrimination, par anticipation. La discrimination est une "prophétie auto-réalisatrice". De nombreux articles s'inscrivent dans ce cadre théorique, entre autres Gronau (1988) , Coate et Loury (1993)

, Francois (1998) , François et van Ours (2000), Lundberg et Rose (2000) , Albanesi et Olivetti (2009) et Dolado et al. (2012).

Les deux grandes théories de la discrimination donnent une explication au même fait empirique : les femmes gagnent moins que les hommes et n'accèdent pas aux mêmes types d'emplois. Ces théories mettent toutes les deux en évidence une perte de revenus pour un groupe et une baisse potentielle du bien-être pour la société [12] ; mais comme les mécanismes d'explication diffèrent, la cause de la perte de revenus pour le groupe discriminé et les solutions pour y remédier diffèrent également. Dans le cadre de la discrimination par les préférences de Becker, toutes les femmes reçoivent un salaire en deçà de leurs compétences. Dans le cadre de la discrimination statistique, les inégalités se manifestent différemment. Si les différences de genre sont exogènes (Phelps, 1972), seules les femmes ayant des caractéristiques inobservables qui se situent au dessus de la moyenne féminine pâtissent de la discrimination. S'il existe des effets de désincitation (Arrow, 1973, Coate and Loury, 1993), la discrimination génère une baisse d'investissement en capital humain et influence les choix de carrière. Ces effets pervers créent des différences de caractéristiques productives, par intériorisation des traitements discriminatoires, qui réduisent les opportunités du groupe discriminé.

Les théories de la discrimination statistique proposent des explications intuitives basées sur le comportement rationnel des agents. La difficulté reste de pouvoir définir des politiques publiques efficaces pour sortir d'une répartition des rôles "genrée" qui réduit les chances des femmes sur le marché du travail (Dolado et al., 2012). En particulier, la discrimination statistique ne prévoit pas d'effet de la politique de la concurrence sur les inégalités entre hommes et femmes. Les théories de la discrimination statistique s'inscrivent dans un cadre de marchés concurrentiels. Dans les modèles proposés jusqu'alors, la concurrence n'influence pas les écarts de salaire, ni les décisions d'embauche, ni de promotion, ni de formation. Voilà pourquoi c'est la théorie de la discrimination par les préférences qui a été utilisée pour comprendre le rôle de la concurrence dans l'évolution des écarts de salaire entre hommes et femmes.

Une voie de recherche consiste à enrichir les modèles de discrimination statistique pour

12. La discrimination par les préférences est inefficiente bien qu'elle maximise l'utilité des employeurs Becker (1957). Dans les modèles de discrimination statistique, l'évolution du bien-être dépend de la formalisation théorique. Coate et Loury (1993) montrent que la discrimination génère un investissement sous-optimal dans l'éducation du groupe discriminé. Dolado et al. (2012) montrent qu'un partage inégal du temps entre activité salariée et activité domestique peut causer une perte de bien-être.

comprendre comment certains changements affectent les inégalités de genre, et ainsi être en mesure de faire de nouvelles propositions. Le passage d'un modèle d'économie fermée à un modèle d'économie ouverte est un des enrichissements possibles : les politiques d'ouverture commerciale peuvent avoir des conséquences différentes sur les opportunités des hommes et des femmes en termes d'emploi et de salaire. C'est cette voie que nous suivons.

A quelles conditions l'ouverture commerciale est-elle bénéfique aux femmes et à l'égalité des opportunités sur le marché du travail ? La section suivante ébauche les grands traits d'un cadre analytique permettant d'aborder cette question, et présente la littérature qui s'est intéressée à l'impact du commerce international sur les inégalités salariales, notamment celles entre hommes et femmes. La question de l'informalité sur le marché du travail est aussi abordée ; car l'emploi informel refaçonne lui aussi les écarts de salaire entre hommes et femmes, et peut interagir avec le commerce international dans la formation et l'évolution de ces inégalités.

1.3. Les rôles du commerce international et de l'emploi informel

Le commerce international et la co-existence d'emplois formels et informels influencent l'ampleur des inégalités entre hommes et femmes car ils modifient la répartition des revenus par des mécanismes qui peuvent se conjuguer à ceux de la discrimination. Alors qu'ils ont tous deux un rôle à jouer dans la compréhension des inégalités dues au genre, les recherches sur le commerce international et sur l'informalité n'en sont qu'à leurs débuts.

Les théories du commerce se sont toujours intéressées à l'impact de l'ouverture commerciale des marchés sur la distribution du revenu et sur l'évolution des salaires. Ces théories peuvent être utilisées et amendées pour comprendre l'impact de l'ouverture commerciale sur les salaires des femmes par rapport à ceux des hommes. Les théories développées par Ricardo et Hekcher-Ohlin expliquent les flux de commerce par les avantages comparatifs des pays. Elles apportent un éclairage sur l'évolution des inégalités de genre suivant le degré d'intégration commerciale lorsqu'il existe dans un pays une répartition sectorielle de la main d'oeuvre selon le genre, certains secteurs étant féminins, comme le textile, d'autres étant masculins, comme le tabac par exemple. Si un pays a pour avantage comparatif un produit dont la production utilise intensivement le travail féminin, l'ouverture va accroître la demande de travail féminin ; et le salaire des femmes va lui aussi augmenter par rapport à celui des hommes. L'effet du commerce international sur les inégalités de genre dépend en particulier des dotations en facteurs de production et du contrôle des hommes et des femmes sur ces facteurs de production. Ainsi Wood (1994) explique comment les différences entre les avantages comparatifs de l'Afrique et de l'Asie permettent de comprendre les différences d'impact du commerce sur les inégalités de genre dans ces régions. En Asie, les secteurs exportateurs ont utilisé intensivement le facteur travail, en embauchant principalement une main d'oeuvre peu qualifiée. L'emploi des femmes a pu augmenter dans ces pays car les femmes peuvent décider de "louer leur force de travail". Pour donner un exemple, l'expansion des industries du textile et de l'habillement avec la hausse de la production destinée à l'exportation a permis une hausse de l'emploi féminin dans certains pays d'Asie (Wood, 1991). En revanche, les secteurs exportateurs des pays d'Afrique ont utilisé intensivement les ressources naturelles, facteur de production relativement plus abondant dans cette région. Le contrôle de ces ressources par les hommes a empêché les femmes de bénéficier de l'ouverture commerciale.

Les théories traditionnelles du commerce international prédisent une baisse des différences de salaire entre la main d'oeuvre qualifiée et la main d'oeuvre non qualifiée dans les pays en développement, relativement abondants en main d'oeuvre non-qualifiée. Or la hausse des inégalités de salaire a été observée dans toutes les régions du monde, dans les pays développés comme dans les pays en développement (Bernard et Jensen, 1997 ; Pavcnik et al., 2004 ; Goldberg et Pavcnik, 2007 ; Brambilla et al., 2011 ; Harrigan et Reshef (2011) ; Krishna et al., 2012). Aussi, la littérature récente qui étudie les liens entre commerce international et évolution des salaires a proposé de nouveaux modèles permettant d'expliquer l'accroissement des inégalités salariales dans toutes les régions du monde, quels que soient les avantages comparatifs des pays. En ce qui concerne l'analyse des effets du commerce international sur les inégalités de genre, un constat identique peut être fait : certains phénomènes ne peuvent pas être expliqués par les théories traditionnelles du commerce. Ces théories permettent d'analyser les différences de demande de travail féminin et masculin entre les secteurs. Elles n'abordent pas le rôle que peut avoir le commerce international sur les inégalités à l'intérieur des secteurs et des entreprises ; elles ne permettent pas non plus de comprendre comment le commerce international et la discrimination interagissent lors de la formation et de l'évolution des inégalités. Afin d'étudier ces questions, il est utile de se tourner vers les nouvelles théories du commerce international qui expliquent les flux d'échanges intra-sectiorels entre les pays et qui introduisent de l'hétérogénéité au niveau des entreprises.

Parmi les nouvelles théories du commerce, plusieurs articles montrent que les échanges internationaux peuvent augmenter les inégalités de salaire entre la main d'oeuvre qualifiée et la main d'oeuvre non-qualifiée, lorsque le commerce international induit une accélération des progrès technologiques au sein des entreprises, et par là même un déplacement de la demande vers le travail qualifié. Neary (2002) montre que dans un modèle d'oligopole la concurrence des entreprises étrangères incite les entreprises domestiques à investir dans de nouvelles technologies pour réduire les coûts variables de production et éviter une baisse des parts de marché. Comme l'innovation et la mise en place de nouvelles technologies requièrent plus de travail qualifié, le salaire des travailleurs qualifiées augmente par rapport au salaire des travailleurs non-qualifiés. Du fait des interactions stratégiques entre les entreprises, une augmentation même faible des importations entraîne une hausse de la demande de travail qualifié suffisante pour expliquer la hausse de salaire supplémentaire associée aux qualifications que nous observons dans les données. Les modèles de concurrence monopolistique de Yeaple (2005) et de Bustos (2011) prédisent également des inégalités entre salariés qualifiés et non-qualifiés qui s'accroissent, dans toutes les régions du monde, avec l'intégration commerciale. Ici aussi l'investissement dans de nouvelles technologies est le canal par lequel l'ouverture accroit la demande de travail qualifié. Bustos (2011) montre que l'expérience de l'Argentine valide la pertinence de ce mécanisme. Ce choix de modélisation est emprunté par le chapitre 2 de cette thèse afin d'explorer les conséquences possibles de l'ouverture commerciale sur les écarts de salaire entre les hommes et les femmes qualifiés et entre les hommes et les femmes non-qualifiés.

D'autres modèles de commerce international expliquent comment des inégalités de salaire peuvent se former entre des travailleurs ayant exactement les mêmes caractéristiques observables. Les mécanismes sont nécessairement différents de ceux des articles précédents où les inégalités augmentaient entre qualifiés et non-qualifiés. Dans le modèle théorique de Helpman et al. (2010), les différences de compétences des candidats à l'embauche sont difficilement repérables. Les entreprises les plus productives sont incitées à investir plus de moyens dans les entretiens d'embauche afin de sélectionner les candidats dotés des meilleures compétences. Ces entreprises, sachant que la productivité moyenne de leurs employés est élevée payent des salaires plus élevés. L'ouverture commerciale rend les entreprises exportatrices encore plus exigeantes. La hausse du critère de sélection induit une hausse des salaires dans les entreprises qui opèrent sur le marché international. Helpman et al. (2012) présentent une analyse empirique des inégalités de salaire au Brésil qui valide les prédictions du modèle. Il y existe une forte dispersion des salaires entre des personnes ayant les mêmes caractéristiques observables, occupant les mêmes types de poste dans les mêmes secteurs mais travaillant dans des entreprises différentes. Ce différentiel de salaire est expliqué en partie par la présence de certaines entreprises, seulement, sur les marchés étrangers : les entreprises exportatrices payent des salaires plus élevés, à compétences observables des salariés égales.

Egger et Kreickemeier (2009, 2012) proposent des modèles où les salariés exigent des "salaires justes", c'est à dire des salaires proportionnels aux profits de l'entreprise. Comme les exportateurs font plus de profits, les salariés travaillant pour les entreprises exportatrices gagnent des salaires plus élevés bien qu'ils aient les mêmes caractéristiques que les salariés des autres entreprises. Une plus grande ouverture commerciale a pour conséquence d'accroître les inégalités de profit entre les entreprises, et donc d'accroître les inégalités de salaire entre les entreprises. Egger et al. (2012) estiment ce modèle avec des données d'entreprises pour cinq pays européens et trouvent que le modèle théorique permet d'expliquer plus de 70% de la dispersion des salaires entre les entreprises, et que la différence de salaire entre exportateurs et non-exportateurs est en moyenne de 10% pour leur échantillon. Davis et Harrigan (2011) proposent un autre mécanisme où l'hétérogénéité des entreprises explique les différences de salaire entre des individus de mêmes caractéristiques. Ils développent un modèle où les entreprises payent des salaires élevés à leur employés pour susciter de plus grands efforts, "un salaire d'efficience". Comme certaines entreprises sont plus à même que d'autres de contrôler l'effort de leurs salariés, les entreprises payent des salaires d'efficience différents alors que les employés ont les mêmes caractéristiques.

Beaucoup d'études empiriques qui analysent l'impact du commerce international sur les inégalités salariales à compétences égales ne distinguent pas la main d'oeuvre masculine de la main d'oeuvre féminine. Seules quelques études échappent à ce constat et s'intéressent à l'effet du commerce international sur les écarts de taux d'emploi et de salaire entre hommes et femmes. Leurs analyses peuvent se classer en deux catégories qui se différencient par les mécanismes étudiés. Le premier canal d'impact analysé est celui de la concurrence. Certains articles étudient la façon dont le commerce international modifie les écarts de salaire via les changements du degré de concurrence induits par un choc de libéralisation commerciale

(Artecona et Cunningham, 2002 ; Black et Brainerd, 2004). Ces auteurs évaluent l'effet d'un changement des flux d'échange de biens sur l'écart de salaire *moyen* entre hommes et femmes au niveau sectoriel. Ils trouvent qu'une hausse de la pénétration des importations est associée à une baisse des écarts de salaire entre hommes et femmes dans les secteurs concentrés, là où l'absence de concurrence permettait aux entreprises de conduire une gestion des ressources humaines discriminatoire et coûteuse.

Le deuxième groupe d'articles s'intéresse à l'évolution des inégalités salariales entre hommes et femmes lorsque le commerce international modifie la demande de travail qualifié par rapport à la demande de travail non-qualifié. Oostendorp (2004) étudie cette question au niveau des emplois et du secteur, pour plusieurs pays. Il trouve que l'accroissement des échanges réduit les écarts de salaire entre hommes et femmes non-qualifiés uniquement. Ozler (2000), Fafchamps (2009), Ederington et al. (2009), Klein et al. (2010) et Juhn et al. (in press) exploitent des données comportant des informations sur l'orientation commerciale de l'entreprise et peuvent ainsi comparer les entreprises exportatrices et les entreprises non-exportatrices. La conclusion générale que nous pouvons tirer de ces articles est que l'ouverture est bénéfique pour les femmes dans les emplois peu qualifiés ; en revanche, l'ouverture ne permet pas de réduire les écarts de taux d'emploi, ni les écarts de salaire dans les emplois qualifiées.

Une littérature récente montre que le commerce international n'a pas les mêmes effets sur les salariés ayant un emploi formel (déclaré) et sur ceux ayant un emploi informel (non déclaré) (Goldberg et Pavcnik, 2003) ; Bosch et al. (2012) ; Arias et al. (2013)). L'emploi informel est défini de plusieurs manières. Une activité peut être considérée comme informelle de par sa nature ; certaines analyses considèrent que les micro-entreprises, le travail indépendant, le travail occasionnel réalisé à domicile pour un tiers (le "casual work") font partie de l'économie informelle. L'absence de protection par un régime de sécurité sociale est souvent utilisée comme un signal d'activité informelle. Enfin, une troisième définition se base sur l'existence d'un contrat de travail légal et déclaré par l'employeur. Nous retenons cette dernière définition.

Henley et al. (2009) documentent, avec des données du Brésil, la façon dont les différentes définitions de l'emploi informel modifient sa mesure. 55% des personnes en emploi n'ont pas de contrat légal ; 50% d'entres elles n'ont pas de couverture par un régime de sécurité sociale tandis que 44% pratiquent une activité associée au secteur informel.

Les différences d'écarts de salaire entre hommes et femmes selon que l'emploi est formel ou informel ont été peu étudiées. L'estimation des écarts dans chaque secteur séparément comporte quelques difficultés méthodologiques notamment du fait de la nécessité de tenir compte des différences de sélection dans l'emploi formel et informel. A notre connaissance, seuls les articles de Tansel (2001) et de Deininger et al. (2013) comparent les écarts de salaire dans les deux secteurs après avoir tenu compte de la sélection. Nous commençons par approfondir l'analyse des écarts de salaire entre hommes et femmes lorsque l'emploi informel est largement répandu.

2. Objectifs et organisation de la thèse

2.1. Choix et limites

Les inégalités de genre dans les pays occidentaux ont été largement étudiées depuis un demi-siècle. Ce n'est que plus récemment que davantage d'études s'intéressent à la situation des femmes par rapport à celle des hommes dans les pays en développement. Si certaines questions sont identiques dans toutes les régions du monde, d'autres requièrent des analyses plus spécifiques. Une particularité des pays en développement réside dans leur fort taux d'emploi informel. Prendre en compte cette caractéristique du marché du travail permet de mieux comprendre la formation et l'évolution des inégalités entre hommes et femmes. L'ouverture commerciale joue aussi un rôle important dans l'évolution des salaires. L'Amérique Latine a connu plusieurs épisodes de libéralisation du commerce dans les années 1990, en particulier avec la création du Mercosur. Ces périodes d'ouverture commerciale peuvent changer les opportunités sur le marché du travail pour les femmes et pour les hommes, notamment au niveau des salaires. Cette thèse aborde cette question et participe ainsi aux prémisses de la recherche sur le rôle de l'ouverture commerciale dans l'évolution des inégalités de genre. La littérature traitant de l'impact de l'ouverture commerciale sur les inégalités de salaire montre que beaucoup de mécanismes sont à l'oeuvre (cf la très brève revue de la littérature récente faite dans la section précédente). De même, plusieurs explications concourent à la compréhension des inégalités entre hommes et femmes sur le marché du travail, chaque explication dévoilant une des multiples facettes des inégalités de genre. Cette thèse souhaite apporter quelques éléments de réponse à trois questions précises.

Afin de **cerner les objectifs** de cette thèse, précisons d'emblée qu'elle se concentre sur les écarts de salaire dus aux différences de traitement entre hommes et femmes, pour des niveaux fixés de caractéristiques productives. Elle n'endogénéise pas les différences de capital humain entre hommes et femmes, ni les décisions faites au sein du ménage ; celles-ci sont considérées comme données [13].

Cette thèse apporte donc de nouveaux éclairages sur les écarts de salaire dus à la discrimination dite “directe”, et non “indirecte” c'est à dire causée par des désincitations ou découragements qui ont lieu avant l'entrée sur le marché du travail et qui réduisent le niveau des caractéristiques productives des femmes. Ainsi, le chapitre 3 étudie comment l'existence d'emplois informels influence les écarts de salaire entre hommes et femmes, conditionnellement à leurs caractéristiques et à leurs choix d'activité. Les chapitres 1 et 2 étudient les conséquences de la discrimination “directe” en économie ouverte, et pour ce faire ils utilisent deux approches différentes de la discrimination, la discrimination par les préférences des employeurs à la façon de Becker et la discrimination statistique. Ces deux approches expliquent le même fait empirique : un homme et une femme ayant les mêmes caractéristiques productives observables ne reçoivent pas en moyenne le même salaire, même s'ils occupent des postes semblables. Cette thèse ne propose pas de test empirique pour distinguer la discrimination par les préférences des employeurs de la discrimination statistique. Les méthodes qui permettent d'identifier la nature de la discrimination sont très rares [14]. Un article qui développerait un test empirique permettant de déterminer si la discrimination est causée par les préférences des employeurs ou par le manque d'information sur la productivité des employés constituerait une contribution importante à la littérature traitant des discriminations.

Les deux premiers chapitres s'intéressent aux effets de l'ouverture commerciale sur les écarts de salaire entre hommes et femmes et étudient deux canaux d'impact : les effets pro-concurrentiels et anti-concurrentiels du commerce international (chapitre 1) et l'investissement dans de nouvelles technologies (chapitre 2). Ces deux chapitres montrent que les conséquences de l'ouverture commerciale sur les salaires des hommes et des femmes dépendent de facteurs tels que le degré initial de concurrence sur le marché national et les

13. Voir le modèle de Lundberg et Startz (1983) pour des prédictions concernant l'impact de la discrimination statistique sur les décisions d'investissement dans l'éducation. Dolado et al. (2012) développe un modèle où l'attachement au marché du travail est endogène

14. Combes et al. (2013) propose un test permettant de distinguer la discrimination due aux préférences des employeurs de celle due aux préférences des clients pour le cas de la discrimination ethnique.

avantages comparatifs du secteur (chapitre 1), ou encore les caractéristiques des employés et les technologies utilisées par l'entreprise (chapitre 2). Bien sûr, d'autres modèles de commerce international pourraient être développés afin analyser d'autres mécanismes par lesquels le commerce international détermine les inégalités de salaire entre hommes et femmes. Cela fait partie des suggestions pour des recherches futures.

Une des difficultés majeures rencontrées durant ce travail réside dans les choix de modélisation. Est-il plus adéquat d'étudier l'impact du commerce international en présence de discrimination par les goûts ou de discrimination statistique ? Que nous apprend la théorie de la discrimination par les goûts quant à l'impact du commerce international sur les écarts de salaire ? Quels nouveaux éclairages apporte la discrimination statistique ?

Le premier chapitre examine comment les changements de degré de la concurrence consécutifs à l'ouverture commerciale modifient les écarts de salaire entre hommes et femmes. Ce chapitre traite du cas où la misogynie des employeurs est à l'origine de la discrimination salariale (théorie de la discrimination de Becker). Dans ce modèle, les employés se différencient uniquement par leur sexe et les employeurs ont des préjugés différents à l'encontre des femmes. La productivité du travail est constante au sein de la force de travail, seul le coût psychologique associé à l'embauche des femmes varie. L'ouverture commerciale peut augmenter le degré de concurrence auquel les entreprises domestiques font face si les entreprises étrangères ont l'avantage compétitif. Dans ce cas, l'ouverture commerciale réduit les profits des entreprises domestiques ; elle peut aussi permettre aux entreprises domestiques d'accéder à de plus vastes marchés et ainsi d'augmenter leurs ventes et leurs profits. L'évolution de l'écart de salaire dépend de la capacité des entreprises discriminantes à maintenir, voire à augmenter, leurs profits dans un marché mondial. Ce chapitre propose ainsi un modèle simple permettant d'identifier non seulement les effets pro-concurrentiels du commerce, bénéfiques à l'égalité de traitement entre hommes et femmes, mais aussi les effets anti-concurrentiels du commerce qui participent à la perpétuation des écarts.

Les choix de modélisation ont été guidés par la volonté d'isoler un mécanisme clé, la concurrence dans une économie ouverte. Pour ce faire, nous choisissons un cadre théorique précis, celui de la concurrence oligopolistique et de la discrimination par les employeurs comme elle est modélisée par Becker. Le choix d'un modèle d'oligopole nous parait pertinent pour analyser les effets de la concurrence, mais d'autres modèles auraient pu être choisis pour mettre en relief cet effet. Un modèle de concurrence monopolistique avec profits variables pourrait être étudié (Melitz and Ottaviano, 2008). Les articles de Zhelobodko et al. (2012) et de Mrázová et Neary (2013) montrent que la spécification des fonctions de demande détermine l'impact du commerce sur les marges des entreprises. L'intégration commerciale, c'est à dire l'accroissement du nombre de pays avec lesquels il est possible d'échanger des biens et des services, peut avoir un effet pro-concurrentiel (Krugman, 1979, Melitz and Ottaviano, 2008) comme anti-concurrentiel. Il serait intéressant, dans de futurs travaux, de tester les prédictions du chapitre 1 dans un modèle plus général. L'objectif serait de savoir comment les hypothèses sur la fonction de demande influencent les interactions entre discrimination à la Becker et intégration commerciale. De même, il serait fort intéressant d'analyser les conséquences de la concurrence sur les écarts de salaire dans un cadre de discrimination statistique, et à cette occasion de proposer un test pour distinguer discrimination statistique et discrimination par les préférences ; cela est aussi un sujet de recherche à venir.

Le premier chapitre analyse l'effet de l'ouverture commerciale sur l'écart des salaires *moyens* des hommes et des femmes. Plusieurs études empiriques montrent que l'écart de salaire entre hommes et femmes varie substantiellement en fonction du niveau de qualification, et ce dans les pays développés et en développement [15]. Il est donc possible qu'une analyse de l'écart de salaire moyen ne permette pas d'identifier complètement l'impact du commerce international. Cette hypothèse s'avérerait correcte si le commerce international affecte différemment l'écart de salaire entre hommes et femmes qualifiés et l'écart de salaire entre hommes et femmes non-qualifiés.

Le deuxième chapitre s'attache à éclaircir cette question, et pour ce faire, propose un modèle théorique où les personnes diffèrent par leurs qualifications et permet ainsi d'étudier l'impact de l'ouverture commerciale sur les écarts de salaire à différents niveaux de qualification. Il conduit cette analyse dans un cadre de discrimination statistique. **Pourquoi choisir la discrimination statistique** pour étudier les effets du commerce international sur les écarts de salaire tout au long de la distribution des qualifications ? La théorie de la discrimination de Becker suppose que les employeurs ont une connaissance parfaite de la productivité des candidats, et que les choix d'embauche et de salaire sont dictés par les préférences misogynes des employeurs. L'hypothèse de l'accès à une information parfaite peut être trop restrictive lorsqu'on s'intéresse à la distribution des écarts de salaire.

15. Voir Nopo et al. (2010) pour l'Amérique Latine, de la Rica et al. (2008) pour l'Espagne et Albrecht et al. (2009) pour les Pays-Bas.

Si certaines compétences sont observables, comme le diplôme, la maîtrise d'une langue, d'autres échappent à l'observation de prime abord, comme la constance de la motivation, la disponibilité. Un emploi se distingue d'un autre par l'ensemble précis de compétences, observables et inobservables, qu'il nécessite. Les emplois peu qualifiés ne demandent pas les mêmes compétences inobservables que les emplois qualifiés. Lemieux (2006) s'intéresse aux inégalités de salaire qui ne peuvent pas être expliquées par les caractéristiques observables et conduit l'analyse des inégalités pour les hommes et pour les femmes séparément. Il trouve qu'aux États-Unis la variance de la partie non expliquée du salaire dépend du niveau de qualification du groupe étudié. Cette variance est bien plus large parmi les salariés les plus qualifiés, et ce pour les hommes comme pour les femmes. Aussi est-il important de considérer un mode de discrimination qui prend en compte le caractère inobservable de certaines caractéristiques et l'incertitude que cela implique pour les employeurs. Voilà pourquoi le deuxième chapitre adopte l'approche de la discrimination statistique.

Se pose ensuite la question du **choix du modèle de commerce international**. Pour analyser l'impact de l'ouverture commerciale sur les écarts de salaire via le canal du progrès technologique, nous avons besoin d'un modèle où les entreprises diffèrent par leur technologie. Aussi ce chapitre intègre-t-il deux littératures : les modèles de discrimination statistique avec des différences de genre exogènes d'une part, et les modèles de commerce avec des entreprises hétérogènes et des différences de qualifications entre les salariés d'autre part. Ajouter, dans un modèle de commerce, des compétences inobservables qui induisent les employeurs à discriminer un groupe permet d'enrichir les prédictions de la littérature sur les liens entre commerce et inégalités de salaire. Quant au choix de modélisation des différences de technologie, nous suivons les modèles de Yeaple (2005) et de Bustos (2011) selon lesquels le progrès technologique est endogène : les entreprises choisissent leur technologie en fonction des compétences des travailleurs disponibles, plutôt que les modèles où les différences technologiques sont fixées comme dans Melitz (2003). D'autres modèles de commerce pourraient être adaptés à un environnement où l'incertitude sur la productivité modifie les politiques d'embauche des entreprises. Cependant, ces choix alternatifs permettraient de mettre en lumière d'autres mécanismes.

Le troisième chapitre aborde une question de recherche encore très peu étudiée, le rôle du secteur informel dans les inégalités de genre. Ce chapitre conduit une étude empirique des écarts de salaire dans les emplois formels et informels, et prépare ainsi le terrain pour de futures recherches, par exemple une analyse des effets du commerce international sur le inégalités de genre lorsque le secteur informel absorbe une large part de l'emploi total.

2.2. Résumé des chapitres

Le premier chapitre est consacré à une analyse théorique et empirique de l'impact de la concurrence étrangère sur les écarts de salaire entre hommes et femmes. Selon la théorie de la discrimination par les préjugés (Becker, 1957), seules des entreprises dégageant des profits positifs peuvent se permettre de payer des salaires plus élevés aux hommes et ainsi financer le surcoût salarial qui les rend moins compétitives. Dans ce cadre, une intensification de la concurrence réduit les profits que les entreprises peuvent distribuer de manière discrétionnaire à leurs employés. Autrement dit, la concurrence oblige les entreprises à payer un salaire identique à des employés de même productivité. Le commerce international, en mettant en concurrence les entreprises domestiques et étrangères, est donc censé réduire l'écart salarial entre les sexes. Cependant, certains travaux empiriques trouvent un effet opposé. Tout en restant dans le cadre de la discrimination par les préjugés, ce chapitre explique pourquoi il n'est pas surprenant que l'ouverture commerciale accroisse la discrimination salariale dans certains cas.

Le modèle théorique est un modèle d'économie ouverte en concurrence imparfaite. Les entreprises ont un pouvoir d'oligopole qui leur permet de faire des profits. Les employeurs misogynes utilisent ces rentes pour s'assurer l'embaucher d'une main d'oeuvre masculine en proposant des salaires plus élevés aux hommes ; les entreprises moins misogynes embauchent des femmes à un salaire inférieur. Les entreprises ont donc des coûts de production différents, qui dépendent du degré de misogynie de l'employeur. Lorsque la concurrence est faible, ces écarts de coût de production peuvent être maintenus. En revanche, lorsque le nombre d'entreprises vendant sur le marché augmente, chaque entreprise a intérêt à baisser ses prix pour attirer davantage de clients. Seules les entreprises ayant un coût de production inférieur au prix en vigueur peuvent se le permettre. L'entrée de produits étrangers augmente la concurrence. Afin de maintenir leur part de marché, les entreprises discriminantes sont incitées à réduire le différentiel de coûts de production, c'est à dire les salaires. Aussi les écarts de salaire diminuent-ils lorsque les entreprises étrangères ont un accès plus facile au marché domestique. Cependant, l'ouverture commerciale signifie aussi que les entreprises domestiques accèdent plus facilement aux marchés étrangers et augmentent ainsi leurs ventes et leurs bénéfices. Cela leur permet de maintenir leurs dépenses salariales discrétionnaires. Le modèle détermine dans quels cas les nouvelles opportunités d'exportation permettent aux entreprises nationales de continuer à discriminer.

Nous utilisons l'expérience de l'Uruguay pour confronter les prédictions théoriques aux données. Dans les années 1990, l'industrie manufacturière uruguayenne a connu un choc de libéralisation commerciale avec la création et la consolidation du Mercosur. Dans certains secteurs, les entreprises uruguayennes ont bénéficié de l'ouverture pour accroitre leurs ventes. Dans d'autres secteurs, en revanche, l'accès des concurrents au marché uruguayen a réduit la production nationale. Nous utilisons ces différences d'impacts de l'ouverture pour évaluer l'impact du commerce extérieur sur les écarts de salaire entre les sexes au niveau sectoriel. Les résultats empiriques confirment les prédictions du modèle. Dans les secteurs concentrés, une entrée plus aisée de produits étrangers sur le marché uruguayen a fait baisser les écarts de salaire entre hommes et femmes. A l'inverse, dans ces secteurs concentrés, un accès des entreprises uruguayennes plus aisé aux marchés étrangers a fait augmenter l'écart de salaire entre hommes et femmes. La situation est différente dans les secteurs très peu concentrés (atomisés), où la concurrence était déjà forte avant l'ouverture commerciale, et où un accès plus facile aux marchés étrangers n'a pas conduit à une hausse de ces écarts. Dans ce dernier cas, la concurrence entre les entreprises domestiques ne permet pas aux entreprises discriminantes d'accéder au marché mondial, où les entreprises plus productives évincent celles qui le sont moins.

Le deuxième chapitre propose un modèle où l'écart de salaire entre hommes et femmes augmente le long de l'échelle des qualifications, fait empirique que l'on retrouve dans presque tous les pays et qui est souvent associé au “plafond de verre”. Les effets du commerce extérieur sur les écarts de salaire peuvent ainsi être identifiés à différents niveaux de qualification. Dans ce modèle, nous supposons que la productivité du travail dépend des qualifications qui sont parfaitement observables, et de caractéristiques inobservables, comme l'engagement au travail. L'engagement au travail ne pouvant pas être anticipé avec certitude par l'employeur, la discrimination statistique suppose que la moyenne du groupe d'appartenance va influencer la décision des employeurs. Les entreprises prennent simultanément leurs décisions d'embauche et d'investissement dans des technologies plus ou moins sophistiquées. L'engagement des candidats n'est pas prédictible, ce qui induit les employeurs à discriminer les femmes qui ont un niveau d'engagement en moyenne inférieur à celui des hommes. Lorsque les qualifications et le progrès technologique sont complémentaires, le progrès technologique est biaisé en faveur des travailleurs qualifiées qui voient leur salaire augmenter plus vite que celui des non-qualifiés. Quand, en plus, l'engagement et le progrès technologique sont complémentaires, nous montrons que, premièrement, l'investissement dans de nouvelles technologies est biaisé en faveur des hommes pour qui le salaire augmente davantage, deuxièmement, les écarts de salaires sont plus élevés pour les salariés qualifiés. L'augmentation de l'écart salarial se produit tout au long de la distribution si les qualifications et l'engagement au travail sont aussi complémentaires dans la fonction de production. Ce chapitre montre que le commerce international creuse les écarts salariaux entre hommes et femmes dans la partie supérieure de la distribution des qualifications et que la réduction des coûts de transport accroit davantage l'écart de salaire parmi les hommes et femmes qualifiés. La théorie permet d'expliquer pourquoi, après l'adoption de nouvelles technologies, ici induite par la libéralisation commerciale, les inégalités de salaire augmentent à la fois au sein de chaque groupe (parmi les femmes et parmi les hommes) et entre les groupes.

Le troisième chapitre conduit une analyse empirique des écarts de salaire entre hommes et femmes dans les secteurs formel et informel au Brésil. En 2009, l'écart brut de salaire est plus élevé dans le secteur informel que dans le secteur formel dans les zones urbaines du Brésil. Ce chapitre montre que ce fait empirique est un artefact de la composition de l'emploi dans les deux secteurs, les caractéristiques et les processus de sélection des hommes et des femmes y étant différents. Tout d'abord, les femmes qui participent au marché du travail ont de meilleurs caractéristiques observables que les hommes, et cet avantage féminin est plus fort parmi les salariés du secteur formel. En conséquence, l'écart brut de salaire sous-estime l'écart de salaire à caractéristiques égales, surtout dans le secteur formel. Une fois qu'on a introduit les caractéristiques observables dans l'équation de salaire, les écarts de salaire dans le secteur formel et informel ne sont pas statistiquement différents l'un de l'autre. Ensuite, la sélection dans les différentes catégories d'emploi, dont l'emploi formel et l'emploi informel, diffère entre les hommes et les femmes. Les différences de biais de sélection affectent l'estimation de l'écart de salaire. Dans le secteur informel, les salaires observés surestiment les offres de salaire pour les hommes et les femmes, mais le biais est plus important pour les hommes. Après avoir corrigé les écarts de salaire du biais de sélection, le secteur informel ne présente plus d'écart de salaire significatif. Dans le secteur formel, en revanche, les salaires observés sous-estiment les offres de salaire pour les hommes, tandis que les salaires observés surestiment les offres potentielles faites aux femmes. Par conséquent, l'écart salarial observé sous-estime les différences d'offres de salaire. L'écart de salaire, corrigé de la sélection, est élevé et fortement significatif dans le secteur formel.

Chapter 1

Gender Wage Discrimination and Trade Openness. Prejudiced employers in an open industry [1]

1.1. Introduction

Several theories of discrimination seek to understand why an important share of the gender wage gap remains unexplained. Discrimination due to prejudiced employers is one of them, though it has been somewhat overshadowed mainly because costly discrimination is not sustainable in competitive markets, which seems inconsistent with the persistence of the wage gap. Yet, once we acknowledge that imperfections in either the factor or the good markets give employers some kind of monopsonistic power, we realize that costly discriminating behaviors might not be competed away in equilibrium. This paper adopts this approach and shows that when "competition among the few" prevails [2], taste-based discrimination provides a coherent explanation for recent evidence on the heterogeneous

1. This chapter is a revised version of the AMSE working paper n° 2012-33. I am grateful to Pierre-Philippe Combes, Matthieu Crozet, Cecilia Garcia-Peñalosa, Peter Neary and Alain Trannoy for helpful comments and suggestions. This paper also benefited from comments received at internal seminars at the Greqam and at the University of Oxford; as well as at the EDGE Phd workshop held at the Bocconi University, the Arnoldshain Seminar at the University of Gottingen, the EUDN PhD meeting at the Timbergen Institute, the LAGV conference in Marseille, the RIEF Phd workshop held at the University of Nice, the EALE and RES annual conferences.

2. This expression, first used by Fellner as a title to his book on oligopoly published in 1949, refers to industries where a small number of (operating or potential) firms compete with each other. In such environments, firms often interact strategically.

effects of openness on the gender wage gap.

Becker's theory of employer discrimination suggests that, in sectors with positive rents, the prejudice of some employers can result in a wage gap between equally productive men and women due to unequal sharing of production revenues across workers' groups. In such sectors, tougher competition puts downward pressure on the wage gap and ultimately no wage discrimination should be observed when firms' profits tend to zero. It follows that trade openness should play a role in reducing the wage gap through its pro-competitive effect. When domestic competitive forces are too weak to curb market power, foreign competition contributes to drive out wage discrimination. Recent empirical evidence shows that increase in trade openness leads to lower gender wage gaps in some cases while in other cases it contributes to a widening of the wage gap. This paper argues that the effect of trade openness on the wage gap is more complex that the the identification of openness with tougher competition along with the extrapolation of Becker's theory imply. It investigates theoretically and empirically in which context trade openness curbs wage discrimination and when it does not.

Several empirical studies have attempted to assess the effect of trade on the gender wage gap through the competition channel. Different results emerge depending on the country under study. Black and Brainerd (2004) show that a rise in import penetration weakens the gender wage gap in concentrated industries in the United States, as Artecona and Cunningham (2002) find for Mexican industries between 1987 and 1993. Berik et al. (2004) look at the impact of both import penetration and export shares on the gender wage gap in the case of Korea and Taiwan. Especially noteworthy is the finding that export shares increase the wage gap in concentrated industries. They conclude that foreign competition is associated with an amplification of the wage gap, especially in imperfectly competitive sectors, thus contradicting Becker's theory of taste-based discrimination. This paper makes clear that this result is consistent with a setting featuring prejudiced employers as openness is not necessary synonymous of a reduction in profits. The lack of theory might explain the misstatements made at the time of interpreting some results and this paper intends to close this gap with a theoretical proposal that clarifies the conditions under which trade can reduce wage discrimination. The theoretical insights also bring novelties to the empirical assessment. Previous papers base the interpretation of their results on the idea that trade openness exerts competitive pressures by confronting domestic firms with foreign firms ignoring that it can increase domestic firms' profit opportunities on foreign markets if they have the competitive advantage. We show that, under specific conditions, openness of trade partners' markets can increase the ability to discriminate by allowing prejudiced employers to improve their export revenues. To the best of my knowledge, there is only one attempt to integrate trade flows in a model of wage discrimination. Menon and van der Meulen Rodgers (2009) use the Borjas and Ramey (1995) oligopolistic model to illustrate the impact of trade on gender wage discrimination. Wages are negotiated according to a Nash bargaining framework and women receive a lower share of the rents of prejudiced employers in the concentrated sector. However, the relationship between trade and discrimination is the result of the assumption that an increase in net trade always reduces the profits of all firms, with the export decision of firms being not formalized.

The first part of my contribution is to provide an explicit trade model under imperfect competition with an endogenous determination of both trade patterns and the gender wage gap. The model describes a single international oligopoly à la Cournot where two countries produce and trade a homogeneous good. Firms' output decisions and export opportunities are determined by their relative costs of production which in turn depends on firms' position on the distribution of prejudice of all incumbents. This partial equilibrium model clarifies the links between the labour market and the product market where firms use their market power to pay different wages.

In a *competitive labour market*, with a large number of firms, discriminatory employers have no effect on the wage of the minority group since its members can easily be absorbed by the unprejudiced employers. In the model developed in this paper, only a fixed and small number of firms demand labour so that the labour market is not perfectly competitive and the labour supply is not perfectly elastic. The model features an *oligopsonistic labour market* where even a small number of discriminatory employers can generate a wage gap. Oligopolists are sensitive to the gender-composition of their workforce as in Becker (1957) and, different levels of prejudice against female workers lead to heterogeneity in firms' unit costs.

In a closed economy a firm's market power is determined by the number of firms while in the open economy it depends also on the number of foreign firms and their competitiveness. The pro-competitive impact of openness on discrimination can be derived in the model and comes from a selection of most competitive (less discriminatory) firms: under certain conditions, only the least-cost firms are able to export, and to maintain their domestic market shares. Firms' profits and the impact of trade liberalization on profits depend on firms' ability to compete, that is to say, on their level of unit cost. As discrimination is costly, prejudiced employers are the ones with the poorest production opportunities. While they can cope with their cost disadvantage in a market sheltered from competition, trade deregulation makes it harder to maintain market shares. Under the threat of exit, previous levels of discrimination are no longer sustainable. An easier entry of foreign products spurs high-cost discriminatory firms to align their costs to the ones of non-discriminatory firms; as a result, demand for male labour dwindles while that for female labour increases which reduces the wage gap. In other words, foreign competition operating through trade creates a selection of firms based on their human resources decision. This difference in the ability to make the most of a market can be tracked down to the "survivor principle" of Stigler (1958); since Melitz (2003), this selection principle has been used in models of trade, where only the most productive firms reap the benefits of trade integration. Melitz (2003) introduces firm heterogeneity, in the form of productivity differences, in a monopolistically competitive model, and fixed export costs generates the selection of the best firms into exporting. Melitz and Ottaviano (2008) incorporate variable markups in a similar framework; trade integration reduces markups which generates the selection effect.

In the current model, countries are asymmetric and trade integration can also have an anti-competition effect. The impact of trade openness on discrimination depends on partners' characteristics that shape market access and thus the trade pattern. Easier access to foreign markets can be an opportunity to enhance profits. If domestic firms have a competitive advantage, it is possible for them to increase their production and profit level. If the cost disadvantage of discriminatory firms is no too high such that they can expand by exporting, trade openness results in a widening of the wage gap even in a Beckerian setting.

The model is confronted with data for Uruguayan manufacturing sectors between 1983 and 2003. We evaluate how international trade contributed to changes in the wage gap at the sector level. In the aftermath of the creation of the MERCOSUR in 1991, Uruguay dramatically opened its economy to international trade. The creation of a common market took place in two steps that generated two waves of liberalization, the first in 1991, and a second and deeper one in 1995. I exploit these substantial changes to study the effect of two-way trade on gender wage discrimination. I focus on imperfectly competitive sectors defined in the empirical strategy by their higher level of concentration. As predicted by the model, sectors where Uruguayan firms enjoy easier access to foreign markets feature an increase in the gender wage gap while greater penetration of the Uruguayan sector by foreign competitors exerts a downward pressure on discrimination.

This paper is related to two strand of literatures. First, it contributes to the literature on competition and gender. The standard theory of employer taste discrimination developed by Becker (1957) is at the core of the few papers dealing with the impact of competition on wage discrimination. According to this theory, prejudiced employers with market power are willing to pay men a premium in order to avoid working with women. The theory implies that discriminating employers earn lower profits than non-discriminating firms. With free entry, discriminating firms are forced out of the market by new firms managed by non-prejudiced employers, and in the long run, this eliminates the wage gap. Empirical studies aim at isolating different competition forces to assess their impact on the gender wage gaps or on gender segregation.

Recent firm-level analyses prove to be consistent with implications of Becker's model of employer discrimination. Hellerstein and Neumark (2006) find that discrimination is observed only among plants with high levels of product market power and profitability is positively correlated with the share of female employees. However, over a five-year period, competitive market forces do not significantly drive discriminatory firms out of business. Weber and Zulehner (forthcoming) exploit Austrian firm data to investigate whether discriminatory firms are more likely to exit the market. Firms with lower female share do have a higher exit rate, though this effect is significant among firms with a female share below the median level only. Firm takeovers are another source of competition that can contribute to lower the gender wage gap due to discrimination. If merger markets are efficient, firms with poor management practices are taken over by firms where management practices succeed in improving productivity. Heyman et al. (2013) test whether firm takeover is a way to eliminate discriminatory human resources policies that are costly under Becker's theory. They provide another evidence for the anti-discrimination effect of competition: they find that, in Sweden, takeovers increase firms' share of female employees in sectors with weak product market competition. They additionally find that takeovers reduce the gender wage gap within firms. Another strand of the literature, more closely related to the methodology of this paper, focuses on changes at the sectoral level. Black and Strahan (2001) use deregulation of the banking sectors in the US to isolate the competition effect. They show that the decline in rents favored more female employees so that they caught up with their male colleagues in terms of wages and job promotions. Second, this paper belongs to the literature on trade and gender, and is particularly related to the papers that investigate how trade flows affect the gender wage gaps depending on the domestic levels of competition, papers that we have discussed earlier (Artecona and Cunningham, 2002, Black and Brainerd, 2004, Berik et al., 2004).

This paper is organized as follows. The next section develops a model of oligopolistic competition and wage discrimination in a closed economy. Section III provides the open economy version to understand under which conditions openness reduces wage discrimination. Section IV describes the empirical methodology, the data and presents the results. The last section concludes.

1.2. Oligopolistic competition and discrimination in a closed economy

1.2.1. The model

Demand

Consumers have access to a homogeneous good. The inverse demand function is linear and gives the -unique- price of the product. It depends positively on the size of demand b [3] and decreases with the aggregate level of production Q in the market :

$$p = b - Q = b - \sum_{i=1}^{N} q_i \tag{1.1}$$

A linear demand function easily features the downward pressure on prices and mark-ups stemming from tougher competition (more firms serving the market), and thus highlights the effect of competition on employers' ability to discriminate.

3. We do not relate consumer demand for goods to household wealth, workers' wages and entrepreneurs' profits. Not incorporating income effects is plausible as individuals working in one sector consume only a small fraction of the good they produce so that demand is not much affected by their revenues.

Production

This model consider a single oligopoly with restricted entry[4]. We assume that there is an exogenous fixed number N of potential firms that can produce the same homogeneous good. Firms, indexed by i, are ranked by their distaste for hiring women $d_i \in [0; \bar{d}]$ which is exogenous and influences employers' human resources policies. Firms are thus *ex ante* heterogeneous in their preferences, and the distribution of prejudices is exogenously given. Employer heterogeneity in d does not impact their production technology though.The equilibrium wage gap d^*, however, is endogenous and ultimately determines the type of worker a firm hires along with its wage bill. The *ex post* distribution of firms' outcomes, e.g. marginal cost and production, is thus endogenous.

Labour is the only factor of production and is inelastically supplied at its sector level $\bar{L}$. Male labour supply is denoted $\bar{L}_m$ and the female labour supply is $\bar{L}_f$; none of them are influenced by the level of discrimination in this model. Firms' technologies are identical and are represented by a linear production function

$$q_i = l_{if} + l_{im}$$

where male labour l_m and female labour l_f are perfect substitutes. Total costs have a simple form that features constant returns to scale once the firm is operating in the market: $C(q_i) = c_i q_i$ where c_i is firm i's unit cost of production. Employers not only take into accounts the wages paid to employees but also their personal distastes for certain type. Employer i is ready to hire women if the gender wage gap compensates its utility loss, i.e. $w_f + d_i < w_m$. As a consequence, firms have different *perceived* labour costs

$$c_i = \begin{cases} w_f + d_i & \text{if firm } i \text{ employs women} \\ w_m & \text{if firm } i \text{ employs men} \end{cases}$$

This setting leads to complete gender segregation across firms[5] and to different levels of *perceived* production costs. Firms hiring men have the same unit labour cost $c_m = w_m$

4. This approach is adopted in chapter 5 of Helpman and Krugman (1987); potential explanations for the absence of free entry are stringent market regulation or deterrent start-up costs.

5. Alternatively, we could use Arrow's (1973) version of the discrimination theory where employers' satisfaction depends on the share of women in firm's employment instead of the absolute number of women. This setting would generate mixed firms which is a more realistic feature. The quantitative results of the model, however, are not affected by the specification choice ; this is why we opt for the standard version of Becker's theory.

while firm hiring women have different *perceived* labour costs, $w_f + d_i$, because of heterogeneity in their tastes.

1.2.2. The firm's output decision

Employer i maximizes a utility function equal to the profits minus the monetary value derived from the disutility of employing women. If $d_i > 0$, employer i is prejudiced against women and discounts his economics profits by $d_i \times l_f$ the utility loss caused by employing l_f women. The setting is a standard one-stage game in which N firms compete in quantity. The price p depends on the production of all incumbent firms and firm i takes the output of other firms as given while maximizing its profits. They consider the following maximization problem where the objective function is concave in q_i:

$$\max_{q_i} \pi_i = q_i \left(p(q_i, \sum_{j \neq i} q_j) - c_i \right)$$

where q_j is the production level of competitor j and the unit cost adjusted for preferences is c_i . Firms are wage-takers and choose the number of workers they hire. The first order conditions for the N different firms can be written:

$$q_i = p - c_i \qquad \forall i = 1, ..., N$$

Among the N firms, N_f firms hire women at a perceived cost $c_{if} = w_f + d_i$ and N_m hire men at the same cost $c_m = w_m$. There are thus $N_f + 1$ equations of firms' production levels :

$$q_{im} = p - w_m \qquad \text{for "male-firms"}$$

$$q_{if} = p - (w_f + d_i) \qquad \text{for "female-firms"}$$

The number of workers they hire is decreasing in their specific costs c_i. Considering how much should be produced, employer i behaves as if the true cost was $w_f + d_i$, even if the real economic cost of a firm hiring women is w_f. Consequently, the first order condition implies that employer i produces less than an employer j with $d_j < d_i$. Among firms that hire women, those with lower prejudice employ more women and produce more. Besides, firms hiring women have lower costs and hence produce more than firms employing men.

Firms' reaction functions

We have seen that employer's type pins down his *perceived* cost which in turn determines his choice of production scale. Substituting the value of p given by the demand function (1.1) into the first order condition gives the reaction function of each firm:

$$q_i = \frac{1}{2}(b - Q_{-i} - c_i)$$

where $Q_{-i} = \sum_{j \neq i} q_j$ is the sum of production from all firms except firm i.
Substituting Q_{-i} in the previous equation, firm i's production level can be written as a function of the average cost of its competitors $\tilde{c}_{-i}$ and its own cost c_i only:

$$q_i = \frac{b - c_i + (N-1)(\tilde{c}_{-i} - c_i)}{N+1} \tag{1.2}$$

Note that since firms are heterogeneous in their unit costs, it is necessary to check whether all of them produce in equilibrium. This involves conditions on the size of the demand b and the number of operating firms N which is exogenously fixed. Appendix A states the conditions that ensure an interior solution.

We can use equations (1.1) and (1.2) to give another expression for the price of the homogeneous good:

$$p = \frac{N}{N+1}\left(\frac{b}{N} + \frac{C(Q,N)}{N}\right)$$

where $C(Q,N) = \sum_i^N c_i$ is the sum of production costs of all operating firms. This expression captures the pro-competitive effect of market size N that plays through a market fragmentation effect and the reduction in the average unit cost of competitors. An increase in N reduces the price and consequently the mark-up firms can enjoy. The price is also positively related to the demand size $\frac{b}{N}$; this explains why firms thrive on penetrating new markets.

1.2.3. The marginal discriminator

We now dwell on labour cost discrepancies across firms and relate male and female wages. We need to determine N_f the number of firms that employ women (N_m the number of firms that employ men is simply $N - N_f$). There is a continuum of prejudice degrees ($d \in R^+$). In order to simplify some of the ensuing analysis, we use a specific parametrization for its distribution among employers. In particular, let us assume that the actual prejudice of incumbents has a discrete uniform distribution over the interval $[0; \bar{d}]$. The difference in prejudice between two firms is $d_i - d_{i+1} = \frac{\bar{d}}{N-1}$. The equilibrium wage gap will be determined by the level of prejudice of the last firm hiring women N_f -called the marginal firm. N_f is the only firm to be indifferent between employing men and employing women. In equilibrium,

$$w_f + d^* = w_m \qquad \text{with } d^* \in [d_{N_f}; d_{N_{f+1}}[\tag{1.3}$$

There is a continuum of equilibrium gender wage gaps comprised between the prejudice of the marginal employer d_{N_f} and the prejudice of the next firm $d_{N_{f+1}}$. Under the assumption of discrete uniform distribution of d, we can express d^* as:

$$d^* = (N_f - 1)\frac{\bar{d}}{N-1} + \nu \qquad \text{with } \nu \in [0\ ; \frac{\bar{d}}{N-1}[$$

Note that this general case $d^* = d_{N_f} + \nu$ can be reasonably reduced to $d^* = d_{N_f} + \epsilon$ as all the employers i with $d_i > d_{N_f}$ can hire men by setting a wage just above the one that makes the previous employer indifferent between men and women. Without loss of generality, we can thus express the wage gap as:

$$d^* = (N_f - 1)\frac{\bar{d}}{N-1} \tag{1.4}$$

We can now express employers' perceived costs in this way:

$$c_i = \begin{cases} w_m - (d^* - d_i) & \text{if } d_i \leq d^* \text{ so that firm } i \text{ employs women} \\ w_m & \text{if } d_i > d^* \text{ so that firm } i \text{ employs men} \end{cases}$$

There is a complete segregation of men and women across firms if $d^* = d_{N_f} + \epsilon$, the marginal firm being pivotal. It is possible that the marginal firm has a mixed labour force. In that case, the wage gap is exactly equal to the monetary equivalent of its prejudice level $d^* = d_{N_f}$, and the marginal employer is indifferent between hiring women or men. The exact gender composition of its labour force depends on the female and male labour supply as well as on the distribution of production levels across firms. We consider the case where the N_f firms completely absorb the female labour supply so that there is no mixed firm. This hypothesis does not alter the results of the model and facilitates the resolution of the labour market clearing conditions.

1.2.4. The labour market equilibrium

Wages of both men and women adjust until full employment is reached. The demand for female labour is given by the total production level of the female firms. Using the first order condition, the labour market clearing conditions can be written:

$$\bar{L}_f = \sum_{1}^{N_f} p - (w_f + d_i) \quad \text{and} \quad \bar{L}_m = \sum_{N_f+1}^{N} p - w_m$$

The sum of the monetary equivalent of the utility loss d_i faced by discriminatory employers who hire women is, under the assumption that the distribution of d follows a discrete uniform over $[0; \bar{d}]$, an arithmetic series:
$\sum_1^{N_f} d_i = d_1 + d_2 ... + d_{N_f} = 0 + \frac{\bar{d}}{N-1} + 2\frac{\bar{d}}{N-1} + ... + (N_f - 1)\frac{\bar{d}}{N-1}$.

$$\sum_{i=1}^{N_f} d_i = \frac{N_f(N_f - 1)}{N - 1}\frac{\bar{d}}{2} \tag{1.5}$$

Using equation (1.5), the labour market clearing conditions can be written:

$$\bar{L}_f = N_f(p - w_m) + N_f(\frac{N_f - 1}{N - 1}\frac{\bar{d}}{2}) \quad \text{and} \quad \bar{L}_m = N_m(p - w_m)$$

This yields the equilibrium wages w_f and w_m:

$$w_f = p - \frac{N_f - 1}{N - 1}\frac{\bar{d}}{2} - \frac{\bar{L}_f}{N_f} \tag{1.6}$$

$$w_m = p - \frac{\bar{L}_m}{N_m} \tag{1.7}$$

From the two wage equations, we can easily find the expression for the gender wage gap $d^* = w_m - w_f$:

$$d^* = \frac{\bar{L}_f}{N_f} - \frac{\bar{L}_m}{N_m} + \frac{N_f - 1}{N - 1}\frac{\bar{d}}{2}$$

Having previously defined d^* as a function of N_f in equation (1.4), we can define implicitly d^*:

$$d^* = 2\bar{d}\left(\frac{\bar{L}_f}{\bar{d} + (N-1)d^*} - \frac{\bar{L}_m}{(N-1)(\bar{d} - d^*)}\right) \tag{1.8}$$

Proofs of the existence and uniqueness of d^* are developed in the appendix.

Let us recapitulate the equations that define the equilibrium of the economy:

$$\begin{aligned}
w_f &= p - \tfrac{N_f - 1}{N-1}\tfrac{\bar{d}}{2} - \tfrac{\bar{L}_f}{N_f} \\
w_m &= p - \tfrac{\bar{L}_m}{N_m} \\
d^* &= w_m - w_f \\
N_f &= 1 + \tfrac{d^*}{\bar{d}}(N-1) \\
p &= \tfrac{N}{N+1}\left(b + w_m - \tfrac{N_f}{N}\left(\tfrac{N_f - 1}{N-1}\tfrac{\bar{d}}{2}\right)\right) \\
q_{im} &= p - w_m \\
q_{if} &= p - (w_f + d_i)
\end{aligned}$$

The first two equations give the wages of women and men as a function of the price, the total number of firms in the sector and the number of firms that hire women, while the third equation defines the wage gap. The fourth equation gives the number of firms employing women which depends on the distribution of prejudice across the firms $\frac{\bar{d}}{N-1}$ and the wage gap. The price is determined by the size of demand and the average of firms' unit costs as given by the fifth equation. The last two equations define firms' output levels that depend on their *perceived* unit costs. The output of firms employing women depends on their d, while all firms employing men produce the same amount as they have the same perceived cost of production w_m.

Evolution of the wage gap

We can derive standard predictions of the Beckerian model by applying the implicit function theorem on Φ

$$\Phi \equiv d^* - 2\bar{d}\left(\frac{\bar{L}_f}{\bar{d} + (N-1)d^*} - \frac{\bar{L}_m}{(N-1)(\bar{d} - d^*)}\right) = 0$$

First, for a given number of firms, the wage gap expands if more women enter the labour market, $\frac{\partial d^*}{\partial \bar{L}_f} > 0$. More firms hire women so that the marginal employer has stronger prejudice and requires a wider wage differential to hire female employees. As expected, the opposite holds when the male labour supply goes up, $\frac{\partial d^*}{\partial L_m} < 0$.

Moreover, it follows that d^* decreases with N, $\frac{\partial d^*}{\partial N} < 0$. Suppose the range of prejudice does not widen, an increase in the number of firms, uniformly distrusted in the segment $[0; \overline{d}]$, has two opposite effects. On the one hand, the difference in prejudice between two firms $\frac{\overline{d}}{N-1}$ is reduced. Keeping N_f constant, this reduces the wage gap because the last firm employing women, the marginal discriminator, has now a lower level of prejudice than before the entry of new firms. On the other hand, an increase in N reduces the level of output produced by each firm; consequently, the number of firms needed to satisfy the full employment condition of women N_f is higher; this puts upward pressure on d_{N_f} the level of prejudice of the marginal discriminator. The first effect dominates, because female firms have the lowest production cost, thus following an increase in N, their market shares are less reduced than the market shares of male firms. To sum up, with a higher number of firms, the full employment of women is satisfied by more firms but with a lower level of prejudice. This effect highlights the role of the number of firms in reducing the incidence of taste-based discrimination. With competition, the demand for low-wage workers increases relatively to the demand for high-wage workers, this reduces the wage gap until the labour market equilibrium is reached.

Selection effect

Another way of formalizing the effect of market structure on employers' ability to discriminate is to compute the cost threshold above which discriminatory firms cannot produce. Let $\bar{c}$ be the maximal unit cost above which a firm stops producing. The solution of a zero-operating profit condition $\bar{c} = p(\bar{c})$ defines the cost cut-off as follows:

$$\bar{c} = b - \left(\frac{V^2}{\overline{d}}(N-1) + V\right) \tag{1.9}$$

where $V = \frac{d_{N_f}}{2}$ is the average perceived-costs difference between female firms and male firms. In other words, V is the *perceived* cost disadvantage of discriminatory firms. Tougher competition, in the sense of more firms producing, reduces the cost threshold above which no firms can produce: $\frac{\partial \bar{c}}{\partial N} < 0$.

The reduction in the cost threshold slows down with the number of producers $\frac{\partial^2 \bar{c}}{\partial N^2} < 0$, which means that the pro-competitive effect is more pronounced when N is small. Furthermore, we are able to derive the implication of the spread in prejudice on the competition effect. The derivative $\frac{\partial^2 \bar{c}}{\partial N \partial d} > 0$ shows that the downward impact of an increase in N on the wage gap is stronger when the dispersion of prejudice is wider. The "disciplinary effect" of competition is more pronounced in sectors with strong stereotypes against women.

Survival of discriminatory firms

Note that the absence of a wage gap does not necessarily mean that prejudiced employers have exited the market. When all women are hired by unprejudiced employers with $d = 0$, prejudiced employers with $d > 0$ can employ men without having to pay them a premium. Thus, they can stay in the market even if competition is fierce following the entry of unprejudiced entrepreneurs. Such a situation exists when the female labour supply is low or when unprejudiced employers are numerous enough.

1.3. The Open Economy

1.3.1. Import penetration, export opportunities and discrimination

We now consider the case where two countries, D and F (for domestic and foreign country respectively), trade a homogeneous good under oligopolistic competition. They do have incentives to engage in intra-industry trade to capture some of the rents that exist in the foreign market. Brander (1981) first formalized how strategic interactions among Cournot oligopolists from two countries lead to intra-industry trade [6]. Country characteristics can differ. Domestic and foreign consumers' inverse demand functions are respectively

$$p_D = b_D - Q_D \tag{1.1a-T}$$

$$p_F = b_F - Q_F \tag{1.1b-T}$$

There are N_F foreign firms which are assumed to be homogeneous so that all firms in F produce with the same unit cost c_F [7]. Markets are segmented although firms can export

6. This type of model has been subsequently used and developed by Combes et al. (1997), Neary (2002) and Neary (2003) among others.

7. We abstract from heterogeneity in costs among foreign firms, and in particular from differences due to discrimination; this assumption does not present implications for the determinants of the wage gap in the domestic country as what really matters for discriminators to be able to sell is the final equilibrium price in the markets.

incurring a transport cost. Foreign firms have to pay τ_D to sell in market D while domestic firms have to pay τ_F to export to market F, but they do not incur any fixed exporting cost. As firms produce under constant returns to scale, they maximize separately their profits -adjusted for their preferences- made on the domestic and foreign markets [8].

When domestic firms maximize their profits from exports to F, π_{DF}, they take as given the production of other domestic firms that export q_{DF}, and of the production of foreign firms q_F. To sell one unit in the foreign market F, they need to produce τ_F units, with $\tau_F > 1$.

$$\max \pi_{iDF} = q_{iDF}(p_F(q_{DF}, q_F) - c_i\tau_F)$$

where q_{iDF} is the sales of the domestic firms i in market F. Optimal sales in market F for firm i are given by:

$$p_F + q_i p'_F(q_i, q_j) \leq c_i\tau_F$$

Production for each market is then [9]:

$$q_{iDD} = \begin{cases} p_D - (w_f + d_i) & \text{if } \ d_i \leq d^* \\ p_D - (w_f + d^*) & \text{if } \ d_i > d^* \end{cases}$$

$$q_{iDF} = \begin{cases} p_F - (w_f + d_i)\tau_F & \text{if } \ d_i \leq d^* \\ p_F - (w_f + d^*)\tau_F & \text{if } \ d_i > d^* \end{cases}$$

Levels of domestic sales and exports depend on the type i of the firm:

$$q_{iDD} = \frac{b - c_{iDD} + (N_D + N_{Df} - 1)(\tilde{c}_{-iD} - c_{iDD})}{N_D + N_{Df} + 1} \tag{1.2a-T}$$

$$q_{iDF} = \frac{b_F - c_{iDF}\tau_F + (N_D + N_{Df} - 1)(\tilde{c}_{-iF} - c_{iDF}\tau_F)}{N_D + N_{Df} + 1} \tag{1.2b-T}$$

8. If marginal costs depended on output levels, export possibilities would influence domestic production level and the separability in firms' production strategies would not hold anymore

9. Iceberg trade costs have been used by Brander (1981) in an oligopolistic competition context. Alternatively, if the transport cost is additive, the first order conditions become: $q_{iDF} = p_F - w_{if} - d_i - \tau_F$ and $q_{iDF} = p_F - w_{if} - d^* - \tau_F$. A unit trade cost would not enter the cost difference between discriminatory and non-discriminatory exporting firms anymore. Consequently, as we will see later, trade liberalization would not affect the wage gap through the intensive margin -volume of exports- anymore but the results on the effect of trade through the extensive margin -type of firms able to export- would remained unchanged.

with $\tilde{c}_{-ih}$ the average unit cost of both domestic and foreign competitors selling in market h. The conditions to have positive production levels in both markets for firm i, $i \in [0;\bar{d}]$, are derived in appendix B.

1.3.2. The labour market

The wage gap is defined as under autarky by equations (1.3) and (1.4). The labour market clearing conditions for female and male labour in the open economy case, using equation (1.5) to substitute for $\sum_i d_i$, are given by:

$$\bar{L}_f = \sum_{i=0}^{d^*} q_{iDD} + q_{iDF} = N_{Df}\left(p_D + p_F - (1+\tau_F)\left(w_m - \frac{N_{Df}-1}{N-1}\frac{\bar{d}}{2}\right)\right)$$

$$\bar{L}_m = \sum_{i=d^*+r}^{\bar{d}} q_{iDD} + q_{iDF} = N_{Dm}(p_D + p_F - w_m(1+\tau_F))$$

where N_{Df} is the number of domestic firms that employ women and N_{Dm} is the number of domestic firms that employ men. We can then derive the equilibrium wages and wage gap under trade:

$$w_f = \frac{1}{1+\tau_F}(p_D + p_F - \frac{\bar{L}_f}{N_{Df}}) \qquad (1.6\text{-T})$$

$$w_m = \frac{1}{1+\tau_F}(p_D + p_F - \frac{\bar{L}_m}{N_{Dm}}) \qquad (1.7\text{-T})$$

$$d^* = \frac{2\bar{d}}{1+\tau_F}\left(\frac{\bar{L}_f}{\bar{d}+(N-1)d^*} - \frac{\bar{L}_m}{(N-1)(\bar{d}-d^*)}\right) \qquad (1.8\text{-T})$$

Proofs of the existence and the uniqueness of d^* are provided in the appendix.
Let us define Φ^T as:

$$\Phi^T \equiv d^* - \frac{2\bar{d}}{1+\tau_F}\left(\frac{\bar{L}_f}{\bar{d}+(N-1)d^*} - \frac{\bar{L}_m}{(N-1)(\bar{d}-d^*)}\right) = 0$$

which is equivalent to the function Φ above but for the trade regime.
Simple comparative statics shows that:

$$\frac{\partial d^*}{\partial \tau_F} = -\frac{\frac{\partial \Phi^T}{\partial \tau_F}}{\frac{\partial \Phi^T}{\partial d^*}} < 0$$

With trade liberalization and the fall in export barriers τ_F, the wage gap in the domestic labour market increases because discriminatory (higher cost) firms benefit from new sales opportunities which increases their ability to discriminate. This result is entirely in line with the conclusions of Becker's model on the role of competition, and stems from the fact that openness may reduce or increase firms' profits; in some circumstances even higher-cost firms can benefit from new profit opportunities in foreign markets. Previous work had simply assumed that openness increases competition, and overlooked the fact that by facilitating access to foreign markets it could also raise profitability.

Trade costs to penetrate the domestic market τ_D have no effect on the wage gap when the number of operating firms remains unchanged. Put differently, τ_D does not affect the wage gap through the intensive margins of firms, i.e. the level of output, but only through the extensive margins, i.e. number of *operating* firms. In the next subsection, we will look at the impact of trade costs τ_D when higher-cost firms may cease production, but keeping the number of *potential* firms constant.

1.3.3. Competition and Firm Selection

To further understand how competition affects wage discrimination, we make use of the cost threshold, the cost above which a firm cannot sell in a market to highlight the selection of firms. We consider a situation where foreign producers have homogeneous unit cost c_F and where discriminatory firms produce positive amounts in the domestic markets [10]. In the open economy framework, firms face different zero profit conditions depending on the market they operate in. Those conditions define the maximum level of factor prices a firm can afford in each market. Equation (1.9a-T) establishes the production cost threshold to sell in the domestic market while equation (1.9b-T) gives the cost threshold to export to market F.

The degree of competition at home

Let $\bar{c}_D$ denotes the cost threshold above which a domestic firm cannot break even in its domestic market. The lower $\bar{c}_D$, the tougher the competition in market D, the lower the profits and the gender wage gap. This cost-threshold is equal to the selling price $\bar{c}_D = p_D$.

10. If discriminatory firms do not operate, there is no pay gap between men and women which is of low interest for the present study. The conditions for discriminatory firms to survive while paying higher wages to male employees are derived in the appendix

$$\bar{c}_D = \frac{b - N_{Df}V + N_{Df}c_F\tau_D}{N_{Df}+1} \tag{1.9a-T}$$

where V is again the average cost disadvantage of male firms compare to all female firms.

To appraise the competitive effect of trade openness, we study the impact of a fall in trade cost τ_D. When a country reduces its trade barriers, the domestic cost cut-off diminishes $\frac{\partial \bar{c}_D}{\partial \tau_D} > 0$; this is due to two different effects. First, foreign firms bear lower trade costs so that the average cost of competitors falls. Second, as foreign firms sell at lower cost they are able to sell more: it generates a fragmentation effect.

The cost cut-off decreases also with the number of foreign firms exporting to the domestic market $\frac{\partial \bar{c}_D}{\partial N} < 0$. This effect operates through the two channels cited above: the fragmentation effect as more firms sell in market D and an indirect effect as an increase in incumbent firms exerts a downward pressure on the average cost.

Lastly, $\frac{\partial \bar{c}_D}{\partial c_F} > 0$ it is obvious that competition is fiercer when foreign competitors are more productive, i.e. when c_F is low.

The degree of competition abroad

Let $\bar{c}_{DF}$ denote the cost threshold above which a domestic firm does not export to the foreign market F. Firms cannot compete in market F if their production costs multiplied by the iceberg trade costs τ_F are greater than the price in market F: $\bar{c}_{DF} = p_F$. The price in F depends on the number of potential exporters N_D and local producers N_F, it depends also on the production costs c_F of local producers, c_{fDF} for exporters hiring female workers and $\bar{c}_{DF}$ for exporters hiring male workers that have the highest production cost.

$$\bar{c}_{DF} = \frac{b_F - N_{Df}V\tau_F + N_F c_F}{N_D(1-\tau_F) + N_F + 1} \tag{1.9b-T}$$

The higher the number of domestic and foreign firms, the lower the cost cut-off $\frac{\partial \bar{c}_{DF}}{\partial N_F} < 0$. The lower the unit-cost of foreign firms, the lower the cost threshold $\frac{\partial \bar{c}_{DF}}{\partial c_F} > 0$. Hence, for high enough N_F and/or c_F, high-cost domestic firms employing men will not be able to export.

As for changes in trade barriers τ_F, it has counter-acting effects on the cost cut-off as it influences differently firms' decisions at the intensive margin -volume of exports- and at the extensive margin -entry into the export market.

$$\frac{\partial \bar{c}_{DF}}{\partial \tau_F} = N_D(b_F + N_F c_F) - (N_D + N_F + 1)(N_{Df} V)$$

On the one hand, the first term shows that a fall in export costs puts a downward pressure on the critical level of unit cost (τ_F and $\bar{c}_{DF}$ are positively correlated). For all exporting firms, it is now less expensive to sell in F; as a result of firms' strategic interactions, the price decreases and so does the cost threshold. This displays the effect of a fall in trade costs through the intensive margin channel.

On the other hand, the second term shows that a fall in τ_F puts an upward pressure on the cost-threshold through the extensive margin channel. As lower trade costs make it easier for firms to break even in the foreign market, new less productive firms are now able to export. The entry of less productive firms is associated with a higher cost threshold. This effect, formalized by the second term of the derivative, is proportional to the cost disadvantage of discriminatory firms V. When transport costs are reduced, their cost disadvantage hinders less their export opportunities which enable them to pay higher wages. The second effect dominates when the cost discrepancies between discriminatory and non-discriminatory firms is high, which corresponds to an industry with a small number of firms.

This is a particularly interesting result as it puts emphasis on an "anti-competitive" effect of openness that has been overlooked in previous empirical analysis. Moreover, it sheds lights on the conditions under which this effect dominates. When a market is heavily concentrated, the extensive margin effect dominates and the wage gap widens. However, as the number of firms increases, the extensive margin effect is offset by the intensive margin effect. The latter being pro-competitive, in sectors with a high enough number of firms, trade liberalization in partner countries decreases the wage gap.

To sum up, profit opportunities can increase with trade. When partners' trade costs fall and when the number of foreign competitors is low, exports opportunities expand, which benefits both non-discriminatory and discriminatory firms. Exports are also higher if domestic firms have a significant cost advantage $c_D < c_F$. Profit opportunities can, however, dwindle with trade if domestic firms do not have the competitive advantage. Foreign competitors N_F producing at lower costs put competitive pressure on domestic firms and make it harder for discriminatory firms to produce. In this case, trade will favor the low-cost non-discriminatory firms over discriminatory ones. Discriminatory firms will have to cease production, lowering the demand for male labour. Hence the wage gap will fall until full employment is restored.

1.3.4. Market access

This model shows that trade liberalization can have differential effects on the gender wage gap as it depends on the size of the demand in foreign market (b_F)the competitive advantage of domestic firms (determined by c_D, N_D, c_F, N_F) along with the trade costs (τ_D and τ_F). We have seen that the maximum labour cost a firm can incur depends on its ability to make profit at home and abroad. This brings to light a close connection with market potential as defined in economic geography models. New Economic Geography (NEG) models formalize a causal relationship between wages and market potential as the latter determines the level of profit that can be shared with employees. What is called the "NEG wage equation", first presented by Fujita et al. (1999), indicates that the wages that can be paid by a firm located in region r depend on the market access of this region MA_r which is a function of trade costs to penetrate foreign markets and the level of competition in those markets. These models typically feature competitive labour market and free entry of firms. In this paper, although the labour market is not competitive and the firms entry is restricted, market potentials influence firms' profits in the same way as in standard economic geography models.

The model hence has novel empirical implications as the size of the wage gap, at the sectoral level, does not depend primarily on trade volumes but rather on market potentials. Both domestic firms' accesses to foreign markets and foreign firms' accesses to the domestic market are used for the first time to capture the pro-competitive effect of trade and geography. This model further helps to understand how wage gaps respond to evolutions of the market access depending on the domestic market structures: an improvement in the access to foreign markets increases the wage gap when only a few firms operates at home while it decreases the wage gap when numerous firms competes at home.

1.4. An empirical investigation

The theoretical model determines the ability to discriminate in imperfectly competitive sectors that are opened to trade. The empirical challenge is thus to measure the degree of both domestic competition and trade openness. To explore the effects of these variables on gender wage discrimination, the empirical analysis proceeds in several steps. In section 4.1, we estimate gender wage discrimination using individual data. Section 4.2 presents the competition variables. Section 4.3 explains how market access are computed. The last step, described in section 4.4, consists of regressing the wage gap due to discrimination on the domestic competition indicator and the market access variables to test the theoretical implications.

We conduct the empirical exercise on data from Uruguay, a country that witnessed an important liberalization episode in the 1990s. Several liberalization agreements took place, at the regional level with the Mercosur founded in 1991 and amended in December 1994 and also with the multilateral negotiations driven by the GATT and WTO. This period contrasted with previous decades during which sectors were protected by tariffs. Uruguay is a small open economy with export and import shares on the increase, as figure 1 shows. Besides its comparative advantage in sectors using intensively natural resources such as food processing industries, the population of Uruguay is relatively educated so that we can expect the country to be able to compete internationally in modern manufacturing sectors as well.

1.4.1. Computing gender wage gaps

1.4.1.1. Uruguayan Household Survey

We use the longitudinal Uruguayan household survey (Encuesta Continua de Hogares ECH) over the period that ranges from 1983 to 2003. The survey covers all the urban areas in the country. It can be seen as representative as the country displays remarkably high levels of urbanization, around 87% of the population lived in urban areas in the 80s and 92% in 2004. The survey provides data on gross hourly wages, occupation, education, age, sector of activity (at a level of disaggregation between one and two digit). Unfortunately variables on unemployment duration and job tenure are missing for many years which impedes us from deriving real experience on the labour market. Other individual variables allow to estimate selection into labour market (marital status, husband's income, number of children...).

Table 1.1 indicates that labour market participation is much lower for women than for men. Around 49% of the female working-age population was active in 1990 while almost 60% of women participated to the labour market at the end of the period. If the participation gap decreased steadily over the period, the unemployment gap however increased.

1.4.1.2. Empirical methodology: decomposition of the sectoral raw wage gaps

To obtain a measure of discrimination, we retrieve, as finely as possible, the part of the wage gap due to differences in treatment of identical productive characteristics such as educational attainment. Indeed, if the endowment in human capital of women happened to be higher, for example, in export oriented sectors compared to import competing sectors, correlations would indicate that export success contributes to the narrowing of the gender wage gap but this would not have anything to do with the mechanism at work in the model.

We restrain the sample to employees aged from 18 to 65, hence excluding employers, unpaid workers and self-employed. The individual characteristics taken into account in this analysis are: the level of education (5 categories), potential experience [11] (age minus 6 minus the number of education years) and potential experience squared. A dummy equal to one if the individual lives in Montevideo controls for wage disparities across the urban center and the rest of the country which is far less urbanized. Estimating the wage gap on employees of the private sector only do not change the results. Besides, one can makes arguments for including or for excluding the occupational controls. Here we consider that human capital characteristics should determine the job position hence we do not control for positions [12].

We estimate the male and female wage equations separately for each sector and year so that the returns to human capital characteristics are allowed to vary across sectors and years. For each year t and sector j, we run the two following wage equations:

$$\ln W_{mjt} = X'_{mjt}\beta_{mjt} + \epsilon_{mjt}$$

11. We acknowledge that it might be a poor proxy for actual experience. More importantly for our purpose, the gap between potential and actual experience is certainly bigger among women who have more and longer career interruptions mainly due to maternity leaves. Gender differentials in actual experience that are not captured by potential experience would lead to overestimate the wage gap due to unequal treatment, as Wright and Ermisch (1991) show for Britain. However, we do not have the possibility to alleviate this problem given the dataset.

12. Strikingly enough, controlling for job occupations increases the unexplained part of the wage gap at the beginning of the period in the following industries: food, machinery, paper and printing and chemical. This result is due to bigger discrepancies in the return to education within occupation compare to the average differences in return when we do not control for occupation.

Table 1.1: Descriptive Statistics for the household survey

	Gender	1990	1995	2000	2004
Observations	Male	*19128*	*20217*	*18057*	*17233*
	Female	*22403*	*23156*	*20522*	*19577*
Participation rate	Male	81.3	83.6	82.1	81
	Female	48.8	54.9	58.7	59.2
Unemployment rate	Male	4.5	7.6	10.7	10.1
	Female	7.1	13	16.9	16.5
Working status: wage earner	Male	66.9	65.7	65.4	67.4
	Female	69.2	68	71.6	74.9
Mean hourly wage (in logarithm)	Male	4.4	4.5	4.6	4.2
	Female	4.18	4.3	4.5	4.1
Employment shares					
Agriculture	Male	4.7	6	5.8	6.9
	Female	1	1.5	1.1	1.8
Manufacturing	Male	22.2	19.6	17	15.8
	Female	19.8	15.5	12.2	11.5
Service	Male	72.8	73.5	76.8	77.1
	Female	79.1	82.9	86.7	86.6
Wage earners in the manufacturing industry	Male	*2595*	*2185*	*1533*	*1385*
	Female	*1225*	*941*	*706*	*637*
Mean hourly wage (in logarithm)	Male	4.4	4.5	4.5	4
	Female	4	4.2	4.3	3.8
Mean age	Male	36.5	36	35.8	37
	Female	35.6	35.8	36	36.5
Primary Education or less	Male	40	59	55	27.7
	Female	38	58	51	22.5
Secondary Education	Male	33	12	15.7	39.1
	Female	44	19	24.1	48
Technical	Male	21	22	21.8	24.2
	Female	10	13	10.4	14.8
College Education	Male	5	7	6.8	5.3
	Female	8	10	14.1	10.7

Source: Based on the Household survey, ECH, INE, Uruguay. Real hourly wages, base year 1997.
The last four rows give the distribution of education among men and women and can be read a follows: e.g. in 1990, 40% of men working in the manufaturingindustry have only primary education or less.

$$\ln W_{fjt} = X'_{fjt}\beta_{fjt} + \epsilon_{mjt}$$

where $\ln W_{gjt}$ is the logarithm of the hourly wage rate for a worker of gender g, working in sector j during year t. The vector of human capital variables, X, includes: five levels of education, potential experience and its squared and an urban dummy. These wage equations are estimated for five manufacturing sectors defined at the 2-digit level: food and beverage, machinery, paper and printing, textile apparel and leather.

Following Oaxaca (1973) and Blinder (1973), the average total wage difference can be decomposed into two terms:

$$\overline{\ln W}_{mj} - \overline{\ln W}_{fj} = \overline{X}'_{fj}(\widehat{\beta_{mj}} - \widehat{\beta_{fj}}) + (\overline{X}_{mj} - \overline{X}_{fj})\widehat{\beta_{mj}} \tag{1.10}$$

where $\overline{\ln W}_{gj}$ denotes the mean log wage among group g in sector j and $\overline{X}_{gj}$ denotes the mean characteristics of group g in sector j. $\widehat{\beta}_{gj}$ represents the estimated parameter from the wage equation. The first term captures differences in returns to similar characteristics; it is "the coefficient effect". The second term is the part of the wage gap due to differences in workers' characteristics; it is "the endowments effect". The part of the wage gap due to the "coefficient effect" is referred to as the adjusted wage gap, that we denote by $\widehat{WG}$ and is used as a measure of wage discrimination:

$$\widehat{WG}_j = \overline{X}_{fj}(\widehat{\beta}_{mj} - \widehat{\beta}_{fj})$$

The adjusted wage gap measures the part of the total wage gap due to average differences in treatment of men and women. It is evaluated at the female average value of each characteristics in X. The adjusted wage gap $\widehat{WG}_j$ is computed for each sector j separately and will be used subsequently in the analysis to evaluate the impact of competition on discrimination.

Table 1.2 presents the results of the decomposition of the total wage gap in the manufacturing industry, for half of the years included in the sample. We can see that both the average raw and adjusted wage gap in the manufacturing sectors dropped in the early 1990s when the Mercosur was first introduced; they further decreased in the mid 1990s which corresponds to a consolidation of the trade agreement. The Uruguayan banking and currency crisis in the early 2000s can be responsible of the rise in the wage gaps during that period. The decomposition shows that differences in human capital endowments between

Table 1.2: Decomposition of the raw wage gap. Manufacturing industry

Year	85	87	89	91	93	95	97	99	2001	2003
Raw Wage Gap	0.31	0.41	0.43	0.38	0.33	0.27	0.21	0.21	0.27	0.22
$ln\bar{W}_m - ln\bar{W}_f$	(0.03)	(0.02)	(0.03)	(0.02)	(0.02)	(0.03)	(0.03)	(0.03)	(0.04)	(0.04)
Decomposition										
Gap due to	0.03	-0.03	-0.02	-0.06	-0.02	-0.06	-0.06	-0.04	-0.04	-0.06
endowments	(0.01)	(0.01)	(0.01)	(0.1)	(0.01)	(0.02)	(0.02)	(0.02)	(0.01)	(0.02)
Gap due to	0.26	0.43	0.44	0.42	0.34	0.32	0.26	0.25	0.30	0.25
returns	(0.03)	(0.02)	(0.03)	(0.02)	(0.02)	(0.02)	(0.03)	(0.03)	(0.03)	(0.03)
Number of men	1383	2857	1863	2383	2326	2164	1975	1632	1425	1216
women	666	1308	857	1261	1139	932	854	701	693	577

Oaxaca and Blinder decomposition of the total difference in average hourly wages. Wages include bonuses. The results are expressed on the logarithmic scale. The difference in percentage points is: $(exp(WG) - 1) \times 100$.

men and women do not contribute to the positive raw wage gap ; indeed, women have a relatively high level of education, even higher than men in some fields as shown in table 1.1. The decomposition highlights that the human capital endowments are on average much less remunerated for women.

For the sake of space, table 1.2 presents the complete decomposition of the raw wage gap for the whole manufacturing industry only.Table 1.3 gives the raw and the adjusted wage gap for each 2-digit manufacturing sector for different sub periods. Table 1.3 also displays the gaps in employment shares in each sector.

Overall, raw wage gaps and wage discrimination have been falling since the beginning of the 1980s. The wage differentials between men and women due to differences in return ranges from 22% to 10% in the whole economy [13] but Both the raw wage gaps and the wage gaps are substantially wider in the manufacturing industries [14]. The adjusted wage gap is much higher in the manufacturing industry where it ranges from 40% to 27%.

At the beginning of the period male wages used to be more than the double of female wages and 40% of the gap remained unexplained; during the first half of the years 2000, the raw wage gap was around 27% and could not be explained by observable characteristics.

Within the manufacturing industry, there are wide differences in wage gaps across

13. Other studies using different methods find higher unexplained wage gaps. For example, Nopo et al. (2010) estimate the unexplained wage gap with a non-parametric matching approach ; they find that in 2005 around 20% of the gap remained unexplained.

14. This paper focuses on the manufacturing industries, as they are the most subject to international trade.

Table 1.3: Employment and Wage Gaps between Men and Women

		1983-1990	1991-1994	1995-1999	2000-2004
Whole economy	*Participation gap*	35	30	26	22
	Female share	40	41	44	47
	Raw wage Gap	29	18	9	3
	Wage Gap	22	24	19	10
Industry	*Employement share*	22	21	16	13
	Female share	21	33	30	32
	Raw wage Gap	57	43	29	26.8
	Wage Gap	39	38	29	27
Textile	*Employment share*	6.4	5.7	3.3	2.8
Apparel	*Female share*	57.9	60.6	57.5	57.5
	Raw Wage Gap	102	78	64	64
	Wage Gap	60	59	56	53
Food	*Employment share*	7.3	6.9	6.1	5.2
Tobacco	*Female share*	22.3	26.5	27.4	30.4
	Raw Wage Gap	46	31	30	28
	Wage Gap	27	26	26	25
Chemical	*Employment share*	2.5	2.4	2	1.9
products	*Female share*	25.8	28.4	40	33.4
Oil	*Raw Wage Gap*	5	16	12	18
	Wage Gap	27	23	20	18
Paper	*Employment share*	1.3	1.3	1.1	1
Printing	*Female share*	27.1	26.5	28.5	33.4
	Raw Wage Gap	35	28	12	18
	Wage Gap	28	27	24	27
Machines	*Employment share*	2.4	2.4	2.1	1.4
	Female share	11.6	11.7	11.4	14.1
	Raw Wage Gap	1	-4	3	-4
	Wage Gap	11	9	7	0

Source: Author's calculation based on the Encuesta Continua de Hogares, INE, Uruguay.
Variables are in percentage.

sectors. In the food, beverage and tobacco industry, where the female share of employment is the highest, the raw and the adjusted are the highest despite a small decrease. In the Machine and Equipment industry, the raw and the adjusted wage gap are particularly low, however, it is also the industry for which the wage gap is less precisely estimated because of a small number of observations. There is a notable decreasing trend in the wage gap across all sectors.

Note that the empirical analysis uses wage gaps estimated for each year and manufac-

Table 1.4: Herfindahl index of production concentration among manufacturing industries

Year	1983-87	1990	1991	1994	1995	2000
Textile Apparel	18	22	23	28	27	15
Chemical	28	24	26	29	30	58
Machines	29	14	12	16	20	30
Food Beverage	33	22	25	29	28	49
Paper	39	32	30	41	43	32

Source: INE, Uruguay. Here $HH = 100 \times \sum_i^N s_i^2$.

turing industry separately to build a panel of sectors from 1983 to 2003. This approach thus allows for heterogeneous returns to characteristics and thus different wage gaps across industries and years.

1.4.2. Measure of domestic competition, Herfindahl index

A large literature deals with the measure of market power at the industry level. The four-firm concentration ratio or the Herfindahl index of concentration are commonly chosen proxies to capture the level of industry competition. For the present analysis, Herfindahl indexes have been computed based on a confidential firm survey. It is computed as $HH = \sum_i^N s_i^2$, $HH_i = \sum_e^N s_{ei}^2$ where s_{ei} is firm e's share of production in industry i. It ranges from 1, a monopolistic situation, to $\frac{1}{N}$ if firms have equal market shares. Table 1.4 presents summary statistics of the sectoral concentration of market shares at the two digit level. Even if the definition of industries is rather aggregated, the index displays wide variations across sectors and time. The most concentrated sector in the early 80s was the paper industry while in 2000, the food and beverage industry and the machinery industry are the most concentrated sectors.

1.4.3. Measures of foreign competition at home and in the foreign markets

1.4.3.1. Trade data

To construct measures of foreign competition, this article employs bilateral trade and production data taken from the *TradeProd database* constructed by the CEPII. They cover the period 1980-2003 for Uruguayan manufacturing sectors. A detailed description of the database can be found in Mayer et al. (2008). This database has the particularity to match trade flows and production levels at the industrial level which allows us to construct trade shares and internal flows (exports minus production) easily. The CEPII provides also the *Distances database* with bilateral distances and common official language which are used to capture part of the trade costs.

1.4.3.2. Market access

In most of the papers dealing with the impact of trade openness on the gender wage gap, foreign competition is captured by import penetration [15]. However, import penetration alone might not be an appropriate measure. First, higher import penetration does not necessarily squeeze profitability if export opportunities are high enough. Second, import penetration can increase either because imports go up or because domestic production goes down; in the latter case, a change in domestic market conditions will mislead us into believing that foreign competition became sharper.

Some studies also regress the wage gap on export shares [16] or on global openness ($\frac{X_j+M_j}{Q_j}$ where M_j is import volume, X_j the exports volume and Q_j the level of production in industry j). Even if it is true that more competitive firms do better at exporting, it does not necessarily mean that higher export shares reflect tougher competition pressure on domestic firms. Export shares can also increase because trade liberalization makes it cheaper, providing higher export revenues without heightening competition. As for global openness, this variable does not allow to disentangle the impact of import penetration from the impact of export orientation on wage gaps.

To partly remedy these issues, one should control for both import and export shares in the same regression; moreover, it is important to test for the robustness of the results by using other indicators of trade openness. We argue that market access is an appropirate measure to capture the ability of foreign firms to sell their products in the domestic market as well as the ability of domestic firms' to sell abroad.

Since the 90s, the economic geography literature has emphasized how proximity to markets with large demand shapes international trade patterns. In their seminal work, Redding and Venables (2004) estimate structurally a model where access to markets and

15. See Artecona and Cunningham (2002), Berik et al. (2004), Black and Brainerd (2004), Menon and van der Meulen Rodgers (2009)
16. Berik et al. (2004), Menon and van der Meulen Rodgers (2009)

sources of supply at the country level explain country variations in per capita income. Recent studies by Fally et al. (2010) and Hering and Poncet (2010) estimate market access at the sectoral level and look at its impact on variations in sectoral wages. We follow here their approach.

We now define two variables. Market access (MA) captures the easiness for Uruguayan firms to penetrate foreign markets (Uruguay's exports). Competitors access to the Uruguayan market (CA) captures the easiness for foreign firms to sell in Uruguay (Uruguay's imports).

A high MA corresponds to a high potential demand addressed to Uruguayan firms given their geographical position, their competitiveness and those of other exporters. MA is thus positively related to firms' potential profitability. In a setting with free entry and no economic profit, an increase in MA leads to an entry of firms. In a sector with restricted entry, an increase in MA raises the profit margin of exporters; this is the profit enhancing effect of trade. To state this in a different manner, the maximum production cost that firms can incur is increasing in their access to foreign markets.

However, profit opportunities abroad depends on the competition among all potential exporters. The oligopolistic framework features firms with heterogeneous costs that operate in the domestic market but might not be able to enter the foreign market. The high-cost discriminatory firms are more likely to enter the foreign markets if they compete with few firms while entering the foreign market. As a result, an increase in MA enable high cost firms to make profits from exports only if the level of concentration is high. If concentration is low, only the low-cost firms will be able to enter the foreign market.

CA measures the ability of foreign producers to sell in the Uruguayan market given their competitive advantage and the transport costs they have to incur to enter Uruguay. An increase in CA increases the volume of foreign goods in the Uruguayan market and reduces the price level through the competition channel. CA captures thus the pro-competitive effect of trade. An increase in CA has a negative impact on the ability to pay some workers a premium and this impact is stronger when the domestic market is concentrated.

To compute MA and CA we first estimate the impact of trade costs and sectors' characteristics on the volume of exports for all pairs of trade partners. We estimate the following gravity equation:

$$lnX_{DFjt} = \sum_{kt} \beta_{kjt}\tau_{k,DFjt} + FX_{Djt} + FM_{Fjt} + \epsilon_{DFjt}$$

where X_{DFjt} is the volume of exports of good j from country D to country F during year t. k is the number of variables that measure trade costs Characteristics of sector j in region D such as the number of firms and the average cost of production are captured by a fixed effect specific to each sector j-country D year t: FX_{Djt}. Similarly, the importing region fixed effect FM_{Fjt} captures market characteristics specific to each sector for a given country and year such as the number of firms operating in sector j in year t and their average competitiveness.

Trade costs to enter market F $\tau_{k,DFjt}$ are captured by a set of variables: bilateral distance, contiguity, common language, regional trade agreement. Tariffs cannot be included because of too frequent missing values for Uruguay. We estimate the bilateral trade equation for each year and industry so that the impact of trade costs β vary across sectors and time for a given pair of trade partners.

The access of Uruguayan firms selling good j to all foreign markets in year t is denoted MA_{jt}. It is the sum of the market access to specific countries F :

$$MA_{URYjt} = \sum_F MA_{URY,Fjt} = \sum_F \left(FM_{Fjt} \prod_k (\tau_{k,URY,Fjt})^{\beta_{kt}} \right)$$

MA_j increases when the trade costs $\tau_{k,URY,Fjt}$ fall.

Foreign firms' access to the Uruguyan access are computed as follows:

$$CA_{URYjt} = \sum_F MA_{F,URYjt} = \sum_F \left(FX_{F,URYjt} \prod_k (\tau_{k,F,URYjt})^{\beta_{kt}} \right)$$

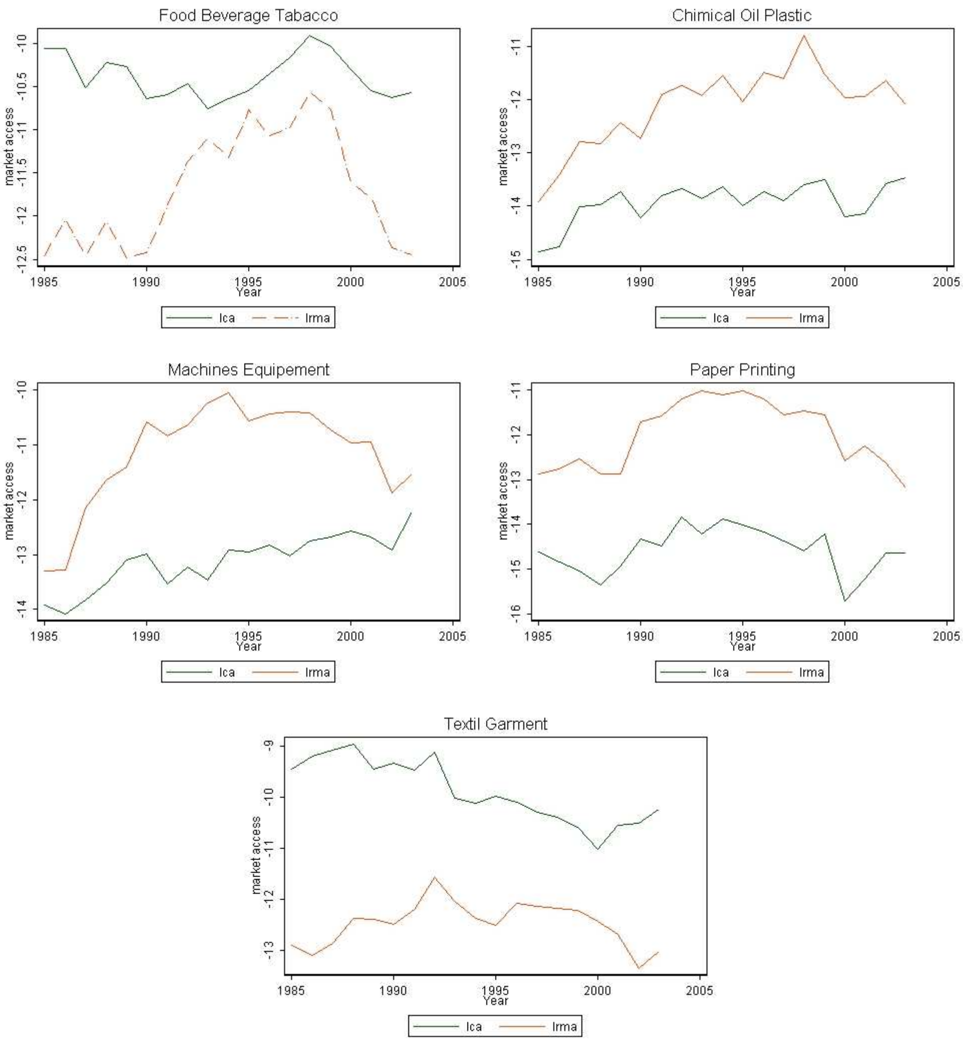
CA increases when the trade costs to enter Uruguay fall, when the demand for good j increases, when the number and productivity of Uruguayan firms producing good j decrease.

Those two synthetic variables capture the sectoral characteristics that determine the wage gap. Besides being closer to the theory, market access has another advantage compare to traditional outcome variable (trade shares). When looking at the impact of openness on firms' behaviour (here human resources policy), we want the openness variable to be exogenous to firms' decisions. We are in firmer ground with market access compare to trade shares.

Figure 1.1 displays the evolution of CA and MA in the five manufacturing sectors we study. Both MA and CA rose in the 1990s except in the Textile and Garment industry.

Most sectors have seen their market accesses dropping sharply in the late 1990s, a consequence of the crisis in the neighbouring countries. The financial crisis began in 1999 in Argentina, spreaded to Uruguay and lasted till the early 2000s in the region.

Figure 1.1: Market Access



Source: Author's computations based on the *TradeProd Database*, CEPII. The Uurguyan firms' access to foreign markets (lca) and foreign firms' acces to the Uruguayn markets (lrma) presetned here are computed based on all Uruguay's trade partners.

1.4.4. Empirical specification: market access as a determinant of the gender wage gap

To identify empirically the pro and anti-competitive effect of trade openness, we need to separate it from the effect of domestic competition. Furthermore, the model underlines that the impact of trade openness depends on the domestic market structure. Thus, we interact the trade openness variables with the level of domestic competition captured by the Herfindahl index. Hence we employ a strategy in line with a difference-in-differences approach as we compare the effect of trade exposure (treatment) in competitive sectors (the control group) and in imperfectly competitive sectors. As foreign competition can impact the level of concentration in an industry by leading some inefficient firms to exit, we interact the openness measure with the level of concentration prior the liberalization episode C_{j0} rather than the contemporaneous level of concentration. We hence specify the wage gap as:

$$\begin{aligned} WG_{jt} = \beta_0 + \beta_1 \ln MA_{jt} + \beta_2 \ln C_{j0} \ln MA_{jt} \\ + \beta_3 \ln CA_{jt} + \beta_4 \ln C_{j0} \ln CA_{jt} + \theta_t + \mu_j + \epsilon_{jt} \end{aligned} \tag{1.11}$$

where WG_{jt} is the estimated gender wage gap [17], MA_{jt} captures profit opportunities in foreign market j at time t while CA_{jt} captures foreign competition pressures due to the entry of foreign products, C_{jt_0} is the level of concentration of sector j in the first period 0, θ_t is a time fixed effect and μ_j is an industry fixed effect. The level of sectoral concentration in the first period C_{j0} are controlled for by the sector fixed effects.

Gender wage gap can vary across sectors because of sectoral features that have nothing to do with competition pressures. To avoid any spurious correlation due to industry characteristics, sector fixed effects are included. They net out the impact of time-invariant industry-specific factors such as social norms regarding female labour (female work in machinery or oil industries may be less accepted than female work in textile and apparel). They are of primordial importance as sectors relying more on male labour force might be

17. Given that the dependent variable is estimated for each year and sector in a first stage, the point estimates for the gender wage gaps are subject to sampling variation. To correct for heteroscedasticity, we estimate this specification by weighted least squares where the weights are the inverse of the standard errors from the estimation of the gender wage gaps.

more male chauvinist, and could be, for some reasons, correlated with concentration or trade orientation, so that omitting them would bias the estimates.

Year fixed effects capture shocks or policies that affect labour market conditions equally in all manufacturing sectors. It includes macroeconomic shocks or government policies that influence female labour supply (child care or parental leave reforms) for example. Since we control for industry and time fixed effects, this specification identifies the impact of trade openness through within-industry variation.

Lagged effects of the explanatory variables are also estimated:

$$\begin{aligned} WG_{jt} = \beta_0 + \beta_1 \ln MA_{jt-1} + \beta_2 \ln C_{j0} \ln MA_{jt-1} \\ + \beta_3 \ln CA_{jt-1} + \beta_4 \ln C_{j0} CA_{jt-1} + \theta_t + \mu_j + \epsilon_{jt} \end{aligned} \tag{1.12}$$

Some specifications also control for past concentration levels C_{jt-1}, which gives an insight on whether women suffer more from discrimination when they work in sectors with stronger domestic market power compare to sectors with little domestic market power. We control also for the lagged share of women in the sector FLS_{jt-1} to deal with additional determinants of the wage gap that are ignored in the theoretical model because of the fixed labour supply assumption.

Turning to the expected signs of the coefficients, an increase in MA creates new opportunities for Uruguayan firms to make profits abroad and by doing so it strengthens their ability to discriminate. This effect is expected to be significant in sectors where discriminatory firms can compete with their domestic counterparts, i.e. in concentrated sectors ($\beta_2 > 0$). However, if there is a sufficiently high number of firms in the sector prior to the liberalization period, only the most productive firms are expected to export. In that case, we do not expect any widening of the wage gap. On the contrary, as most productive non-discriminatory firms expand in the foreign markets, they put more pressure on the labour demand which reduces the gender wage gap ($\beta_1 < 0$).

An increase in CA corresponds to more entries of foreign products which increases competition pressures. We expect it to reduce discrimination only in concentrated sectors where domestic competition is low enough to allow costly hiring decisions ($\beta_4 < 0$). In sectors atomized prior to the liberalization period (low C_{j0}), incentives to cut unit costs are already very high, no costly discrimination can take place, hence the impact of trade on discrimination, if there is one, does not play through the pro-competitive effect.

1.4.5. Results

Tables 1.5 and 1.6 report the results obtained from the estimation of equations (1.11) and (1.12) using as regressors the access to the MERCOUR and to the world markets respectively.Columns (1) to (4) of each table report the results of estimating equation (1.11) using contemporaneous market access while columns (5) to (8) report the results of estimating the equation (1.12) using the lagged explanatory variables. In order to account for time-varying sector characteristics that might be correlated with the gender wage gap, we control for the concentration level lnC and the female labour share $lnFLS$ in columns (4) and (8).

Table 1.5: Market Access on the Gender Wage Gap. Mercosur trade partners

Dependant variable	Adjusted wage gap							
Explanatory	Contemporaneous				Lagged			
variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
lnCA	0.483*		0.550***	0.496**	0.511*		0.552**	0.662***
	(0.183)		(0.099)	(0.153)	(0.205)		(0.121)	(0.090)
lnCA×lnC$_0$	-0.135*		-0.149***	-0.137**	-0.144*		-0.156**	-0.187***
	(0.052)		(0.030)	(0.047)	(0.058)		(0.035)	(0.025)
lnMA		-0.443**	-0.409*	-0.415*		-0.697*	-0.699**	-0.652*
		(0.158)	(0.165)	(0.180)		(0.292)	(0.242)	(0.260)
lnMA×lnC$_0$		0.125**	0.106*	0.110*		0.204*	0.200**	0.186*
		(0.041)	(0.048)	(0.045)		(0.080)	(0.064)	(0.070)
lnC$_{t-1}$				0.102*				0.011
				(0.044)				(0.050)
lnFLS				0.016				-0.121*
				(0.046)				(0.047)
Constant	0.573**	0.115	0.256	-0.109	0.335	0.089	0.132	0.072
	(0.133)	(0.306)	(0.309)	(0.336)	(0.158)	(0.188)	(0.265)	(0.426)
Observations	98	98	98	98	96	96	96	96
R-squared	0.352	0.343	0.392	0.420	0.345	0.365	0.399	0.418
Sector FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Weighted least squares regressions. Standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1
C$_0$ is the average value of the Herfindahl index between 1983 and 1987.

In Table 1.5, CA and MA are computed for Mercosur countries only, namely Argentina, Brazil, Paraguay and Uruguay. In columns (1),(2), (5) and (6) the wage gap is explained by either CA or MA. Yet, all sectors feature two-way trade; with the Mercosur, firms within the same sector enjoyed new market opportunities and in the same time, had to cope with new entries of products from their trade partners. As the two dimensions have opposite effects on the ability to discriminate, it is worth controlling for the two variables in the same regression.

The effect of foreign competition $lnCA$ is stable and significant. It comes out that foreign competition is associated with an increase in the adjusted wage gap *in non-concentrated sectors*, as the positive coefficient on $lnCA$ indicates. This point estimate gives the impact of competitors access for sectors with an initial Herfindahl index equals to zero, that is to say for sectors with a very large number of firms, which does not correspond to the oligopolistic framework developed in the model. The model developed in section 2 cannot explain why a surge in the entry of foreign goods is positively correlated with the wage gap in sectors with a large number of firms. A similar results is found by Black and Brainerd (2004) when they regress the gender wage gap on import penetration. They suggest that this can be due to a second effect of trade, namely the increase in demand for skills. Yet, we should bear in mind that differences in observable skills are controlled for in the first stage of both studies so that a rise in wage inequality between skilled and unskilled workers fostered by trade is not what drives this result. An unequal access to high-skilled positions or an increase in returns of skills that are not observable by the econometrician such as tenure or vocational training are potential relevant explanations.

That being said, the principal coefficient of interest with regard to the taste discrimination framework is the interaction of foreign competition with the concentration level, considered as a proxy of market power. The robust negative sign associated with the interaction $\mathrm{lnCA}\times\mathrm{lnC}_0$ shows that among concentrated sectors, the wage gap is lower in sectors where firms face new competitive forces due to an easier entry of foreign products. This effect can be interpreted as the consequence of the reduction in market power that was previously used by employers to discriminate against women.

The MA variable measures Uruguayan firms' access to foreign market, or export potentials. First, the negative and significant coefficients on $lnMA$ revels that in markets with low market power, the ability to enter foreign markets does not translate into increasing ability to discriminate. This is in line with the model prediction: for a high enough number of firms, only the most productive no discriminatory firms exports. Moreover, the expansion of those firms make it harder for the discriminatory firms to break even in their own domestic market, which explains the reduction in the wage gap. This is what we refer to as the "intensive margin effect" of trade partners' liberalization.

Secondly, the positive and significant coefficients on $lnMA \times lnC_0$ makes out that, when the sector is highly concentrated, higher sales opportunities abroad correspond to higher adjusted wage gap. This is a situation where the "extensive margin effect" dominates, that is to say when less productive discriminatory firms are able to enter foreign markets and gain profit margins abroad.

Table 1.6: Market Access on the Gender Wage Gap. All trade partners

Dependant variable	Adjusted gender wage gap							
Explanatory		Contemporaneous				Lagged		
variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
lnCA	0.473		0.582**	0.512**	0.536		0.635**	0.745***
	(0.249)		(0.136)	(0.116)	(0.284)		(0.149)	(0.141)
lnCA×lnC_0	-0.132		-0.157**	-0.140**	-0.151		-0.179**	-0.211***
	(0.070)		(0.038)	(0.036)	(0.081)		(0.043)	(0.041)
lnMA		-0.443*	-0.470*	-0.458		-0.710*	-0.769*	-0.726*
		(0.192)	(0.213)	(0.246)		(0.320)	(0.284)	(0.306)
lnMA×lnC_0		0.126*	0.123	0.122		0.207*	0.220**	0.207*
		(0.051)	(0.060)	(0.064)		(0.088)	(0.077)	(0.083)
lnC_{t-1}				0.099*				0.008
				(0.043)				(0.052)
lnFLS				0.022				-0.119*
				(0.043)				(0.046)
Constant	0.590**	0.152	0.284	-0.074	0.338	0.105	0.146	0.097
	(0.156)	(0.295)	(0.305)	(0.321)	(0.181)	(0.183)	(0.269)	(0.433)
Observations	98	98	98	98	96	96	96	96
R-squared	0.349	0.338	0.387	0.414	0.343	0.358	0.395	0.413
Sector FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Weighted least squares regressions. Standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1
C_0 is the average value of the Herfindahl index between 1983 and 1987.

Table 1.6 reports the effect of competitors' access to the Uruguayan markets CA and Uruguayan sectors' access to foreign markets $lnMA$ when we consider all the trade partners of Uruguay. Results are similar to those obtain with the previous definition of market access, the estimated coefficients are stable and significant except for the contemporaneous impact of MA that is insignificant.

The last four columns show the impact of both $lnCA_{t-1}$ and $lnMA_{t-1}$. The impact of CA, lagged by one period, is of the same sign but of larger magnitude than the contemporaneous impact. The impact of MA is now significant and corroborates the model predictions on the unequivocal effect of trade partners' liberalization. An improvement in export opportunities across all destination markets does not contribute to wage disparities across employees in competitive sectors but it does in concentrated sectors.

The effect of trade inetragtion depends on the level of domestic concentration C_0. It is thus useful to quantify the effect of market access for the actual value of the Herfindahl index in order to see which effect dominates.

Table 1.7: Impact of trade integration on the wage gap by sector

	Paper	Food Beverage	Chemical products	Machines	Textile
MERCOSUR					
$\ln CA_t$	-0.004	0.018	0.041	0.034	0.097
$\ln CA_{t-1}$	-0.021	0.010	0.041	0.031	0.117
$\ln MA_t$	-0.013	-0.032	-0.05	-0.044	-0.094
$\ln MA_{t-1}$	0.027	-0.003	-0.034	-0.025	-0.110
World market					
$\ln CA_t$	0.000	0.024	0.047	0.040	0.104
$\ln CA_{t-1}$	-0.026	0.009	0.044	0.034	0.13
$\ln MA_t$	-0.012	-0.033	-0.053	-0.0467	-0.103
$\ln MA_{t-1}$	0.030	-0.004	-0.039	-0.028	-0.123
$\ln C_0$	3.653	3.486	3.32	3.371	2.913

Note: The effect is computed based on columns (4) and (8) of table 1.5 for the effect of trade with MERCOSUR countries and columns (4) and (8) of table 1.6 for the effect of trade with all countries.

Table 1.7 displays the effect of both CA and MA on the gender wage gap in each sectors, given the level of concentration in the pre-liberalization period. Each row give the value of $\frac{\partial WG_j}{\partial lnCA_j}$ at the sectoral value of the Herfindahl ln_0 and for a one unit change in $lnCA_j$ or in $lnMA_j$ [18]. The sector "Paper and Printing" is the most concentrated sector in Uruguay during the late 1980s. In this sector, the lagged market access variables display the effect of trade integration in a imperfectly competitive sector. An increase in MA_{t-1} has increased the gender wage gap while an increase in CA_{t-1} has decreased the wage gap. The total effect on the period depends on the changes in of both wariables. In all other sectors, the effect of trade integration

18. The standard deviations of $lnCA_j$ and $lnMA_j$ vary between 0.5 and 1 depending on the sector.

1.5. Conclusion

This paper develops a model of wage discrimination with intra-industry trade to highlight the possible channels through which trade openness impacts the wage gap that arises because of employers' prejudices against women. As far as we know, it is the first explicit model where both the wage gap and the trade pattern are endogenously determined. The model formalizes the intuitive pro-competitive effect of trade on the wage gap, but also highlights the potential profit enhancing effect of openness, and by doing so it explains otherwise puzzling results.

Trade openness has heterogeneous effects on the ability to discriminate. First, trade liberalization makes it easier for foreign firms to penetrate the market which corresponds to tougher foreign competition at home. This drives down oligopoly profits, reduces the production of high-cost discriminatory firms and can even force them to cease production. This selection of firms puts a downward pressure on the gender wage gap.

Second, the liberalization of trade partners' markets has counteracting effects. If domestic firms have a competitive advantage over foreign firms and competition among domestic firms is not too fierce, trade liberalization enables less productive firms to enter foreign markets by reducing the cost of exporting which boosts their rents instead of exerting a pro-competitive effect. To put it differently, freer trade makes it easier for prejudiced employers to employ and pay workers according to their preferences if they can sustain their cost disadvantage compared to their domestic and foreign competitors. However, if discriminatory firms are able to sustain their cost disadvantage at home but not abroad, better export opportunities benefit only the most productive domestic firms that expand abroad, increase their demand for female labour which thus reduces the wage gap. This effect dominates when the number of firms is high enough.

To provide some empirical evidence of these mechanisms, we take advantage of the sharp liberalization episode that took place in Uruguayan following the creation of Mercosur in 1991 and its consolidation in 1995. We estimate market access variables to give a measure of the pattern of competitive advantage between trade partners, which is closer to the theory than the trade output variables used so far. Uruguay is an interesting country to explore the impacts of market access as it is a small economy that is less likely to influence the outcomes of trade agreement negotiations. This ensures the exogeneity of changes in trade policies with respect to domestic industries characteristics.

The main theoretical predictions are supported by the empirical findings. Foreign competition curbs the adjusted wage gap in sectors previously sheltered from competition. On the contrary, profit opportunities from export increase the adjusted wage gap when domestic concentration is high but not when concentration is low. However, if competition can reduce the unexplained wage gap, it does not suppress it completely. In particular, the remaining wage gap in rather competitive sectors is positively affected by an increase in foreign firms' access to the domestic market. This empirical result remains a puzzle and calls for further investigation.

Further avenues of research could consist in testing the robustness of the theoretical predictions to other modes of competition. Employer discrimination could be integrated into a monopolistically competitive model of trade with heterogeneous firms in terms of prejudice and endogenous markups. One possibility is to build a model close to Melitz and Ottaviano (2008), where a higher number and higher productivity of competing firms reduces the market price, thus generating a selection of the most productive firms, as in the model presented in this paper. The opportunity for discriminating firms to enhance profits would then hinge on countries asymmetry in productivity distributions. Alternatively, following the work by Zhelobodko et al. (2012) and Mrázová and Neary (2013), it would be useful to investigate how assumptions about the functional form of product demand shape the ability of high-prejudice high-cost firms to benefit from trade.

APPENDIX

1.A. Conditions for an interior solutions for firms' production levels

The production level of firm i given by its reaction function depends on its own cost, the number and average cost of its competitors and the size of demand:

$$q_i = \frac{b - c_i + (N-1)(\tilde{c}_{-i} - c_i)}{N+1}$$

Firms employing men have the highest unit cost and thus the lowest production level. They are the first to cease production if competition pressures heighten. In what follows, we derive the conditions to have an interior solution for discriminatory firms' production. As non-discriminatory firms have lower cost, they necessarily produce if discriminatory firms produce. In the case where no high-cost firm can survive, there is no wage gap and I derive the condition for N identical firms incurring a unit labour cost.

1.A.1. The closed Economy Case

Discriminatory firms pay a wage $w_f + d^*$ to their male employees ; they produce a positive amount q_m if :

$$q_m > 0 \Leftrightarrow b > w_f + d^* + \frac{N_f d^*}{2}$$

where $N_f \frac{d^*}{2}$ is the cost disadvantage between discriminatory firms and non-discriminatory -or rather female-type- firms and $d^* = d_{N_f} \frac{\bar{d}}{N-1}$. High wage gaps are sustainable in markets with large enough demand. The higher the number of firms, the higher the demand level b needed for male firms to sustain their cost disadvantage.

If all women are hired by the non prejudiced employer, there is no cost difference between male-firms and the female firm, $d^* = 0$ and $w_f = w_m = w$. All firms produce the same amount $q = \frac{b-w}{N+1}$ and an interior solution requires that demand be large enough:

$$q > 0 \Leftrightarrow b > w$$

1.A.2. The Open Economy Case

In the open economy setting, domestic firms can either produce locally and export to foreign markets, produce only for the domestic market or cease production all together. This separation of markets requires to examine four conditions.

Positive Wage Gap. Discriminatory and Non-discriminatory firms.

Are discriminatory firms able to export?

$$q_{mDF} > 0 \Leftrightarrow b_F > \tau_F(w_f + d^* + \frac{N_f d^*}{2}) + N_F(\tau_F(w_f + d^*) - c_F)$$

where $\tau_F N_f \frac{d^*}{2}$ is the cost disadvantage between domestic discriminatory firms and domestic non-discriminatory firms and $\tau_F(w_f + d^*) - c_F$ is the cost difference between domestic discriminatory firms and foreign firms.

Discriminatory firms are able to export if $c_F > \tau_F(w_f + d^*) + S$ with $S = \frac{\tau_F}{N_F}(w_f + d^*(1 + \frac{N_f}{2}))$ Put differently, $q_{mDF} > 0$ if discriminatory domestic firms have a strong competitive advantage. $\tau_F(w_f + d^*)$ represents the production cost to export and S take into account the cost disadvantage generated by discrimination. Discriminatory firms need to compensate for their higher cost compared to non-discriminatory domestic firms that export to the foreign market.

If discriminatory firms do not have a competitive advantage, then it is necessary for them that few foreign firms N_F operate in the destination market F. If $\tau_F(w_f+d^*)+S > c_F$ then $q_{mDF} > 0$ if $N_F < \frac{b_F - \tau_F(w_f+d^*(1+\frac{N_f}{2}))}{\tau_F(w_f+d^*)-c_F}$

Are non-discriminatory domestic firms able to export?

If discriminatory firms are not competitive enough and foreign firms N_F are too numerous, they do not export and we need to look whether non-discriminatory firms are able to enter the foreign market. Non-discriminatory firms employ women but can be prejudiced against women; this situation takes place whenever there is a positive wage gap at home, and the discrepancy between male and female wages compensate employer's discomfort of hiring women. Thus, the following condition depends on the prejudice of each specific firm. For every firm i with $d_i < d^*$:

$$q_{iDF} > 0 \Leftrightarrow b_F > (N_F + 1)(\tau_F(w_f + d_i)) + \tau_F d^*(N_D - \frac{N_f}{2}) - N_F c_F$$

A firm hiring women, with a employer of prejudice d_i, exports if $c_F > \tau_F(w + d_i) + S_i$, with $S_i = \frac{\tau_F}{N_F}(w_f + d_i - d^*(N_D + \frac{N_f}{2}))$. The rationale behind the condition remains the same: higher demand b_F in market F makes it easier for domestic firms to export; the cost advantage of domestic firm need to compensate for the transport cost and for the impact of their prejudice d_i. Note that having positive exports is less demanding for less prejudiced firms as they perceive that they bear lower labour costs and are ready to hire more women, we can see this as S_i decreases with d_i.

If $c_F < \tau_F(w + d_i) + S_i$, then $q_{iDF} > 0 \Leftrightarrow N_F < \frac{b_F - \tau_F(w+d_i) + d^*(N_D + \frac{N_f}{2})}{\tau_F(w+d_i) - c_F}$
A lower number of competitors compensate for the absence of a strong competitive advantage over foreign firms.

Are discriminatory firms able to sell on the domestic market?

Discriminatory firms able to sell on the domestic market if:

$$q_{mDD} > 0 \Leftrightarrow b > w_f(N_F + 1) + d^*(N_F + 1 + \frac{N_f}{2}) - \tau_D c_F N_F$$

if $w_f(N_F + 1) + d^*(N_F + 1 + \frac{N_f}{2}) < \tau_D c_F N_F$ it is always the case $q_{mDD} > 0$.
However, if discriminatory domestic firms have not a competitive advantage, then it is necessary for them that there are few foreign firms willing to sell in the domestic market: if $w_f(N_F + 1) + d^*(N_F + 1 + \frac{N_f}{2}) > \tau_D c_F N_F$ then $q_{mDD} > 0 \Leftrightarrow N_F < \frac{b - w_f - d^*(1 + \frac{N_f}{2})}{w_f + d^* - \tau_D c_F}$

No wage gap: the Homogeneous Firms Case

Are domestic firms able to export?
If there is no cost differences between m-type firms and f-type firms , $w_f = w_m = w$, then $q_{DF} = \frac{b_F - \tau_F w + N_F(c_F - \tau_F w)}{N+1}$ and:

$$q_{DF} > 0 \Leftrightarrow b_F > \tau_F w - N_F(c_F - \tau_F w)$$

If $c_F > \tau_F w$ it is always true. If $c_F > \tau_F w$, then $q_{DF} > 0 \Leftrightarrow N_F < \frac{b_F - \tau_F w}{\tau_F w - c_F}$

A higher demand in market F makes it easier for domestic firms to export. On the other side, a higher number of foreign competitors make it harder.

Are domestic firms able to sell on their market?

If there is no cost differences between m-type firms and f-type firms , $w_f = w_m = w$, then $q_{DD} = \frac{b - w + N_F(\tau_D c_F - w)}{N+1}$ and:

$$q_{DD} > 0 \Leftrightarrow b > \tau_F w - N_F(\tau_D c_F - w)$$

If $\tau_D c_F > w$ it is always true. If $c_F > w$, then $q_{DD} > 0 \Leftrightarrow N_F < \frac{b-w}{w - \tau_D c_F}$.

1.B. Proofs of the existence and uniqueness of the wage gap d^*

The wage gap d^* is defined by $d = F(d)$. To make sure this equation has a solution, we need to define under which conditions the function F cross the 45° line.

As F is decreasing in d ($F'(d) < 0$), we thus have to show that $F(0) > 0$ and $F(\bar{d}) < \bar{d}$.

$F(0) = 2(L_f - \frac{L_m}{(N-1)}) > 0$ if $L_f > \frac{L_m}{N-1}$

$F(\bar{d}) < 0$ so that $F(\bar{d}) < \bar{d}$

Moreover F is strictly decreasing as $F'(d) < 0$, it implies that $F(d)$ cross only once the 45ï£¡ line. Thus d^* is unique.

To sum up, $d = F(d)$ has a unique solution if $L_f > \frac{L_m}{N-1}$ which requires that the female labour force is not fully employed by one firm only (that would be the unprejudiced one).

If $L_f \leq \frac{L_m}{N-1}$ there is no equilibrium wage gap in this model.

1.C. Descriptive Statistics

Table 1.8: Summary Statistics: Evolution of Market Access and Competitiors' Acess between 1983-90 and 1991-2003

	Benchmark estimation		With Regional trade agreement in trade costs	
	ΔlMA	ΔlCA	ΔlMA	ΔlCA
	1983-90	1991-2003	1983-90	1991-2003
Textile Apparel	-9	-81	59	-10
Chemical	86	44	130	85
Machines	97	71	195	141
Food Beverage	71	-37	79	-31
Paper	35	53	145	147

Source: Own computations based on the *TradeProd Database* from the CEPII.

Table 1.9: Table of Correlations

	wage gap	lnMA	lnCA	lnHerf	lnFLS
wage gap	1				
lnMA	-0.36	1			
lnCA	0.56	0.04	1		
lnHerf	-0.45	0.37	-0.39	1	
lnFLS	0.73	-0.20	0.52	-0.51	1

Table 1.10: Summary Statistics: Trade Patterns of Manufacturing Industries

Indicator	Period	Net trade	Import penetration	Export share	Openness
Industry	83-90	19	8	13	21
	91-94	-6	15	13	26
	95-99	-14	19	15	31
	00-04	-7	22	19	35
Food	83-90	78	1	11	12
Beverage	91-94	66	2	10	12
Tobacco	95-99	54	5	14	18
	00-04	50	6	17	18
	83-90	84	2	27	29
Textile	91-94	60	7	28	34
Apparel	95-99	49	12	33	43
	00-04	44	15	40	52
	83-90	-28	40	38	57
Machines	91-94	-59	70	19	56
	95-99	-72	130	23	71
	00-04	-62	220	52	89
	83-90	-51	10	4	13
Chemical	91-94	-52	25	7	26
Oil	95-99	-50	22	7	25
	00-04	-44	24	9	28
	83-90	-40	7	3	9
Paper	91-94	-40	10	4	12
Printing	95-99	-38	16	7	21
	00-04	-33	37	20	44

Source: Own computations based on the *TradeProd Database*, CEPII.
Net trade equals $\frac{X-M}{X+M}$; import penetration is $\frac{M}{Q}$ and openness is $\frac{X}{Q}+(1-\frac{X}{Q})\frac{M}{Q+M-X}$.

Chapter 2

Gender Wage Gaps across Skills and Trade Openness [1]

2.1. Introduction

The effect of international trade on gender wage inequality depends on workers' skill levels. Recent empirical evidence has found that international trade contributes to a reduction in both the gender employment gap and the gender wage gap only in low-skill jobs (see Ozler (2000), Ederington et al. (2009), Fafchamps (2009), Fafchamps et al. (2009), Juhn et al. (in press) which we discuss below). Despite a strong empirical interest, the channels through which trade can have such an effect have not been formalized. This paper develops a model where international trade affects the gender wage gap differently at different points of the skill distribution. It shows that under general assumptions the gender wage gap widens at the top of the skill distribution following trade integration, while the gap is reduced at the bottom of the skill distribution.

The model features two groups of workers, men and women, whose characteristics vary in two dimensions, skills and job commitment which corresponds to workers' availability and willingness to maintain a intense and continuous working life. We assume that men

1. This chapter is a revised version of the AMSE working paper n° 2012-32. I am grateful to Matthieu Crozet, Cecilia Garcia-Peñalosa, James Harrigan, Peter Neary, Alain Trannoy and Federico Trionfetti for helpful comments and suggestions. This paper also benefited from comments received at seminars at the University College of Dublin and the University of Goettingen, at the internal seminars of the Aix-Marseille School of Economics, the Paris School of Economics and the Department of Economics at Sciences Po Paris, as well as at the MONDES conference on "Inequalities, Skills and Globalization" in Lille, the ETSG, EALE and EEA annual conferences.

and women have the same skill distribution that is perfectly observable. Commitment, however, is unobservable by the employer which generates statistical discrimination. In particular, employers discriminate against women because they have *on average* a lower labour market commitment [2]. As employers pay worker-specific wages, a woman is hired at a lower wage compared to a man with identical skills to compensate for the loss in case of lower commitment. This setting has been inspired by Lazear and Rosen's (1990) dynamic model of statistical discrimination where women face a lower promotion probability along the job ladder of a given firm because of learning in top jobs and a lower propensity for women to remain on the job. In our model, workers are sorted across firms rather than types of jobs; moreover, the matching is not determined by learning but by technology differences that result from firms' endogenous investment decisions. Firms make a simultaneous decision on technology investment and hiring as in Yeaple (2005). They calculate the expected workers' productivity conditional on the technology, their observation of the workers' skill levels and their expectation about the workers' degree of commitment. We assume that high-skill workers are more productive than low-skill workers (absolute advantage) but they are even more so in firms with sophisticated technology (comparative advantage). Similarly, strongly committed workers are always more productive than less-committed workers (absolute advantage) but they are more so in firms with sophisticated technology with sophisticated technology (comparative advantage).

The model gives the sorting of men and women across firms and the wage gap distribution in a closed economy setting. The most skilled workers are employed in high-technology firms where the reward to skills and expected commitment are higher. Yet, the skill threshold for women to be hired by a high-technology firm is higher than men to compensate for the uncertainty on their level of commitment. The higher female skill-threshold generates higher gender wage gaps in the upper part than in the lower part of the distribution.

We then shed light on the implications of international trade for the gender wage gap.

2. Gender differences in labour market commitment stem from work interruptions typically due to maternity and child rearing. They also result from the impossibility to work overtime as well as lower energy on the job due to greater time spent on housework and childcare. See Gauthier et al. (2002) among others for empirical evidence on gender differences in time allocation following child birth. Budig and England (2001) shows that the existing gender differences in the allocation of time between paid work and housework affect mothers over and above the reduction in real labour market experience. Changes in time spent on the job cannot explain the lower wages received, even controlling for fine characteristics of the job. Boye (2010) shows that total time spent on both paid work and housework is higher for women and that the resulting gender difference in leisure time causes gender differences in psychological distress. This might in turn affect energy on the job.

We consider a monopolistic competition framework (Krugman, 1980) where two identical countries trade different varieties of a differentiated good. Trade is costly, generating both fixed and variable costs, so that only the most productive firms, i.e. those using the "high" technology, engage in exporting along the lines of Melitz (2003). A reduction in trade costs spurs firms to adopt "high" technology to benefit from larger markets. The new investments in technology increase the demand for skilled and strongly committed workers. Because demand for commitment is now higher, trade liberalization increases the gender wage gap in the upper tail of the distribution. Because of general equilibrium effects, the non-traded good sector expands which generates a reduction in the gender wage gap at the bottom of the distribution. However, the effect on the mean gender wage gap is ambiguous.

The model offers an explanation to several empirical findings. First, empirical studies that analyze the distribution of the gender wage gap show the gap is higher in the upper part of the wage distribution in both developed and developing countries [3]. This paper provides a simple explanation for that finding based on statistical discrimination and strong but general assumptions on the production function. The empirical literature highlights three phenomena that contribute to the increase in the gender wage gap along the wage distribution. Firstly, women are less often promoted to top jobs, the glass-ceiling effect [4]. Secondly, within jobs, women are paid less than their male counterparts, especially in high-responsibility high-wage jobs [5]. Thirdly, the sorting of women into low-wage firms, the glass-door effect, also contributes to higher adjusted wage gaps at the top of the wage distribution [6]. The model presented in this paper does not feature jobs specifically. It generates a gender wage gap conditional on skills that increases along the distribution for two reasons: the sorting of workers across heterogeneous firms differs for men and women, and within firms, women receive lower-wages.

3. Recent examples in this literature include Nopo et al. (2010) for Latin American countries, de la Rica et al. (2008) for Spain and Albrecht et al. (2009) for the Netherlands.

4. Gobillon et al. (2012) show that, in France, women have lower probability to be hired at all ranks of positions compared to men and that the gender gap in the probability to access high-wage positions is substantially larger than gap in the probability to enter low-wage positions.

5. See all studies that control for precise occupation cells such as Jurajda and Harmgart (2007) for Germany, Oostendorp (2004) for a cross-country analysis.

6. Meyersson Milgrom et al. (2001) show that segregation into low-wage occupations and low-wage establishments explains part of the wage gap in Sweden while Amuedo-Dorantes and De la Rica (2006) and Woodcock (2008) come to similar conclusions for Spain and the United-States. Javdani (2012) applies the methodology of Pendakur and Woodcock (2010) on Canadian data to decompose gender wage gaps along the distribution into a within-firm glass-ceiling effect and a glass-door effect i.e. the under-representation of women in high-wage firms.

A second empirical fact with which the model is consistent concerns the effect of trade openness on wage inequality. A large body of empirical evidence shows that exporters differ from non-exporters. They are bigger, more productive, more skill-intensive and pay higher wages, the exporter wage premium [7]. These differences help understand wage inequality. The skill premium is found to increase with trade exposure in both developed and developing countries [8]. Looking at both men and women, Klein (2010) finds that the export-wage premium increases with the skill level within gender groups. The model presented in this paper provides a mechanism that explains the increase in skill rewards with trade integration for both men and women.

The third body of empirical literature closely related to this paper highlights that international trade impacts the relative demand for female labour differently among skilled and unskilled workers. Following trade integration and the expansion of exporting sectors, women benefit from employment gains but mostly in unskilled occupations. There is an increase in female relative wages in unskilled occupations, but not in skilled occupations (Oostendorp, 2004). Joekes (1995) illustrates this pattern with data for the textile, apparel and food processing industries in Bangladesh and Morocco. Nicita (2008) conducts a simulation exercise using the expansion of the textile and apparel industry in Madagascar and finds that women benefited substantially less than men in terms of employment and wages because men are more often hired in skilled jobs. Paul-Majumder and Begum (2000) draw similar conclusions on the consequences of the growth in the export-oriented industries in Bangladesh. Other papers investigate firm-level changes following trade liberalization and confirm the pattern observed at the sectoral level. Exporting firms, that invest more in capital-intensive technologies, employ a lower share of skilled women (Ozler, 2000, Ederington et al., 2009). Juhn et al. (in press) find that following trade liberalization in Mexico, firms have adopted new technologies and the gender wage gap has been

7. See the influential paper by Bernard and Jensen (1997) for evidence on the exporter wage premium and skill-biased shift in labour demand in U.S. manufacturing during the 1980s. Bustos (2011) gives evidence based on Argentinian firm data that corroborates her theoretical predictions: by increasing potential export revenues and making costly investment worthy, reduction in trade costs favours investment in new technologies which increases the demand for skilled workers. Helpman et al. (2012) use firm-level data for Brazil and show that there is significant wage inequality among workers with similar observable characteristics, holding similar jobs in the same sector. This wage differences are explained in part by the trade orientation of the firm.

8. Empirical assessments of the impact of trade openness on wage inequality are for instance, Bernard and Jensen (1997) on the US, Pavcnik et al. (2004) on Brazil, Brambilla et al. (2012) on several Latin-American countries. See also Goldberg and Pavcnik (2007) for a literature review.

reduced in blue-collar occupations but not in white-collar occupations. The exporter wage premium is lower for women. Klein (2010) finds that, in the German manufacturing industries, women face a wage penalty that increases with the skill level. The wage gap is smaller in exporting plants for low-skilled individuals but not for college educated individuals. Fafchamps (2009) uses matched employer-employee data for Morocco and finds that the exporter wage premium is smaller for women as well. Our model is consistent with the fact that international trade affects differently men and women depending on their skill levels.

This paper is related to several strands of literature. First, it contributes to a large body of work dealing with how trade openness, associated with firm heterogeneity, influences wage inequality. We can distinguish two groups of theoretical models where international trade contributes to wage inequality. One group of papers focuses on the impact of trade on the skill-premium through the investment in new technologies. Neary (2002) develops an oligopolistic model where the threat of foreign product entry spurs firms to invest in new technologies in order to reduce production costs. Since innovation is skill intensive, trade openness increases the relative demand for skilled workers thereby increasing the skill-premium. Yeaple (2005), Bustos (2011) and Sampson (in press) develop models with monopolistic competition. They also show that trade liberalization contributes to rising wage inequality between high-skill and lower-skill workers through differences in firm technology. The present paper follows this approach and adds another dimension of worker heterogeneity that is unobservable. The mechanism of skill-biased technological change has received recent empirical support.

Leonardi (2007) finds that there is a positive correlation between wage dispersion and firms' differences in capital intensities within sectors in the United States. Heterogeneity in firm capital-labour ratios impacts mostly male residual wage inequality above the median wage. Abowd et al. (2007) investigate how a firm's technology influences its demand for skills in the United States during the 1990s. The results indicate substantial firm differences in both the distributions of skills and of technology as measured by capital per worker or computer-intensive technologies. They show that firms that are more intensive in technology are more likely to use high-education workers. Bustos (2011) shows that in Argentina, the increase in the skill-premium is driven by investment in technology following trade liberalization.

Another group of papers investigates the effect of international trade on within-group inequality. In Helpman et al. (2010) workers differ in their unobservable abilities. Following trade integration, the most productive firms start exporting. Exporters are able to hire the best workers to whom they pay higher wages because they invest in better screening technologies. In Egger and Kreickemeier (2009, 2012), similar workers demand fair wages to their employers. The exporter wage premium is explained by exporters' higher profits. Trade liberalization increases profit differences between exporters and non-exporters and thus increases wage inequality among similar individuals. Those models imply a uniform wage within firms. The model presented in this paper differs in that it features within-firm as well as between-firm wage dispersion. This is due to the introduction of observable skill differences and group differences in unobservable ability. This setting enables us to draw a link between the rise in the skill-premium and the rise in the male wage premium. Within-firm dispersion is consistent with empirical evidence. In a study covering the United States from the 1960s to the late 1980s, Davis et al. (1991) investigate the rise in wage inequality within groups defined by their education, experience and gender. They show that, first, within-firm wage dispersion accounts for 35 to 40 percent of the wage dispersion in each group. Second, within-firm wage inequality is stronger among non-production workers than among production workers. Similarly, Iranzo et al. (2008) explore firm-level data for Italy and find considerable within-firm variation in the individual worker's effect of the wage equation.

This work is also related to recent trade models using labour assignment to provide insights about the impact of globalization on labour markets (see for example Yeaple (2005), Ohnsorge and Trefler (2007), Costinot and Vogel (2010)). The novelty of the present paper is to introduce statistical discrimination. We are then able to show that the wage dispersion induced by trade occurs both within gender groups, along the skill distribution, and between gender groups, generating changes in the gender wage gap adjusted for observable skills. In doing so, the paper contributes to the literature that investigate the linkages between the overall wage structure and the gender wage gaps[9]. This paper shows that trade openness affects simultaneously the overall wage structure through an increase in the skill premium and the gender wage gap.

Finally, this paper belongs to the small literature that studies the effect of trade open-

9. The wage structure is the values the labour market attaches to skills and other productive characteristics. For studies of the US labour market, see Blau and Kahn (1992, 1994, 2003)

ness on the adjusted gender wage gap. One set of of papers focuses on the competition effect of international trade in a taste-based discrimination framework. According to Becker's theory, prejudiced employers can engage in discrimination only if they earn enough profits and an increase in competition pressure reduces the gender wage gap. Artecona and Cunningham (2002) and Black and Brainerd (2004) provide empirical appraisals of the foreign competition effect on the average gender wage gap at the sectoral level. They show that higher import penetration reduces the gender wage gap at the sectoral level, in accordance with the prediction of Becker's theory. Ederington et al. (2009) develop a model of taste-based discrimination where an increase in import penetration raises the female share of employment within firms. In this model, the gender wage gap is exogenously fixed and only an exogenous increase in imports is considered. Ben Yahmed (2012) presents a trade model with taste-based discrimination and oligopolistic competition to draw attention to both pro and anti-competition effects of international trade. The predictions of the model are confirmed by the empirical analysis of trade liberalization in Uruguay. When foreign firms benefit from an easier access to the Uruguayan market, the gender wage gap shrinks in sectors that were concentrated prior liberalization. This result is a validation of the prediction: "competition eliminates discrimination". When trade liberalization facilitates the access of Uruguayan firms to foreign markets, however, the gender wage gap increases, only in sectors that were concentrated prior liberalization. This is a validation of the prediction: "profit-enhancing opportunities reinforce discrimination".

The present study investigates a different mechanism. It focuses on how biased technological change induced by trade openness impacts men and women at different skill levels. Closely related to this paper, a few empirical studies have pointed out the heterogeneous effects of trade on the relative position of women depending on the skill intensity of the occupation. Oostendorp (2004) looks at the impact of sectoral trade shares on the gender wage gap within narrowly defined occupations for more than 80 countries. Exploiting the changes in trade intensity within a given occupation-sector-country cell over time, he finds that an increase in the sectoral trade share narrows the occupational wage gap for unskilled labour only and the occupational gender wage gap is lower in unskilled occupations compared to skilled occupations, the difference being bigger in developing countries. Joekes (1995) highlights that the expansion of the export manufacturing sectors in Morocco and Bangladesh created new sources of employment for women but in unskilled occupations, mainly in the textile and clothing industries. This result is confirmed by Fafchamps (2009) who finds that Moroccan exporters, concentrated in light industries such as textile and apparel where the workforce is mainly unskilled, employ significantly more women and pay them on average lower wages controlling for education.

Ozler (2000) uses plant-level data from Turkey and shows that trade liberalization in the 1980s led to employment gains for women relative to men in the manufacturing sector. Women, however, continued to be employed in low-skill and low-pay jobs within plants. Furthermore, among plants with a high female share, as well as among large establishments, investments in machinery and equipment brought about a decline in the female share of employment. This finding supports the argument that employment gains for women following trade liberalization might be reversed as a consequence of technological upgrading. Ederington et al. (2009) use plant-level data for Columbia to study changes in employment within firms over the period 1985-1991. They show that plants that have the highest female share of employment are less intensive in capital and pay lower wages compared to the industry average. As for the role of openness, the share of exports in the total production of the plant is positively associated with the female share the plant which implies that openness can be good for women's employment opportunities. In the same direction, a reduction in tariffs has a positive effect on female share of employment at the plant level. However, when they distinguish between the share of females among skilled workers and among unskilled workers, they reveal that those employment gains benefit mostly unskilled women while trade openness has been detrimental to skilled women. Indeed, an increase in the export share of the plant reduces the female share of skilled workers. As for a reduction in tariffs, it increases the demand for unskilled female labour but not the demand for skilled women among exporting plants, while it increases the demand for both types of female labour among non-exporting plants.

Two other papers investigate the impact of trade on gender inequality at the firm level. Klein et al. (2010) investigate how the trade orientation of firms impact wage inequality between and within male and female groups of workers for the German manufacturing industries. They find that women face a wage penalty compared to men and that this penalty increases with the skill level. The wage gap is smaller in exporting plants for low-skilled individuals but not for college educated individuals. They additionally find that the export-wage premium increases with the skill level within groups. To sum up, trade openness contributes to wage dispersion among men and among women, but the effect on the wage gap depends on the skill level of workers. Juhn et al. (in press) provide an explanation for narrowing gender wage gaps among blue-collars but not among white-collars, a pattern they observe in Mexico in the aftermath of NAFTA. In their model, all productive characteristics are observable; the gender difference is biological: physical strength. They assume that the new technology reduces the need for physical strength in blue collar occupations so that the relative demand for female labour increases in those occupations. We depart from their setting by proposing a model with worker heterogeneity in two dimensions, an observable characteristic and an unobservable characteristic unequally distributed among men and women. Because workers' productivity depends on the unobservable characteristics, employers engage in statistical discrimination. Because different technologies value differently the observable and the unobservable characteristics, the gender wage gap varies with technology and with skill levels. This paper gives general conditions on the production technology under which we can generate non-monotonic effects of trade on the gender wage gap.

The rest of the paper is organized as follows. Next section describes the setup of the model. Section 3 provides the equilibrium in a closed economy where the distribution the gender wage gap across fits within-country evidence. In section 4, we characterize the open economy equilibrium and derive the implications of international trade and further reductions in trading costs for the distribution of the gender wage gap. The final section concludes.

2.2. Setup of the model

2.2.1. Demand

Preferences are identical across all consumers who choose a quantity of a homogeneous good and a quantity of varieties of a differentiated good. The utility function is Cobb Douglas between the differentiated good X and the homogeneous good Y and presents a CES sub-utility over the varieties i of X. This function expresses a love of variety of consumers. Then

$$U = Y^{1-\beta} X^{\beta}$$

$$X = \left(\sum_{i}^{N} x_i^{\alpha} \right)^{\frac{1}{\alpha}}$$

where the elasticity of substitution across varieties of X is given by $\sigma = \frac{1}{1-\alpha}$. The price index of the differentiated good X is : $P_X = \left(\sum_i p_i^{1-\sigma}\right)^{\frac{1}{1-\sigma}}$. If all prices are equal, the price index is $P_X = pN^{\frac{1}{1-\sigma}}$. It decreases with N the number of varieties produced and the elasticity of substitution σ. Consumers choose the share of their income M they will devote to the differentiated good by maximizing their utility subject to their revenue constraint. The price of the homogeneous good is normalized to one.

$$X = (\beta M)/P_X$$

$$Y = (1-\beta)M \tag{2.1}$$

Let us denote by $E = \beta M$ is the portion of income spent on the differentiated good. Consumers decide also how much of each variety they consume. As they value diversity, they consume a positive amount of each symmetric variety and spend a larger share of their budget on lower-price varieties:

$$x_i = \frac{E}{P_X} \left(\frac{p_i}{P_X} \right)^{-\sigma} \tag{2.2}$$

The demand for variety i takes into account the average price of good X. The term $\frac{E}{P_X}$ corresponds to the aggregate demand for X while the price differential $\frac{p_i}{P_X}$ models the competition effect between variety i and the other varieties.

2.2.2. Worker heterogeneity in observable and unobservable characteristics

The workforce is heterogeneous in both skills and job commitment. There is a continuum of skills s distributed among the population according to a distribution function L over the support $[0, \bar{s}]$. $L(s)$ is the inelastic supply of labour with skill no greater than s. We assume that men and women have the same exogenous skill distribution $L_f(s) = L_m(s) = L(s)$ where f and m denote, respectively, female and male. The mass of workers per group is normalized to one. As for the differences in job commitment, let us assume that there are two types of individuals, the highly-committed that spend the maximum time and effort in the firm over the period $e = \bar{e}$ and the low-committed ones for which $e = \underline{e}$ [10]. We simplify the model by assuming that men always exhibit a high level of commitment $Pr_m(e = \bar{e}) = 1$ while women have a probability to favour labour market activity over their domestic activities equal to $Pr_f(e = \bar{e}) = \eta$ with $0 < \eta < 1$ [11]. There is no correlation between s and e which means that the probability of being highly committed to one's job is independent of one's skill level [12].

The skill of a worker can be perfectly observed by the employers. However the level of job commitment is unobservable : employers cannot anticipate the time and energy a particular worker is going to put in the job. Even though employers expect some women to be highly committed, they are unable to know which ones at the time of hiring. As a consequence, employers expect a lower female productivity because of the *average* female labour market attachment. Labour productivity is increasing in both s and e and depends on the technology j in use, as we will see in the next sub-section.

2.2.3. Production

The productivity of a worker endowed with skills s and a level of commitment e when working with technology j is noted $\varphi_j(s, e)$. Because employers cannot observe e, they form expectations based on observables, i.e. the skill and the sex of the worker. We denote by $\tilde{\varphi}_{jg}(s)$ the *expected* productivity of a worker with skill s from group g as viewed by the employer prior hiring when technology j is used. As men's productivity is perfectly observable, $\tilde{\varphi}_{jm}(s) = \varphi_j(s, \bar{e})$. For women, employers form identical expectations given by: $\tilde{\varphi}_{jf}(s) = E(\varphi_j(s, e)|\eta) = \eta\varphi_j(s, \bar{e}) + (1 - \eta)\varphi_j(s, \underline{e})$. Employers anticipate different productivities for a man and a woman endowed with the same skill level and working with the same technology : $\tilde{\varphi}_{jm}(s) > \tilde{\varphi}_{jf}(s) \quad$ for all $j \in \{l, h\}$ and for all $s \in]0; \bar{s}]$.

10. In sociology, the preference theory developed in Hakim (2000) argues that differences in women's preferences for combination of domestic activities and paid employment explain differences in labour market attachment among women. She sorts women into three categories: home-centered, adaptative and work-centered. Only women belonging to the last two categories participate to the labour market. We model the difference between these two groups by an exogenous difference in job commitment. Another study that documents the heterogeneity in women's decisions over work and family life balance is Blair-Loy (2003).

11. This amounts to a normalization of male probability of commitment. We could allow for heterogeneity among men too. The crucial assumption is that men are more likely than women to be work-centered and thus have a higher probability to be highly committed.

12. Skill investment is exogenous in this model. Our results will hold if we allowed for a correlation between skills and commitment sufficiently low compared to the degree of complementarity in the production function as we will see below.

In sector Y, the homogeneous good sector, firms produce under constant returns to scale and perfect competition using labour only. We assume that labour productivity does not depend on either workers' skills or effort in this sector and we set $\varphi_Y = 1$. We denote by c_Y the unit cost of production equal to the wage per efficiency unit of labour : $c_Y = \frac{w_Y}{\varphi_Y}$. Under perfect competition in both product and labour markets, firms set prices equal to their unit cost of production $p_Y = \frac{w_Y}{\varphi_Y}$. We choose the price of good Y as the numeraire $p_Y = 1$, consequently we have $c_Y = w_Y = \varphi_Y = 1$.

In sector X, the differentiated good sector, firms operate under imperfect competition and increasing returns to scale. We assume that the sector is characterized by horizontal product differentiation and monopolistic competition where N firms produce each a variety of the differentiated product. Firms have to pay a fixed investment cost to produce one variety. This innovation cost F acts as an entry barrier which ensures that each variety is produced by only one firm. As varieties are not perfect substitutes, firms enjoy some market power that enable them to make positive operating profits and pay the fixed cost. After choosing its technology, the firm can produce a variety of good X hiring labour. The following assumptions characterize the technology and the productivity function.

Assumption A1. ***Fixed and variable costs***
Firms can invest in two different technologies indexed by $j = \{l, h\}$. To acquire the high-technology firms bear a higher fixed cost $F_h > F_l$ but benefit from a higher productivity of labour for a given skill level and commitment, $\varphi_h(s, e) > \varphi_l(s, e)$. If a worker has no skill, $s = 0$, his/her productivity is the same in sector X and Y : $\varphi_h(0, e) = \varphi_l(0, e) = 1$.

Firms choose the type of investment they make considering both its cost and the resulting gain in productivity. This specification is consistent with R&D being positively correlated with firm productivity (see Klette and Kortum (2004) for example).

Assumption A2. ***Log-supermodularity in skills and technology***
Skill acts as a strategic complement to technology upgrading:

$$\frac{\varphi_h(s', e)}{\varphi_h(s, e)} > \frac{\varphi_l(s', e)}{\varphi_l(s, e)} \quad \textit{for any } s' > s \quad \forall e$$

The productivity gain derived from hiring a worker with a higher skill is greater under technology h. This means that workers with higher skill levels have a comparative advantage in the sophisticated technology.

Assumption A3. ***Log-supermodularity in commitment and technology***
Job commitment and technology upgrading are complementary:

$$\frac{\varphi_h(s,\bar{e})}{\varphi_h(s,e)} > \frac{\varphi_l(s,\bar{e})}{\varphi_l(s,e)} \qquad \textit{for any } \bar{e} > e \quad \forall s$$

Assumption A3 implies that strongly committed workers have a comparative advantage in the high technology.

Assumption A4. ***Log-supermodularity in skills and commitment***
Job commitment and skills are complementary:

$$\frac{\varphi_j(s',\bar{e})}{\varphi_j(s,\bar{e})} > \frac{\varphi_j(s',e)}{\varphi_j(s,e)} \qquad \textit{for any } \bar{e} > e \quad \textit{and } s' > s \quad \forall j = \{l,h\}$$

A high skill level is more valuable when the worker's job commitment is high.

Assumptions A2 to A4 require the productivity function to be non separable in s, e and j.

2.3. The closed economy Equilibrium

2.3.1. Profit maximization under monopolistic competition

Firms operating with the same technology j are symmetric. In particular a worker with a given level of skill s and sex g has the same expected productivity, denoted by $\tilde{\varphi}_{jg}$, in any firm of type j. As a result, the technology $j = \{h,l\}$ specifies all relevant firm's variable. We can thus solve firms' problem in sector X using two representative firms h and l.

Risk-neutral employers hire workers in a perfectly competitive labour market. The wage paid by a firm j to a worker g with skill s is denoted by $w_{jg}(s)$. Total production cost for a firm j can be written as :

$$TC_j = \frac{1}{N_j}\sum_g \left(\int_{s\in S_{jg}} w_{jg}(s)l(s)ds \right)$$

where S_{jg} is the set of skills of workers belonging to group g employed by a firm of type j. N_j is the endogenous number of j-firms. We assume that the fixed component of production uses labour in the same way as the variable component of production. The fixed cost is denominated in units of firm output. In other words, a firm produces consumption goods as well as a specific investment good using the same mix of workers [13].

$$q_j + F_j = \frac{1}{N_j} \sum_g \left(\int_{s \in S_j} \varphi(s) l(s) ds \right)$$

We denote by $\tilde{c}_j$ the *expected* cost per efficiency unit of labour under technology j. It is equal the ratio of worker's wage over worker's expected productivity, $\tilde{c}_j = \frac{w_g(s)}{\tilde{\varphi}_{jg}(s)}$. The expected profit of a firm using technology j can be written:

$$\pi_j = p_j q_j - \tilde{c}_j(q_j + F_j)$$

Firms maximize their expected profits with respect to quantities [14] and take the wage rate per efficiency unit of labour as given.

$$\pi_j = max_{q_j} \{p_j q_j - \tilde{c}_j(q_j + F_j)\}$$

The first-order condition for equilibrium is :

$$p_j = \frac{\sigma}{\sigma - 1} \tilde{c}_j \tag{2.3}$$

Under competitive labour markets and monopolistic competition, firms with technology j hire workers up to the point where the wage per efficiency unit of labour, $\tilde{c_j} = w_j(s, \eta)/\varphi_j(s, \eta)$, equals the marginal revenue product $p_j \frac{\sigma - 1}{\sigma}$. Hence, employees working with the same technology are paid the same fraction of their respective expected

13. The alternative option is to denominate the fixed cost in unites of final good instead of firm output. Whether the firms use or not labour in the fixed component of production does not alter the results on wage inequality, cf. Sampson (in press) for a proof in a similar setting. Other papers explicitly model innovation and investment in R&D, which is part of the fixed component of production, as another activity that requires its specific mix of workers, usually using more intensively skilled labour, as in Neary (2002) for example.

14. Under monopolistic competition without any strategic interactions, competition on prices or on quantities lead to the same equilibrium result.

productivity:

$$w_{jg}(s) = p_j \frac{\sigma - 1}{\sigma} \tilde{\varphi}_{jg}(s)$$

with $0 < \frac{\sigma-1}{\sigma} < 1$.

Firms offer wages that are specific to workers' attributes. This specification is consistent with empirical evidence on within-firm wage dispersion [15] and on within-firm gender wage gaps.

2.3.2. The wage distribution for men and women

We follow Yeaple (2005) where workers with different skills sort across h and l type firms. In this paper, workers not only differ in their observable skill s but also in their unobservable degree of job commitment e. Following the literature on job assignment, we assume that workers know the wage they can earn if they are matched to a given firm j and go to the firm that offers the highest wage.

Proposition 1. ***Sorting of workers***
If higher skill workers have a comparative advantage in h-type firms then h-type firms hire the most skilled workers of each group g

We prove this result in the appendix by showing that if positive assortative matching is not followed, the value of the output and wages can increase by switching the assignment of workers to firms [16]. Positive assortative matching between firms and workers has received empirical support: several papers find that most productive firms employ more skilled workers [17].

The wage distribution for men and women is given by the function $w_{jg}(s) = \tilde{c_j}.\tilde{\varphi}_{jg}(s)$ where the wage of a worker is equal to the cost per unit of efficient labour times the expected productivity of the worker. We can give an expression for the wage that depends on firms' technologies and the skill thresholds s_{jg} below which a worker from group $g = \{f, m\}$ is

15. Davis et al. (1991) on the United-States and Iranzo et al. (2008) on Italy, for example. Meng (2004), among others, shows that men and women receive different wage within firms in Germany

16. This sorting mechanism has been first suggested by Roy (1951) where workers self-select into the occupation that gives them the highest expected earnings.

17. Abowd et al. (1999) for France, Haltiwanger, Lane and Spletzer (1999, 2007) and Woodcock (2008) for the U.S., Haskel et al. (2005) for the UK, Iranzo et al. (2008) and Mion and Naticchioni (2009) for Italy and Lopes de Melo (2013) for Brazil

not hired by a firm $j = \{l, h\}$.

$$w_g(s) = \begin{cases} c_Y \varphi_Y = 1 & \text{if } s < s_{lg} \\ \tilde{c}_l \tilde{\varphi}_{lg}(s) & \text{if } s_{lg} \leq s < s_{hg} \\ \tilde{c}_h \tilde{\varphi}_{hg}(s) & \text{if } s_{hg} \leq s \end{cases} \tag{2.4}$$

Among each group $g = \{m, f\}$, workers with a skill level equal to the threshold s_{lg} is indifferent between working in sector Y and working in a firm l in sector X. Similarly a worker with a skill level s_{hg} is indifferent between working in a firm using either technology h or l : $\tilde{c}_l \tilde{\varphi}_{lg}(s_{hg}) = \tilde{c}_h \tilde{\varphi}_{hg}(s_{hg})$. Consequently, we can rank the unit cost of production :

$$\frac{\tilde{c}_l}{c_Y} = \frac{\varphi_Y(s_{lg})}{\tilde{\varphi}_{lg}(s_{lg})} = \frac{1}{\tilde{\varphi}_{lg}(s_{lg})} < 1 \qquad \text{and} \qquad \frac{\tilde{c}_h}{\tilde{c}_l} = \frac{\tilde{\varphi}_{lg}(s_{hg})}{\tilde{\varphi}_{hg}(s_{hg})} < 1 \tag{2.5}$$

Firms in the diversified sector have lower unit cost of production than firms in sector Y. Within sector X, firms using the low technology have higher unit cost than firms using the high technology.

Using the indifference condition for both groups, we can rank the skill threshold required to men and women.

$$\frac{\varphi_Y(s_{lf})}{\tilde{\varphi}_{lf}(s_{lf})} = \frac{\varphi_Y(s_{lm})}{\tilde{\varphi}_{lg}(s_{lm})} \Leftrightarrow \frac{1}{\tilde{\varphi}_{lf}(s_{lf})} = \frac{1}{\tilde{\varphi}_{lm}(s_{lm})}$$

and

$$\frac{\tilde{\varphi}_{lm}(s_{hm})}{\tilde{\varphi}_{hm}(s_{hm})} = \frac{\tilde{\varphi}_{lf}(s_{hf})}{\tilde{\varphi}_{hf}(s_{hf})} \Leftrightarrow \frac{\tilde{\varphi}_{hf}(s_{hf})}{\tilde{\varphi}_{hm}(s_{hm})} = \frac{\tilde{\varphi}_{lf}(s_{hf})}{\tilde{\varphi}_{lm}(s_{hm})}$$

These two equations show that s_{jf} is a function of s_{jm} and η. Using both indifference conditions we can give the following proposition on the different sorting of men and women into heterogeneous firms:

Proposition 2. ***Ranking of male and female skill requirements***

i) Under the assumptions that $Pr_f(e = \bar{e}) < Pr_m(e = \bar{e})$ and φ_l is increasing in e, employers using the technology l require from women a higher skill level $s_{lf} > s_{lm}$

ii) Under the assumptions A2 and A3, the skill threshold to work for a firm h is higher for women $s_{hf} > s_{hm}$

The proof of proposition 2 is developed in the appendix.

Consequently, there are women working in sector Y who have a greater skill level than men working in a firm l; this holds for workers with skills comprised between the male and female threshold for entering sector X, $s_{lm} \leq s \leq s_{lf}$. Similarly, a female worker employed in a firm l can have a greater skill level than a men working in a firm h; this holds for workers with skills comprised between the male and female threshold for entering a firm h, $s_{hm} \leq s \leq s_{hf}$.

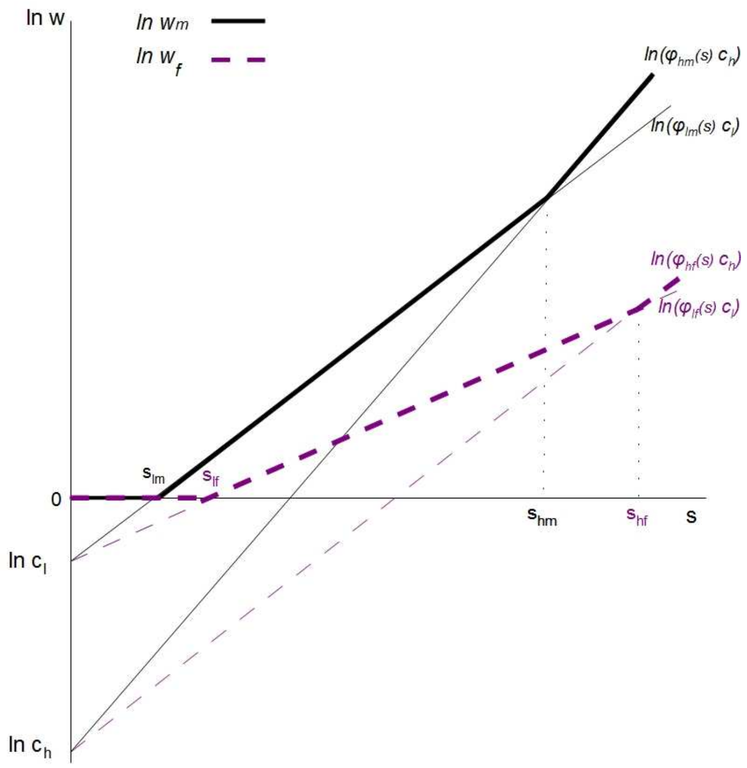


Figure 2.1: The wage distribution for men and women

We can now describe the wage distribution for both men and women. The slope of the wage profile becomes steeper at each group-specific skill threshold s_{lg} and s_{hg} because the technology l enhances worker productivity compared to the technology used in sector Y and the technology h features stronger skill complementarity than the technology l. Within groups, the skill of any worker using the technology l is lower than the skill of a worker using the technology h[18].

We can further give the distribution of the wage gap along the skill distribution where $WG(s) = \frac{w_m(s)}{w_f(s)}$ is the gap between a man and a woman of skill s.

$$WG(s) = \begin{cases} 1 & \text{if } s \leq s_{lm} \\ \tilde{c}_l \frac{\tilde{\varphi}_{lm}(s)}{\varphi_Y} & \text{if } s_{lm} \leq s \leq s_{lf} \\ \frac{\tilde{\varphi}_{lm}(s)}{\tilde{\varphi}_{lf}(s)} & \text{if } s_{lf} \leq s \leq s_{hm} \\ \frac{\tilde{c}_h}{\tilde{c}_l} \frac{\tilde{\varphi}_{hm}(s)}{\tilde{\varphi}_{lf}(s)} & \text{if } s_{hm} \leq s \leq s_{hf} \\ \frac{\tilde{\varphi}_{hm}(s)}{\tilde{\varphi}_{hf}(s)} & \text{if } s_{hf} \leq s \end{cases}$$

Proposition 3. *Under assumptions A1, A2 and A4, the gender wage gap is increasing in the skill level.*

The increase in the gender wage gap with skill, as depicted in figure 2.1, can be explained as follows. There is no wage gap between men and women in sector Y because of the assumption that labour productivity in Y does not depend on either skills or job commitment. We do not need such a strong assumption to generate an increasing gap further on but it simplifies the exposition. Production in sector Y can be thought of as involving mainly routine tasks. For workers with skill levels comprised between s_{lm} and s_{lf}, the gender wage gap is equal to $\tilde{c}_l \frac{\tilde{\varphi}_{lm}(s)}{\varphi_Y}$ which increases with s from (A1) and is greater than the gender wage gap at the bottom of the distribution. For the latter to be true, we need that technology l features stronger complementarities with skills compared to the technology used in sector Y. The supermodularity of φ in skills and technology upgrading (A2), ensures that the gender wage gap is increasing in skills when men and women work with different technologies. In particular, (A2) ensures that $\frac{\tilde{c}_h}{\tilde{c}_l} \frac{\tilde{\varphi}_{hm}(s)}{\tilde{\varphi}_{lf}(s)}$ increases in s. The supermodularity of φ in skills and commitment (A4) ensures that the the gender wage gap increases when men and women work with the same technology. In particular, (A4)

18. It would be possible to smooth out the breaks in the wage distribution of both men and women, and thus in the gender wage gap by introducing a continuum of production technologies instead of just two, as in Sampson (in press).

ensures that the ratios $\frac{\tilde{\varphi}_{lm}(s)}{\tilde{\varphi}_{lf}(s)}$ and $\frac{\tilde{\varphi}_{hm}(s)}{\tilde{\varphi}_{hf}(s)}$ are increasing in s.

2.3.3. Free entry and market clearing

Investment in technology is unrestricted so that the number of firms adjusts until profits using either technology are zero. For each type of technology, the unit cost under which total revenues equal total (labour) costs is :

$$\tilde{c_j} = \frac{\sigma - 1}{\sigma}(EP_X^{\sigma-1})^{\frac{1}{\sigma}}((\sigma - 1)F_j)^{\frac{-1}{\sigma}} \tag{2.6}$$

The different fixed costs generate two productivity cutoffs. Producing with the technology h requires a higher productivity $\tilde{c}_h < \tilde{c}_l$ to be able to make higher operating profits to pay for the higher fixed cost. Firms make their investment and human resources decisions jointly as the unit cost of producing with a given technology depends on the skill level of the workforce.

Using equation (5) and the zero profit conditions for both types of firms, we obtain:

$$\frac{\tilde{\varphi}_{hg}(s_{hg})}{\tilde{\varphi}_{lg}(s_{hg})} = \left(\frac{F_h}{F_l}\right)^{\frac{1}{\sigma}} \tag{2.7}$$

This expression pins down the skill threshold to enter a firm h for both men and women as a function of the technologies' parameters. An increase in the fixed cost to invest in the high technology increase the skill threshold required to workers.

Female and male total labour supply is assumed to be fixed and is divided across the tree types of firms. The numbers of high-technology and low-technology firms in sector X are given by :

$$N_h(q_h + F_h) = \int_{s\in S_{hf}} \tilde{\varphi}_{hf}(s)l(s)ds + \int_{s\in S_{hm}} \tilde{\varphi}_{hm}(s)l(s)ds$$

$$N_l(q_l + F_l) = \int_{s\in S_{lf}} \tilde{\varphi}_{lf}(s)l(s)ds + \int_{s\in S_{lm}} \tilde{\varphi}_{lm}(s)l(s)ds$$

Using the free entry condition :

$$N_h = \frac{1}{\sigma F_h}(\int_{s\in S_{hf}} \tilde{\varphi}_{hf}(s)l(s)ds + \int_{s\in S_{hm}} \tilde{\varphi}_{hm}(s)l(s)ds) \tag{2.8}$$

$$N_l = \frac{1}{\sigma F_l}(\int_{s\in S_{lf}} \tilde{\varphi}_{lf}(s)l(s)ds + \int_{s\in S_{lm}} \tilde{\varphi}_{lm}(s)l(s)ds) \tag{2.9}$$

The number of firm j depends on the four skill thresholds s_{jg} with $j = \{h, l\}$ and $g = \{m, f\}$. The threshold s_{hm} is pinned down by the free entry condition in sector X while the sorting of workers across the two types of firms relates s_{hm} to s_{hf}. The market clearing condition for good Y determines the skill threshold s_{lm}.

To close the model, we finally use the market clearing condition in sector Y where the level of production is $Y = \sum_g \int_0^{s_{lg}} l(s)ds$.
The demand for good Y, given by the Cobb-Douglas preferences, must equal the production of the good. Since Y is the numeraire $p_Y = 1$, the market clearing condition is :

$$Y = (1-\beta)M$$

where M is total revenue which equals total wages (firms make no positive profits in equilibrium) : $M = \sum_g(\int_{s\in S_{Y_g}} l(s)ds + \int_{s\in S_{lg}} w_{lg}(s)l(s)ds + \int_{s\in S_{hg}} w_{hg}(s)l(s)ds)$. Consumption of good Y is a function of the cost thresholds s_{lg} and s_{hg}.

Using equations (2.13) and (2.5), replacing M in the equation for the demand of good Y and equalizing demand and production for good Y we obtain :

$$\frac{\beta}{1-\beta}\tilde{\varphi}_l(s_{lm})\sum_g \int_0^{s_{lg}} l(s)ds = \sum_g \left(\int_{s_{lg}}^{s_{hg}} \tilde{\varphi}_{lg}(s)l(s)ds + \frac{\tilde{\varphi}_l(s_{hm})}{\tilde{\varphi}_h(s_{hm})} \int_{s_{hg}}^{\bar{s}} \tilde{\varphi}_{hg}(s)l(s)ds \right) \tag{2.10}$$

Equation (2.10) defines the skill threshold below which individuals are working in sector Y.

2.4. The open economy

2.4.1. Profit maximization and export patterns in the open economy

We assume that the domestic country trades with an identical foreign country so that we need to define the allocations and equilibrium in one country only [19]. Markets are segmented because of a variable trade cost τ which includes freight and insurance costs

19. Assuming that the trading partner is identical allows us to consider only one set of skill thresholds, $s_{lf}, s_{lm}, s_{hf}, s_{hm}$, which are common to each country. Country differences, for example in the skill distribution or in the technology, would give rise to different thresholds and equilibrium conditions that vary across countries.

along with tariffs. As a result, a firm may charge different prices on the domestic and foreign market. Besides, a firm incurs a fixed export cost F^t to start exporting as in Melitz (2003). F^t covers fixed market access costs such as setting up new distribution channels, shipping requirements as well as ensuring that the firm's goods conforms to foreign standards and regulatory environment. The fixed cost generates a selection of firms into exporting as established by the empirical literature. Regardless of the export decision, a firm always incurs the investment cost F_j . Because this overhead production cost is already incurred, a firm would not export and not produce for its own domestic market. Indeed domestic sales yield always strictly higher operating profits compared to sales to foreign markets because of the additional fixed and variable costs.

The demand for a variety i of the differentiated good comes now from both domestic and foreign consumers who are assumed to have the same preferences:

$$x_i = p_i^{-\sigma} E P_X^{\sigma-1}$$
$$x_i^t = (p_i^t)^{-\sigma} E P_X^{\sigma-1} \tag{2.11}$$

where p_i is the price of variety i on the domestic market and p_i^t is the price of variety i when it is traded to a foreign market. E is the share of the income spent on goods X. The price index is now :

$$P_X = (\sum_i p_i^{1-\sigma} + \sum_k p_k^{t1-\sigma})^{\frac{1}{1-\sigma}}$$

where p_k^t is the price of variety k traded by a foreign firm and sold on the domestic market. Firms are subjected to per-unit iceberg trade cost τ. To address the foreign demand, a firm needs to produce $q^t = \tau x_i^t$ as a share τ of the production is required for transportation.

Firms maximize their profits with respect to either price or quantity :

$$\pi_j = \max_{p_j}\{p_j q_j + I^t.(p_j^t \frac{q_j^t}{\tau}) - \tilde{c}_j(q_j + F_j + I^t.(q_j^t + F^t))\}$$

where I^t equals 1 if the firm exports and $q_j^t = \tau(p_i^t)^{-\sigma} E P_X^{\sigma-1}$. As marginal costs are constant, we can separate the profits they earn on each market. The pricing rule in the domestic market implies, exactly as in the autarky case, that the marginal cost of production equates the marginal revenue.

$$p_j \frac{\sigma - 1}{\sigma} = \tilde{c}_j \tag{2.12}$$

Firms that export will set higher prices in the foreign markets that reflect the increased marginal cost due to the transportation cost τ that is completely supported by the consumer (the standard mill pricing strategy):

$$p_j^t \frac{\sigma - 1}{\sigma} = \tau \tilde{c}_j \Leftrightarrow p_j^t = \tau p_j$$

The marginal cost of production is still given by $\frac{w_{jg}(s)}{\tilde{\varphi}_{jg}(s)}$ so that the sorting of workers across firms stated in proposition 1 continues to hold, h-firms employ the workers with the highest skill level.

To know what are the firms that export, we need to compare the profits made when exporting with the profits made when selling only in the domestic market. Profits of a firm j are:

$$\pi_j = \begin{cases} \tilde{c_j}^{1-\sigma} \frac{\sigma^{-\sigma}}{(\sigma-1)^{1-\sigma}} E P_X^{\sigma-1} - \tilde{c_j} F_j & \text{if firm } j \text{ serves only the domestic market} \\ \tilde{c_j}^{1-\sigma} \frac{\sigma^{-\sigma}}{(\sigma-1)^{1-\sigma}} E P_X^{\sigma-1}(1+\tau^{1-\sigma}) - \tilde{c_j}(F_j + F^t) & \text{if firm } j \text{ serves both markets} \end{cases}$$

Three cases arise :

i if $F^t \tau^{\sigma-1} \geq F_h$, no firm export

ii if $F_l \leq F^t \tau^{\sigma-1} \leq F_h$, h firms only export

iii if $F^t \tau^{\sigma-1} \leq F_l$, both l and h firms export

We can see directly that if there is no fixed export cost, $F^t = 0$, all firms that continue to be active are able to export and no level of variable cost $\tau > 1$ can generate the selection of the most productive firms into exporting. As the differences between exporters and non exporters -within sectors- are empirically pervasive, it is accepted that models with CES demand should assume a combination of fixed and variable trade costs to generate a sorting of firms according to their productivity.

From now on, we focus on the case 2 where only the high-technology firms are able to export. The free entry conditions determine which workers are employed by exporters. For

h firms, the zero-profit conditions implies :

$$\tilde{c}_h = (\sigma(F_h + F^t))^{\frac{-1}{\sigma}} (\frac{\sigma}{\sigma - 1})^{\frac{1-\sigma}{\sigma}} EP_X^{\sigma-1}(1 + \tau^{1-\sigma})^{\frac{1}{\sigma}}$$

We denote $\tilde{c}_j^a$ the marginal cost of j firms under autarky. The expected cost per efficiency unit of labour that firms h can pay $\tilde{c}_h$ is larger under trade, $\tilde{c}_h > \tilde{c}_h^a$. This stems from the increase in market size that benefits exporting firms.

The zero profit condition for l-firms is :

$$\tilde{c}_l = (\sigma F_l)^{\frac{-1}{\sigma}} (\frac{\sigma}{\sigma - 1})^{\frac{1-\sigma}{\sigma}} (EP_X^{\sigma-1})^{\frac{1}{\sigma}}$$

2.4.2. The wage distribution in the open economy

Trade openness has an impact on the skill-thresholds that define which type of men and women are hired by high-tech firms. As before, we relate the two zero-profit conditions for h and l firms to find the new skill-threshold s_{hg}:

$$\frac{\tilde{c}_h}{\tilde{c}_l} = \left(\frac{(F_h + F^t)}{F_l(1 + \tau^{1-\sigma})} \right)^{\frac{1}{\sigma}}$$

From the above equation, we can see that the difference in marginal costs between the two types of firms is smaller under trade than under autarky, $1 > \frac{\tilde{c}_h}{\tilde{c}_l} > \frac{\tilde{c}_h^a}{\tilde{c}_l^a}$. Using the indifference conditions for the marginal workers of each group whose skill levels define the skill-threshold, $w_{lg}(s_{hg}) = w_{hg}(s_{hg}) \Leftrightarrow \frac{c_h^t}{c_l^t} = \frac{\tilde{\varphi}_{lg}(s_{hg})}{\tilde{\varphi}_{hg}(s_{hg})}$, we have :

Proposition 4. *When only h firms export,*

i) the skill threshold to enter a firm h is lower under trade compared to the autarky case for both groups, $s_{hg} < s_{hg}^a \quad$ *for* $g = \{l, h\}$*. More workers are matched with a high technology firm under trade.*

ii) the skill threshold to enter a firm h is still higher for women, $s_{hm} < s_{hf}$

iii) trade liberalization further reduces the skill requirement for both groups, $\frac{\partial(\tilde{c}_h/\tilde{c}_l)}{\partial\tau} > 0 \Rightarrow \frac{\partial s_{hg}}{\partial\tau} > 0 \quad \forall g$

Although the expression for $\tilde{c}_l$ does not change, its value changes with openness. The decrease in the skill threshold s_{hg} to enter h firms raises wages for the most skill workers; this in turn raises total income which corresponds to a higher demand for the non-trade good. This effect will be explicit when the general equilibrium effect is highlighted. Sector Y thus demands more labour. Consequently, we have a higher skill threshold to enter the manufacturing industry under trade $s_l > s_l^a$ and the marginal production cost of a low technology firm goes down $\tilde{c}_l < \tilde{c}_l^a$. Trade openness brings an increase in productivity in the manufacturing sector along with a higher demand for local services for instance, as a result some workers move from the manufacturing sector to the non-traded sectors; this is in line with general employment patterns.

Proposition 5. *When only h firms export,*

i) the skill threshold to enter a firm l is higher under trade than under autarky for both groups, $s_{lg}^t > s_{lg}^a$

ii) the skill threshold to enter a firm l remains higher for women under trade, $s_{lm}^t < s_{lf}^t$

iii) trade liberalization further increases the skill threshold above which workers are employed in the traded sector, $\frac{\partial(\tilde{c}_l/c_Y)}{\partial\tau} > 0 \Rightarrow \frac{\partial s_{lg}}{\partial\tau} > 0 \quad \forall g$

This is consistent with two stylized facts. First, the share of manufacturing employment in female employment is lower than the share of manufacturing employment in male employment. Second, trade openness does not reverse this pattern.

The wage function has the same form than under autarky but the values of the skill thresholds s_{lg} and s_{hg} as well as the cost thresholds $\tilde{c}_l$ and $\tilde{c}_h$ have changed:

$$w_g(s) = \begin{cases} c_Y\varphi_Y = 1 & \text{if } s \leq s_{lg} \\ \tilde{c}_l\tilde{\varphi}_{lg}(s) & \text{if } s_{lg} \leq s \leq s_{hg} \\ \tilde{c}_h\tilde{\varphi}_{hg}(s) & \text{if } s_{hg} \leq s \end{cases} \tag{2.13}$$

To measure how these changes affect the gender wage gap along the skill distribution, we compare the gap under autarky with the gap under openness. The gender wage gap $\frac{w_m(s)}{w_f(s)}$ is now given by :

$$WG(s) = \begin{cases} 1 & \text{if } s \leq s_{lm} \\ \tilde{c}_l\frac{\tilde{\varphi}_{lm}(s)}{\varphi_Y} & \text{if } s_{lm} \leq s \leq s_{lf} \\ \frac{\tilde{\varphi}_{lm}(s)}{\tilde{\varphi}_{lf}(s)} & \text{if } s_{lf} \leq s \leq s_{hm} \\ \frac{\tilde{c}_h}{\tilde{c}_l}\frac{\tilde{\varphi}_{hm}(s)}{\tilde{\varphi}_{lf}(s)} & \text{if } s_{hm} \leq s \leq s_{hf} \\ \frac{\tilde{\varphi}_{hm}(s)}{\tilde{\varphi}_{hf}(s)} & \text{if } s_{hf} \leq s \end{cases}$$

Comparing the gender wage gap in autarky and in the open economy for different skill segments, we can state the following proposition that is made explicit in appendix C.

Proposition 6. *Following trade integration,*

i) the gender wage gap is reduced at the bottom of the skill distribution as $s_{lm} > s^a_{lm}$

ii) the gender wage gap widens at the top of the distribution given that $s_{hm} < s^a_{hm}$ *and the wage profile is steeper under technology h*

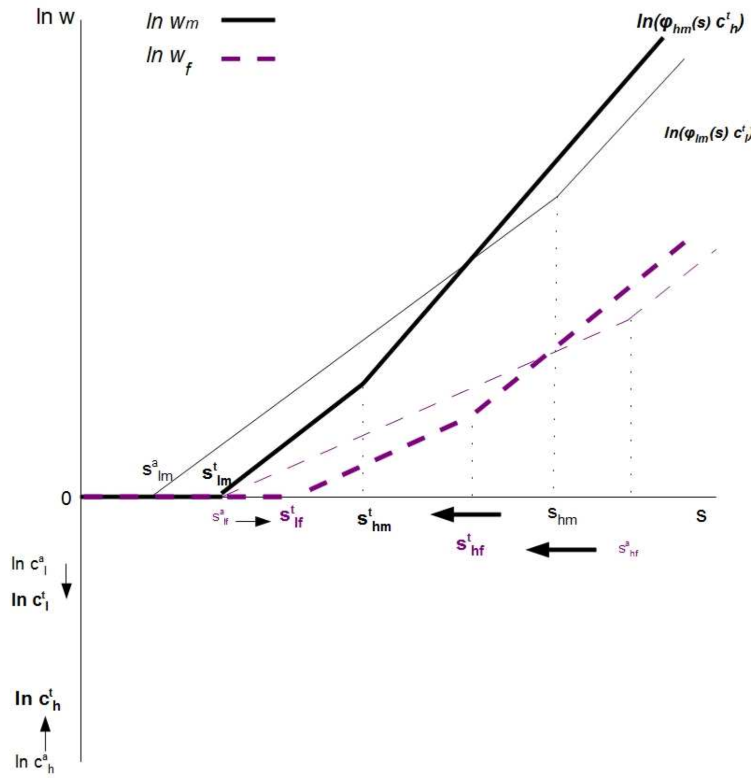


Figure 2.2: Changes in the gender wage gap with trade openness

Why do we observe those changes in the gender wage gap with international trade? Following trade integration, there is a reallocation of workers towards high-technology firms.

Workers moving to h firms increase their productivity and earn higher wages compared to autarky. This has different effects on the gender wage gap at the top and at the bottom of the wage distribution. The increase in domestic income induces a rise in the demand of good Y (preferences are homothetic). The non-traded good sector expands and employs more workers. This movement induces a reduction in the gender wage gap up to the new male skill-threshold s_{lm}, i.e. in the segment $[s^a_{lm}; s_{lm}]$. The reallocation of workers toward h firms generates an increase in the gender wage gap from s_{hm} because the point at which men work with the best technology arrives sooner than under autarky. It increases the gender wage gap up to the point s^a_{hf} because the high technology features stronger complementarity with job commitment than the low technology. Among workers with the highest skill level, above the autarky female threshold i.e. in the segment $[s^a_{hf}; \overline{s}]$, the gender wage gap remains unchanged.

2.4.3. Free-entry and market clearing

In the case where only h firms export and using the free entry condition, the number of firms is given by :

$$N_h = \frac{1}{\sigma(F_h + F^t)}\left(\int_{s\in S_{hf}} \tilde{\varphi}_{hf}(s)l(s)ds + \int_{s\in S_{hm}} \tilde{\varphi}_{hm}(s)l(s)ds\right) \tag{2.14}$$

$$N_l = \frac{1}{\sigma F_l}\left(\int_{s\in S_{lf}} \tilde{\varphi}_{lf}(s)l(s)ds + \int_{s\in S_{lm}} \tilde{\varphi}_{lm}(s)l(s)ds\right) \tag{2.15}$$

More workers are hired by h firms under trade as the skill threshold is lower $s_{hg} > s^a_{hg} \quad \forall g$.

Finally, the market clearing condition for good Y determines the new skill threshold s_{lm}. Good Y is not traded. The market clearing condition is still given by $Y = (1-\beta)M$,where M equals total wages in the open economy. Skilled workers' wages have increased following trade liberalization as more firms adopt the high-technology. $M = \sum_g(\int_{s\in S_{Y_g}} l(s)ds + \int_{s\in S_{lg}} w_{lg}(s)l(s)ds + \int_{s\in S_{hg}} w_{hg}(s)l(s)ds)$. Using (2.13) with the new skill thresholds,

$$M = \sum_g\left(\int_0^{s_{lg}} l(s)ds + \tilde{c}_l \int_{s_{lg}}^{s_{hg}} \tilde{\varphi}_{lg}(s)l(s)ds + \tilde{c}_h \int_{s_{hg}}^{\overline{s}} \tilde{\varphi}_{hg}(s)l(s)ds\right)$$

Using equation (2.5) and equalizing demand and production for good Y, we have :

$$\frac{\beta}{1-\beta}\tilde{\varphi}_l(s_{lm})\sum_g\int_0^{s_{lg}} l(s)ds = \sum_g\left(\int_{s_{lg}}^{s_{hg}} \tilde{\varphi}_{lg}(s)l(s)ds + \frac{\tilde{\varphi}_l(s_{hm})}{\tilde{\varphi}_h(s_{hm})}\int_{s_{hg}}^{\bar{s}} \tilde{\varphi}_{hg}(s)l(s)ds\right) \quad (2.16)$$

This equation determines the skill threshold below which individuals are now working in sector Y and closes the model.

What are the effects of trade integration on the number of operating firms? Under the assumption that only h firms are able to export ($F_l \leq F^t\tau^{\sigma-1} \leq F_h$), there is a reallocation of labour towards h firms (s_{hg} falls) but the change in the number of h firms remains ambiguous. The increase in market size with trade integration leads to an increase in total output produced by h type firms. But the increase in the fixed operating costs ($F_h + F_t$ instead of F_h) puts a downward pressure on the number of firms investing in the high-technology. Each h firm must produce more to meet the fixed export cost. From equations (2.14) and (2.14), we cannot tell whether the increase in the quantity produced by each h firm fully compensate the increase in total output produced by h firms. What we can see, however, is that a reduction in trade costs τ increases N_h the number of firms adopting the high-technology and reduces N_l.

2.5. Conclusion

This paper offers a theoretical explanation for varying gender wage gaps along the skill distribution and for the heterogeneous impact of trade openness on the wage gap depending on the position along the skill distribution. We need three supermodularity assumptions on the labour productivity function to give general conditions under which we find the pattern observed in empirical studies. More precisely we show that if skills and job commitment are complements to technological upgrading and if skills and to each other, statistical discrimination based on job commitment expectations generates a higher gender wage gap at the upper part of the distribution. In a closed economy, the model puts forward one reason for the glass ceiling effect as well as the increase in residual wage disparity within gender groups as documented by numerous empirical studies.

The analysis provides insights into the impact of trade openness in a setting with intra-industry trade and monopolistic competition. First, we show that when trade openness induces technological change biased towards observable and unobservable productive characteristics, it increases the wage gap at the top of the skill distribution. Second, general equilibrium effects implies that the gender wage gap is reduced at the lower part of the distribution. As a result the average gender wage gap may increase or decrease following trade integration.

The paper adds to the understanding of the interactions between the overall wage structure of an economy and the gender wage gap, and can be used to interpret more general shocks that affect the demand for observable and unobservable characteristics of workers. It provides a rationale for looking at the contribution of what we call employers' requirement for commitment in shaping gender inequalities. Constructing a empirical measure for "commitment requirement" at the job level would be the first step of an empirical analysis aiming at testing the predictions of the model. The new job classification could then be used to address the issue of the gender wage gaps differently than what has been done in the literature, and to explore whether the effects of trade openness on the gender wage gap depends on both skill and commitment.

An extension of the model would be to develop an asymmetric country case and to investigate whether changes in the wage gaps depends on the characteristics of the trade partner. We could explore the consequences of having different technologies, or different distribution of commitment among men and women, across countries. This extension would be useful in providing policy recommendations

APPENDIX

2.A. Sorting of heterogeneous workers across firms

We can prove by contradiction, that a high-technology firm hires workers with higher skill level compared to the skill level of workers in a low-technology firm.

Consider two workers with skill $s_1 < s_2$. Let us assume that worker 1 is hired by a firm h and worker 2 is hired by a firm l.
Firm h pays worker 1 so that its profit is maximized :

$$\frac{\sigma - 1}{\sigma} p_h = \frac{w_h(s_1)}{\tilde{\varphi}_h(s_1)}$$

Firm l pays worker 2 so that its profit is maximized :

$$\frac{\sigma - 1}{\sigma} p_l = \frac{w_l(s_2)}{\tilde{\varphi}_l(s_2)}$$

Firm l would not increase its profit by hiring worker 1 at a wage just above the one paid by a firm l :

$$\frac{\sigma - 1}{\sigma} p_l \leq \frac{w_h(s_1)}{\tilde{\varphi}_l(s_1)}$$

Firm h would not increase its profit by hiring worker 2 at a wage just above the one paid by a firm h :

$$\frac{\sigma - 1}{\sigma} p_h \leq \frac{w_l(s_2)}{\tilde{\varphi}_h(s_2)}$$

Equations 1 and 3 implies that $\frac{p_l}{p_h} \leq \frac{\tilde{\varphi}_h(s_1)}{\tilde{\varphi}_l(s_1)}$
Equations 2 and 4 implies that $\frac{p_l}{p_h} \geq \frac{\tilde{\varphi}_h(s_2)}{\tilde{\varphi}_l(s_2)}$
Which implies that $\frac{\tilde{\varphi}_h(s_2)}{\tilde{\varphi}_l(s_2)} \leq \frac{\tilde{\varphi}_h(s_1)}{\tilde{\varphi}_l(s_1)}$. But this contradicts the assumption that more skilled workers have a comparative advantage in the high-technology.

2.B. Ranking of of male and female skill requirements

The indifference condition states that :

$$\frac{\tilde{\varphi}_{hf}(s_{hf})}{\tilde{\varphi}_{hm}(s_{hm})} = \frac{\tilde{\varphi}_{lf}(s_{hf})}{\tilde{\varphi}_{lm}(s_{hm})}$$

$$\Leftrightarrow \frac{\eta\varphi_h(s_{hf},\bar{e}) + (1-\eta)\varphi_h(s_h,\underline{e})}{\varphi_h(s_{hm},\bar{e})} = \frac{\eta\varphi_l(s_{hf},\bar{e}) + (1-\eta)\varphi_h(s_h,\underline{e})}{\varphi_l(s_{hm},\bar{e})}$$

That we can rearrange

$$\Leftrightarrow \frac{\eta + (1-\eta)\frac{\varphi_h(s_{hf},\underline{e})}{\varphi_h(s_{hf},\bar{e})}}{\eta + (1-\eta)\frac{\varphi_l(s_{hf},\underline{e})}{\varphi_l(s_{hf},\bar{e})}} = \frac{\varphi_l(s_{hf},\bar{e})}{\varphi_l(s_{hm},\bar{e})}\frac{\varphi_h(s_{hm},\bar{e})}{\varphi_h(s_{hf},\bar{e})}$$

Let us prove by contradiction that $s_{hf} > s_{hm}$.

Suppose that $s_{hf} = s_{hm} = s_h$, the condition is now

$$\frac{\eta + (1-\eta)\frac{\varphi_h(s_h,\underline{e})}{\varphi_h(s_h,\bar{e})}}{\eta + (1-\eta)\frac{\varphi_l(s_h,\underline{e})}{\varphi_l(s_h,\bar{e})}} = \frac{\varphi_l(s_h,\bar{e})}{\varphi_l(s_h,\bar{e})}\frac{\varphi_h(s_h,\bar{e})}{\varphi_h(s_h,\bar{e})} \Leftrightarrow \frac{\varphi_h(s_h,\underline{e})}{\varphi_h(s_h,\bar{e})} = \frac{\varphi_l(s_h,\underline{e})}{\varphi_l(s_h,\bar{e})}$$

Which contradicts the supermodularity assumption between technology and commitment. So that the male and female skill requirements cannot be equal.

Suppose now that $s_{hf} < s_{hm}$. By supermodularity between technology upgrading and skills, we know that :

$$\frac{\eta + (1-\eta)\frac{\varphi_h(s_{hf},\underline{e})}{\varphi_h(s_{hf},\bar{e})}}{\eta + (1-\eta)\frac{\varphi_l(s_{hf},\underline{e})}{\varphi_l(s_{hf},\bar{e})}} < 1$$

By supermodularity between technology upgrading and skills and the fact that labour productivity is increasing in skills, we know that:

$$\frac{\varphi_h(s_{hm},\bar{e})}{\varphi_h(s_{hf},\bar{e})} > \frac{\varphi_l(s_{hm},\bar{e})}{\varphi_l(s_{hf},\bar{e})} > 1$$

Combining the two we have :

$$\frac{\eta + (1-\eta)\frac{\varphi_h(s_{hf},\underline{e})}{\varphi_h(s_{hf},\bar{e})}}{\eta + (1-\eta)\frac{\varphi_l(s_{hf},\underline{e})}{\varphi_l(s_{hf},\bar{e})}}\frac{\varphi_l(s_{hm},\bar{e})}{\varphi_l(s_{hf},\bar{e})} < \frac{\varphi_h(s_{hm},\bar{e})}{\varphi_h(s_{hf},\bar{e})}$$

which contradicts the indifference condition. The female skill requirement to be hired by a high-tech firm cannot be lower than the male skill requirement.

2.C. Proof of proposition 5 on the changes in the gender wage gap with trade openness

How has the gender wage gap changed compared to the autarky case? Changes in the gender wage gap $\frac{WG(s)}{WG^a(s)}$ are non-linear in s.

For $s \in [0; s^a_{lm}]$, there is no wage gap under either trade or autarky.

For $s \in [s^a_{lm}; s_{lm}]$, $\frac{WG(s)}{WG^a(s)} = \frac{1}{\tilde{c}^a_l \tilde{\varphi}_{lm}(s)}$, the wage gap is *lower* under trade as more men are employed in sector Y where there is no wage gap.

For $s \in [s_{lm}; s^a_{lf}]$, $\frac{WG(s)}{WG^a(s)} = \frac{\tilde{c}_l}{\tilde{c}^a_l}$, the wage gap is *lower* under trade as the unit cost of l-firms has decreased.

For $s \in [s^a_{lf}; s_{lf}]$, $\frac{WG(s)}{WG^a(s)} = \tilde{c}_l \tilde{\varphi}_{lf}(s)$, the wage gap is *higher* under trade.

For $s \in [s_{lf}; s_{hm}]$, the wage gap is of the same magnitude under trade and autarky.

For $s \in [s_{hm}; s^a_{hm}]$, $\frac{WG(s)}{WG^a(s)} = \frac{\tilde{c}_h \tilde{\varphi}_{hm}(s)}{\tilde{c}_l \tilde{\varphi}_{lm}}$ which is greater than 1 as sorting implies that $\tilde{c}_h \tilde{\varphi}_{hm}(s) > \tilde{c}_l \tilde{\varphi}_{lm}$ for $s > s_{hm}$. The wage gap is *higher* under trade.

For $s \in [s^a_{hm}; s_{hf}]$, $\frac{WG(s)}{WG^a(s)} = \frac{\tilde{c}_h}{\tilde{c}^a_h} \frac{\tilde{c}_l}{\tilde{c}^a_l}$, the wage gap is *higher* under trade.

For $s \in [s_{hf}; s^a_{hf}]$, $\frac{WG(s)}{WG^a(s)} = \frac{\tilde{\varphi}_{hm}(s)}{\tilde{\varphi}_{lm}}$ which is greater than 1. The wage gap has increased with trade.

For $s \in [s^a_{hf}; \bar{s}]$, $\frac{WG(s)}{WG^a(s)} = 1$

Chapter 3

Gender wage gaps in formal and informal jobs, evidence from Brazil [1]

3.1. Introduction

A striking characteristic of labour markets in developing countries is the existence of a large informal sector where labour regulations, including minimum wages and parental leaves, are inexistent. While labour protection and labour costs are lower in the informal segment of the labour market, informal jobs may offer other features valuable to workers such as flexibility. Those aspects may influence wages differently for men and women. It is thus important to distinguish the formal and the informal segments of the labour market when examining the gender wage gaps in developing countries. Moreover, policy makers may be concerned about the gender wage differences in the two segments separately as it can shed some light on how regulation affects women's prospects in the labour market. The aim of this paper is to investigate how informality shapes labour market outcomes for men and women, and in particular to examine whether there exist positive gender wage gaps in both formal and informal jobs and whether they are significantly different from one another. In doing so, we will raise the following questions: Do men and women sort differently across labour market statuses? How does the selection process affect the gender wage gaps in formal and informal jobs?

1. I am grateful to Stephen Bazen, Cecilia Garcia-Peñalosa, Ioana Marinescu, Dominique Meurs, Alain Trannoy and Federico Trionfetti for helpful comments and suggestions. This paper also benefited from comments received at the internal seminar of the Aix-Marseille School of Economics and at the workshop of the 4th Brixen Summer School.

A vast literature has focused on earnings inequality due to informality in the labour market. Many papers have tried to understand whether the labour market is segmented or whether the existence of two different segments is the result of competitive allocation of workers. However, very few works have looked into gender differences within each segment. This paper investigates this issue and complements the limited empirical evidence on the gender wage gap in the informal labour market. Tansel (2001) estimates the gender pay differential among employees with social security coverage and workers without, in Turkey. She controls for self-selection into multiple work statuses and finds that the adjusted wage gap is substantial among covered (formal) workers but not significant among uncovered (informal) workers. Deininger et al. (2013) look at the gender wage gap in India and find that the share of the gap due to different returns to characteristics is higher among casual workers than among non-casual workers. They control for selection into labour market participation but they do not take into account the selection into multiple employment statuses conditional on being active. We depart from these papers in two ways. First in the definition of informality as we focus on employers' compliance with labour regulation rather than on social security coverage or temporary work. Second in the empirical methodology as we compare two approaches to deal with non-random selection into multiple employment outcomes.

Our empirical analyses uses the Brazilian household survey, the Pesquisa Nacional por Amostra de Domicilios (PNAD), for the year 2009. The PNAD provides information on whether the worker's labour card is signed by the employer so that we are able to adopt a definition of informality based on employers' compliance with labour market regulation. A formal worker is an employee with a registered labour contract, hence entitled to labour rights and benefits, while an informal worker is employed without having a legal contract declared by his/her employer.

This paper raises the question of whether the differences in gender wage gaps across formal and informal jobs are due to labour regulation or to gendered selection into formal vs. informal employment. The endogeneity of work status is a major concern as failing to deal with non-random selection would lead to misleading estimates of gender wage gaps for two reasons. First, self-selection on unobservables would bias the coefficient estimates in the wage equation. Second, if selection is not random the observed wage gap does not reflect the gap in wage offers. It is thus important to recover the differences in wage *offers* to conduct the decomposition on the appropriate total wage difference. In the aim of controlling for self-selection, we first study the sorting of men and women into different employment statuses using a multinomial logit model. Some studies have focused on two alternatives, formal vs. informal. In our setting, it is relevant to describe potential work statuses more broadly as other situations are common alternatives to salaried work, especially for women, such as inactivity, self-employment and unemployment. Since the definition of the set of alternatives can affect the treatment of the selection bias, we choose to consider all the potential outcomes: inactive, unemployed, formal salaried work, informal salaried work, self-employment and employer.

We then investigate how selection into work status affects the estimation of the gender wage gaps. In the literature, the effect of selection on wage estimations is addressed with approaches similar to the well-known Heckman two-stage procedure. The control function consists of estimating a selection equation in a first stage and constructing the correction terms, the control function, to be used as a regressor in the main wage regression. The literature has proposed different methods for addressing selection into multinomial potential outcomes. We use the strategies of Lee (1983) and Dubin and McFadden (1984) where the selection model is specified as a multinomial logit model and we compare the results obtained under the different assumptions that those methods imply (see Bourguignon et al. (2007) for a discussion of the two approaches). Wage equations are estimated for formal salaried workers and informal salaried workers separately in order to compute the gender wage gap separately for formal workers and informal workers. We use a version of the Oaxaca-Blinder-Ransom decomposition that proposes a satisfactory solution to the choice of the non-discriminatory wage structure (Fortin, 2008).

Looking at the raw data, we find that women are more often unemployed than men and that the informality rate is higher among working women compared to working men. We also find that the size of the raw wage gap differs across groups of education, the formal and the informal gaps being significantly different only for certain education groups. This pattern is in line with recent evidence on the heterogeneity of informal labour markets (Gunther and Launov, 2012) and points to different labour market selection processes across formal and informal sectors. We show that men and women differ in the magnitude and direction of their selectivity bias in formal and informal jobs. Controlling for selection into work status affects the estimation of the gender wage gap, especially in the informal segment of the labour market where the gap is no longer significant. The gender wage gap remains significantly positive only among formal employees. Because labour market decisions and the gender wage gaps differ across the schooling distribution, we conduct the analysis for three different education groups.

This paper contributes to the small literature on labour market outcomes for men and women when a large share of employment is informal. This analysis is most closely related to the papers that study the gender wage gap among informal workers and formal workers separately. Tansel (2001) defines informality as the absence of social security protection and estimates the gender wage gaps among covered and uncovered wage earners in Turkey. In the wage equation, she controls for endogenous selection into multiple outcomes using the strategy developed by Lee (1983). The potential outcomes are divided into five categories: non-participation, private sector covered wage work, uncovered wage work, self-employment and other employment. She finds that, in 1994, the adjusted wage gap is strong and positive among covered workers but not significant among uncovered workers. Deininger et al. (2013) look at the gender wage gap in India in formal vs. informal jobs where informal work is defined as casual work in either agricultural or non-agricultural sectors. They control for selection into labour market participation using the Heckman's (1979) methodology. They find that the gender wage gap due to different returns to characteristics is particularly important for casual workers working in the agriculture; however, gender discrimination is much lower or inexistent in non-agricultural sectors. A few studies focus on the difference in the formal wage premium for men and women. Arabsheibani et al. (2003) study the evolution of wages for men and women in Brazil over the period 1988-1998. Their results seem to indicate that informality is more penalizing for men than for women, in other words that the formal wage premium is greater for men, however they do not test for the significance of the formal premium difference. Pagán and Ullibarri (2000) find that women tend to work more in unregistered (informal) firms In Mexico. Accordingly to the findings of Arabsheibani et al. (2003) for Brazil, they show that the informal wage penalty is lower for women than for men.

This paper is also related to the vast literature on the segmentation of the labour market and the formal wage premium. Maloney (1999) questions the dualistic view of the labour market and points out that the mobility of workers between the formal and the informal segments of the labour market suggests that the market is not segmented along this line. Carneiro and Henley (2002) explore how expected earnings differ in the informal and formal sectors controlling for selection of workers. Their selection correction approach consists in estimating the probability of being either a formal or an informal worker which has a significant impact on the estimation of earnings for both formal and informal workers. They find that some workers are actually better off choosing the informal segment of the labour market. Gunther and Launov (2012) also highlight the heterogeneous composition of the informal sector in Côte d'Ivoire. They do not reject the hypothesis that the labour market is dual as some workers are involuntarily employed without contract, even if some workers seem to choose informal jobs over formal employment.

Magnac (1991) tests the hypothesis of segmented labour markets against the hypothesis of competitive markets in the urban areas of Colombia. He uses a sample of married women as he argues they represent the group that faces higher labour market entry costs because of domestic and familial responsibilities. He cannot reject the hypothesis of competitive labour markets for married women and concludes that unobserved characteristics, abilities or preferences are the drivers of the choice between formal and informal jobs.

Pradhan and Van Soest (1995) study sector participation for both men and women in urban areas of Bolivia. They control for selection into formal jobs, informal jobs or non-participation and compare two selection models that make different assumptions on the underlying choice structure. In the ordered probit model, all workers want to enter the formal sector; informal jobs are a second best option. This model corresponds to a dualistic view of the labour market (Fields, 1975) where the formal sector offers better jobs that are rationed. The second approach uses an unordered model, the multinomial logit model and the selection term is constructed according to Lee's (1983) formulas that makes no assumptions about the ordering of sector preferences. They find that the ordered model describes best men outcomes. Male predicted wages are higher in the formal sector. For women, however, the opposite holds. According to the multinomial logit model, average expected earnings are higher in the informal sector for all females; according to the ordered probit, the predicted wage offers are higher in the formal sector for only 9 percent of women, those with a high level of education. They conclude that women's sector choice cannot be explained by restrictions to entry in the formal sector only. Women may choose to enter the informal sector to maximise their earnings. Voluntary employment in the informal sector can be explained by comparative advantage in informal jobs for workers who would not earn better wages in the formal sector. In addition to the articles mention above, this conclusion can also be found in Gindling (1991), Rosenzweig (1988), and Maloney (2004).

The present paper also contributes to the literature on gender wage gaps and selection into employment. Arabsheibani et al. (2003) study the gender wage differentials in Brazil over the period 1988-1998. They find that the gender wage gap, especially the part due to different returns of identical characteristics, has fallen over the period but remains positive. Madalozzo (2010) confirms the fall in the wage gap until the end of the 90s and finds no further decrease in the 2000s. Santos and Ribeiro (2006) find evidence of a glass ceiling in Brazil. These three papers study the gender wage gap in Brazil but they do not distinguish between formal and informal employees, nor do they investigate the impact of different selection biases between men and women on the gender wage gap.

A vast literature, starting in the late 1970s, have studied the effect of the selection bias on the gender wage gap, mostly focusing on the United States. Among recent papers, Blau and Kahn (2006) show that the decline in the gender wage gap during the 1980s was overstated as it is largely explained by sample selection. They also show that selection has also contributed to the slower reduction in the gender wage gap during the 1990s. Looking at European countries and the United States, Olivetti and Petrongolo (2008) point out that non-random selection explains why gender employment gaps are negatively correlated with gender wage gaps across countries. Women are on average positively selected into employment. Countries with particularly high gender employment gaps, such as southern Europe, are characterised by a strong female selection bias which in turn reduces the observed gender wage gap. This small observed gender wage gap is actually an artefact of the selection process: women who are employed have better abilities than non-employed women which overestimates female wage offers. Appleton et al. (1999) investigate how selection biases the gender wage gap in three African countries. She highlights that the observed wage gap is narrower than the gap in wage offers in Ethiopia and Uganda but not in the Côte d'Ivoire where female observed wages underestimate female wage offers. These studies find that correction for selection has important consequences for the assessment of gender wage gaps. We do not know any paper that has assessed the effect of the selectivity bias on gender wage gap estimations in labour markets where the co-existence of formal and informal jobs modifies the selection process.

The present paper is also linked to the empirical research on the heterogeneity of the wage gaps across groups with different skill levels. Albrecht et al. (2003) show that the gender wage gap is increasing along the wage distribution in Sweden. de la Rica et al. (2008) find that in Spain the gender wage gap is high and increases with wage (glass-ceiling effect) among highly educated workers while it is lower and decreases with wage among less educated workers (floor effect). The innovation of this paper is to explore how the wage gap differs by education groups for informal wage-earners and formal wage-earners separately.

The remainder of the paper is organized as follow. We start by discussing the impact of informality on gender employment and wage inequality while reviewing the related literature. In section 3 we describe the data and provide descriptive statistics on gender inequalities in the Brazilian labour market. Section 4 sets up the empirical model. In section 5 we discuss the results, looking at the selection into potential outcomes for men and women before moving onto the comparison of the gender wage gaps in the formal and informal sectors. The last section concludes.

3.2. Gender and Informality

Why would the gender wage gap differ across the formal and the informal segments of the labour market? As far as we know, the existing theoretical explanations have focused on the understanding of the formal wage premium, but they have not provided any explanation for gender differences in formal wage premium nor have they explained gender wage differences *within* each sector. Put differently, there are no theoretical models that explain why the formal gender wage gap may or may not differ from the informal gender wage gap. We use the existing literature to postulate hypotheses about the mechanisms behind the gender gaps *within* each segment and why those gaps may differ.

According to the dualistic view of the labour market, the informal segment is characterized by lower wages. Empirical evidence, looking at salaried workers and not at self-employed, confirms that formal jobs offer on average higher wages than informal jobs (see Magnac (1991) who analyses female wages in Colombia, Gasparini and Tornarolli (2009) who focus on different Latin American countries and Almeida and Carneiro (2007) who find that the formal raw formal wage premium is positive in Brazil and decreases with regulation enforcement). Comparisons of raw average wage gaps are informative about the accepted wage offers but conceal heterogeneity in workers' observable and unobservable attributes. Empirical papers show that the formal-informal wage difference differs depending on workers' skill levels. Studying the urban labour market in Mexico, Gong and Van Soest (2002) find a significant wage premium in formal jobs for educated men but not for men with low-education who earn more on average in informal jobs. For women, the differences between formal and informal wages is small. It is thus informative to first look at gender wage differences for different education groups. It is also important to compute wage gaps adjusted for all characteristics in order to compare individuals with similar observable productivity within the two segments.

What would explain different gender wage gaps in formal and informal jobs once we have controlled for observable characteristics? From the labour supply side, if individuals have different preferences for the type of jobs, the theory of compensating wage differentials can give an explanation for formal-informal wage differences within groups and it can also help understand the gender wage gaps in formal jobs and in informal jobs. Formal jobs offer non-monetary benefits that are not available in informal jobs such as job severance contribution, maternity leave, unemployment benefits, social security. In a frictionless market, workers with identical productivity should earn a higher wage in the informal segment to compensate for the absence of non monetary benefits. If women value job protection more than men, for maternity reasons in particular, then women should be ready to accept lower wages compared to men in the formal sector but not in the informal sector. This would lead to a gender wage gap among formal employees only. However, if women value the flexibility of informal jobs more than men, we should also observe a gender wage gap among informal employees as well. As there are reasons to value the amenities of both sectors, workers' preferences over formal or informal employment will hinge on the balance of the advantages and disadvantages of both statuses depending on workers' characteristics. Gender differences in preferences are not a priori clear cut, which impedes us from drawing theoretical predictions on the overall effect of preferences on gender wage gaps in both sectors.

From the labour demand side, job offers stem from both registered and unregistered firms. Firms operating informally will not offer legal contracts to their employees. Firms operating formally might decide to hire workers formally or informally. Why would employers set different wages to a man and a woman with similar observable characteristics and employed under the same type of contract? Employers compare the costs and benefits of labour contract registration for both men and women and set their hiring decisions and wage setting rule accordingly. Employers may expect a higher quit rate among women because of, for example, permanent or temporary leave due to maternity. Lazear and Rosen (1990) provide a theoretical explanation where stronger domestic responsibilities generate higher female quit rates and lower female wages due to statistical discrimination. Bertrand et al. (2010) show that among high-skill employees small differences in labour market attachment in terms of working hours or short leave lead to enormous pay penalties for women. A higher quit rate generates higher costs because of vacancy and replacement costs; it can also generate forgone profits if no one can replace the employee on leave or if the time out of the job causes a loss of (general or specific) skills. Employers may want to compensate for the higher female quit rate by paying them lower wages. This argument applies especially to formal jobs where employers abide by the labour regulation such as the protection of the job during maternity leave.

The higher risk of quit among women is also expected to have stronger repercussions in high-skill jobs that require specific skills or training, and to be less important in jobs that entail routine tasks only. de la Rica et al. (2008) analyses the gender wage gap in Spain using quantile techniques; they show that among highly educated workers, the wage gap increases along the wage distribution which is in line with the *glass ceiling* story. For these reasons, we would expect higher gender wage gaps among formal employees, especially for workers with high level of education. However, de la Rica et al. (2008) also show evidence of a *sticky floor*: among less educated worker, the wage gap is stronger for those at the bottom of the wage distribution. They explain this results by the much lower labour attachment of low-skilled women. Accordingly, the wage gap is expected to be significant among informal employees with low level of education, earning low wages.

The question of whether the gender wage gap is higher in the formal or the informal segment of the labour market has no straightforward answer and requires empirical investigations. Moreover, the empirical investigation need to account for the endogenous sorting of men and women into the different statuses as it can influence the wage equation estimates.

3.3. The Econometric model

To compare the gender wage gaps among formal and informal employees, we investigate how selection shapes the gender wage gaps in these two different segments of the labour market. We first compute the raw wage gaps and the wage gap adjusted for observable characteristics in both segments. Comparing the raw and the adjusted wage gaps enables us to say something about the role of observables characteristics on gender wage inequality. Next, we compute the wage gaps controlling for both observable characteristics and the selection into the different labour statuses.

3.3.1. The raw and the adjusted wage gaps

The raw wage gap in sector j is estimated from an equation where $\ln w_{ij}$ the hourly log wage is regressed on a constant and a female dummy only:

$$\ln w_{ij} = \beta_0 + \alpha_j F_{i(j)} + u_{ij} \tag{3.1}$$

where $F_{i(j)} = 1$ if employee i working in j is a woman. The raw wage gap is: $E(\ln w|female) - E(\ln w|male) = \widehat{\alpha}_j$.

Different methods are used in the literature to compute the adjusted wage gap. One method is to estimate a mincerian wage equation on a pooled sample with a female dummy to capture the gender wage gap. The problem with this method is twofold. First, it might suffer from misspecification if the differences in returns to specific characteristics matter for the estimation of the wage gap. Second, we cannot estimate the selection rule for men and women separately using one wage equation on a pooled sample.

Instead, we use a version of the wage gap decomposition developed by Oaxaca (1973) and Blinder (1973) that avoids important methodological problems discussed in Oaxaca and Ransom (1994) and Oaxaca and Ransom (1999). The decomposition methodology that follows has been presented in Fortin (2008) and is not sensitive to the choice of the reference wage structure. The reference wage structure is taken from the estimation of a common wage regression on the pooled sample of both men and women where the male advantage equals the female disadvantage with respect to the reference. We estimate three equations, two separate wage equations for men and women and a pooled wage equation with gender dummies and an identification restriction. Each equation is estimated separately for the formal and the informal segments denoted with the subscript $j = 2, 3$.

$$\ln w_{ipj} = \beta_{0pj} + \alpha_{pfj} F_i + \alpha_{pmj} M_i + \mathbf{X_i} \beta_{\mathbf{pj}} + u_{ij} \qquad \text{with } \alpha_{pfj} = -\alpha_{pmj} \tag{3.2a}$$

$$\ln w_{ifj} = \beta_{0fj} + \mathbf{X_i} \beta_{\mathbf{fj}} + u_{ifj} \tag{3.2b}$$

$$\ln w_{imj} = \beta_{0mj} + \mathbf{X_i} \beta_{\mathbf{mj}} + u_{imj} \tag{3.2c}$$

where X is a set of control variables that includes the number of years of education, the age and the age squared, the tenure and the tenure squared, whether the person is black, whether the person lives in an urban area, dummies for regions and sectors. To capture demand side effects, we use the regional unemployment rate that characterizes the state of the local labour market. We construct the regional unemployment for different education groups in order to identify the impact of lower labour demand even when controlling for regional dummies. The assumption is that labour markets are skill-specific, at least to some extent. Even if workers may accept a job for which they are overqualified, the unemployment rate among people of the same (generally defined) skill level will impact their decision to participate, their job finding rate and their wages.

The zero conditional mean assumption $E(u_m|x_m) = E(u_f|x_f) = 0$ ensures that the the error is uncorrelated with the regressors so that the OLS estimates are unbiased. The zero conditional mean assumption also ensures that the total average wage gap can be exactly decomposed into terms based on observables and their returns. For the wage decomposition to be exact though, only a weaker ignorability assumption is sufficient; what is needed is that the distribution of u given X is the same for the two groups. In other terms, the decomposition allows for selection on unobservables as long as they are the same for both men and women and yields identical selection biases. See Fortin et al. (2011) for a discussion of the assumptions required for identification in wage decompositions. Under the ignorability assumption, the total wage gap in each segment can be decomposed into three terms:

$$\overline{\ln W}_{mj} - \overline{\ln W}_{fj} = (\mathbf{\overline{X}'_m} - \mathbf{\overline{X}'_f})\widehat{\beta_{\mathbf{pj}}} + \mathbf{\overline{X}'_m}(\widehat{\beta_{\mathbf{mj}}} - \widehat{\beta_{\mathbf{pj}}}) + \mathbf{\overline{X}'_f}(\widehat{\beta_{\mathbf{pj}}} - \widehat{\beta_{\mathbf{fj}}})$$

The first term accounts for gender differences in characteristics, it is the endowment term. The last two term account for gender differences in the prices associated with given characteristics, it is also called the coefficient term and is here decomposed into the male advantage with respect to the reference prices and the female disadvantage with respect to the reference prices. The adjusted wage gap is the sum of the male advantage and the female disadvantage in the treatment of the characteristics :

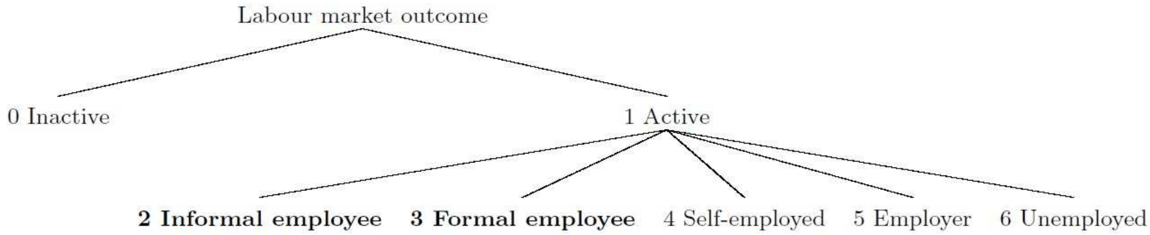
$$\overline{WG}_j = \overline{\mathbf{X}}'_{\mathbf{m}}(\widehat{\beta}_{\mathbf{mj}} - \widehat{\beta_{\mathbf{pj}}}) + \overline{\mathbf{X}}'_{\mathbf{f}}(\widehat{\beta_{\mathbf{pj}}} - \widehat{\beta_{\mathbf{fj}}}) \tag{3.3}$$

The adjusted wage gap takes into account the observable differences in characteristics between men and women, however it does not account for the selection of men and women into formal or informal jobs because of unobserved characteristics.

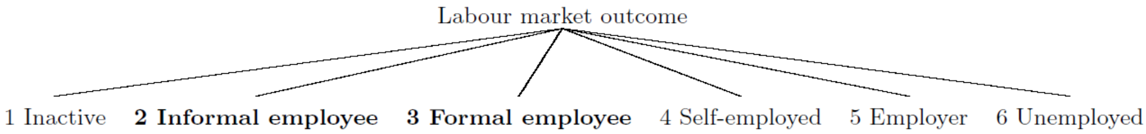
This can be problematic given that the conditional independence assumption is strong and that even the ignorability assumption may not hold in our case. Women have a much lower labour market participation rate than men and the selection of men and women into different types of jobs is certainly not random. What is more, selection into employment may follow different processes for men and women. The descriptive statistics (see below) show that the female unemployment rate is higher than the male unemployment rate and that the informality rate is higher among active women compared to active men (see table 3.3). If $E(u|X) \neq 0$ in equation (3.2), the coefficients of the wage equation are biased. If the ignorability assumption does not hold, men employed in a given type of job are different in observables and in unobservables from women who are employed in the same type of job. In that case, the selection biases differ for men and women and the estimations of the wage gaps are thus biased too. To eliminate the selection biases we adopt a control function approach that is presented in the next sub-section.

3.3.2. Treatment for selection into multiple employment statuses

Selection into formal salaried work vs. informal salaried work can be analysed using binary models but these models ignore potentially important differences among salaried workers and people in other situations such as inactivity, unemployment and self-employment. In this paper, we use a multinomial model to estimate the probability to be in formal employment and in informal employment taking into account that several relevant alter-



(a) Sequential decisions



(b) Simultaneous decisions

Figure 3.1: Work status

natives exist. In this setting, individuals have to choose between being inactive or entering the labour market where there are multiple potential outcomes. Individuals have different probabilities to be in a given work status depending on their preferences as well as on demand constraints and employers behaviours that may cause job rationing and segregation.

Different models of the individuals' (constrained or unconstrained) choices can be imagined. One possibility is to model a two-step sequential decision process where first the individuals decide to enter the labour market or not. In a second step, active individuals are selected into various employment categories or into unemployment.

Another alternative is to consider a one-step process where selection into inactivity, unemployment or the various employment categories happens simultaneously. In that case, the model has six mutually-exclusive outcomes denoted j: inactivity ($Y_i = 1$), informal employment ($Y_i = 2$), formal employment ($Y_i = 3$), self-employment ($Y_i = 4$), employer ($Y_i = 5$) and unemployment ($Y_i = 6$).

In the sequential process, individuals make the decision to participate or not to the labour market before knowing in which situation they will be in case of participation; they have a preference for being inactive vs. being active whatever the final situation. In our analysis, the first stage choice is simultaneous with the second stage chances of being in a given work status. We do not have determinants that may drive the first step choice and not the second step choice. In other words, the preference for being active is determined by the preferences over the different work statuses. For this reason, we prefer the simultaneous decision model.

Let us denote V_{ij} the latent value (or utility) associated with being in state j. State j is observed $Y_i = j$ if the value associated with this state is higher than the value of the other states, or in other words, if status j is the best available option for individual i.

$$Y_i = j \text{ if } V_{ij} > \max_{k \neq j}(V_{ik})$$

We assume that the utility associated with work status j follows a linear function: $V_{ij} = \mathbf{Z_i}\alpha_\mathbf{j} + \mu_{ij}, \qquad j = 1, ..., 6$. If we further assume that the errors are independent and identically distributed following a type I extreme value distribution, the probability of being in status j for individual i is defined by the multinomial logit model (McFadden, 1973):

$$P_{ij} = Pr(Y_i = j) = \frac{exp(Z_i\alpha_j)}{\sum_j^N exp(Z_i\alpha_j)} \tag{3.4}$$

The full model of selection and wage determination can be written as follows

$$\ln w_{ij} = \mathbf{X_{ij}}\lambda_\mathbf{j} + u_{ij}, \text{ if } V_{ij} > \max_{k \neq j}(V_{ik}) \text{ for } j = 2, 3$$

$$V_{ij} = \mathbf{Z_i}\alpha_\mathbf{j} + \mu_{ij}, \qquad j = 1, ..., 6$$

where individual i earns a wage w_{ij} if she is a formal worker $j = 2$ or an informal worker $j = 3$ and j is the observed outcome if the value associated with state j is the highest. A selection bias arises if the unobserved characteristics that influence wages u_{ij} are correlated with the unobserved determinants of the selection process μ_{ij}, if $E(u|x,)$.

The vector $\mathbf{X}$ includes the wage determinants, namely: years of education, age and age squared, tenure and tenure squared, whether the person is black, whether the person lives in an urban area, a macroeconomic demand side variable to capture rationing: regional unemployment rate by education group, regional and sector dummies. In the selection equation, the vector $\mathbf{Z}$ is composed of elements of $\mathbf{X}$ as potential earnings influence the choice of work status. We do not include tenure and sectoral dummies in $\mathbf{Z}$ as those characteristics are unknown before being employed. The vector **Z** additionally includes variables that are not in **X**. These excluded variables are important for addressing the selection bias and must meet two conditions. They should be orthogonal to the errors of the second-stage equation and also relevant to sectoral-choice determination in the outcome equation. We discuss the set of excluded variables in detail below.

To control for selection in the wage equation, we introduce a correction term that we denote $h(P_1, ..., P_6)$ where P_j denotes the probability to be in state j. The control function $h(.)$ is equal to the conditional mean of the residuals $E(u_j|X, Y = j)$. The methods available to compute $h(.)$ differ by their assumptions on the covariances between the error term of the wage equation and the error terms of the outcome equations.

Lee's (1983) approach assumes that the joint distribution of u_j and a transformation of μ_j does not depend on the other μ_k for $k \neq j$. Under this assumption and a additional linearity assumption the expected value of u_j, conditional on category j being observed is:

$$E(u_j|X, Y = j) = \sigma\rho_j \left(-\frac{\phi(\Phi^{-1}(P_j))}{P_j} \right)$$

where σ is the standard deviation of the wage errors and ρ is the correlation coefficient between the errors of the outcome equation and the errors of the wage equation. The control function is $h = -\frac{\phi(\Phi^{-1}(P_j))}{P_j}$ and $\sigma\rho_j$ are estimated by least squares. Only one correlation parameter ρ_j is estimated per wage equation under this method. Note that when $\sigma\rho_j$ is negative, workers are positively selected into work status j as $\sigma\rho_j \left(-\frac{\phi(\Phi^{-1}(P_j))}{P_j} \right)$ is strictly positive.

The distributional assumption might be too restrictive as the selection bias potentially originates in the correlation of u_j not only with μ_j but also with μ_k for $k \neq j$. Thus we also follow Dubin and McFadden (1984) who make less restrictive assumptions on the correlation between u_j and the $(\mu_k - \mu_j)$. The linearity assumption on the conditional mean of the wage equation residuals (Dubin and McFadden, 1984) is as follows:

$$E(u_j|X, Y = j) = \sigma \frac{\sqrt{6}}{\pi} \sum_k \rho_{jk}(\mu_k - E(\mu_k))$$

where j is the final outcome and $k = 1, ...6$ all the potential outcomes. ρ_{jk} is the correlation coefficient between u_j and μ_k and Dubin and McFadden (1984) make the restriction that the correlation coefficients sum up to zero $\sum_k \rho_{jk} = 0$. Given the multinomial logit formulas we have:

$$E(\mu_j - E(\mu_j)|V_j > \max_{s\neq j}(V_s), Z) = -\ln(P_j)$$

$$E(\mu_k - E(\mu_k)|V_j > \max_{s\neq j}(V_s), Z) = \frac{P_k \ln(P_k)}{1 - P_k}, \text{ for } k \neq j$$

The following wage equations corrected for selection are then estimated by least squares:

$$\ln w_{ipj} = \lambda_{pfj} F_i + \lambda_{pmj} M_i + \mathbf{X_i} \gamma_{\mathbf{p}} \mathbf{j} + \theta_{\mathbf{pj}} \mathbf{h_{pj}}(\mathbf{P_1}, ..., \mathbf{P_6}) + u_{ij} \text{ with } \lambda_{pfj} = -\lambda_{pmj} \quad (3.5a)$$

$$\log w_{ifj} = \mathbf{X_{ij}} \gamma_{\mathbf{fj}} + \theta_{\mathbf{fj}} \mathbf{h_{fj}}(\mathbf{P_1}, ..., \mathbf{P_6}) + \epsilon_{ifj} \quad (3.5b)$$

$$\log w_{imj} = \mathbf{X_{ij}} \gamma_{\mathbf{mj}} + \theta_{\mathbf{mj}} \mathbf{h_{mj}}(\mathbf{P_1}, ..., \mathbf{P_6}) + \epsilon_{imj} \quad (3.5c)$$

where $\theta_{\mathbf{j}} \mathbf{h_j}(\mathbf{P_1}, ..., \mathbf{P_6}) = E(u_j|X, Y = j)$ and depends on the model assumptions. The estimation of equations (3.5) allows us to recover ρ_j the correlation between u_j and μ_j when Lee's model is adopted and the correlation between u_j and all the μ_k for $k = \{1...j...6\}$ if the Durbin-Mac Fadden's approach is used.

We present the total decomposition with an additional term that captures the difference in average selection bias:

$$\begin{aligned}\overline{\ln W}_{mj} - \overline{\ln W}_{fj} = (\overline{\mathbf{X}}'_{\mathbf{m}} - \overline{\mathbf{X}}'_{\mathbf{f}})\widehat{\gamma_{\mathbf{pj}}} + \overline{\mathbf{X}}'_{\mathbf{m}}(\widehat{\lambda}_{\mathbf{mj}} - \widehat{\gamma_{\mathbf{pj}}}) + \overline{\mathbf{X}}'_{\mathbf{f}}(\widehat{\gamma_{\mathbf{pj}}} - \widehat{\gamma_{\mathbf{fj}}}) \\ + \ \theta_{\mathbf{mj}} \mathbf{h_{mj}}(\mathbf{P_1}, ..., \mathbf{P_6}) - \theta_{\mathbf{fj}} \mathbf{h_{fj}}(\mathbf{P_1}, ..., \mathbf{P_6})\end{aligned}$$

The last term capturing the selection effect has been treated in different ways in the literature on wage gap decomposition. Neuman and Oaxaca (2004) present different variations of the decomposition when selection is controlled for and show how the selection term can be included in the endowment term and/or in the coefficient term. We follow Yun (2007) who advocates treating selection as a separate term in the decomposition. In that way, the selection term provides a measure of the difference between the observed wage gap and the gap in wage offers [2].

The wage gap due to different returns to observable characteristics in sector j is:

$$\overline{WG}_{Sj} = \overline{\mathbf{X}}'_{\mathbf{m}}(\widehat{\gamma_{\mathbf{mj}}} - \widehat{\gamma_{\mathbf{pj}}}) + \overline{\mathbf{X}}'_{\mathbf{f}}(\widehat{\gamma_{\mathbf{pj}}} - \widehat{\gamma_{\mathbf{fj}}}) \tag{3.6}$$

The adjusted wage gap in equation (3.6) differs from the one in (3.3). First, the coefficients are now unbiased following the treatment for selection. Second, instead of explaining part of the total observed wage gap, the difference in returns now explains the gap in wage offers $\overline{\ln W}_{mj} - \overline{\ln W}_{fj} - (\theta_{mj} h_{mj}(P_1, ..., P_6) - \theta_{fj} h_{fj}(P_1, ..., P_6))$.

Equations (3.5) are also estimated for various education groups separately to explore how the selection rules and the gender wage gaps (3.6) differ across groups.

3.3.3. Identification

To identify the effect of selection and purge the wage estimates from the selection bias without relying on the difference in the functional forms, we need variables that determines the potential work status but do not affect directly wages. The validity of this method hinges on the exclusion restrictions. Given the data available, the excluded variables for this an analysis are various demographic characteristics: the presence of children, the presence of children under 14 years old, the marital status, a dummy for lone mothers and the number of family members holding formal jobs.

While it may be argued that children can affect the productivity of women on the job and thus may not be an appropriate excluded variable, the number of family members holding formal jobs has a priori no direct effect on wages. Moreover, it determines women and men sectoral-choices for two reasons. The first argument is based on the need of secure source of earnings and social security coverage. A family member can provide a relatively stable flow of income and access to social securityif he/she holds a formal job. The security brought by job protection and social security coverage of the household member makes labour participation less necessary and formal employment less valuable for the other family members. In other words, a person will have a lower probability to target his/her job search specifically towards formal jobs if another family member is already

2. This approach has been adopted by Reimers (1983) for the analysis of the ethnic wage gap in the U.S., by Wright and Ermisch (1991), Ogloblin (1999), Appleton et al. (1999) among others for gender wage gap decomposition, and by Ermisch and Wright (1993) for the estimation of wage offers in part-time and full-time jobs among women

in formal employment. Conversly, having no family members in formal employment can make people searching more intensively for formal jobs, especially if they are risk-averse. The second reason why the presence of a formal salaried worker in the family impacts the probability to be in formal vs. informal employment is the network effect. Arguably, an individual with family members who are working can receive more information about job opennings, how and where to search for jobs and/or might be recommended for a job. This networking effect, however, should play a role at a more extended level than the family level.

Our empirical approach will hence consist of computing the formal (informal) gender wage gaps adjusted for observable characteristics in a first step and in a second step controlling additionally for endogenous selection into formal (informal) employment. The latter step implies to estimate the probability to be in each outcome which we will do using a multinomial logit. This empirical strategy will be applied to the whole sample and to different education groups to capture potential heterogeneity in the selection patterns and wage gaps along the skill distribution.

3.4. Empirical results

3.4.1. The data

Individual information is taken from the 2009 Brazilian household survey, the Pesquisa Nacional por Amostras de Domicilio (PNAD), that covers both rural and urban areas. The PNAD provides information about the individuals of roughly 100,000 households. In 2009, around 252,000 working-age people (18-65) were interviewed, among whom 52% were women and 85% lived in urban areas. Sample weights ensure the representativeness of the survey. The different employment categories are the following: employees (wage-earners of the public and private sectors) which include domestic workers employed by private households; self-employed; employer; unpaid and family workers The survey provides direct and reliable information that enables us to classify employees into formal and informal wage-earners. Individuals are asked if their labour card is signed by their employer; if it is not, they are not registered and are not entitled to any labour rights or benefits. The labour card is used in the private sector; workers in the public sector have other types of contracts and are considered as formal employees in this study. In this paper, we focus on gender differences among informal *wage-earners* only, including domestic workers but excluding self-employed, employers, unpaid and family workers.

Table 3.1 gives the demographic, household and educational characteristics of men and women holding formal and informal jobs. Informal employees are on average younger than formal employees. Men and women working formally are of the same age on average but in the shadow sector women are slightly older than men. Women who hold informal jobs are more often the head of the household and live less often in couples compared to women in formal jobs. A larger share of women have young children in the informal sector as 45% of women women working informally have children under 14 years of age against 40% for women in the formal sector.

The PNAD provides information on the composition of the household. A household can be made of several families, e.g. two families sharing a dwelling or one family hiring a domestic employee with or without his/her family. Women tend to live in households/families with a higher share of formal wage-earners; this differential can be explained by the higher male participation rate and lower male informality rate compared to the corresponding female rates, a difference that is discussed below. Both men and women in formal employment are better educated than those in informal employment and women are more educated than men in both segments of the labour market. Full-time work is less common among women and among informal workers. There are no major differences across gender or sector in the distribution of age at first job nor in the average tenure, which is somewhat surprising as we could have expected higher turnover and lower tenure in informal jobs.

Table 3.2 describes in more detail the educational attainment for different employment statuses. It reveals that the female distribution of school attainment dominates the male distribution. There are fewer low-educated women and more high-educated women participating to the labour market. The same applies for unemployed and shadow workers. The table also shows that the informal population is diverse. 37% of women, against 47% of men, have primary education or less, at the same time, 10% of unregistered women and 8% of unregistered men have tertiary education. This is consistent with a sorting of men and women where sex is a signal for labour market attachment or quit probability and a higher education level compensate for a higher average quit rate among women (see Lazear and Rosen (1990) for a theoretical model and de la Rica et al. (2008) for an empirical analysis where they explain the distribution of the wage gap in Spain with a similar rational.).

Table 3.1: Descriptive statistics by sex, 2009

	Formal				Informal			
	(1) Men		(2) Women		(3) Men		(4) Women	
Demographics								
Age (mean)	38.15	(12.04)	38.06	(11.66)	33.98	(12.17)	35.31	(11.64)
Head of household	0.64	(0.48)	0.27	(0.45)	0.51	(0.50)	0.30	(0.46)
Living in couple	0.81	(0.39)	0.70	(0.46)	0.76	(0.43)	0.62	(0.48)
Children under 14	0.40	(0.49)	0.40	(0.49)	0.40	(0.49)	0.45	(0.50)
Household composition								
Number of people	3.8	(1.6)	3.7	(1.6)	4.1	(1.9)	4	(1.9)
Family members	3.5	(1.3)	3.3	(1.3)	3.8	(1.7)	3.5	(1.5)
among the working-age household members								
Share of the household members with a formal job[a]	0.29	(0.40)	0.40	(0.44)	0.15	(0.30)	0.32	(0.41)
Share of the family members with a formal job[a]	0.29	(0.39)	0.41	(0.42)	0.15	(0.30)	0.33	(0.42)
Mother lives in the household	0.30	(0.46)	0.32	(0.46)	0.40	(0.49)	0.29	(0.45)
Education								
Illiterate	0.07	(0.26)	0.05	(0.22)	0.12	(0.33)	0.07	(0.25)
Years of schooling (mean)	8.16	(4.34)	9.30	(4.35)	6.73	(4.36)	7.93	(4.21)
Job related variables								
Hourly Wage	7.99	(19.27)	6.46	(18.26)	4.13	(14.85)	3.60	(5.70)
Hours of Work	43.5	(11.7)	36.2	(14)	42.7	(12.5)	35	(15.3)
Full time	0.88	(0.34)	0.66	(0.48)	0.84	(0.40)	0.59	(0.50)
Several jobs	0.05	(0.22)	0.05	(0.22)	0.05	(0.22)	0.05	(0.21)
Union membership	0.22	(0.41)	0.21	(0.41)	0.07	(0.25)	0.04	(0.20)
Public sector	0.12	(0.33)	0.21	(0.41)	.	.	.	.
Civil servant	0.07	(0.25)	0.13	(0.34)	.	.	.	.
Age at first job								
Under 10	0.13	(0.34)	0.10	(0.30)	0.13	(0.34)	0.09	(0.29)
10-14	0.39	(0.49)	0.31	(0.46)	0.42	(0.49)	0.34	(0.47)
15-17	0.26	(0.44)	0.26	(0.44)	0.26	(0.44)	0.27	(0.44)
17-19	0.14	(0.35)	0.18	(0.39)	0.12	(0.33)	0.15	(0.36)
20-24	0.06	(0.24)	0.12	(0.32)	0.05	(0.22)	0.10	(0.30)
25-29	0.01	(0.09)	0.02	(0.16)	0.01	(0.09)	0.02	(0.15)
More than 30	0.00	(0.03)	0.02	(0.12)	0.00	(0.04)	0.02	(0.14)
Tenure (mean number of years)	2.80	(3.00)	2.82	(3.06)	2.77	(2.90)	2.96	(3.03)
Night work	0.02	(0.14)	0.01	(0.08)	0.02	(0.13)	0.01	(0.08)
N	81027		59015		17060		16549	

Source: Author's calculation based on the PNAD 2009, IBGE, Brazil. Standard deviations in parentheses. The columns give the shares among male formal wage-earners (1), female formal wage-earners (2), male informal wage-earners (3) and female informal wage-earners (4). [a] The share of working-age household/family members holding formal jobs excludes the respondent.

Table 3.3 highlights differences across gender and educational level in participation rates, unemployment rates and informality rates in 2009. The participation rate is lower for women and the participation gap decreases with education. The average participation is rate is 66% for women and 89% for men. Among people with primary education or less, only 53% of women decide to participate in the labour market while 85% of men do so, which corresponds to a gap of 31 precentage points. The participation rate increases with education and more rapidely for women. Among people with tertiary education, the participation is gap is of 10 percentage points.

Table 3.2: Share of educated people among active, unemployed and informal workers

	All		Active		Unemployed		Informal workers	
	Men	Women	Men	Women	Men	Women	Men	Women
Primary or less	35	32	33	26	23	19	47	37
Secondary	50	49	51	51	63	65	45	53
Tertiary	15	19	16	23	14	16	8	10
	100	100	100	100	100	100	100	100

Source: Author's calculation based on the PNAD 2009, IBGE, Brazil.

Table 3.3: Descriptive statistics by education and sex groups, 2009

Level of education	Participation rate		Unemployment rate		Informality rate among working individuals	
	Men	Women	Men	Women	Men	Women
Total	89	66	6	11	19	25
Primary or less	85	53	4	8	23	30
Secondary	91	68	7	13	15	22
Tertiary	90	80	5	7	8	9

Source: Author's calculation based on the PNAD 2009, IBGE, Brazil.

The female unemployment rate is higher in all education-groups, the difference is larger for people with medium level of education. For workers with primary education, the unemployment gap is around 4 percentage points. For active people with secondary education, the unemployment rate is higher, especially for women at 13%, leading to a higher gender gap of 6 percentage points. The unemployment gap is lower among workers with tertiary education.

The informality rate measures the share of wage-earners without a labour contract; it is higher for women than for men, the difference being larger for people with secondary education or less. The informality rate decreases with education. Among female wage-earners, 30% of women with preimary education or less are employed without a contract, 22% among women with secondary education and 9% of women with tertiary education have no contract. The gender gaps in informality rates decreases with education as well, it is of 7 percentage points among workers with secondary education or less. It is lower of only 1 percentage point among workers with tertiray education.

Table 3.4: Employment shares and informality rate by sex and sectorss

	Employment share			Informality rate		
Sector	Overall	Men	Women	Overall	Men	Women
Agriculture	22	24	18	20	27	8
Industry	14	16	12	16	16	15
Construction Mining	7	12	1	29	28	57
Services	57	48	69	24	18	30

Source: Author's calculation based on the PNAD, 2009, IBGE, Brazil.

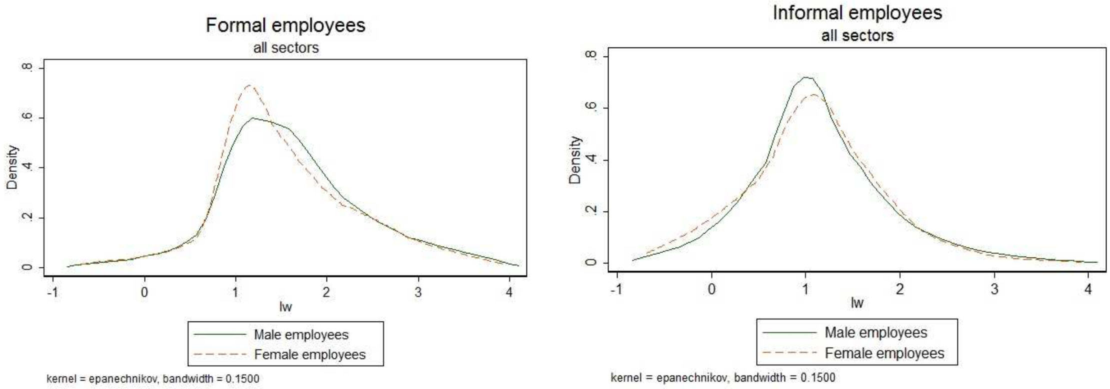
We now turn to the distribution of formal and informal jobs across sectors. We can see in table 3.4 that 69% of female employees work in the service sector where the informality rate for women is 30%. Only 48% of male employees work in this sector and have a lower informality rate, 18%. The highest informality rate is in the construction and mining activities. Only 1% of working women are employed in the construction sector but 57% of them hold informal jobs. The manufacturing industry employs 14% of the labour force and the informality rates for men and women are similar, 16% and 15% respectively. However, in argiculture, which employs 22% of the labour force, the female informality rate is lower than the male informality rate by almost 20 percentage points.

3.4.2. Wage distributions across genders

To complete the preliminary description of the gender differences in the formal and the informal segments of the labour market, we compute raw wage differences. Table 3.1 shows that average raw hourly wages are higher in formal jobs and that in both formal and informal jobs men earn on average more than women. Figure 3.2 displays the wage distributions for men and women in both the formal and informal sectors.

Among formal workers, the female wage distribution is shifted farther to the left compared to the male wage distribution which indicates that the raw difference between male and female wages is positive especially in the middle of the wage distribution. This is true

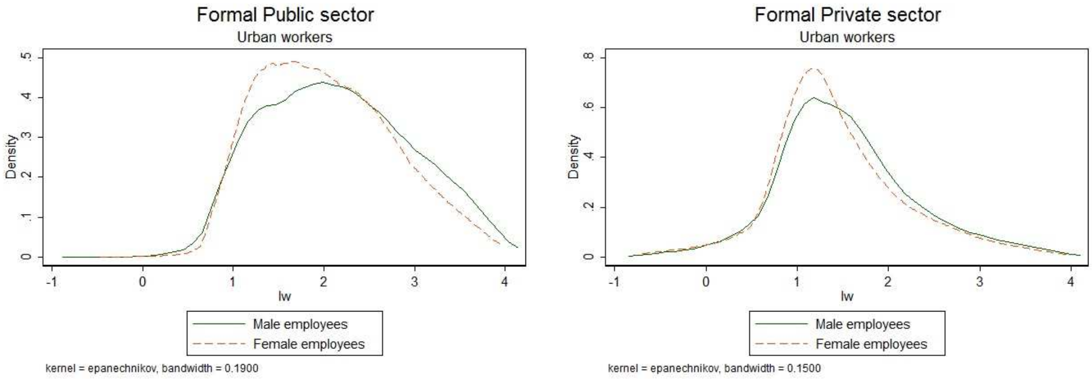
Figure 3.2: Wage Distributions by sex



Source: PNAD, 2009, IBGE, Brazil.

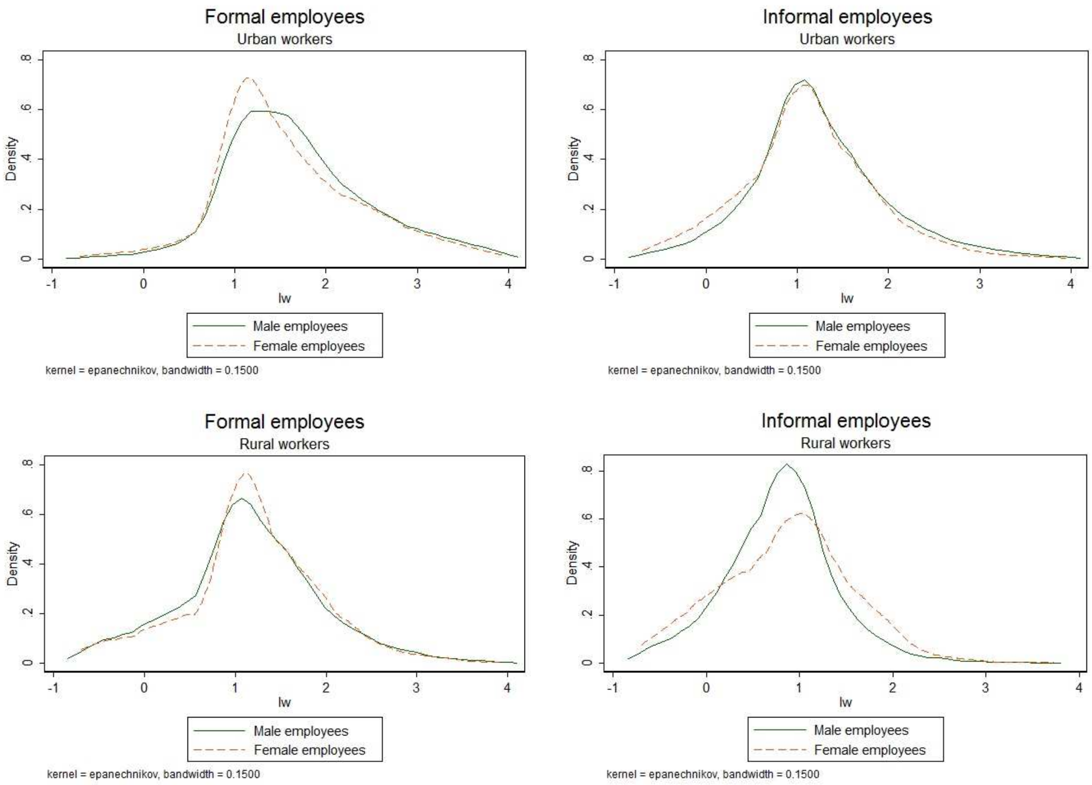
for both private and public formal wage-earners as shown in figure 3.3. On the other hand, in the informal sector, the male and female wage distributions almost overlap except at the bottom where the lower tail of the female distribution is fatter. This description is valid for wage-earners working in the service sector and in the manufacturing industries. However in agriculture the two wage distributions almost overlap in the formal sector except for a fatter lower tail of the female distribution, while in the informal sector the female wage distribution is to the left of the male wage distribution. This pattern holds for urban workers but not for rural workers as figure 3.4 shows. In rural areas, the female wage distribution dominates the male distribution in the formal sector. However, in the informal sector, the female distribution has larger tails both at the bottom and at the top of the wage distribution. For this reason, we separate rural and urban workers in the following analysis of gender wage gaps in informal and in informal jobs.

Figure 3.3: Wage Distributions by sex, public and private formal wage-earners, urban areas



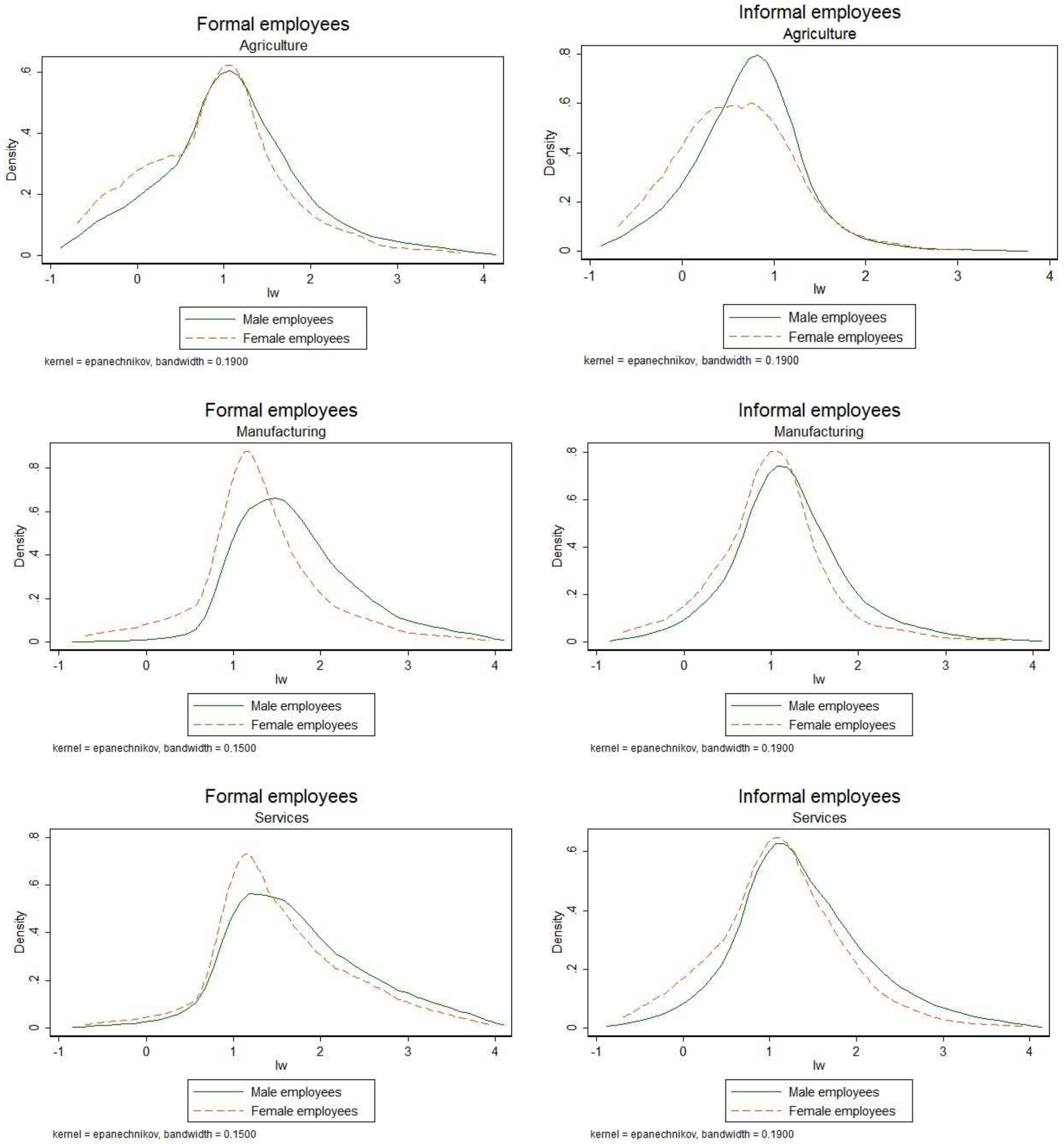
Source: PNAD, 2009, IBGE, Brazil.

Figure 3.4: Wage Distributions by sex,urban and rural wage-earners



Source: PNAD, 2009, IBGE, Brazil.

Figure 3.5: Wage Distributions by sex and sector



Source: PNAD, 2009, IBGE, Brazil.

3.4.3. Selection into multiple potential employment statuses

Table 3.5: Labour market status, marginal effects for men and women separately. Urban workers

Women	Inactive	Informal employee	Formal employee	Self-employed	Employer	Unemployed
Age	0.005***	-0.003***	-0.001***	0.002***	0.001***	-0.003***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Years of education	-0.021***	-0.012***	0.033***	0.000	0.003***	-0.004***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Having Children	0.009*	-0.000	-0.007	-0.004	-0.002*	0.004
	(0.004)	(0.003)	(0.003)	(0.002)	(0.001)	(0.003)
... under 14	0.010**	-0.008**	-0.013***	0.020***	0.003**	-0.012***
	(0.004)	(0.003)	(0.004)	(0.003)	(0.001)	(0.002)
Living in couple	0.066***	-0.043***	-0.040***	-0.002	0.007***	0.012***
	(0.004)	(0.003)	(0.003)	(0.002)	(0.001)	(0.002)
Lone mother	-0.086***	0.037***	0.031***	-0.004	0.000	0.022***
	(0.006)	(0.005)	(0.006)	(0.004)	(0.002)	(0.005)
Formal workers	0.023***	-0.003	-0.005*	-0.018***	-0.007***	0.010***
in the household	(0.003)	(0.002)	(0.002)	(0.002)	(0.001)	(0.001)
Unemployment rate	0.127	0.218***	-0.976***	0.289*	-0.020	0.368***
(regional, education specific)	(0.104)	(0.058)	(0.066)	(0.114)	(0.022)	(0.048)
Men	Inactive	Informal employee	Formal employee	Self-employed	Employer	Unemployed
Age	0.002***	-0.004***	-0.002***	0.005***	0.002***	-0.002***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Years of education	-0.007***	-0.011***	0.024***	-0.006***	0.006***	-0.003***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Having children	0.035***	0.001	-0.047***	-0.008*	-0.005**	0.028***
	(0.002)	(0.003)	(0.004)	(0.003)	(0.002)	(0.002)
... under 14	-0.097***	0.000	0.090***	0.026***	0.015***	-0.034***
	(0.002)	(0.003)	(0.004)	(0.003)	(0.002)	(0.002)
Living in couples	-0.034***	-0.015***	0.055***	-0.012**	0.017***	-0.010***
	(0.003)	(0.003)	(0.004)	(0.004)	(0.002)	(0.002)
Formal workers	0.014***	0.004**	0.007**	0.009**	-0.022***	0.005***
in the household	(0.001)	(0.001)	(0.002)	(0.003)	(0.002)	(0.001)
Unemployment rate	-0.482***	-0.040	0.418***	-0.287***	-0.156***	0.196***
(region, education specific)	(0.056)	(0.060)	(0.081)	(0.066)	(0.035)	(0.043)

Notes: Marginal effects, standard errors in parenthesis. The marginal effects of each explanatory variables on the probability to be in the six different outcomes are computed based on the multinomial logit estimation.

We start our empirical analysis by estimating the multinomial logit equation (3.4) to understand the impact of supply side and demand side variables on the probability of being in each outcome. We estimate the multinomial logit model for men and women separately. The marginal effects are reported in table 3.5 for urban workers and in table 3.10 in the appendix for rural workers. The tables provide an estimate of the effect of a marginal change in each variable, for an individual with average characteristics in the male sample and in the female sample. The relative risk ratios of the multinomial logit estimation are provided in the appendix.

Education and age determine men's and women's outcomes in the same direction though the magnitudes of the effects differ. The number of years of education reduces the probability of being out of the labour force much more for women; it also reduces the probability to be informally employed while increasing the chances to be formally employed, the latter effect being stronger for women again. The probability of formal and informal salaried work decreases with age for both men and women, as does the probability of being unemployed.

Other variables such as the family structure have opposite effects on men and women. The presence of young children and living in couples reduce the probability of inactivity for men while it increases it for women. A woman with young children has a lower probability to be formally or informally employed and will choose self-employment more often. This does not hold for lone mothers who have a greater probability to be working in a salaried job. Contrary to women living in couples, men with young children have a lower probability to be inactive or self-employed but a higher probability to hold a formal job. Those results are consistent with the traditional division of roles within the household.

We find that higher regional unemployment rates increase non-participation for women although the marginal effect is not significant. Regional unemployment rate reduces the probability to find a formal job and increases the probability to hold an informal job for women. The opposite holds for men. Higher unemployment rates increase labour participation. There is no discouragement effect in the Brazilian urban labour market. In addition, higher unemployment rates increase the probability that men hold formal jobs while it reduces their probability to be self-employed or employers. This may reveal an insurance effect: as it becomes tougher to find a job, men tend to search more intensively for formal jobs that are more secured and provide unemployment benefits in case of lay off.

3.4.4. Wages

Tables 3.6 and 3.7 present the estimates of the female wage equations and the male wage equations in urban areas.

Table 3.6: Hourly wages in the informal and formal sectors. Women in urban areas

	OLS		Selection			
	Informal	Formal	Informal		Formal	
Control function			Lee	DMF	Lee	DMF
Years of education	0.046**	0.083**	0.036**	0.018	0.137**	0.237**
	(0.002)	(0.002)	(0.002)	(0.023)	(0.009)	(0.016)
Age	0.037**	0.033**	0.036**	0.024**	0.035**	0.011
	(0.002)	(0.003)	(0.003)	(0.005)	(0.002)	(0.006)
Age^2	-0.000**	-0.000**	-0.000**	-0.000**	-0.000**	-0.000
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Tenure in years	-0.022**	0.004	-0.022**	-0.022**	0.005	0.003**
	(0.004)	(0.003)	(0.003)	(0.001)	(0.004)	(0.000)
Tenure^2	0.002**	-0.001**	0.002**	0.002**	-0.001**	-0.001**
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Black	-0.041**	-0.092**	-0.039**	-0.038**	-0.090**	-0.086**
	(0.012)	(0.008)	(0.009)	(0.001)	(0.004)	(0.004)
Unemployment rate	-4.095**	-6.805**	-3.694**	-1.939**	-6.466**	-3.578**
(region, education specific)	(0.466)	(0.755)	(0.309)	(0.504)	(0.095)	(0.226)
Constant	-0.080	0.482**	-0.288**	0.659	-0.760**	-2.106**
	(0.077)	(0.079)	(0.092)	(0.529)	(0.267)	(0.036)
Sector dummies	yes	yes	yes	yes	yes	yes
Region dummies	yes	yes	yes	yes	yes	yes
σ^2			0.478**	1.811	0.857**	12.931*
			(0.059)	(1.000)	(0.253)	(5.389)
ρ_1				0.454**		0.001
				(0.060)		(0.010)
ρ_2			-0.288**			-1.141**
			(0.032)			(0.046)
ρ_3				0.183	-0.702**	
				(0.503)	(0.019)	
ρ_4				0.274		0.401**
				(0.289)		(0.067)
ρ_5				-1.799**		-0.572**
				(0.195)		(0.176)
ρ_6				0.821**		0.983**
				(0.147)		(0.035)
R^2	0.28	0.52				
N	14,511	32,133	14,511	14,511	32,133	32,133

Notes: * $p < 0.05$; ** $p < 0.01$ Standard errors in parenthesis. Clustered s.e. in OLS regressions.
Bootstrap estimates of the s.e. when controlling for selection to account for the two-step procedure.

Table 3.7: Hourly wages in the informal and formal sectors. Men in urban areas

	OLS		Selection			
	Informal	Formal	Informal		Formal	
Control function			Lee	DMF	Lee	DMF
Years of education	0.058**	0.086**	0.041**	0.044*	0.080**	0.116**
	(0.002)	(0.002)	(0.004)	(0.017)	(0.000)	(0.007)
Age	0.052**	0.053**	0.048**	0.037**	0.050**	0.046**
	(0.003)	(0.003)	(0.001)	(0.000)	(0.000)	(0.001)
Age^2	-0.001**	-0.000**	-0.001**	-0.001**	-0.000**	-0.000**
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Tenure in years	-0.004	0.004	-0.004**	-0.003	0.004**	0.002**
	(0.005)	(0.003)	(0.000)	(0.009)	(0.001)	(0.001)
Tenure^2	0.000	-0.001*	0.000	0.000	-0.001**	-0.000*
	(0.001)	(0.000)	(0.000)	(0.001)	(0.000)	(0.000)
Black	-0.106**	-0.087**	-0.105**	-0.104**	-0.087**	-0.085**
	(0.013)	(0.008)	(0.008)	(0.003)	(0.007)	(0.007)
Unemployment rate	-4.122**	-6.491**	-4.047**	-1.867*	-6.603**	-5.355**
(region, education specific)	(0.322)	(0.392)	(0.274)	(0.904)	(0.031)	(0.097)
Constant	-0.079	0.107	-0.345**	0.878**	0.323**	-0.720**
	(0.064)	(0.064)	(0.020)	(0.067)	(0.018)	(0.066)
Sector dummies	yes	yes	yes	yes	yes	yes
Region dummies	yes	yes	yes	yes	yes	yes
σ^2			0.852	3.673**	0.266**	9.481**
			(0.460)	(0.153)	(0.001)	(1.891)
ρ_1				-0.172**		0.001
				(0.005)		(0.018)
ρ_2			-0.396**			-1.032**
			(0.014)			(0.024)
ρ_3				0.517**	0.270**	
				(0.178)	(0.011)	
ρ_4				0.378*		0.519**
				(0.189)		(0.093)
ρ_5				-1.469**		-0.677**
				(0.073)		(0.064)
ρ_6				0.742**		0.977**
R^2	0.34	0.48				
N	12,594	41,679	12,594	12,594	41,679	41,679

Notes: * $p < 0.05$; ** $p < 0.01$ Standard errors in parenthesis. Clustered s.e. in OLS regressions. Bootstrap estimates of the s.e. when controlling for selection to account for the two-step procedure.

We can see in tables 3.6 and 3.7 that the return to education is stronger in the formal sector for both men and women, this pattern is robust to the introduction of the selction control function. Age has also a significant positive impact on wages, the effect is of the same magnitude in both segments but it is stronger for men than for women. We do not see here evidence of a concave effect of age on wages.

Tenure in current firm increases male wages in formal jobs but not in informal jobs. As for women, the effect is not significant in formal jobs while it has a negative effect in informal jobs. As we control for age, this result does not mean that actual wages are declining for women. Negative returns to tenure in informal jobs means that women that keep on working informally for the same employer have lower wages compared to women who have changed job more recently. The negative returns of tenure with the same employer may be due to low female job mobility along with monopsony power of employers. Kambourov and Manovskii (2009) and Sullivan (2009) argue that specific skills are occupation rather than firm specific. They find that tenure with the same employer has zero or negative effects on wages when tenure in occupation and in the industry are controlled for. Schmiedern (2007) also finds negative returns to tenure with the employer for women in Germany.

The regional unemployment rate affects negatively wages; this effect is also robust to selection treatment. It has a stronger negative impact on female wages. For both women and men, unemployment reduces more the formal employees' wages; this result indicates that the formal segment of the labour market is competitive.

In columns (3) to (6) of tables 3.6 and 3.7, the control function is included as an additional regressor. The selection bias is significant in both the formal and the informal sectors, for both men and women. Tables 3.6 and 3.7 report the correlations between the errors of the wage equation and the errors of the selection equation when all education groups are pooled together. The correlation coefficient gives us the direction of the average selection rules for men and for women. Note that when Lee's approach is adopted, a negative $\sigma_j \rho_j$ implies a positive selection bias as $\sigma_j \rho_j \left(-\frac{\phi(\Phi^{-1}(P_j))}{P_j} \right)$ is strictly positive. Men are positively selected in informal employment and negatively selected in formal employment according to Lee's method. For given values of observable characteristics, men holding informal jobs have unobserved characteristics that are most valued in this sector. Consequently, observed wages overestimate male wage offers in informal jobs. On the other hand, men are negatively selected into the formal sector. Those with the highest wage potentials in formal jobs do not self-select into those jobs and choose other work statuses. Negative selection occurs when the reservation wage is increasing with the wage offer. This selection pattern remains the same when we estimate the selection term for different education groups. As for women, they are positively selected in both informal and formal jobs. The average selection rule hides heterogeneity across education groups. The positive selectivity bias in formal jobs holds for women with secondary education or less but not for women with tertiary education who are negatively selected in formal jobs as men are. Highly educated women working in the formal sector are those with lower wage potential compared to highly educated women in other work statuses.

Results for rural workers are shown in the appendix in tables 3.18 and 3.19. The return to education are smaller than in urban areas and tenure has no significant impact on formal wages. For women, tenure is negatively associated with wages in the informal segment as we observe in urban areas. The unemployment rate has a much lower downward effect for women and is not significant for men.

3.4.5. The gender wage gap in informal and formal jobs

Table 3.8 displays the estimated gender wage gaps among urban salaried workers, for the whole population as well as for different groups of education. Table 3.20 in the appendix shows the results for rural workers.

The total raw wage gaps are positive and significant in both formal and informal jobs. The average raw gap is significantly higher among informal employees when it is estimated on the whole population. However, this conceals different composition of the male and female labour force. When we estimate the gaps for different education groups, we see that the gap in informal jobs is higher than the gap in formal jobs only for the most educated employees but not significantly so. The small sample size for workers with tertiary education might be responsible of the lower precision in the estimates. For workers with primary education or no education, the wage gap is stronger among employees with a legal contract which is at odds with the intuition that labour market regulation, in particular minimum wages, should reduce the scope for wage gaps at the bottom of the wage distribution. Another striking pattern is the increase in the wage gap with the education level which can be interpreted as a form of “glass ceiling” in both the formal and the informal segments. The raw wage gaps does not account for the labour force heterogeneity. As men and women might have different characteristics in both types of jobs, a more detailed analysis is needed. Does the gender pay gap differ systematically between the formal and informal sectors once we control for the workforce characteristics? Does it depend on the education group the workers belong to?

Controlling for observable characteristics such as the exact number of years of education, age, tenure, sector of activity and location, increases the wage gap in both formal and informal sectors. This is an expected result as women are more educated than men and working women present overall better characteristics on average than working men in this sample. Since, the female advantage in observables is stronger in the formal sector, the formal adjusted wage gap increases more than the informal adjusted wage gap (from panel 1 to panel 2 in table3.8). As a result, the wage gaps in formal jobs and in informal jobs are not statically different from one another. Although skills receive lower returns in informal jobs, the gender differences in returns is about the same in percentage terms in formal and informal jobs: the average wage gap is about 0.2 log points which amounts to a difference of 22 percent. If we look at the gaps for different education groups, adjusting women's returns to the returns obtained by men would increase women's wages by 17 to 21 percent among workers with primary education and by 22 to 25 percent among workers with secondary education. For high-skilled workers however, the adjusted wage gaps are statistically different in the two segments. It is higher among formal employees at 26 percent compared to 19 percent among informal employees. The so-called "glass ceiling effect" is stronger in jobs with legal labour contracts which goes in the direction of one hypothesis formulated in section 2.

We now turn to the effect of the selection bias on the gender wage gaps. The data give information on observed wages only, for workers working in a given sector. To infer the magnitude of the wage gap correctly though, we want to compare wage *offers* (that would be) made to all men and women. If selection into sector is non-random, observed wages either overstate or understate wage offers. If the selection bias differs by gender, the observed raw wage gap, given in the first panel of table 3.8, will not reflect the raw difference in wage offers. Controlling for sector participation enables us to recover the average wage offers within each sector, providing our control function captures properly the selection bias. Panel 3 shows how selection changes the average gender wage gaps differently in the informal and formal sectors.

In the informal sector, the observed wage gap overstates the wage gap in wage offers. This is because observed informal wages overestimate informal wage *offers* for both men and women but male wage offers are more strongly overestimated than female wage offers. Controlling for inclusion in the informal salaried worker sample reduces the average informal wage offer more for men than for women, and thus reduces the wage gap that can be explained by differences in characteristics and returns. Among informal employees, differences in returns have no role in explaining the gap anymore. Put differently, after purging the estimates from the selection effect, we cannot reject the hypothesis that men and women receive equal treatment for their skills in the informal sector.

In the formal sector, on the other hand, the gender gap in wage offers is offset by the selection bias and is underestimated by the observed gender wage gap. This is because observed male wages underestimate male wage *offers* while observed female wage overestimate female wage offers. Observable characteristics are better among working women which makes the part of the gender wage gap due to different returns even bigger than the total wage difference adjusted for the selection bias. The increase in the wage gap with education is robust to the treatment of selection.

These results highlight that labour regulation may impact gender wage inequality in the urban labour market in Brazil. The finding that wage gaps are positive and significant only in formal jobs is consistent with the following explanation. If employers believe that women have a higher quite probability, statistical discrimination induces employers to pay lower wages to women because they expect higher average female labour cost. We argue that the gap in gender expected labour cost because of gender differences in labour market attachment is higher in jobs where employment protection is binding. When an employee takes a temporary leave, his/her job must remain available to him/her, generating costs due to vacancy and replacement. This effect is expected to be weaker in informal job because the job of the employee on leave can be allocated to another worker permanently. We also find that the wage gap is higher among high-skilled workers in formal jobs, a result that is commonly found in the literature on gender wage gaps. This finding is often explained by statistical discrimination that produces higher gender gaps in high-wage jobs. Higher gender differences in pay among formal workers and the increase in the pay gap with the education level are thus consistent.

Table 3.8: Gender wage gap decomposition. Informal and formal sectors, urban areas.

Level of Education		All	Primary or less	Secondary	Tertiary
1-Raw wage gap					
$\overline{\ln W}_{mj} - \overline{\ln W}_{fj}$					
	Informal	**0.133****	**0.058***	0.193**	0.244**
		(0.014)	(0.026)	(0.015)	(0.030)
	Formal	**0.075****	**0.176****	0.197**	0.215**
		(0.005)	(0.020)	(0.016)	(0.012)
	Welch's t-statistics	-2.51	3.94	0.18	-1.26
2-Controlling for observables only					
Part due to differences in returns					
$\overline{WG}_j = \overline{\mathbf{X}}'_{\mathbf{m}}(\widehat{\beta}_{\mathbf{mj}} - \widehat{\beta_{\mathbf{pj}}}) + \overline{\mathbf{X}}'_{\mathbf{f}}(\widehat{\beta_{\mathbf{pj}}} - \widehat{\beta_{\mathbf{fj}}})$					
	Informal	0.200**	0.191**	0.223**	**0.173****
		(0.019)	(0.030)	(0.018)	(0.026)
	Formal	0.214**	0.151**	0.197**	**0.232****
		(0.010)	(0.014)	(0.012)	(0.013)
	Welch's t-statistics	0.08	-1.60	-1.37	2.66
3-Controlling for observables and self-selection					
3.1-Wage gap after subtracting the selection bias					
$\overline{\ln W}_{mj} - \overline{\ln W}_{fj} - (\theta_{mj}h_{mj} - \theta_{fj}h_{fj})$					
Lee	Informal	-0.125	-0.289	-0.159	0.455
		(0.237)	(0.279)	(0.312)	(0.853)
	Formal	0.612**	0.622*	0.500	0.639
		(0.219)	(0.263)	(0.295)	(0.516)
DMF	Informal	0.219	0.146	0.451	-0.934
		(0.308)	(0.347)	(0.445)	(1.053)
	Formal	0.325**	0.082	0.303*	0.572**
		(0.115)	(0.227)	(0.121)	(0.121)
3.2-Part due to difference in returns					
$\overline{WG}_{Sj} = \overline{\mathbf{X}}'_{\mathbf{m}}(\widehat{\gamma}_{\mathbf{mj}} - \widehat{\gamma_{\mathbf{pj}}}) + \overline{\mathbf{X}}'_{\mathbf{f}}(\widehat{\gamma_{\mathbf{pj}}} - \widehat{\gamma_{\mathbf{fj}}})$					
Lee	Informal	**-0.063**	**-0.147**	**-0.139**	0.389
		(0.237)	(0.284)	(0.310)	(0.851)
	Formal	**0.974****	**0.388****	**0.553****	0.329**
		(0.050)	(0.019)	(0.021)	(0.015)
	Welch's t-statistics	4.28	1.70	2.21	-0.07
DMF	Informal	0.271	0.295	0.478	-0.990
		(0.310)	(0.353)	(0.445)	(1.053)
	Formal	0.455**	0.049	0.297*	0.565**
		(0.114)	(0.226)	(0.121)	(0.120)
	Welch's t-statistics	0.56	-0.59	-0.39	1.47
Number in Informal		27,105	9,856	14,443	2,806
Share of women		53%	51%	54%	57%
Number in Formal		78,378	11,586	39,717	17,705
Share of women		44%	33%	41%	60%

Notes: * $p < 0.05$; ** $p < 0.01$ s.e. in parenthesis. Panel 1: equation (3.1). Panel 2: equation (3.3). Panel 3.2: equation (3.6). The results are expressed on the logarithmic scale. To obtain the difference in percentage points: $(exp(WG) - 1) \times 100$. The Welch's test is applied to test the difference between the formal and the informal gaps with different population sizes and variances. Bold characters indicate that the difference between the formal and the informal wage gaps is significant at 10% when $|t| > 1.64$, the difference is significant at 5% if $|t| > 1.96$

3.5. Conclusion

This paper investigates gender wage inequality in formal and informal jobs in Brazil. The data shows that the total average gender wage gap is positive and significant in both sectors. The informal sector features the highest total average gender wage gap but this conceals differences in male and female characteristics. When we ignore the selection bias, the differences in returns are the same in formal and informal jobs and are responsible for about 22% of the pay gap. This paper additionally shows that the similarity between the formal and informal wage gaps is artificially generated by different selection of men and women in formal and informal jobs. In the informal sector, both male and female observed average wages overestimate their respective average wage offers but not by the same magnitude. The stronger male selection bias in informal jobs displaces male observed wage distribution further to the right compared to the female observed wage distribution. As a result the observed wage gap overestimates the gap in wage offers. We find that the difference in average wage offers faced by men and women is actually entirely explained by differences in selection bias. The gender gap due to different returns is not significant in the informal sector. The opposite happens in the formal sector. The gender difference in selectivity bias narrows the gender gap in observed wages. This is because observed female wages overestimate female wage offers while observed male wages underestimate male wage offers. As a result, even after controlling for selection, the gender wage gap due to different returns is strongly positive in formal jobs. Moreover, the gender wage gap increases with education in the formal sector.

Bigger gender differences in returns in the formal sector certainly can not lead to the conclusion that employment protection legislation is detrimental to women. First, the formal segment of the labour market provides higher wages to women, even if the formal wage premium is lower for women than for men. Additionally, given that women face a higher unemployment rate and need to take maternity leave, the flow of earnings of women relative to men can be higher in the formal sector because unemployment benefits and maternity leave benefits compensate for wage losses in the formal sector while wage losses are not compensated for in the informal sector. Further work is needed, first to really identify the impact of labour regulation on discriminatory behavior and, second, to investigate how participating in the informal sector affects gender differences in earnings over the life cycle.

Moreover, it would also be important to explore the selection of men and women into rural migration and how this impacts the gender wage gaps differently in the formal and informal sectors. Indeed, rural migration differs across gender, it is usually more prevalent among the male population, and could thus affect the estimation of the wage gap, and differently so in rural and urban areas.

APPENDIX

3.A. Multinomial logit estimates

Table 3.9: Labour market status. Urban workers

Relative risk ratios from the multinomial logit estimation. Base: formal employee

Women	Inactive	Informal employee	Self-employed	Employer	Unemployed
Age	0.020***	-0.018***	0.031***	0.040***	-0.027***
	(0.001)	(0.001)	(0.001)	(0.002)	(0.001)
Years of education	-0.206***	-0.226***	-0.132***	0.075***	-0.175***
	(0.002)	(0.003)	(0.003)	(0.007)	(0.003)
Children	0.057**	0.028	-0.010	-0.103	0.066*
... under 14	0.085***	-0.017	0.249***	0.215***	-0.076*
	(0.022)	(0.029)	(0.032)	(0.063)	(0.030)
Living in couple	0.368***	-0.148***	0.146***	0.576***	0.256***
	(0.022)	(0.027)	(0.030)	(0.065)	(0.031)
Lone mother	-0.426***	0.122**	-0.182***	-0.086	0.086
	(0.039)	(0.044)	(0.053)	(0.127)	(0.050)
Formal workers	0.098***	0.011	-0.161***	-0.376***	0.121***
in the household	(0.015)	(0.019)	(0.025)	(0.068)	(0.019)
Unemployment rate	4.116***	5.580***	7.536***	2.039	7.393***
(regional, by education group)	(0.425)	(0.566)	(0.600)	(1.279)	(0.580)
Constant	0.579***	1.564***	-1.821***	-5.372***	0.621***
	(0.111)	(0.138)	(0.172)	(0.357)	(0.150)
Men	Inactive	Informal employee	Self-employed	Employer	Unemployed
Age	0.022***	-0.025***	0.031***	0.046***	-0.030***
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Years of education	-0.127***	-0.154***	-0.113***	0.063***	-0.102***
	(0.003)	(0.003)	(0.002)	(0.004)	(0.004)
Children	0.432***	0.134***	0.059*	0.000	0.567***
	(0.026)	(0.028)	(0.025)	(0.042)	(0.035)
... under 14	-1.181***	-0.246***	-0.114***	0.129***	-0.735***
	(0.029)	(0.025)	(0.023)	(0.037)	(0.032)
Living in couple	-0.425***	-0.271***	-0.229***	0.271***	-0.294***
	(0.027)	(0.027)	(0.026)	(0.049)	(0.032)
Formal workers	0.103***	0.023	-0.094***	-0.362***	0.069***
in the household	(0.012)	(0.014)	(0.017)	(0.041)	(0.014)
Unemployment rate	-5.140***	-1.324*	-0.799	-4.334***	1.710*
(regional, by education group)	(0.573)	(0.583)	(0.502)	(0.792)	(0.682)
Constant	-0.424**	1.468***	-0.499***	-4.090***	-0.111
	(0.145)	(0.127)	(0.119)	(0.219)	(0.176)

Notes: In the multinomial logit model, the risk of $y = j$ is measured as the risk of the outcome relative to the base outcome, $Pr(y = j)/Pr(y = 3) = exp^{X\beta_j}$ and the relative risk ratios for a one-unit change in X is the exponentiated value of the coefficient

Table 3.10: Labour market status, rural workers.

Marginal effects for men and women separately

Women	Inactive	Informal employee	Formal employee	Self-employed	Employer	Unemployed
Age	-0.002***	-0.002***	0.001***	0.005***	0.000***	-0.002***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Years of education	-0.014***	-0.003***	0.028***	-0.012***	0.001***	0.001
	(0.001)	(0.001)	(0.001)	(0.001)	(0.000)	(0.000)
Children	-0.030**	-0.004	0.020**	0.017	-0.002	-0.000
	(0.010)	(0.007)	(0.006)	(0.010)	(0.002)	(0.004)
... under 14	-0.019*	-0.004	-0.010	0.032**	0.005*	-0.003
	(0.010)	(0.006)	(0.006)	(0.010)	(0.002)	(0.004)
Living in couple	0.006	-0.043***	-0.049***	0.103***	-0.007*	-0.010
	(0.012)	(0.009)	(0.009)	(0.012)	(0.003)	(0.005)
Lone mother	-0.042*	0.062***	-0.013	-0.022	-0.003*	0.018*
	(0.019)	(0.015)	(0.012)	(0.021)	(0.001)	(0.009)
Formal workers	0.030***	0.000	-0.015***	-0.018*	-0.001	0.003
in the household	(0.007)	(0.004)	(0.005)	(0.007)	(0.001)	(0.002)
Unemployment rate	0.998***	0.486***	-0.808***	-0.858***	-0.002	0.184*
(region, education specific)	(0.236)	(0.143)	(0.127)	(0.257)	(0.029)	(0.072)
Men	Inactive	Informal employee	Formal employee	Self-employed	Employer	Unemployed
Age	0.001***	-0.006***	-0.002***	0.007***	0.001***	-0.001***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Years of education	-0.002**	-0.020***	0.019***	-0.002	0.005***	0.000
	(0.001)	(0.001)	(0.001)	(0.001)	(0.000)	(0.000)
Children	0.023***	-0.025**	-0.037***	0.040***	-0.007*	0.007**
	(0.005)	(0.009)	(0.009)	(0.010)	(0.004)	(0.002)
... under 14	-0.053***	0.038***	0.076***	-0.062***	0.006	-0.004
	(0.004)	(0.008)	(0.007)	(0.009)	(0.003)	(0.002)
Living in couples	-0.036***	-0.050***	0.037***	0.054***	0.005	-0.011**
	(0.006)	(0.009)	(0.008)	(0.010)	(0.003)	(0.003)
Formal workers	0.017***	-0.010*	-0.008	0.016**	-0.016***	0.000
in the household	(0.002)	(0.004)	(0.005)	(0.006)	(0.004)	(0.001)
Unemployment rate	0.373**	0.680**	-0.708***	-0.494*	-0.072	0.221***
(region, education specific)	(0.127)	(0.216)	(0.177)	(0.251)	(0.075)	(0.058)

Notes: Marginal effects, standard errors in parenthesis. The marginal effects of each explanatory variables on the probability to be in the six different outcomes are computed based on the multinomial logit estimation.

3.B. Wage equations on the pooled sample

Table 3.11: Hourly wages, urban areas. Pooled sample of men and women, formal and informal workers separately.

	OLS		Selection			
	Informal	Formal	Informal		Formal	
Control function			Lee	DMF	Lee	DMF
Female	-0.100**	-0.107**	-0.097**	-0.076**	-0.109**	-0.040**
	(0.005)	(0.004)	(0.005)	(0.006)	(0.005)	(0.006)
Male	0.100**	0.107**	0.097**	0.076**	0.109**	0.040**
	(0.005)	(0.004)	(0.005)	(0.006)	(0.005)	(0.006)
Years of education	0.053**	0.085**	0.047**	0.063**	0.082**	0.090**
	(0.002)	(0.002)	(0.002)	(0.005)	(0.003)	(0.006)
Age	0.044**	0.045**	0.043**	0.037**	0.044**	0.031**
	(0.002)	(0.002)	(0.002)	(0.002)	(0.003)	(0.003)
Age^2	-0.000**	-0.000**	-0.000**	-0.000**	-0.000**	-0.000**
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Tenure in years	-0.014**	0.005*	-0.014**	-0.013**	0.002	0.000
	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)
Tenure^2	0.001**	-0.001**	0.001**	0.001**	-0.000**	-0.000
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Black	-0.072**	-0.090**	-0.072**	-0.069**	-0.091**	-0.088**
	(0.009)	(0.007)	(0.009)	(0.009)	(0.007)	(0.007)
Unemployment rate	-4.202**	-6.614**	-4.057**	-2.866**	-6.780**	-6.150**
(region, education specific)	(0.342)	(0.548)	(0.339)	(0.327)	(0.512)	(0.469)
Constant	-0.070	0.240**	-0.177*	1.223**	0.222**	0.272**
	(0.060)	(0.059)	(0.075)	(0.176)	(0.066)	(0.097)
Sector dummies	yes	yes	yes	yes	yes	yes
Region dummies	yes	yes	yes	yes	yes	yes
σ^2			0.456**	5.585**	0.784**	4.690**
			(0.061)	(1.838)	(0.117)	(0.563)
ρ_1				0.290**		0.590**
				(0.041)		(0.059)
ρ_2			-0.129**			0.024
			(0.038)			(0.080)
ρ_3				0.485**	-0.051*	
				(0.128)	(0.022)	(0.087)
ρ_4				0.635**		0.255
				(0.092)		(0.137)
ρ_5				-1.444**		-1.139**
				(0.339)		(0.234)
ρ_6				1.656**		1.376**
				(0.229)		(0.166)
N	27,105	78,367	27,105	27,105	69,009	69,009

Notes: * $p < 0.05$; ** $p < 0.01$ Standard errors in parenthesis. Clustered s.e. in OLS regressions. Bootstrap estimates of the s.e. when controlling for selection to account for the two-step procedure.

3.C. Wage equations by education groups

3.C.1. Workers with primary education or less

Table 3.12: Hourly wages. Women with primary education or less, urban areas.

	OLS		Selection			
	Informal	Formal	Informal		Formal	
Control function			Lee	DMF	Lee	DMF
Years of education	0.026**	0.009**	0.026**	0.012	0.013	0.000
	(0.004)	(0.003)	(0.008)	(0.013)	(0.013)	(0.026)
age	0.024**	-0.007	0.024**	0.020	-0.007**	-0.002**
	(0.005)	(0.005)	(0.001)	(0.015)	(0.002)	(0.000)
Age^2	-0.000**	0.000*	-0.000**	-0.000	0.000**	0.000**
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Tenure in years	-0.017	-0.012*	-0.017	-0.018	-0.011**	-0.012**
	(0.010)	(0.005)	(0.011)	(0.011)	(0.001)	(0.003)
Tenure^2	0.001	0.001	0.001	0.001	0.001**	0.001**
	(0.001)	(0.001)	(0.001)	(0.001)	(0.000)	(0.000)
Black	0.005	-0.027*	0.004	0.004	-0.027**	-0.027**
	(0.018)	(0.012)	(0.020)	(0.013)	(0.005)	(0.007)
Constant	-0.084	1.338**	-0.080	0.170	1.206**	1.521**
	(0.106)	(0.097)	(0.167)	(0.481)	(0.078)	(0.581)
Sector dummies	yes	yes	yes	yes	yes	yes
Region dummies	yes	yes	yes	yes	yes	yes
σ^2			0.298**	0.593	0.121**	0.581
			(0.002)	(0.354)	(0.024)	(1.473)
ρ_1				0.562		0.266
				(0.374)		(0.796)
ρ_2			0.008			0.951
			(0.047)			(0.495)
ρ_3				-0.325	-0.219**	
				(0.592)	(0.053)	
ρ_4				-0.108		-0.498
				(0.534)		(0.934)
ρ_5				-0.983		0.258
				(0.811)		(0.396)
ρ_6				0.760		-0.916**
				(0.762)		(0.113)
R^2	0.21	0.17				
N	5,032	4,043	.	.	.	.

Notes: * $p < 0.05$; ** $p < 0.01$ Standard errors in parenthesis. Clustered s.e. in OLS regressions. Bootstrap estimates of the s.e. when controlling for selection to account for the two-step procedure.

Table 3.13: Hourly wages. Men with primary education or less, urban areas.

	OLS		Selection			
	Informal	Formal	Informal		Formal	
Control function			Lee	DMF	Lee	DMF
Years of education	0.020**	0.027**	0.014**	0.010	0.022**	0.031**
	(0.004)	(0.003)	(0.005)	(0.018)	(0.001)	(0.001)
age	0.031**	0.022**	0.028**	0.023**	0.020*	0.018**
	(0.004)	(0.003)	(0.001)	(0.007)	(0.008)	(0.005)
Age^2	-0.000**	-0.000**	-0.000**	-0.000**	-0.000	-0.000**
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Tenure in years	0.023**	0.013**	0.023	0.023**	0.013	0.013**
	(0.008)	(0.004)	(0.018)	(0.005)	(0.008)	(0.001)
Tenure^2	-0.003**	-0.001**	-0.003	-0.003**	-0.001	-0.001**
	(0.001)	(0.000)	(0.002)	(0.001)	(0.001)	(0.000)
Black	-0.089**	-0.042**	-0.089**	-0.088**	-0.041**	-0.040**
	(0.019)	(0.008)	(0.005)	(0.020)	(0.000)	(0.011)
Constant	0.161*	0.542**	-0.029	1.047*	0.758**	0.581
	(0.073)	(0.046)	(0.161)	(0.490)	(0.193)	(0.354)
Sector dummies	yes	yes	yes	yes	yes	yes
Region dummies	yes	yes	yes	yes	yes	yes
σ^2			0.446	2.440	0.190**	3.150
			(0.544)	(1.268)	(0.007)	(1.814)
ρ_1				0.086		-0.117
				(0.193)		(0.148)
ρ_2			-0.362**			-0.678**
			(0.116)			(0.146)
ρ_3				0.644**	0.322**	
				(0.187)	(0.003)	
ρ_4				0.105		0.356*
				(0.451)		(0.149)
ρ_5				-1.520**		-0.924**
				(0.299)		(0.083)
ρ_6				0.746		1.289**
				(0.478)		(0.145)
R^2	0.22	0.19				
N	4,824	8,467	.	.	.	.

Notes: * $p < 0.05$; ** $p < 0.01$ Standard errors in parenthesis. Clustered s.e. in OLS regressions. Bootstrap estimates of the s.e. when controlling for selection to account for the two-step procedure.

3.C.2. Workers with secondary education

Table 3.14: Hourly wages. Women with secondary education, urban areas.

	OLS		Selection			
	Informal	Formal	Informal		Formal	
Control function			Lee	DMF	Lee	DMF
Years of education	0.018**	0.056**	0.001	0.060	0.068**	0.198**
	(0.003)	(0.003)	(0.009)	(0.031)	(0.006)	(0.000)
age	0.041**	0.016**	0.039**	0.024**	0.016**	-0.003
	(0.003)	(0.002)	(0.000)	(0.008)	(0.000)	(0.003)
Age^2	-0.000**	-0.000	-0.000**	-0.000**	-0.000**	0.000
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Tenure in years	-0.023**	0.002	-0.023**	-0.022**	0.002	0.002
	(0.006)	(0.003)	(0.007)	(0.006)	(0.001)	(0.003)
Tenure^2	0.002**	-0.001*	0.002**	0.002**	-0.001**	-0.001*
	(0.001)	(0.000)	(0.001)	(0.001)	(0.000)	(0.000)
Black	-0.037*	-0.060**	-0.035**	-0.034**	-0.060**	-0.058**
	(0.015)	(0.007)	(0.011)	(0.011)	(0.002)	(0.000)
Constant	-0.176	0.283**	-0.311**	0.263	0.046	-1.506**
	(0.117)	(0.085)	(0.017)	(0.266)	(0.163)	(0.136)
Sector dummies	yes	yes	yes	yes	yes	yes
Region dummies	yes	yes	yes	yes	yes	yes
σ^2			0.489**	1.214	0.178**	6.029**
			(0.048)	(0.716)	(0.009)	(1.070)
ρ_1				-0.007		-0.149**
				(0.202)		(0.022)
ρ_2			-0.319**			-1.094**
			(0.045)			(0.022)
ρ_3				0.606*	-0.248*	
				(0.298)	(0.102)	
ρ_4				-0.700*		0.374**
				(0.334)		(0.092)
ρ_5				-0.687		-0.349**
				(0.426)		(0.093)
ρ_6				0.895*		1.001**
				(0.357)		(0.010)
R^2	0.22	0.26				
N	7,878	17,924	.	.	.	.

Notes: * $p < 0.05$; ** $p < 0.01$ Standard errors in parenthesis. Clustered s.e. in OLS regressions. Bootstrap estimates of the s.e. when controlling for selection to account for the two-step procedure.

Table 3.15: Hourly wages. Men with secondary education, urban areas.

	OLS		Selection			
	Informal	Formal	Informal		Formal	
Control function			Lee	DMF	Lee	DMF
Years of education	0.045**	0.063**	0.013	0.085**	0.045**	0.091**
	(0.004)	(0.002)	(0.015)	(0.023)	(0.004)	(0.008)
age	0.058**	0.043**	0.052**	0.053**	0.036**	0.041**
	(0.004)	(0.004)	(0.006)	(0.008)	(0.001)	(0.002)
Age^2	-0.001**	-0.000**	-0.001**	-0.001**	-0.000**	-0.000**
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Tenure in years	-0.013	0.000	-0.013**	-0.014*	0.000	-0.000
	(0.009)	(0.004)	(0.001)	(0.006)	(0.002)	(0.007)
Tenure^2	0.002	-0.000	0.002**	0.002*	-0.000	-0.000
	(0.001)	(0.000)	(0.000)	(0.001)	(0.000)	(0.001)
Black	-0.093**	-0.072**	-0.093**	-0.092**	-0.072**	-0.070**
	(0.015)	(0.007)	(0.012)	(0.011)	(0.002)	(0.003)
Constant	-0.514**	-0.173	-0.662**	0.457	0.343**	-0.821**
	(0.068)	(0.095)	(0.132)	(0.266)	(0.081)	(0.147)
Sector dummies	yes	yes	yes	yes	yes	yes
Region dummies	yes	yes	yes	yes	yes	yes
σ^2			1.130**	4.544**	0.262**	3.911**
			(0.380)	(1.472)	(0.019)	(0.758)
ρ_1				-0.184		-0.019
				(0.205)		(0.025)
ρ_2			-0.416			-0.906**
			(0.316)			(0.022)
ρ_3				0.464**	0.559**	
				(0.106)	(0.067)	
ρ_4				0.521*		0.579**
				(0.248)		(0.066)
ρ_5				-1.389**		-0.804**
				(0.091)		(0.065)
ρ_6				0.809**		0.950**
				(0.181)		(0.070)
R^2	0.26	0.32				
N	6,565	26,205	.	.	.	.

Notes: * $p < 0.05$; ** $p < 0.01$ Standard errors in parenthesis. Clustered s.e. in OLS regressions. Bootstrap estimates of the s.e. when controlling for selection to account for the two-step procedure.

3.C.3. Workers with secondary education

Table 3.16: Hourly wages. Women with tertiary education, urban areas.

	OLS		Selection			
	Informal	Formal	Informal		Formal	
Control function			Lee	DMF	Lee	DMF
Years of education	0.127**	0.152**	0.096**	0.174**	0.121**	0.148**
	(0.014)	(0.004)	(0.001)	(0.039)	(0.012)	(0.018)
age	0.032**	0.048**	0.014	0.014	0.044**	0.029**
	(0.012)	(0.004)	(0.010)	(0.011)	(0.009)	(0.001)
Age^2	-0.000	-0.000**	-0.000	-0.000*	-0.000*	-0.000**
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Tenure in years	-0.017	0.009	-0.019	-0.022	0.009**	0.008
	(0.027)	(0.005)	(0.017)	(0.027)	(0.003)	(0.010)
Tenure^2	0.001	-0.001*	0.001	0.001	-0.001**	-0.001
	(0.003)	(0.000)	(0.003)	(0.003)	(0.000)	(0.001)
Black	-0.119*	-0.138**	-0.119	-0.121**	-0.138**	-0.134**
	(0.049)	(0.016)	(0.075)	(0.031)	(0.024)	(0.001)
Constant	-1.167**	-0.997**	-1.810	1.789	-0.318	-0.553*
	(0.410)	(0.275)	(0.960)	(1.586)	(0.459)	(0.223)
Sector dummies	yes	yes	yes	yes	yes	yes
Region dummies	yes	yes	yes	yes	yes	yes
σ^2			4.358**	24.638	0.377**	7.519**
			(1.546)	(15.131)	(0.039)	(1.074)
ρ_1				0.158		0.420*
				(0.174)		(0.199)
ρ_2			-0.387**			-0.654**
			(0.019)			(0.009)
ρ_3				0.892**	0.590**	
				(0.280)	(0.178)	
ρ_4				-1.196*		-0.929**
				(0.573)		(0.002)
ρ_5				-0.209		-0.423**
				(0.474)		(0.040)
ρ_6				0.366		1.151**
				(0.688)		(0.165)
R^2	0.31	0.35				
N	1,601	12,513	.	.	.	.

Notes: * $p < 0.05$; ** $p < 0.01$ Standard errors in parenthesis. Clustered s.e. in OLS regressions. Bootstrap estimates of the s.e. when controlling for selection to account for the two-step procedure.

Table 3.17: Hourly wages. Men with tertiary education, urban areas.

	Informal	Formal	Informal Lee	DMF	Formal Lee	DMF
Years of education	0.121**	0.150**	0.110**	0.097**	0.131**	0.128**
	(0.011)	(0.006)	(0.002)	(0.033)	(0.004)	(0.008)
age	0.043**	0.065**	0.034**	0.038*	0.054**	0.025*
	(0.012)	(0.004)	(0.006)	(0.019)	(0.005)	(0.011)
Age^2	-0.000*	-0.001**	-0.000	-0.000	-0.000**	-0.000**
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Tenure in years	-0.024	0.002	-0.028**	-0.030	0.003**	0.001
	(0.018)	(0.007)	(0.009)	(0.025)	(0.001)	(0.006)
Tenure^2	0.002	-0.001	0.002**	0.002	-0.001	-0.000
	(0.002)	(0.001)	(0.000)	(0.002)	(0.000)	(0.001)
Black	-0.192**	-0.153**	-0.191**	-0.188**	-0.153**	-0.148**
	(0.039)	(0.022)	(0.044)	(0.044)	(0.009)	(0.014)
Constant	-0.290	-1.554**	-1.126	0.584	-0.852**	-0.194
	(0.283)	(0.115)	(0.788)	(0.938)	(0.030)	(0.572)
Sector dummies	yes	yes	yes	yes	yes	yes
Region dummies	yes	yes	yes	yes	yes	yes
σ^2			3.353	7.439	0.464**	4.528*
			(2.675)	(7.806)	(0.032)	(2.300)
ρ_1				-0.222		-0.610**
				(0.446)		(0.155)
ρ_2			-0.379**			0.371
			(0.038)			(0.563)
ρ_3				-0.200	0.761**	
				(0.386)	(0.165)	
ρ_4				1.194**		-0.197
				(0.432)		(0.538)
ρ_5				-1.016**		-0.869**
				(0.186)		(0.198)
ρ_6				0.364		1.302**
				(0.450)		(0.034)
R^2	0.27	0.36				
N	1,205	9,215	1,205	1,205	9,215	9,215

Notes: * $p < 0.05$; ** $p < 0.01$ Standard errors in parenthesis. Clustered s.e. in OLS regressions. Bootstrap estimates of the s.e. when controlling for selection to account for the two-step procedure.

3.D. Results for rural workers

Table 3.18: Hourly wages. Women in rural areas.

	OLS		Selection			
	Informal	Formal	Informal Lee	DMF	Formal Lee	DMF
Years of education	0.037**	0.062**	0.033**	0.062**	0.070**	0.053*
	(0.007)	(0.004)	(0.006)	(0.019)	(0.012)	(0.025)
age	0.033**	0.033**	0.029**	0.020	0.034**	0.021**
	(0.010)	(0.005)	(0.005)	(0.011)	(0.002)	(0.007)
Age^2	-0.000**	-0.000**	-0.000**	-0.000*	-0.000**	-0.000**
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Tenure in years	-0.036	-0.005	-0.034*	-0.032*	-0.005	-0.009
	(0.023)	(0.013)	(0.017)	(0.016)	(0.008)	(0.009)
Tenure^2	0.003	0.000	0.002	0.002	0.000	0.001
	(0.002)	(0.001)	(0.002)	(0.002)	(0.001)	(0.001)
Black	-0.049	-0.036	-0.045	-0.050	-0.036*	-0.032
	(0.028)	(0.022)	(0.036)	(0.040)	(0.016)	(0.022)
Unemployment rate	-2.228*	-2.448**	-1.674	-2.424**	-2.455**	-1.551*
(region, education specific)	(0.946)	(0.769)	(1.337)	(0.933)	(0.509)	(0.763)
Constant	0.121	0.428*	-0.238	0.046	0.233	1.360*
	(0.191)	(0.166)	(0.327)	(0.556)	(0.372)	(0.640)
Sector dummies	yes	yes	yes	yes	yes	yes
Region dummies	yes	yes	yes	yes	yes	yes
σ^2			0.687**	2.109	0.172**	1.257*
			(0.225)	(1.545)	(0.059)	(0.536)
ρ_1				0.817		1.207**
				(0.465)		(0.223)
ρ_2			-0.309**			0.897
			(0.117)			(0.619)
ρ_3				1.146	-0.170	
				(0.636)	(0.222)	
ρ_4				-1.292*		0.547
				(0.515)		(0.570)
ρ_5				0.198		-1.692
				(1.638)		(0.917)
ρ_6				0.209		0.639*
				(0.547)		(0.316)
N	1,571	1,822	1,571	1,571	1,822	1,822

Notes: * $p < 0.05$; ** $p < 0.01$ Standard errors in parenthesis. Clustered s.e. in OLS regressions. Bootstrap estimates of the s.e. when controlling for selection to account for the two-step procedure.

Table 3.19: Hourly wages. Men in rural areas.

	OLS		Selection			
	Informal	Formal	Informal		Formal	
Control function			Lee	DMF	Lee	DMF
Years of education	0.017**	0.044**	0.016*	-0.009	0.046**	0.053**
	(0.004)	(0.004)	(0.008)	(0.016)	(0.002)	(0.014)
Age	0.037**	0.036**	0.037**	0.029**	0.037**	0.041**
	(0.004)	(0.005)	(0.005)	(0.010)	(0.003)	(0.006)
Age^2	-0.000**	-0.000**	-0.000**	-0.000**	-0.000**	-0.000**
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Tenure in years	0.003	0.009	0.003	0.002	0.009	0.009
	(0.015)	(0.006)	(0.010)	(0.013)	(0.010)	(0.008)
Tenure^2	0.000	-0.001	0.000	0.000	-0.001	-0.001
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Black	-0.029	-0.049**	-0.029	-0.028	-0.049**	-0.049**
	(0.023)	(0.015)	(0.016)	(0.026)	(0.011)	(0.014)
Unemployment rate	0.077	-0.956	0.122	0.968	-0.943*	-0.601
(region, education specific)	(0.576)	(0.665)	(0.484)	(0.909)	(0.475)	(0.515)
Constant	0.184*	0.484**	0.150	0.163	0.374**	0.280
	(0.083)	(0.132)	(0.166)	(0.233)	(0.069)	(0.428)
Sector dummies	yes	yes	yes	yes	yes	yes
Region dummies	yes	yes	yes	yes	yes	yes
σ^2			0.254**	0.450	0.168**	0.777**
			(0.047)	(0.315)	(0.008)	(0.241)
ρ_1				-0.490		1.544**
				(0.917)		(0.425)
ρ_2			-0.067			-0.099
			(0.213)			(0.378)
ρ_3				-0.577	-0.149**	
				(0.342)	(0.055)	
ρ_4				-0.044		0.890**
				(0.682)		(0.268)
ρ_5				-1.907**		-0.678
				(0.633)		(0.682)
ρ_6				0.318		0.246
				(0.315)		(0.275)
R^2	0.25	0.28				
N	4,196	3,737	.	.	.	.

Notes: * $p < 0.05$; ** $p < 0.01$ Standard errors in parenthesis. Clustered s.e. in OLS regressions. Bootstrap estimates of the s.e. when controlling for selection to account for the two-step procedure.

Table 3.20: Gender wage gap in the informal and formal sectors, rural areas

Level of Education	**All**	**Primary**	**Secondary**	**Tertiary**
Raw wage gap from equation (3.1)				
Informal	0.095**	0.120*	0.156*	0.059
	(0.018)	(0.023)	(0.028)	(0.165)
Formal	-0.064*	0.027	0.073*	0.015
	(0.028)	(0.030)	(0.031)	(0.039)
Controlling for observables from equation (3.3)				
Informal	0.268**	0.283**	0.229**	0.227
	(0.044)	(0.038)	(0.058)	(0.168)
Formal	0.099**	0.037	0.115**	0.098*
	(0.020)	(0.026)	(0.024)	(0.045)
Controlling for observables and self-selection from equation (3.6)				
Lee				
Informal	0.408*	0.589	0.531	.
	(0.208)	(0.309)	(0.566)	.
Formal	0.114	0.100	-0.121	.
	(0.154)	(0.210)	(0.160)	.
DMF				
Informal	0.840*	1.292**	0.901	.
	(0.335)	(0.484)	(0.572)	.
Formal	-0.149	0.116	-0.348	.
	(0.251)	(0.508)	(0.226)	.
Number of men, Informal	4,198	3,025	1,135	38
Number of women, Informal	1,571	831	688	52
Number of men, Formal	3,983	1,875	1,525	231
Number of women, Formal	2,191	505	958	489

Notes: * $p < 0.05$; ** $p < 0.01$ Standard errors in parenthesis.

Conclusion générale

Cette thèse a abordé le sujet des inégalités de genre sur le marché du travail en posant deux questions : comment le commerce international, d'une part, et l'emploi informel, d'autre part, modifient-ils les écarts de salaire entre hommes et femmes ? Si la littérature empirique a traité, sans épuiser, la première question, très peu d'analyses théoriques ont tenté de déceler les mécanismes par lesquels le commerce international influence les inégalités de genre. Dans une première partie, cette thèse a souhaité réduire ce déficit d'analyses théoriques en développant deux modèles qui explorent des mécanismes différents. Un modèle d'oligopole et discrimination par les préférences des employeurs a été développé dans le premier chapitre afin d'évaluer l'impact du commerce sur les écarts de salaire via les changements de degré de concurrence. Ce modèle établit les résultats suivants : si les entreprises étrangères ont un avantage compétitif, l'ouverture commerciale concourt à la baisse des écarts de salaire. En revanche, si les entreprises domestiques détiennent un avantage compétitif fort, l'intégration commerciale des marchés permet aux entreprises domestiques, même discriminantes, d'augmenter leurs profits, induisant de ce fait un accroissement de l'écart de salaire. Les prédictions théoriques sont confirmées par les résultats empiriques de l'analyse des écarts de salaire en Uruguay, entre 1983 et 2003, période incluant un choc de libéralisation commerciale.

Le deuxième chapitre a développé un modèle de commerce en concurrence monopolistique avec des entreprises hétérogènes et une discrimination statistique, afin d'évaluer l'impact du commerce sur les écarts de salaire à différents niveaux de la distribution des qualifications. Pour ce faire, nous avons proposé un cadre théorique où les individus, hommes et femmes, diffèrent par des caractéristiques observables, les qualifications, et par des caractéristiques inobservables, l'engagement au travail. Les entreprises prennent leurs décisions d'investissement et d'embauche conjointement, en tenant compte des complémentarités entre les caractéristiques des employés et celles des technologies. Les résultats de l'analyse théorique peuvent être résumés comme suit : l'intégration commerciale augmente les inégalités entre les femmes, et entre les hommes, lorsque les qualifications et le progrès technologique sont complémentaires. Si les femmes sont discriminées à cause d'une plus grande incertitude quant à leur engagement au travail, l'intégration commerciale accroît les inégalités entre hommes et femmes qualifiés lorsque l'engagement au travail et le progrès technologique sont complémentaires.

Les travaux de cette thèse participent à une meilleure compréhension de l'impact du commerce international sur les inégalités de salaire entre hommes et femmes mais la réponse est nécessairement incomplète. Nous proposons ici plusieurs pistes de recherche pour approfondir l'analyse de cette question. En ce qui concerne les effets du commerce international sur les écarts de salaire entre hommes et femmes via le canal de la concurrence, le cadre théorique que nous avons proposé utilise la théorie des préférences discriminatoires de Becker et un modèle de commerce en oligopole. Ce modèle pourrait être développé dans un cadre de concurrence monopolistique plutôt qu'oligopolistique, tout en continuant à utiliser une fonction de demande qui implique une élasticité de substitution croissante, comme par exemple dans l'article de Melitz et Ottaviano (2008). Lorsque la fonction de demande implique une élasticité de substitution croissante avec le nombre d'entreprises sur le marché, l'intégration commerciale des marchés a alors un effet pro-concurrentiel : les marges des entreprises baissent. Nous avons montré que lorsque les pays sont asymétriques, les marges des entreprises domestiques discriminantes peuvent s'accroître avec l'intégration des marchés si elles ont un avantage compétitif par rapport aux entreprises étrangères. Les travaux de Zhelobodko et al. (2012) et de Mrázová et Neary (2013) ont montré que la nature des préférences des consommateurs conditionne les effets de l'intégration commerciale et que certaines fonctions de demande peuvent même induire des effets anti-concurrentiels. Il serait intéressant d'utiliser ces apports dans un modèle avec des entreprises hétérogènes en terme d'attitude discriminatoire, afin de généraliser les conditions sous lesquelles le commerce peut augmenter les écarts de salaire dus aux préférences discriminatoires des employeurs.

Le deuxième chapitre fournit des prédictions sur le rôle joué par le commerce international dans l'évolution des inégalités salariales à l'intérieur des groupes, ici définit par le sexe, ainsi qu'entre les groupes, ici les écarts de salaire entre hommes et femmes. Ces prédictions sont en accord avec plusieurs faits empiriques établis par la littérature. Cela étant, le modèle propose des mécanismes précis pour comprendre ces faits empiriques, mécanismes qui méritent d'être testés plus spécifiquement. De futurs analyses empiriques permettraient d'identifier si la dimension de l'engagement au travail est une variable pertinente pour expliquer la distribution des écarts de salaire, et l'effet de l'ouverture commerciale sur cette distribution.

Par ailleurs, cette thèse se concentre sur les écarts de salaire dus aux différences de traitement entre hommes et femmes, pour un niveau fixé d'offre de travail et de caractéristiques productives. Il serait intéressant d'analyser la façon dont l'ouverture commerciale modifie les décisions d'offre de travail et d'investissement en capital humain, prises par les femmes et les hommes. Plusieurs mécanismes pourraient être étudiés.

La deuxième question à laquelle cette thèse apporte des éléments de réponse est celle de l'impact de l'emploi informel sur l'ampleur des inégalités entre hommes et femmes. Très peu d'analyses empiriques comparent les inégalités de genre dans les emplois formels et informels ; aucune étude, à ma connaissance, tente de comprendre pourquoi les écarts de salaire peuvent différer dans les deux segments. Pourtant, cette question est fondamentale car elle aborde une particularité importante des pays en développement, un fort taux d'emploi informel, qui ne peut pas être omise pour comprendre la formation et l'évolution des inégalités entre hommes et femmes dans ces pays.

Le troisième et dernier chapitre de cette thèse s'est employé à étudier le rôle du secteur informel dans l'ampleur des écarts de salaire entre hommes et femmes, et ainsi a introduit une autre dimension à la réflexion. L'emploi salarié est hétérogène non pas seulement par le niveau de qualification requis ou le degré d'ouverture commerciale du secteur mais aussi par l'encadrement légal auquel l'emploi est -ou non- soumis. Ce chapitre a proposé un très bref exposé des intuitions théoriques pouvant expliquer les différences de degré d'inégalité salariale dans les emplois formels et dans les emplois informels. L'apport de ce travail repose principalement sur une analyse empirique de données brésiliennes, analyse qui s'est attachée à comparer les écarts de salaire dans les deux segments du marché du travail brésilien. Il s'est agi d'évaluer l'impact de la sélection dans l'emploi sur les écarts de salaire dans chacun des segments. Les résultats de l'analyse empirique peuvent être résumés comme suit : l'écart brut de salaire est plus élevé dans le secteur informel que dans le secteur formel au Brésil. Cependant, lorsque nous prenons en compte les différences de caractéristiques observables entre hommes et femmes, les écarts ajustés de salaires sont similaires dans les deux segments du marché du travail. Ensuite, lorsque nous prenons en compte la sélection dans les différentes catégories d'emplois, le différentiel de salaire est réduit, jusqu'à n'être plus significatif, dans le secteur informel. Dans le secteur formel, en revanche, l'écart de salaire, une fois qu'on a traité le biais de sélection, demeure élevé et fortement significatif.

Un différentiel de salaire plus élevé dans le secteur formel ne signifie pas que la législation sur la protection de l'emploi porte préjudice aux femmes. Premièrement, les salaires demeurent plus élevés pour les femmes dans le secteur formel. Deuxièmement, sachant que le taux de chômage féminin est plus élevé et que les femmes ont besoin de prendre des congés maternité, l'emploi formel permet aux femmes de limiter la fluctuation de leurs revenus grâce aux allocations chômage et aux congés maternité rémunérés. L'absence de respect de la législation du marché du travail constitue un risque de perte de revenus plus important pour les femmes que pour les hommes. Aussi, d'autres analysent sont requises afin d'identifier l'impact de la régulation sur les comportements discriminants des employeurs. Il serait important d'étudier, au moyen de données de panel, comment l'emploi informel affecte les différences de revenus entre hommes et femmes tout au long de la vie. Ensuite, il serait intéressant d'explorer l'impact de la migration rurale sur les écarts de salaire entre hommes et femmes dans les emplois formels et informels. En effet, la migration rurale touche davantage les hommes que les femmes et génère des effets de sélection sur le marché du travail urbain et rural qui peuvent expliquer une partie des écarts de salaire. Enfin, de futurs travaux pourraient examiner les effets du commerce sur les écarts de salaire dans les emplois formels et informels ainsi que sur la probabilité d'être en emploi formel ou informel pour les hommes et les femmes.

Bibliographie

Abowd, John M, Francis Kramarz, and David N Margolis, "High wage workers and high wage firms," *Econometrica*, 1999, *67* (2), 251–333.

_ **, John Haltiwanger, Julia Lane, Kevin L McKinney, and Kristin Sandusky**, "Technology and the demand for skill : an analysis of within and between firm differences," Technical Report, National Bureau of Economic Research 2007.

Albanesi, Stefania and Claudia Olivetti, "Home production, market production and the gender wage gap : Incentives and expectations," *Review of Economic dynamics*, 2009, *12* (1), 80–107.

Albrecht, James, Aico van Vuuren, and Susan Vroman, "Counterfactual distributions with sample selection adjustments : Econometric theory and an application to the Netherlands," *Labour Economics*, 2009, *16* (4), 383 – 396.

_ **, Anders Bjorklund, and Susan Vroman**, "Is There a Glass Ceiling in Sweden ?," *Journal of Labor Economics*, 2003, *21* (1), pp. 145–177.

Almeida, Rita and Pedro Carneiro, "Inequality and employment in a dual economy : Enforcement of labor regulation in Brazil," 2007.

Altonji, Joseph G. and Rebecca M. Blank, "Race and gender in the labor market," in O. Ashenfelter and D. Card, eds., *Handbook of Labor Economics*, Vol. 3 of *Handbook of Labor Economics*, Elsevier, October 1999, chapter 48, pp. 3143–3259.

Amuedo-Dorantes, Catalina and Sara De la Rica, "The Role of Segregation and Pay Structure on the Gender Wage Gap : Evidence from Matched Employer-Employee Data for Spain," *The B.E. Journal of Economic Analysis and Policy*, 2006, *5* (1), 10.

Angelov, Nikolay, Per Johansson, and Erica Lindahl, "Is the Persistent Gender Gap in Income and Wages Due to Unequal Family Responsibilities ?," Technical Report, Institute for the Study of Labor (IZA) 2013.

Appleton, Simon, John Hoddinott, and Pramila Krishnan, "The gender wage gap in three African countries," *Economic Development and Cultural Change*, 1999, *47* (2), 289–312.

Arabsheibani, G Reza, Francisco Galrão Carneiro, and Andrew Henley, *Gender wage differentials in Brazil : trends over a turbulent era*, Vol. 3148, World Bank, 2003.

Arias, Javier, Erhan Artuc, Daniel Lederman, and Diego Rojas, "Trade, informal employment and labor adjustment costs," *World Bank Policy Research Working Paper*, 2013, (6614).

Arrow, Kenneth, "Some mathematical models of racial discrimination in the labour market," *Racial Discrimination in Economic Life (Lexington, 1972)*, 1972.

_ , "The theory of discrimination," *Discrimination in labor markets*, 1973, *3* (10).

Artecona, Raquel and Wendy Cunningham, *Effects of Trade Liberalization on the Gender Wage Gap in Mexico*, Vol. World Bank 2002.

Arulampalam, Wiji, Alison L Booth, and Mark L Bryan, "Is there a glass ceiling over Europe ? Exploring the gender pay gap across the wage distribution," *Industrial and Labor Relations Review*, 2007, pp. 163–186.

Becker, Gary, *The Economics of Discrimination*, University of Chicago Press, 1957.

Becker, Gary S, "A Theory of the Allocation of Time," *The economic journal*, 1965, *75* (299), 493–517.

Ben Yahmed, Sarra, "Gender wage discrimiantion and trade openness. Prejudiced employers in an open industry," AMSE Working Papers 33 2012.

Berik, Günseli, Yana van der Meulen Rodgers, and Joseph E. Zveglich, "International Trade and Gender Wage Discrimination : Evidence from East Asia," *Review of Development Economics*, 2004, *8* (2), 237–254.

Bernard, Andrew B. and J.Bradford Jensen, "Exporters, skill upgrading, and the wage gap," *Journal of International Economics*, 1997, *42* (1-2), 3 – 31.

Bertrand, Marianne, Claudia Goldin, and Lawrence F Katz, "Dynamics of the gender gap for young professionals in the financial and corporate sectors," *American Economic Journal : Applied Economics*, 2010, pp. 228–255.

Black, Sandra E. and Elizabeth Brainerd, "Importing equality ? The impact of globalization on gender discrimination," *Industrial and Labor Relations Review*, July 2004, *57* (4), 540–559.

_ **and Philip E. Strahan**, "The Division of Spoils : Rent-Sharing and Discrimination in a Regulated Industry," *American Economic Review*, September 2001, *91* (4), 814–831.

Blair-Loy, Mary, *Competing devotions : Career and family among women executives*, Harvard University Press, 2003.

Blau, Francine D and Lawrence M Kahn, "Gender Differences in Pay," *The Journal of Economic Perspectives*, 2000, *14* (4), 75–99.

_ **and** _ , "The US Gender Pay Gap in the 1990s : Slowing Convergence," *Industrial and Labor Relations Review*, 2006, pp. 45–66.

_ **, Marianne A Ferber, and Anne E Winkler**, *The economics of women, men, and work*, Prentice Hall Englewood Cliffs, NJ, 2006.

Blinder, Alan S., "Wage Discrimination : Reduced Form and Structural Estimates," *The Journal of Human Resources*, 1973, *8* (4), pp. 436–455.

Borjas, George J. and Valerie A. Ramey, "Foreign Competition, Market Power, and Wage Inequality," *The Quarterly Journal of Economics*, 1995, *110* (4), pp. 1075–1110.

Bosch, Mariano, Edwin Goñi-Pacchioni, and William Maloney, "Trade liberalization, labor reforms and formal–informal employment dynamics," *Labour Economics*, 2012, *19* (5), 653–667.

Bourguignon, François, Martin Fournier, and Marc Gurgand, "Selection bias corrections based on the multinomial logit model : Monte Carlo comparisons," *Journal of Economic Surveys*, 2007, *21* (1), 174–205.

Boye, Katarina, "Time spent working : Paid work, housework and the gender difference in psychological distress," *European Societies*, 2010, *12* (3), 419–442.

Brambilla, Irene, Rafael Dix-Carneiro, Daniel Lederman, and Guido Porto, "Skills, Exports, and the Wages of Seven Million Latin American Workers," *The World Bank Economic Review*, 2012, *26* (1), 34–60.

Brander, James A., "Intra-industry trade in identical commodities," *Journal of International Economics*, 1981, *11* (1), 1 – 14.

Budig, Michelle J. and Paula England, "The wage penalty for motherhood," *American sociological review*, 2001, pp. 204–225.

Bustos, Paula, "The Impact of Trade Liberalization on Skill Upgrading Evidence from Argentina," mimeo 2011.

Carneiro, Francisco Galrão and Andrew Henley, "Modelling Formal vs. Informal Employment and Earnings : Micro-econometric Evidence for Brazil," 2002.

Coate, Stephen and Glenn C Loury, "Will affirmative-action policies eliminate negative stereotypes ?," *The American Economic Review*, 1993, pp. 1220–1240.

Combes, Pierre-Philippe, Bernard Caillaud, and Bruno Jullien, "Common Market with Regulated Firms," *Annals of Economics and Statistics / Annales d''Economie et de Statistique*, 1997, (47), pp. 65–99.

_ , Bruno Decreuse, Morgane Laouenan, and Alain Trannoy, "Customer Discrimination and Employment OUtcomes : Theory and Evidence from the French Labor Market," Discussion Papers 2013016, Université catholique de Louvain, Institut de Recherches Economiques et Sociales June 2013.

Costinot, Arnaud and Jonathan E. Vogel, "Matching and Inequality in the World Economy," *Journal of Political Economy*, 2010, *118* (4), 747–786.

Davis, Donald R. and James Harrigan, "Good jobs, bad jobs, and trade liberalization," *Journal of International Economics*, 2011, *84* (1), 26 – 36.

Davis, Steve J., John Haltiwanger, Lawrence F. Katz, and Robert Topel, "Wage Dispersion between and within US Manufacturing Plants, 1963-86," *Brookings Papers on Economic Activity. Microeconomics*, 1991, pp. 115–200.

de la Rica, Sara, Juan Dolado, and Vanesa Llorens, "Ceilings or floors ? Gender wage gaps by education in Spain," *Journal of Population Economics*, 2008, *21*, 751–776.

Deininger, Klaus, Songqing Jin, and Hari Nagarajan, "Wage Discrimination in India's Informal Labor Markets : Exploring the Impact of Caste and Gender," *Review of Development Economics*, 2013, *17* (1), 130–147.

Dolado, Juan J, Cecilia García-Peñalosa, and Sara de la Rica, "On gender gaps and self-fulfilling expectations : altrnative implications of paid-for training," *Economic Inquiry*, 2012.

Dubin, Jeffrey A and Daniel L McFadden, "An econometric analysis of residential electric appliance holdings and consumption," *Econometrica : Journal of the Econometric Society*, 1984, pp. 345–362.

Eckstein, Zvi and Eva Nagypal, "The evolution of US earnings inequality : 1961-2002," *Federal Reserve Bank of Minneapolis Quarterly Review*, 2004, *28* (2), 10–29.

Ederington, Josh, Jenny Minier, and Kenneth R. Troske, "Where the Girls Are : Trade and Labor Market Segregation in Colombia," IZA Discussion Papers 4131, Institute for the Study of Labor (IZA) 2009.

Egger, Hartmut and Udo Kreickemeier, "Firm Heterogeneity And The Labor Market Effects Of Trade Liberalization," *International Economic Review*, 2009, *50* (1), 187–216.

_ and _ , "Fairness, trade, and inequality," *Journal of International Economics*, 2012, *86* (2), 184–196.

_ , Peter Egger, and Udo Kreickemeier, "Trade, wages, and profits," CESifo Working Paper : Trade Policy 3911 2012.

Ermisch, John F. and Robert E. Wright, "Wage Offers and Full-Time and Part-Time Employment by British Women," *The Journal of Human Resources*, 1993, *28* (1), pp. 111–133.

Fafchamps, M., "Human capital, exports, and earnings," *Economic Development and Cultural Change*, 2009, *58* (1), 111–141.

_ **, M. Söderbom, and N. Benhassine**, "Wage Gaps and Job Sorting in African Manufacturing," *Journal of African Economies*, 2009, *18* (5), 824–868.

Fally, Thibault, Rodrigo Paillacar, and Cristina Terra, "Economic geography and wages in Brazil : Evidence from micro-data," *Journal of Development Economics*, 2010, *91* (1), 155 – 168.

Fang, Hanming and Andrea Moro, "Chapter 5 - Theories of Statistical Discrimination and Affirmative Action : A Survey," in Alberto Bisin Jess Benhabib and Matthew O. Jackson, eds., , Vol. 1 of *Handbook of Social Economics*, North-Holland, 2011, pp. 133 – 200.

Flabbi, Luca, "Gender discrimination in a search model with matching and bargaining," *International Economic Review*, 2010, *51* (3), 745–783.

Fortin, Nicole M, "The Gender Wage Gap among Young Adults in the United States The Importance of Money versus People," *Journal of Human Resources*, 2008, *43* (4), 884–918.

Fortin, Nicole, Thomas Lemieux, and Sergio Firpo, "Decomposition methods in economics," *Handbook of labor economics*, 2011, *4*, 1–102.

Francois, Patrick, "Gender discrimination without gender difference : theory and policy responses," *Journal of Public Economics*, 1998, *68* (1), 1–32.

_ **and Jan C van Ours**, "Gender Wage Differentials in a Competitive Labour Market : The Household Interaction Effect," CEPR Discussion Papers 2603 November 2000.

Fujita, Masahisa, Paul Krugman, and Anthony J. Venables, *The Spatial Economy : Cities, Regions, and International Trade*, Vol. 1 of *MIT Press Books*, The MIT Press, 1999.

Gasparini, Leonardo and Leopoldo Tornarolli, "Labor informality in Latin America and the Caribbean : patterns and trends from household survey microdata," *Desarrollo y Sociedad*, 2009, (63), 13–80.

Gauthier, Anne H., Frank F. Furstenberg et al., “The transition to adulthood : A time use perspective,” *The Annals of the American Academy of Political and Social Science*, 2002, *580* (1), 153–171.

Gobillon, Laurent, Dominique Meurs, and Sébastien Roux, “Estimating Gender Differences in Access to Jobs,” IZA Discussion Papers 6928, Institute for the Study of Labor (IZA) 2012.

Goldberg, Pinelopi Koujianou and Nina Pavcnik, “The response of the informal sector to trade liberalization,” *Journal of Development Economics*, 2003, *72* (2), 463 – 496.

_ **and** _ , “Distributional Effects of Globalization in Developing Countries,” *Journal of Economic Literature*, 2007, *45* (1), pp. 39–82.

Gong, Xiaodong and Arthur Van Soest, “Wage differentials and mobility in the urban labour market : a panel data analysis for Mexico,” *Labour Economics*, 2002, *9* (4), 513–529.

Gronau, Reuben, “Sex-Related Wage Differentials and Women’s Interrupted Labor Careers-the Chicken or the Egg,” *Journal of Labor Economics*, 1988, *6* (3), pp. 277–301.

Gunther, Isabel and Andrey Launov, “Informal employment in developing countries : opportunity or last resort ?,” *Journal of Development Economics*, 2012, *97* (1), 88–98.

Gupta, Nabanita Datta, Ronald L Oaxaca, and Nina Smith, “Swimming upstream, floating downstream : Comparing women’s relative wage progress in the United States and Denmark,” *Industrial and Labor Relations Review*, 2006, pp. 243–266.

Hakim, Catherine, *Work-Lifestyle Choices in the 21st Century : Preference Theory*, Oxford University Press, 2000.

Haltiwanger, John C., Julia I. Lane, and James R. Spletzer, “Productivity differences across employers : The roles of employer size, age, and human capital,” *The American Economic Review*, 1999, *89* (2), 94–98.

Haltiwanger, John C, Julia I Lane, and James R Spletzer, “Wages, productivity, and the dynamic interaction of businesses and workers,” *Labour Economics*, 2007, *14* (3), 575–602.

Harrigan, James and Ariell Reshef, "Skill biased heterogeneous firms, trade liberalization, and the skill premium," Technical Report, National Bureau of Economic Research 2011.

Haskel, Jonathan E, Denise Donna Hawkes, and Sonia Pereira, "Skills, human capital and the plant productivity gap : UK evidence from matched plant, worker and workforce data," CEPR Discussion Papers 5334 2005.

Havet, Nathalie and Catherine Sofer, "Les nouvelles théories économiques de la discrimination," *Travail, genre et sociétés*, 2002, (1), 83–115.

Hellerstein, Judith K. and David Neumark, "Using Matched Employer-Employee Data to Study Labor Market Discrimination," in William M. Rodgers, ed., *Handbook on the Economics of Discrimination*, Vol. 3, Elsevier, 2006, pp. 29–60.

Helpman, Elhanan and Paul Krugman, *Market Structure and Foreign Trade : Increasing Returns, Imperfect Competition, and the International Economy*, Vol. 1, The MIT Press, 1987.

_ , Oleg Itskhoki, and Stephen Redding, "Inequality and unemployment in a global economy," *Econometrica*, 2010, *78* (4), 1239–1283.

_ , _ , Marc-Andreas Muendler, and Stephen James Redding, "Trade and Inequality : From Theory to Estimation," NBER Working Papers 17991, National Bureau of Economic Research 2012.

Henley, Andrew, G Reza Arabsheibani, and Francisco G Carneiro, "On defining and measuring the informal sector : Evidence from Brazil," *World Development*, 2009, *37* (5), 992–1003.

Hering, Laura and Sandra Poncet, "Market access and individual wages : evidence from China," *The Review of Economics and Statistics*, 2010, *92* (1), pp. 145–159.

Heyman, Fredrik, Helena Svaleryd, and Jonas Vlachos, "Competition, Takeovers, and Gender Discrimination," *Industrial and Labor Relation Review*, 2013, *66*, 409–511.

Iranzo, Susana, Fabiano Schivardi, and Elisa Tosetti, "Skill Dispersion and Firm Productivity : An Analysis with Employer-Employee Matched Data," *Journal of Labor Economics*, 2008, *26* (2), 247–285.

Javdani, Mohsen, "Glass Ceilings or Glass Doors ? The Role of Firms in Male-Female Wage Disparities," 2012.

Joekes, Susan, "Trade-Related Employment For Women In Industry And Services In Developing Countries," Working Paper 5, United Nations Research Institute for Social Development 1995.

Juhn, Chinhui, Gergely Ujhelyi, and Carolina Villegas-Sanchez, "Men, women, and machines : How trade impacts gender inequality," *Journal of Development Economics*, in press.

Jurajda, Stepán and Heike Harmgart, "When do female occupations pay more ?," *Journal of Comparative Economics*, 2007, *35* (1), 170 – 187.

Kambourov, Gueorgui and Iourii Manovskii, "Occupational mobility and wage inequality," *The Review of Economic Studies*, 2009, *76* (2), 731–759.

Klein, Michael W., Christoph Moser, and Dieter M. Urban, "The contribution of trade to wage inequality : the role of skill, gender , and nationality," Technical Report, National Bureau of Economic Research 2010.

Klette, Tor Jakob and Samuel Kortum, "Innovating Firms and Aggregate Innovation," *Journal of Political Economy*, 2004, *112* (5), pp. 986–1018.

Krishna, Pravin, Jennifer P. Poole, and Mine Zeynep Senses, "Trade, Labor Market Frictions, and Residual Wage Inequality across Worker Groups," *American Economic Review*, 2012, *102* (3), 417–23.

Krugman, Paul, "Scale Economies, Product Differentiation, and the Pattern of Trade," *The American Economic Review*, 1980, *70* (5), pp. 950–959.

Krugman, Paul R, "Increasing returns, monopolistic competition, and international trade," *Journal of international Economics*, 1979, *9* (4), 469–479.

Kuhn, Peter, "Demographic groups and personnel policy," *Labour Economics*, 1993, *1* (1), 49–70.

Lazear, Edward P. and Sherwin Rosen, "Male-Female Wage Differentials in Job Ladders," *Journal of Labor Economics*, 1990, *8* (1), pp. S106–S123.

Lee, Lung-Fei, "Generalized econometric models with selectivity," *Econometrica*, 1983, pp. 507–512.

Lemieux, Thomas, "Increasing residual wage inequality : Composition effects, noisy data, or rising demand for skill ?," *The American Economic Review*, 2006, pp. 461–498.

Leonardi, Marco, "Firm heterogeneity in capital–labour ratios and wage inequality," *The Economic Journal*, 2007, *117* (518), 375–398.

Lopes de Melo, Rafael, "Firm Wage Differentials and Lab or Market Sorting : Reconciling Theory and Evidence," mimeo 2013.

Lundberg, Shelly and Elaina Rose, "Parenthood and the earnings of married men and women," *Labour Economics*, 2000, *7* (6), 689–710.

Lundberg, Shelly J and Richard Startz, "Private discrimination and social intervention in competitive labor market," *The American Economic Review*, 1983, *73* (3), 340–347.

Madalozzo, Regina, "Occupational segregation and the gender wage gap in Brazil : an empirical analysis," *Economia Aplicada*, 2010, *14* (2), 147–168.

Magnac, Th, "Segmented or competitive labor markets," *Econometrica : journal of the Econometric Society*, 1991, pp. 165–187.

Maloney, William F, "Does informality imply segmentation in urban labor markets ? Evidence from sectoral transitions in Mexico," *The World Bank Economic Review*, 1999, *13* (2), 275–302.

Mayer, Thierry, Rodrigo Paillacar, and Soledad Zignago, "TradeProd. The CEPII Trade, Production and Bilateral Protection Database : Explanatory Notes," MPRA Paper, University Library of Munich, Germany 2008.

McFadden, D, "Conditional logit analysis of qualitative choice behavior," *Frontiers in Econometrics*, 1973, pp. 105–142.

Melitz, Marc J., "The Impact of Trade on Intra-Industry Reallocations and Aggregate Industry Productivity," *Econometrica*, 2003, *71* (6), 1695–1725.

_ **and Giancarlo I. P. Ottaviano**, "Market Size, Trade, and Productivity," *Review of Economic Studies*, 01 2008, *75* (1), 295–316.

Meng, Xin, "Gender earnings gap : the role of firm specific effects," *Labour Economics*, 2004, *11* (5), 555 – 573.

Menon, Nidhiya and Yana van der Meulen Rodgers, "International Trade and the Gender Wage Gap : New Evidence from India's Manufacturing Sector," *World Development*, 2009, *37* (5), 965 – 981.

Meurs, Dominique and Sophie Ponthieux, "L'écart des salaires entre les femmes et les hommes peut-il encore baisser ?," *Économie et statistique*, 2006, *398* (1), 99–129.

Michael, Robert T and Gary S Becker, "On the new theory of consumer behavior," *The Swedish Journal of Economics*, 1973, pp. 378–396.

Milgrom, Eva M. Meyersson, Trond Petersen, and Vemund Snartland, "Equal Pay for Equal Work ? Evidence from Sweden and a Comparison with Norway and the U.S.," *Scandinavian Journal of Economics*, 2001, *103* (4), 559–583.

Mion, Giordano and Paolo Naticchioni, "The spatial sorting and matching of skills and firms," *Canadian Journal of Economics/Revue canadienne d'économique*, 2009, *42* (1), 28–55.

Mrázová, Monika and J Peter Neary, "Not so demanding : preference strucutre, firm behavior, and welfare," 2013.

Neary, J. Peter, "Competitive versus Comparative Advantage," *World Economy*, 2003, *26* (4), 457–470.

Neary, J.Peter, "Foreign Competition and Wage Inequality," *Review of International Economics*, 2002, *10* (4), 680–693.

Neuman, Shoshana and Ronald L Oaxaca, "Wage decompositions with selectivity-corrected wage equations : A methodological note," *The Journal of Economic Inequality*, 2004, *2* (1), 3–10.

Nicita, Alessandro, "Who Benefits from Export-led Growth ? Evidence from Madagascar's Textile and Apparel Industry," *Journal of African Economies*, 2008, *17* (3), 465–489.

Nopo, Hugo, Juan Pablo Atal, and Natalia Winder, "New Century, Old Disparities : Gender and Ethnic Wage Gaps in Latin America," IZA Discussion Papers 5085 2010.

Oaxaca, Ronald, "Male-Female Wage Differentials in Urban Labor Markets," *International Economic Review*, 1973, *14* (3), pp. 693–709.

Oaxaca, Ronald L and Michael R Ransom, "On discrimination and the decomposition of wage differentials," *Journal of Econometrics*, 1994, *61* (1), 5 – 21.

Oaxaca, Ronald L. and Michael R. Ransom, "Identification in Detailed Wage Decompositions," *The Review of Economics and Statistics*, 1999, *81* (1), pp. 154–157.

Ogloblin, Constantin G., "The Gender Earnings Differential in the Russian Transition Economy," *Industrial and Labor Relations Review*, 1999, *52* (4), pp. 602–627.

Ohnsorge, Franziska and Daniel Trefler, "Sorting It Out : International Trade with Heterogeneous Workers," *Journal of Political Economy*, 2007, *115* (5), 868–892.

Olivetti, C. and B. Petrongolo, "Unequal Pay or Unequal Employment ? A Cross-Country Analysis of Gender Gaps," *Journal of Labor Economics*, 2008, *26* (4), 621–654.

Oostendorp, Remco H., "Globalization and the Gender Wage Gap," Policy Research Working Paper Series 3256, The World Bank 2004.

Ozler, Sule, "Export Orientation and Female Share of Employment : Evidence from Turkey," *World Development*, 2000, *28* (7), 1239 – 1248.

Pagán, José A and Miren Ullibarri, "Group heterogeneity and the gender earnings gap in Mexico," *Economía Mexicana, Nueva Época*, 2000, *9* (1), 23–40.

Paul-Majumder, Pratima and Anwara Begum, "The gender imbalances in the export oriented garment industry in Bangladesh," Development Research Group/Poverty Reduction and Economic Management Network, Washington, DC., The World Bank 2000.

Pavcnik, Nina, Andreas Blom, Pinelopi Goldberg, and Norbert Schady, "Trade Liberalization and Industry Wage Structure : Evidence from Brazil," *World Bank Economic Review*, 2004, *18* (3), 319–344.

Pendakur, Krishna and Simon Woodcock, "Glass Ceilings or Glass Doors ? Wage Disparity Within and Between Firms," *Journal of Business and Economic Statistics*, 2010, *28* (1), 181–189.

Phelps, Edmund S., "The Statistical Theory of Racism and Sexism," *The American Economic Review*, 1972, *62* (4), pp. 659–661.

Pradhan, Menno and Arthur Van Soest, "Formal and informal sector employment in urban areas of Bolivia," *Labour Economics*, 1995, *2* (3), 275–297.

Redding, Stephen and Anthony J. Venables, "Economic geography and international inequality," *Journal of International Economics*, 2004, *62* (1), 53 – 82.

Reimers, Cordelia W, "Labor market discrimination against Hispanic and black men," *The review of economics and statistics*, 1983, *65* (4), 570–579.

Rosén, Åsa, "Search, bargaining, and employer discrimination," *Journal of labor Economics*, 2003, *21* (4), 807–829.

Roy, A. D., "Some Thoughts on the Distribution of Earnings," *Oxford Economic Papers*, 1951, *3* (2), pp. 135–146.

Sampson, Thomas, "Selection into trade and wage inequality," *American Economic Journal : Microeconomics*, in press.

Santos, Renato Vale and Eduardo Pontual Ribeiro, "Diferenciais de Rendimentos entre Homens e Mulheres no Brasil Revisitado : Explorando o Teto de Vidro," *Centro Universitario Newton Paiva/MG e PPGE/UFRGS*, 2006.

Schmiedern, Johannes, "Returns to Tenure : Is Specific Human Capital Acquired on the Job ?," mimeo 2007.

Stigler, George J., "The Economies of Scale," *Journal of Law and Economics*, 1958, *1*, pp. 54–71.

Sullivan, Paul, "Estimation of an occupational choice model when occupations are misclassified," *Journal of Human Resources*, 2009, *44* (2), 495–535.

Tansel, Aysit, "Wage Earners, Self Employed and Gender in the Informal Sector in Turkey," in "in" Economic Research Forum 2001.

Weber, Andrea and Christine Zulehner, "Competition and Gender Prejudice : Are Discriminatory Employers Doomed to Fail ?," *Journal of the European Economic Association.*

Weichselbaumer, Doris and Rudolf Winter-Ebmer, "A Meta-Analysis of the International Gender Wage Gap," *Journal of Economic Surveys*, 2005, *19* (3), 479–511.

Wood, Adrian, "North-South trade and female labour in manufacturing : An asymmetry," *The Journal of Development Studies*, 1991, *27* (2), 168–189.

_ , *North-South Trade, Employment and Inequality : Changing Fortunes in a Skill-Driven World*, Oxford University Press, 1994.

Woodcock, Simon D, "Wage differentials in the presence of unobserved worker, firm, and match heterogeneity," *Labour Economics*, 2008, *15* (4), 771–793.

Wright, Robert E and John F Ermisch, "Gender discrimination in the British labour market : a reassessment," *The Economic Journal*, 1991, *101* (406), 508–522.

Yeaple, Stephen Ros, "A simple model of firm heterogeneity, international trade, and wages," *Journal of International Economics*, 2005, *65* (1), 1 – 20.

Yun, Myeong-Su, "An extension of the Oaxaca decomposition using generalized residuals," *Journal of Economic and Social Measurement*, 2007, *32* (1), 15–22.

Zhelobodko, Evgeny, Sergey Kokovin, Mathieu Parenti, and Jacques-François Thisse, "Monopolistic competition : Beyond the constant elasticity of substitution," *Econometrica*, 2012, *80* (6), 2765–2784.