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Bastien Alvarez. Marchés du travail et migrations dans une économie européenne intégrée. Economics and Finance. Université Paris-Saclay, 2020. English. NNT : 2020UPASI007 . tel-03167560

HAL Id: tel-03167560

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Marchés du Travail et Migrations dans
une Économie Européenne Intégrée

*Labour Markets and Migrations in an
Integrated European Economy*

Thèse de doctorat de l'Université Paris-Saclay

École doctorale n° 578, Sciences de l'Homme et de la
Société (SHS)

Spécialité de doctorat: Sciences économiques

Unité de recherche : Université Paris-Saclay, ENS Paris-Saclay, Centre
d'Économie de l'ENS Paris-Saclay, 91190, Gif-sur-Yvette, France

Référent: ENS Paris-Saclay

Thèse présentée et soutenue à Paris-Saclay, le 17 décembre 2020, par

Bastien ALVAREZ

Composition du jury:

Matthieu Crozet Professeur, Université Paris-Saclay	Président
Maria Bas Professeure, Université Paris 1 Panthéon-Sorbonne	Rapporteur
Pamina Koenig Professeure, Université de Rouen	Rapporteur
Simone Bertoli Professeur, Université Clermont Auvergne	Examineur
Jean-Christophe Poutineau Professeur, Université de Rennes 1	Examineur

Direction de la thèse:

Hubert Kempf Professeur, ENS Paris-Saclay	Directeur
-----------------------------------------------------	-----------

Acknowledgements

C'est avec reconnaissance que je pense à toutes les personnes ayant contribué à faire de ces dernières années une réussite. Elles se sont révélées formatrices, stimulantes et parfois difficiles et le cours qu'elles ont pris doit beaucoup aux professeurs, collègues et amis que j'ai côtoyé. Tout sentiment de gratitude n'ayant pas vocation à être couché par écrit, ces quelques lignes n'ont pas de prétention à l'exhaustivité.

Je souhaite d'abord remercier mon directeur, Hubert Kempf qui m'a donné la possibilité de me lancer dans ce processus. Ayant suivi son cours en master 2 ETE, je savais notre intérêt pour les questions européennes partagé. J'ai été très heureux de pouvoir commencer une thèse sous sa direction et je lui suis reconnaissant pour sa patience et sa compréhension. Vos commentaires ont beaucoup contribué à améliorer mon travail et j'ai beaucoup appris concernant l'économie théorique grâce à vous.

Maria Bas et Pamina Koenig ont accepté de rapporter cette thèse et je les en remercie sincèrement. Je suis certain que leurs commentaires et leurs remarques vont permettre d'améliorer ce travail. Je remercie aussi Simone Bertoli, Matthieu Crozet et Jean-Christophe Poutineau pour leur présence dans mon jury et d'avoir consacré du temps à mon travail.

Toute ma reconnaissance va à mes co-auteurs, pas simplement pour le travail effectué en commun, sans lequel je n'aurais pas pu écrire cette thèse, bien évidemment, mais aussi pour leur soutien constant. La collaboration avec Gianluca a toujours été très fluide et il a m'a beaucoup appris par ses méthodes de travail, par ses connaissances en économétrie et par sa manière de présenter en séminaire. Je le remercie aussi pour la disponibilité et l'aide qu'il m'a apporté sur le reste de ma thèse. Merci à Enxhi qui, par ses connaissances techniques sur les chaînes de valeur ajoutée, a rendu possible l'écriture du deuxième chapitre. Elle m'a beaucoup inspiré : sa discipline de travail et sa capacité à travailler quelles que soient les circonstances sont exemplaires. Enfin, je dois faire part de ma très grande reconnaissance envers Farid. Il m'a permis de travailler avec lui et Gianluca et cette collaboration a accouché d'un beau chapitre. Par ailleurs, nos discussions, ses conseils et ses pressions - bien intentionnées - ont été indispensables à la réussite de cette thèse. Je le remercie aussi pour son appui dans ma recherche d'un post-doctorat pour

cette année. La confiance qu'il m'a accordé depuis plus de deux ans maintenant me touche sincèrement.

Je souhaite aussi remercier mon laboratoire, le CEPS (ancien CES-Cachan), de m'avoir donné l'opportunité de côtoyer une telle équipe et de m'avoir fourni d'aussi bonnes conditions de travail avec des bureaux spacieux (bien qu'un peu frais l'hiver) et la possibilité de participer à des conférences qui ont favorisé mon développement professionnel. Pendant ces années Emmanuelle a toujours été disponible et attentive à notre bien-être et notre réussite. Pour cela et pour son rôle dans mon comité de suivi je l'en remercie. La thèse n'aurait évidemment pas été la même sans tous les collègues doctorants. Je suis particulièrement reconnaissant à Samuel qui m'a accueilli dans le laboratoire comme doctorant « senior » et m'a grandement aidé d'un point de vue personnel et professionnel. Je remercie aussi particulièrement Julien et Florian pour leur aide, leur soutien et leur présence au laboratoire et au cours de ces années. Merci également aux doctorants et ex-doctorants du laboratoire, Marine, Sébastien, Ninon, Alix, Loïc, Juan Daniel, Maiva, pour les moments passés au laboratoire et nos repas. Je souhaite le meilleur à ceux qui sont toujours en train d'avancer sur leur thèse. Un petit mot de remerciement aussi pour Eva, gestionnaire du laboratoire, pour sa disponibilité et son aide.

Ayant passé près d'un an à travailler au Cepii sur les données qui ont servi au chapitre 3, je me dois de remercier l'équipe pour l'hébergement et pour son accueil. J'ai pu y rencontrer des économistes de grande qualité et le temps passé y fut très agréable. Sur ce dernier point, mes collègues de bureau, Kevin, Julia et Sarah, ont joué un rôle clé et je les remercie pour leur présence.

Différents chercheurs ont pris le temps de s'intéresser à mon travail au cours de ces quatre années et de faire des commentaires ayant permis de l'améliorer. Ma reconnaissance va à Erwan Moussault, Hippolyte d'Albis, et Francesco De Palma, entre autres. Elle va aussi à Agnès Benassy-Quéré avec laquelle j'ai fait mon mémoire de M2 et qui m'a soutenu par la suite dans mon souhait de continuer avec une thèse.

En raison de l'intérêt pour la recherche économique qu'ils m'ont transmis et de la possibilité qu'ils m'ont donné de travailler avec eux, je remercie aussi Balázs Egert, Zack Brown et Nick Johnstone. Le rôle de mes amis au cours de ces quatre années a été capital pour mon moral. Je me dois cependant de mettre en avant ma gratitude à l'égard de Robin et Abder pour les séminaires de travail et discussions sur cette expérience que nous partageons ainsi que

Kamran pour son rôle décisif dans mes études et son amitié continue depuis lors.

Comme tout un chacun, je dois remercier ma famille et plus particulièrement mes parents. Pour m'avoir soutenu dans le désir d'effectuer un doctorat mais aussi pour leur rôle dans l'apparition de certaines des qualités qui m'ont permis de le mener à son terme. Il peut s'agir de la stimulation particulière qui émane d'une grande famille, de leurs encouragements à la curiosité, de leur ouverture d'esprit ou de toute autre raison que je ne peux imaginer, mais je leur en suis reconnaissant.

Enfin ma gratitude va à celle qui m'est la plus intime pour son soutien, son aide, ses conseils, sa patience, son amour, sa volonté d'être à mes côtés et qui me pousse ainsi à m'améliorer et à me dépasser.

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Résumé en Français

L'étendue de la construction européenne laisse aujourd'hui peu de domaines en marge. Ce qui était au départ principalement un projet commercial a progressivement pris de l'ampleur et s'est mué en une union douanière, une union monétaire, une zone de libre circulation et un marché unique. L'intensification des échanges et des flux migratoires en ayant résulté est l'aspect le plus voyant de cette intégration économique européenne et il contribue à une intégration partielle des marchés du travail nationaux. C'est aussi le plus critiqué : les échanges mettent en concurrence des travailleurs de pays différents alors que les migrations accroissent la concurrence au sein de chaque marché du travail.

Cette thèse traite des effets de l'intégration européenne sur les marchés du travail en étudiant les interactions entre politiques européennes et des sujets aussi variés les choix éducatifs, les conditions de travail, le niveau des salaires et les délocalisations. Des méthodes variées, théorique et empiriques, sont employées pour cela.

Le reste de ce résumé aborde un par un les chapitres de la thèse. Chaque chapitre peut être lu de façon indépendante; une trame générale les lie cependant ensemble. Le premier et le deuxième chapitre étudient tous deux l'effet de la mobilité des travailleurs sur des facteurs de moyen ou long-terme : l'éducation et les choix de localisation de production des entreprises. Les chapitres 2 et 3 s'intéressent quant à eux aux effets de politiques liées aux élargissements de l'UE en 2004 et 2007. Bien évidemment, les effets de l'intégration européenne sur le marché du travail forment un thème englobant l'ensemble de cette thèse.

Chapitre 1: Mobilité des travailleurs et hétérogénéité des compétences en Europe

L'objectif du premier chapitre est de réconcilier deux branches de la littérature économique sur la mobilité des travailleurs afin de réévaluer la valeur de celle-ci comme mécanisme d'ajustement en Europe. D'un côté, la mobilité des travailleurs est considérée comme un moyen d'ajustement utile face

aux chocs de court-terme (voir Mundell 1961, Bayoumi 1994 et Farhi and Werning 2014). La littérature empirique a montré que, partant d'un niveau assez bas dans les années 90 (Decressin and Fatas, 1995), son utilité s'est renforcée depuis la création de l'Euro et la Grand Récession (Beyer and Smets 2015, Jauer et al. 2019 et Arpaia et al. 2016). D'autre part, la littérature du *brain drain/gain* explore les interactions entre mobilité des travailleurs et décisions d'investissement éducatif et leurs implications de long-terme (Mountford 1997, Stark, Helmenstein, and Prskawetz 1997, Beine, Docquier, and Rapoport 2001, Docquier and Rapoport 2012, Beine, Docquier, and Rapoport 2001, Stark and Wang 2002 or Docquier and Rapoport 2012). Les opportunités migratoires accroissent les incitations à l'éducation en raison de différences de rentabilité de celle-ci dans les pays d'origine et à l'étranger. Si une grande partie de la main d'œuvre éduquée décide de se rendre à l'étranger, l'existence d'opportunités liées à la migration peuvent causer une perte nette en capital humain pour le pays d'origine (*brain drain*). Mais un gain net est aussi possible si l'effet portant sur les incitations est plus important sur le stocks de capital humain que celui de l'émigration. Ce mécanisme repose entièrement sur l'existence de différences de productivité ou de salaires persistantes entre les pays concernées. Bien qu'en Europe celles-ci soient limitées, prendre en compte les relations entre mobilité et éducation a un intérêt. Les citoyens de l'UE-15 vivant dans un autre pays de la même zone sont relativement plus éduqués que la population générale et cet écart s'accroît avec le temps.

Ainsi, ce chapitre présente un modèle à générations imbriquées permettant de réconcilier les éléments présentés auparavant. Ainsi il comprend deux pays identiques où des agents hétérogènes investissent dans leur éducation en présence de fluctuations économiques. De manière à reproduire le contexte Européen, il n'y a pas de différences persistantes de productivité entre pays mais uniquement des chocs aléatoires qui conduisent à des cycles migratoires. La rentabilité de l'éducation est ainsi globalement similaire dans les deux pays et, à la différence de la majorité de la littérature sur le *brain drain*, la possibilité pour les agents économiques de migrer ne suffit pas à elle seule à augmenter le niveau d'éducation et de compétence.

Nous montrons que si les agents peuvent migrer, des chocs de court-terme amène toutefois à une augmentation générale du niveau d'éducation. En effet, dans une économie en récession la migration est perçue comme une option permettant d'augmenter son salaire à condition de pouvoir en payer le coût. L'existence d'une telle option renforce les incitations à s'éduquer pour

accroître son revenu futur et faciliter le paiement du coût de migration. Cet effet pro-éducation repose ainsi davantage sur la présence d'un coût de migration que sur une différence de productivité entre les deux pays. Du rôle de coût résulte aussi un arbitrage à effectuer entre d'un côté l'effet pro-éducation et de l'autre la taille des flux migratoires et leur capacité comme mécanisme d'ajustement. Conformément aux observations, les agents les plus éduqués ont aussi une tendance à migrer plus forte, étant plus à même de payer le coût de migration. L'utilisation de la base de données "Migration" de l'OCDE permet ensuite de confirmer empiriquement le rôle du coût de migration dans la taille des flux migratoires en Europe.

La dernière étape consiste à simuler le modèle pour estimer les effets macroéconomiques de la mobilité des travailleurs. Elle permet d'illustrer l'effet persistant d'un choc de productivité dans le temps ainsi que l'arbitrage évoqué auparavant. De plus, la simulation nous autorise à étudier les conséquences de la mobilité des travailleurs et des chocs sur les inégalités. La présence d'un choc positif de productivité dans le pays domestique y réduit les inégalités tout en les augmentant à l'étranger. En effet, l'arrivée de travailleurs qualifiés dans cette économie domestique accroît la compétition entre travailleurs de qualifications similaires et réduit ainsi le salaire de ces derniers, *ceteris paribus*, tandis que l'effet opposé a lieu dans le pays étranger. La simulation permet de comparer deux régimes migratoire – frontières ouvertes ou fermées – et suggère que les inégalités internes aux pays et entre eux sont plus élevées quand il est possible de migrer.

Ce chapitre contribue à la littérature économique en montrant la possibilité d'un effet pro-éducation des migrations ne reposant pas tant sur des différences de productivité que sur la présence d'un coût de migration. Par ailleurs, il montre que deux effets potentiellement positifs de la mobilité des travailleurs (effet sur l'éducation et ajustement économique) portant sur deux échelles de temps différentes sont substitués.

Chapitre 2: L'intégration européenne et l'arbitrage entre délocalisations et immigration

Ce chapitre étudie le lien entre flux migratoire Est-Ouest en Europe et chaînes de valeurs globales après l'élargissement de l'UE de 2004 et montre que les migrations réduisent les délocalisations. La littérature économique a exploré une grande variété de canaux liant migrations et commerce. Par exemple,

à travers l'effet de réseaux les migrations réduisent les frictions informationnelles et favorisent ainsi le commerce (e.g., Gould 1994, Head and Ries 1998, Rauch and Trindade 2002 et Felbermayr and Toubal 2012). Nous nous concentrons ici sur la relation entre délocalisations et emploi de travailleurs étrangers. Celle-ci a été introduite dans la littérature par Ramaswami (1968) puis plus récemment formalisée par Olney (2012) et Ottaviano, Peri, and Wright (2013). Il n'y a pas de consensus empirique concernant la nature de cette relation (voir Kugler and Rapoport 2005 et Barba Navaretti, Bertola, Sembenelli, et al. 2008 du côté de la complémentarité et Javorcik et al. 2011 ou Ottaviano, Peri, and Wright 2013 en faveur d'une substituabilité). Afin de faciliter l'identification, ce chapitre fait usage d'une particularité du processus d'ouverture des marchés du travail ouest-européens aux travailleurs d'Europe de l'Est et de l'analyse du commerce international en chaînes de valeurs et montre ainsi une substituabilité entre l'emploi de travailleurs étrangers et les délocalisations. Nous utilisons l'existence de mesures transitoires limitant la libre circulation des citoyens est-européens imposées suite à l'élargissement de 2004. Ces restrictions ont été mises en place par la majorité des pays de l'UE-15 et visaient à limiter les flux l'arrivées de travailleurs des nouveaux Etats Membres. Leur suppression s'est faite de façon échelonnée à travers l'Europe de l'Ouest ce qui a donné à des différences dans la dynamique des flux d'migratoires provenant d'Europe Centrale et Orientale entre les pays de destination. Nous combinons les données de l'enquête européenne sur les forces de travail pour l'aspect migrations avec la base de données WIOD pour l'aspect commerce international. Ainsi nous pouvons construire des indicateurs au niveaux sectoriel et occupationnel et le WIOD nous permet de calculer le commerce de biens intermédiaires en valeur ajouté, une mesure des délocalisations n'ayant pas été utilisé dans la littérature dans laquelle ce travail s'inscrit. Notre méthode d'identification repose sur l'échelonnement de l'ouverture des marchés du travail ouest-européens et sur l'utilisation d'une stratégie de variable instrumentale qui évite le problème d'endogénéité de cet exercice.

Nos résultat montrent que, suite à l'ouverture des marchés du travail ouest-européens, les secteurs ayant été confrontés à un choc migratoire plus important importent moins de valeur ajouté incorporé dans les biens intermédiaires en provenance d'Europe de l'Est. Cette effet concerne principalement les travailleurs peu qualifiés. Une fois les restrictions de circulation levées, il est devenu relativement plus aisé pour les entreprises d'Europe de l'Ouest d'importer des travailleurs plutôt que des biens. En conséquence, la présence

de travailleurs peu qualifiés est-européens s'est accrue en à l'Ouest alors que les délocalisations ont diminué, *ceteris paribus*. Un calcul simple permet d'estimer que les délocalisations de la production à direction des 10 nouveaux États Membres ont été réduite d'une valeur de 3,5 milliards € pendant la période ayant suivi la libéralisation des marchés du travail de l'Ouest. De plus, nous montrons que les chaînes de valeurs mondiales ont été affectées puisque les délocalisations à destinations d'autres zones du monde ont aussi été réduite. Nous apportons aussi des éléments de preuve montrant que cette dynamique ne s'est pas faite au détriment des travailleurs natifs.

Ce travail est, à notre connaissance, le premier à fournir des preuves concernant l'effet de l'ouverture des marchés du travail ouest-européens sur les chaînes de valeurs mondiales. Nous contribuons aussi à la littérature par l'étude de la relation commerce-migrations au niveau sectoriel et occupational.

Chapitre 3: Libéralisation commerciale, syndicats et travailleurs: salaires et conditions de travail

Dans le dernier chapitre, nous utilisons une nouvelle base de données au niveau travailleurs et portant sur 9 pays d'Europe Centrale et Orientale pour comprendre les effets d les salaires et conditions de travail de la libéralisation commerciale entraînée par les élargissements de l'UE en 2004 et 2007. A cette occasion les nouveaux Etat Membres ont dû calquer leurs régimes tarifaires sur celui utilisé par l'UE ce qui s'est traduit en pratique par une baisse substantielle des droits de douanes. La littérature traditionnelle portant sur les libéralisations commerciales mettait l'accent sur ses conséquences mesurées en terme d'emploi et de salaires (Richardson (1995)), mais des études plus récentes ont revitalisé cette question en apportant des preuves solides de l'impact négatif d'épisodes de libéralisation sur l'emploi dans des pays développés (Autor, Dorn, and Hanson, 2013; Dauth, Findeisen, and Suedekum, 2014) ou en développement (Topalova, 2007; Dix-Carneiro and Kovak, 2017; Dix-Carneiro and Kovak, 2019). Ces nouvelles études se basent en général sur une analyse au niveau des marchés du travail locaux, mais se concentre sur un pays unique, ce qui ne permet pas de comprendre comment des facteurs au niveau national pourraient influence les réactions locales aux libéralisations.

Notre analyse empirique fait usage d'une large base de données d'environ 2.8 millions de travailleurs vivant à travers 9 pays et 20 régions d'Europe

Centrale et Orientale en 2014. Ceci nous permet d'étudier comment la libéralisation commerciale interagit avec une mesure de la libéralisation des marchés du travail : l'évolution du taux de syndicalisation. Il existe une littérature conséquente montrant la forte influence de ce taux sur les salaires et l'emploi (Freeman and Medoff 1984, Blanchflower and Bryson 2004, Barth, Bryson, and Dale-Olsen 2020), mais pas sur les conditions de travail. D'autre part, le processus d'entrée de ces 9 pays dans l'UE fut accompagné d'une baisse considérable, et différenciée selon les pays, du taux de syndicalisation, apportant ainsi une variation amplement suffisante pour identifier statistiquement les liens potentiels avec la libéralisation commerciale. De plus, au-delà de la question des salaires, ce chapitre étudie une nouvelle marge d'ajustement sur le marché du travail : les conditions de travail. Nous utilisons une définition large de ces conditions : les heures travaillées au-delà du temps de travail "ordinaire", ce qui inclut le travail en rotation, le travail pendant le weekend ou la nuit. Ces formes d'organisation du travail ont des conséquences négative en termes de santé et nous permettent d'explorer une autre dimension des effets de la libéralisation sur le bien-être.

Notre stratégie empirique repose sur la comparaison des salaires et conditions de travail de travailleurs à tout point de vue identiques mais vivant dans des régions faisant face à des chocs de libéralisation commerciale différents. Nous suivons Kovak (2013) et Dix-Carneiro and Kovak (2017, 2019) pour la construction de ce type de choc régional. Nos résultats montrent que la baisse des droits de douanes a réduit les salaires et détériorer les conditions de travail. D'après nos estimations, un travailleur moyen vivant dans une région où la baisse des droits de douanes est 10 points de pourcentages plus forte dispose d'un salaire horaire 5% plus faible que des travailleurs équivalent vivant dans d'autres régions. Ces effets sont renforcés par l'érosion des institutions protectrices du marché du travail que les 9 pays de notre échantillon ont connu au cours du processus d'intégration à l'UE. Nos résultats montrent que ces effets diffèrent à travers les régions, les secteurs, les firmes et les travailleurs.

Ce chapitre contribue ainsi à la littérature économique du fait de l'étude conjointe des libéralisations commerciales et du marché du travail. Ceci est permis par l'utilisation de données au niveau travailleurs pour plusieurs pays simultanément : nous pouvons étudier la manière dont l'érosion des taux de syndicalisation oriente les conséquences de la libéralisation commerciale sur le marché du travail. Ce chapitre innove par ailleurs par l'utilisation des conditions de travail comme sujet d'étude, du fait du manque d'intérêt y

ayant été dévolu par la littérature économique bien que l'impact sur la santé soit démontré.

General Introduction

“L’originalité française tient au fait que la démocratie parlementaire est acquise avant même que ne se soient produits les grands bouleversements industriels [...] Malgré les besoins en main d’œuvre de la grande industrie, les élus républicains sont contraints pour enraceriner le nouveau régime de multiplier les concessions [...] Jusqu’ici, personne n’a expliqué par quelle magie sociale les paysans ont pu rester en majorité sur leurs terres et les classes moyennes s’étoffer considérablement sans que cela empêche les “grandes usines” de tourner [...] C’est à ce niveau qu’il faut faire intervenir l’immigration. En effet, avec l’unification du marché du travail, les anciennes formes de cloisonnement (marchés régionaux, divisions ville/campagne, etc.) ont cédé la place à de nouvelles segmentations incompréhensibles si on ne les rapporte pas à la nouvelle logique parlementaire qui leur donne naissance. ”

Gérard Noiriel, *Le Creuset français*

This thesis delves into the transformations brought by European integration to a wide array of policy relevant issues, including education choices, working conditions, wages and offshoring. To that end both theory and empirical methods are used, involving diverse quantitative techniques and large micro-level datasets.

European construction started as a mostly commercial project but now encompasses a large number of policies, integrated up to different points. Going beyond a simple free-trade area, the European Union is also a custom union, a monetary union, an open borders area and a single market. Central to the realization of the latter is the guarantee of four freedoms - movements, goods, services, capital and workers - leading to a large level of economic integration. In particular, the complete tariff liberalization, the establishment of a free trade zone, a custom union and common rules facilitated within-EU trade over the years. The resulting increase in trade and GDP described in the literature is relatively large but very heterogeneous across Europe (Felbermayr, Gröschl, and Heiland, 2018; in 't Veld, 2019; Mayer, Vicard, and Zignago, 2019). The process also led to the liberalization of mobility between

Member States and fostered migration across the zone. In 2018, intra-EU-28 movers represent 4.2% of the working-age population. Of course, the distribution of those movers is not uniform in term of origin and destination. For instance, the 2004 enlargement resulted in a substantial rise in the population from new member states in other EU countries (Kahanec et al. 2013, Holland et al. 2011). The central role of these migrants in short-term labor mobility across Europe (see Bertoli, Brücker, and Moraga, 2013) is also relevant for the functioning of the monetary union. Even within the EU-15, migration flows are quite substantial : around 0.5% of Euro Area nationals settled in Germany at some point from 2010 to 2016. Research also show that mobility has increased Europe since the 1990 (Beyer and Smets 2015 Jauer et al. 2019 Arpaia et al. 2016).

As working in a different country and importing goods from another part of Europe gets easier, competition between workers beyond national borders becomes more prevalent. This phenomenon feeds a need for common labour market rules (for instance posted workers regulation, portability of unemployment rights, mutual recognition of diplomas) that reinforces the integration process but also affect national dynamics regarding labour market institutions. Such dynamics however largely remain national, due to the heterogeneity in the implementation of common European policies but also the size of migrations flows. Chapter 1 discusses in greater detail the level of labour mobility in Europe and in Western Europe. This justifies the mention of "labour markets" in the title of this thesis.

The Brexit however vividly demonstrates the opposition that these changes can spark and that there is a possibility to stop or reverse European integration. As far-right parties have been shown to benefit from both trade liberalization (Colantone and Stanig, 2018; Dippel et al., 2020) and immigration (Otto and Steinhardt, 2014; Barone et al., 2016; Harmon, 2018; Edo et al., 2019) across Europe, this perspective is not unique to Great Britain. Therefore, studying any of these single reform has merit by itself under a public policy point of view, but three additional reasons can be brought forward to explain the wider benefit of studying European integration. First, the heterogeneity of European countries allows to study the effect of policies in ways that would not be possible for single countries. The interaction of national and European policies allows to distinguish with greater ease the interaction between policies implemented at different levels. This advantage is used in Chapter 3 to understand the interaction between national level labour market institutions and European-level trade policy. It constitutes one of the main

contributions to the associated literature. Differences of the timing of implementation of a common European policy by member states can also bring public policy heterogeneity within the EU. The identification in Chapter 2 relies on the staggered removal of freedom of movement restrictions.

Second, in terms of methodology, the European integration process being foremost a political process, it is relatively easier to differentiate the policy from the structural change that might allow increased integration (such as improvement in transportation and communication technology). Economic integration is hardly unique to Europe. Developed countries witnessed such transformation over the course of the 19th and 20th century, but the political frameworks were usually pre-existing to the technological determinant of integration. In the USA, the common market was established by the Constitution of 1787. Tariffs between State were suppressed, and the common trade policy was entrusted to the Federal government. However, substantial integration of the US market only occurred when technology allowed it, for instance railway in the second part of the 19th century (Donaldson and Hornbeck, 2016) or highways in the first part of the 20th century (Michaels, 2008). In India, unified under British colonial rule and whose main internal customs disappeared in 1879, the role of railways in promoting economic integration was also important (Donaldson, 2018). In the case of France, the economic unification of France and its link with migration and politics is nicely formulated by Gerard Noiriel in the citation preceding this introduction. Immigration went hand in hand with the modernization of the economy and facilitated the process. Although political constraints partly explain this recourse to immigration, the political framework was already largely complete when economic integration occurred in France and in the other previous examples. For Europe, in contrast, the limiting factor to integration is more political and the current organization of the EU was designed with the objective of developing economic integration of countries that were *already integrated* at the national level. Regardless of the EU, Member States continue to advance policies promoting national economic integration and adaptation to new technologies. Hence, European integration takes the form of a series of new common or harmonized policies that reshape in part the economic structure of member states, while other exogenous factors that could complexify the analysis, such as technology, are less of important than for other historic examples.

Third, the study of the European experience constitutes a useful benchmark for other current and future similar efforts around the world. The extent of the European integration process is such that it brings insights for the different ways in which economic integration might be conducted elsewhere. Various organizations have already been created with the objective of creating common markets, such as the Association of Southeast Asian Nations (ASEAN), the Mercosur in South America, the Eurasian Economic Space, comprising Russia surrounding countries. Two custom and monetary unions are present in Central and Western Africa. The latter aspires, supplemented with other West African countries, to create a single market with a common currency. Similar plans are harboured in the Arabic peninsula by the Gulf Cooperation Council. Other customs unions exist in Central and South America and in East and Southern Africa.

The three chapters of this thesis are independent but not unrelated. The first and the second chapters deal with the effect of labour mobility on medium to long term factors, namely education and firms' production location decision. The second and third chapters study the effect of policies that are part of the EU enlargements of 2004 and 2007. The labour market and, in particular, how it is affected by EU integration, is a common theme of all chapters. The rest of the introduction describes the context, content and main contributions of each chapter to the economic literature.

Chapter 1: Labour mobility and skill heterogeneity in Europe

The first chapter aims at bringing together two branches of the economic literature on labour mobility in order to reassess its value as an adjustment mechanism in Europe. On one hand, labour mobility is considered a useful mechanism of adjustment to short-term shocks (see Mundell 1961, Bayoumi 1994 and Farhi and Werning 2014). Starting from a relatively low point in the 1990's (Decressin and Fatas, 1995), empirical research demonstrate an increase in the relevance of that adjustment mechanism in Europe since the creation of the Euro Area and the Great Recession (Beyer and Smets 2015, Jauer et al. 2019 and Arpaia et al. 2016). On the other hand, the interaction between labour mobility and decisions to invest in education brings long-term implications that are explored in the brain drain/gain literature (Mountford 1997, Stark, Helmenstein, and Prskawetz 1997, Beine, Docquier,

and Rapoport 2001, Docquier and Rapoport 2012, Beine, Docquier, and Rapoport 2001, Stark and Wang 2002 or Docquier and Rapoport 2012). Migration opportunities reinforce education incentives due to different education return at home and abroad. If a large share of the educated workforce decides to go abroad, migration opportunities can result in a net loss of human capital (“brain drain”) for the source country. Alternatively, if the increased incentives to educate has a larger effect on the stock of human capital than emigration a “brain gain” is observed. The entire mechanism relies on the existence of a persistent productivity or wage gap between the countries. Considering the interplay between labour mobility and education is not baseless in Europe, despite the lack of such large gaps between countries. Indeed, EU-15 citizens living in another EU-15 countries are increasingly more educated than the general population.

In that light, this chapter presents an overlapping generation model that should be able to reconcile those facts. It comprises two identical countries with heterogeneous agents investing in education and economic fluctuations. The model is designed to fit the European context : there is no permanent productivity differential but only random shocks that drive migration cycles. Hence the expected return of education is broadly similar in the two countries and, in contrast to most brain drain models, labour mobility does not by itself raise human capital.

Nonetheless, it is shown that if agents are mobile, short-term asymmetric shocks lead to a population-wide upgrade in skills. Indeed, in a depressed economy the possibility to migrate provides an outside option for agents willing to pay a migration cost. It reinforces incentives to educate and be more skilled in order to pay for such option if needed. The skill upgrade effect therefore relies on the presence of a migration cost and hedging against risk and not only on productivity differences between the two countries. The role of the migration cost also points toward a trade-off between the skill upgrade effect and the size of migration flows and its value as an adjustment mechanism. In accordance with observation, this mechanism also results in a skill-biased migration pattern as the most educated agents are more likely to be able to afford the migration cost. Using the OECD migration database, empirical evidence is provided to confirm the role of migration costs in the size of migration flows in Europe.

In a final step, a simulation of the model is conducted to assess the macroeconomic effects of labour mobility. It allows to illustrate the persistent effect of productivity shocks as well as the trade-off mentioned earlier. Additionally,

it allows to derive insights on the practical consequences of labour mobility and productivity shocks on inequality. The occurrence of a positive productivity shock in the domestic country leads to a reduction in inequality there but in an increase abroad. The arrival of highly skilled workers in the high productivity country strengthen competition within that skill group and reduces wages of the highest earners, while the opposition effect occurs abroad. The use of simulation also allows a comparison between the two migration regimes - open or closed borders - that suggest a higher level of within and between countries inequality when migrating is possible.

Overall that chapter contributes to the literature by highlighting the presence of a skill upgrading effect that is not reliant so much on productivity differences than on the presence of migration costs and hedging against risk. Moreover, it points out that two potentially beneficial effects of labour mobility on two different time frames (skill upgrade and economic adjustment) are substitutes.

Chapter 2: European integration and the trade-off between offshoring and immigration

The second chapter investigates the link between East-West migration flows in Europe and global value chains after the 2004 European enlargement to provide evidence that migration leads to a reduction in offshoring. A diversity of channels linking trade and migration have been explored by the economic literature. Such mechanisms includes the network effect, where migration reduces information frictions and therefore fosters trade (e.g., Gould 1994, Head and Ries 1998, Rauch and Trindade 2002 and Felbermayr and Toubal 2012). We focus here on the relationship between production offshoring and foreign workers employment that was first discussed by Ramaswami (1968) and more recently formalized by Olney (2012) and Ottaviano, Peri, and Wright (2013). Empirical studies disagree on the nature of that relationship (see Kugler and Rapoport 2005 and Barba Navaretti, Bertola, Sembenelli, et al. 2008 on the complementarity side and Javorcik et al. 2011 or Ottaviano, Peri, and Wright 2013 on the substitutability side).

To facilitate identification, this chapter uses a specific aspect of the opening of Western Europe labour markets to Eastern European workers and international trade value chain analysis to demonstrate a substitutability between employment of foreign workers and offshoring. We make use of the

implementation of optional transitional restrictions on freedom of movement that immediately followed the 2004 EU enlargement. These restrictions aimed at limiting the inflows of workers from new Members States and were put in place by most of the EU-15 countries. Their removal was staggered across Western Europe and led to different dynamics of immigration from Central and Eastern Europe for each country of destination. We combine data from the European Labour Force Survey on the migration side with the World Input-Output Database (WIOD) for the trade aspect. This allows use to conduct estimation at the sector and occupational level. Moreover, the WIOD dataset is used to construct intermediate goods in value added, a measure of offshoring that was not used in that literature before. Our identification strategy relies on the staggering of the opening of Western Europe labour markets to Eastern Europeans workers and on an instrumental variable, hence tackling potential endogeneity in the trade-migration relationship.

We find that Western European sectors with larger post-liberalization migration shocks import less value in intermediate goods from Eastern Europe. This effect mostly concerns the immigration of low skilled workers. We explain that once the movement of labour restrictions were removed, it became relatively easier for firms to import workers rather than goods. This resulted in an increased presence of low occupation Eastern European workers in Western Europe and lower offshoring, *ceteris paribus*. Back-of-the-envelope calculation indicates that offshoring to the 10 new Member States was reduced by 3.5 billion \$ in the period following opening of labour markets. Moreover, we show that offshoring to other area of the world is also reduced, hence affecting global value chains. We also bring evidence that this change was not detrimental to native workers.

This work is, to our knowledge, the first to provide evidence regarding the effect of the removal of freedom of movement restrictions in Europe on global value chains. We also to contribute to the literature by looking at the trade-migration relationship at the sector and occupation level.

Chapter 3: Trade liberalization, trade unions and workers: wages and working conditions

In the last chapter, we use a new large worker-level dataset spanning across 9 Central and Eastern European countries to understand the effects of EU-induced trade liberalization on wages and working conditions. The EU enlargements of 2004 and 2007 led to a large reduction tariffs by the new Member States that had to align their tariffs schemes on the EU's. The traditional literature on trade liberalization tended to emphasize its mild consequences on wages and employment (Richardson, 1995), but recent empirical evidence revamped this debate by showing strong evidence of the negative impact of trade liberalization episodes on employment in both developed (Autor, Dorn, and Hanson, 2013; Dauth, Findeisen, and Suedekum, 2014) and developing countries (Topalova, 2007; Dix-Carneiro and Kovak, 2017; Dix-Carneiro and Kovak, 2019). Although these new results are often based on analysis conducted at the level of local labour markets, the usual focus on a single country prevents to understand how country-level factors might influence local reactions to liberalization.

Our empirical analysis makes use of a very large cross-section of about 2.8 millions of Central and Eastern European workers in 2014 across 9 countries and 20 regions that allows us to consider how tariff liberalization interact with a measure of labour market liberalization : the evolution of union density. A large literature shows its strong influence on wages and employment (Freeman and Medoff 1984, Blanchflower and Bryson 2004, Barth, Bryson, and Dale-Olsen 2020) but not on working conditions. Besides, the EU accession process was accompanied by a substantial but differentiated decline in union density across the 9 countries considered in this chapter, providing enough variation to identify potential links with tariff liberalization. Moreover, beyond wages, the chapter consider a new margin of adjustment: working conditions. We follow a broad definition of these working conditions that are hours worked during "non-standard" working hours, including shift, weekend and night work. Such types of work arrangement have been shown to have adverse health outcomes (Hagedorn et al., 2016; Malinowski, Minkler, and Stock, 2015) and allows us to explore another dimension of the effects of trade liberalization on workers' welfare.

The empirical strategy consists in comparing wages and working conditions of observationally equivalent workers living in regions with different tariff liberalization shocks. We construct such regional shocks by following Kovak

(2013) and Dix-Carneiro and Kovak (2017, 2019). Results show that the tariff liberalization reduced hourly wages and deteriorated working conditions. We find that the average worker in regions facing a 10 percentage points larger tariff reduction has an hourly wage in 2014 which is about 5% smaller relative to observationally equivalent workers in other regions. These effects are magnified by the erosion of protective labour market institution that these countries experienced over the course of the accession process. Our results show non neutral effects across regions, sectors, firms and workers due to the reduction in import tariffs and the demise of unionization.

This chapter contributes to the literature by studying jointly trade and labour market liberalization, thanks to our multi-country worker level sample. It allows us to investigate the role of union density declines in shaping the labour market effects of trade liberalization. This work is also innovative in its focus on wage and working conditions. This margin of adjustment has seldom been studied in the economic literature whereas its health impact is demonstrated.

Chapter 1

Labour Mobility and Skill Heterogeneity in Europe

1.1 Introduction

The Great Recession and its consequences in Europe illustrate plainly the importance of adjustment mechanisms in a currency area. Their role is to limit divergence in labour market conditions after a shock with asymmetric effects on the different regions of the area. Labour mobility was identified very early (Mundell, 1961) as such a short-run smoothing mechanism, together with wage and price flexibility or fiscal transfers. Renewed interest in the recent years led to new analysis regarding the validity of labour mobility as an adjustment mechanism (e.g., Bayoumi 1994 and Farhi and Werning 2014) and its role in the Euro Area (EA) in that regard. Beyer and Smets (2015) show that the response of migration following a demand shock is quite similar in level in both the US and the EU over a 10 year period (around 50% of adjustment on the 1977-2013 time frame).

However, this literature stays clear of dealing with the long-run effects of migrations in their evaluation of labour mobility as a useful characteristic for a currency area. As shown by the large literature on brain gain, a migration option affects individual incentives to invest in education and can result in both a “brain drain” on the educated workforce of source countries or a “brain gain” inducing individuals to invest more in education (e.g., Mountford 1997, Stark, Helmenstein, and Prskawetz 1997, Beine, Docquier, and Rapoport 2001, Stark and Wang 2002 and Docquier and Rapoport 2012). Since European citizens can move freely within the European Union (EU) and most diplomas are easily transferable from one country to another, the consequences of brain drain and brain gain should be taken into account.

This paper aims at bridging the gap between the literature on labour mobility in the EA and the migration literature dealing with the longer term

effects regarding education, in order to reconsider the validity of labor mobility as adjustment mechanism in the EA. To that end, two stylized facts regarding migration in Europe are reported. First, we give preliminary evidence of the presence of migration cycle accompanying business cycles in the EA. Migration data show that Spain and Germany received net inflows of EA citizens for the respective periods during which they were growing relatively faster than the rest of the EA. These inflows were of the order of 0.7% and 0.5% of their population. We also show that EU-15 citizens living in a different country than their own in that area are by and large more educated than those who did not move, highlighting the importance of skill heterogeneity for European migrations, a fact largely absent from the literature on labour mobility in Europe.

Then, we consider a two-country overlapping generations (OLG) model with risk, migration and heterogeneous agents. As in Beine, Docquier, and Rapoport (2001), the presence of heterogeneous agents and higher education returns abroad will lead to a skill upgrade effect in an OLG model. But here, this result is obtained without the need to assume persistent productivity divergence. This feature makes less sense for the case of intra-EA migrations than it does for world-level migration - the traditional focus of the brain gain literature (Docquier and Rapoport, 2012). Another difference is the source of risk : in Beine, Docquier, and Rapoport (2001), Stark and Wang (2002) or Docquier and Rapoport (2012), agents have no certainty that they will be able to relocate themselves abroad for a given returns on education. In this paper, the possibility to relocate is certain, to reflect the European freedom of movement, whereas the returns on education are not. Levhari and Weiss (1974) pioneered the issue of education choice with uncertain returns, and this paper borrows its consumer's program.

As a result, only in the case of a country-specific shock do we observe migrations. Agents will move out if the economic outlook is sufficiently better in the other country. Economic cycles lead to migration cycles, of which the skill upgrade effect is an externality. The mechanism is the following : labour mobility adds an outside option in case of an asymmetric shock reducing agents' wages. That option entails a migration cost which is easier to afford for more skilled agents as the wage differential between countries is higher for them. This provides incentives for agents to smooth their revenue by investing more in education. Depending on the strength of the asymmetric shock, migration will be in the interest of only some agents. As a result, the whole population invests more in education, but only the top of the skill

distribution will migrate. The presence of aggregate risk is essential. Removing it would restrict the skill upgrade to migrating individuals only and increased risk can affect the skill and welfare distribution under certain conditions. In that respect, the skill upgrade effect of this paper resemble the one present in Katz and Rapoport (2005) as it also relies on a migration cost and a variable education return and. But the latter is here micro-founded as productivity shocks cause variation in wages and migration thank to the formalization of the labour market.¹ This allows us to put study the trade-off between the long-run skill upgrade effect and the short-run macroeconomic adjustment role of labour mobility. Indeed, a lower migration cost lead to an increase in migration flows while reducing the value of education as an option.

We also show that a system of tax/subsidy will affect the proportion of agents that aims to migrate as a response to a given shock and also the returns of education.² Based on our model, we then check empirically that migration flows follow economic cycles and we test the role of migration cost in that respect. We also simulate the model, in order to illustrate the skill upgrade effect due to migration and to present the trade-off that it implies with labour mobility as an adjustment mechanism. Finally, we use the simulation to look at the persistent effect of productivity shock in our framework, that results from the presence of a migration cost.

The rest of the paper is organized as follows. Section 1.2 provides a discussion of the recent literature dealing with labour mobility in Europe and provides two overlooked stylized facts. Section 1.3 presents the model in closed economy (without labour mobility) and provides a steady-state equilibrium. Section 1.4 introduces the possibility migrate, looks at how this affect individual incentives to invest in education and presents the equilibrium. Section 1.5 tests empirically some of the results of the model. Section 1.6 present the simulation of the model in close and open economy. Section 1.7 discusses the results in the context of EA reform and section 1.8 concludes.

¹Other differences in this work include the OLG framework (that allows to look at the long-run accumulation of human capital), the possibility for every agent to migrate irrespective of education level and the fact that the education investment decision is continuous rather than discreet.

²This is inspired by the fact that formal transfers between countries (or more complex system designed to the same effect) are often proposed as a way to improve the functioning of the EMU. Such transfers would constitute an additional adjustment mechanism to the EA (see Farhi and Werning, 2017).

1.2 Labour Mobility in Europe

Freedom of movement for workers was introduced as a right by the Treaty of Rome (1957). It was then extended to all European citizens by the Treaty of Maastricht (1992).³ Other laws and treaty were passed to foster and facilitate the use of that freedom : the Schengen agreement and convention (1985 and 1990), the Erasmus program for students (1987), the Regulation 883/2004 on the portability of unemployment benefits.

But it is only the perspective of a common currency that led to academic interest in the topic of labour mobility in Europe. Decressin and Fatas (1995) found a much lower adjustment capacity in Europe than in the US, at a time when the EMU was still being negotiated. More studies have been conducted in the aftermath of the Great Recession and usually emphasized a rise in labour mobility in Europe (and a decrease in the US, the traditional benchmark of the EA). Beyer and Smets (2015) show that on the long term the response of migration following a demand shock is quite similar in level in both the US and the EU (around 50% of adjustment over 10 years) on the 1977-2013 period. Jauer et al. (2019) look at the 2005-2011 period, so as to contrast the adjustment by migration before and after the crisis. On the pre-crisis period they find a weaker mobility response to an asymmetric shock in Europe than in the US. However, after the crisis, the picture is reversed as mobility declined in the US and increased in Europe. Looking at short-run responses and using a similar method, Arpaia et al. (2016) find that since the introduction of the Euro, migration following an asymmetric shock has almost doubled and that real wages are also more flexible, although still lower than in the US. Beine, Bourgeon, and Bricongne (2019) use OECD data from 1980 to 2010 and look at the sensitivity of migration flows between countries to short-term economic factors. They find that relative business cycles are of particular importance in the choice of destination by migrants and that European integration led to increased mobility of workers. The rest of the section presents two stylized facts that will motivate our undertaking.

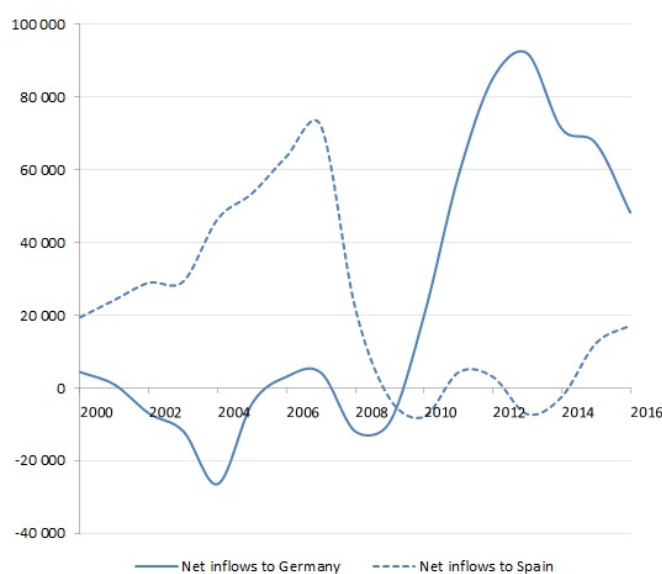
Stylized fact 1 : Intra-EA migrations react to business cycles We first aim to point out the cyclical aspects of intra-EA migration since its inception. Using data from the OECD migration database, Figure 1.1 represents the net inflows of EA nationals to Germany and Spain.⁴ There is a clear reaction to

³Under the condition that the citizen has sufficient resources to live in the Member State.

⁴That is the difference between the number of EA nationals settling in and leaving Germany or Spain each year. It is a flow and not a stock.

economics cycles. In the first half of the period, Spain is booming while Germany's growth is much slower. The net inflows of EA national is increasing in Spain and stable and close to 0 in Germany. When the Crisis of 2008 occurs and Spain's unemployment rate surges, the situation is reversed. One can see in Figure A1 and A2 of the Appendix a similar pattern even when we split the EA in two groups : Periphery and rest of the EA.⁵ In magnitude, net inflows of EA citizens from 2010 to 2016 represent 0.54% of the German population, with Periphery citizens over-represented (around 2/3 of the inflow). Net inflows from 2000 to 2008 represent around 0.89% of Spain's population (see Table A1 of the Appendix). Net inflows to Italy and the Netherlands are also available in the Appendix. The Netherlands, whose economic cycle after the crisis was closer to Germany's also displays a increased in net inflows from other EA countries. For Italy, the evolution is much slighter, with a small decrease of inflows after 2008, which still remain positive. Consistently, Italy's economic evolution was much closer to that of the aggregate EA.

Figure 1.1. Net inflows of Euro Area nationals (in thousands)



Source: OECD migration database.

Nevertheless, this fact does not mean that EA nationals are sufficiently mobile to constitute a powerful adjustment mechanism. As first noticed by Bertoli, Brücker, and Moraga (2013) for Germany, a noticeable part of the increase of migrants during the Crisis is due to diversion of Eastern European migrants from the Southern countries. Basso, D'Amuri, and Peri (2019) also find that labour mobility in the EA is propped up by the higher mobility of

⁵Spain, Portugal, Italy, Ireland, Cyprus and Greece.

foreign-born individuals. But those numbers are not trivial. If we take the cumulative gross inflows of EA nationals to Germany since 2010 we find that 1.2 millions individuals settled in the country at some point, that is around 0.5% of the population of the EA (excluding Germany). That seems substantial enough to show that, if extended to all other EA countries, workers do take into account the possibility to move in a different country.⁶ We also notice that there are no strong net outflows when country is relatively worse off.⁷

Stylized fact 2 : Mobile EU-15 nationals are more educated than stayers

Using Eurostat data, Figure 1.2 represents the share of EU-15 nationals (aged 25 to 54) who completed some higher education. The full line is the share for EU-15 nationals living in a different EU-15 country (movers) whereas the dotted line represent those living in their native country (stayers). Movers are substantially more educated (10 percentage points) and the gap has been increasing, leading to think that the educated population is increasingly mobile. Of the studies cited above, only Basso, D'Amuri, and Peri (2019) considers this kind of heterogeneity although they do not discuss their results. They find stronger population elasticity for high education individuals. These facts underline the need to consider education and skills when studying the effects of labour mobility in Europe. Sections 1.3 and 1.4 present a model bringing together those elements and able to explain the two stylized facts that were just presented.

1.3 The Closed Economy Framework

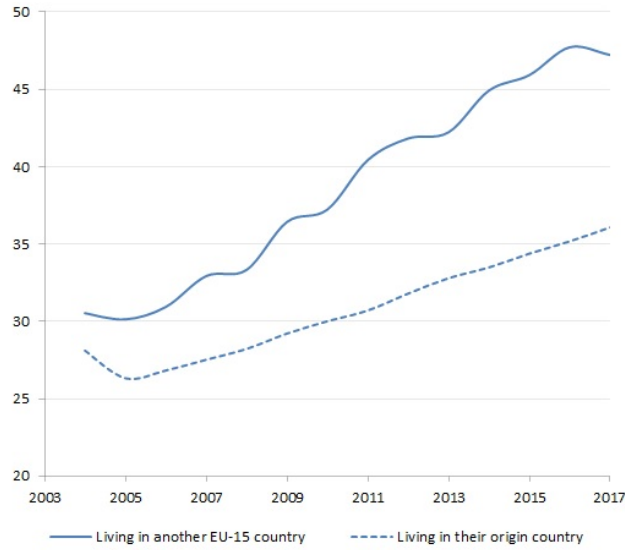
To reconcile the part of the economic literature that focuses on migration with the one describing labour mobility as simple adjustment mechanism, we propose a model of self-selection in migration with investment in education that includes economic cycles. This section introduces the model in closed economy, meaning in the absence of migration. It lays out the main hypothesis and conditions on which our results depend. It then solves the model under specific functional forms and gives the steady-state equilibrium that is used as a benchmark in Section 1.4.

Let's suppose there are N dynasties noted i in a closed economy. At each

⁶Euro Area students are also required to register in Germany and therefore represented here, but the number of European students from 2000 to 2012 (last available date) was stable and the variation from one year to the next quite small (a few thousands at most).

⁷This observation does not hold for Eastern European citizens.

Figure 1.2. Completion of higher education by EU-15 citizen
(as a share of 25-54 year-olds)



Source: EU Labor Force Survey.

period t each dynasty is formed by two overlapping agents j , a young one ($j=1$) and a middle-aged one ($j=2$). Each agent lives for two periods and is endowed with 1 unit of labour. At the beginning of each period, the economy is hit by a stochastic productivity shock :

$$A_t \sim \mathcal{N}(1, \sigma_A^2) \quad (1.1)$$

There is a representative firm using labour, enhanced by human capital, to produce the consumption good. Its price is normalized : $p_t = 1$.

1.3.1 Households

Households live for two periods and work for the representative firm for a wage. In their first period, as in Levhari and Weiss (1974), they can work for a wage or study. Agents can allocate a share $e_{1,t}^i$ of their labour endowment in education investment to have more human capital in second period. In their first period, agents inherit human capital from their middle-aged predecessor with a depreciation rate δ . In their second period, agents can only work and their education effort pays off with a higher wage due to higher human capital. Therefore the wage of the second period is a function of the

human capital $h_{j,t}^i$, itself a function of the education investment.⁸ Each dynasty differs by its capacity to transform education investment into human capital and skills, represented by the parameter γ^i which is inherited. It is chosen randomly in a distribution at the very first period such that there is a mass of dynasties N^γ having a given γ level.

The human capital production functions allows to take into consideration both private choice and the role of cultural capital in facilitating education as described in Bourdieu and Passeron (2018). The latter concept is described by the presence of the previous generation human capital in equation 1.2 and is in agreement with empirical studies, such as Hertz et al. (2008).

$$h_{1,t}^i = (1 - \delta)h_{2,t}^i \quad (1.2)$$

$$h_{2,t+1}^i = \gamma^i e_{1,t}^i + h_{1,t}^i \quad (1.3)$$

The family-specific heterogeneity parameter γ^i affects the capacity to transform the education investment $e_{1,t}^i$ in human capital in the next period. Agent of similar age of all families with the same γ therefore have the same level of human capital at any period t and can be considered as being of the same skill type k .⁹ For each generation at each period, the mass of agents with a given γ level can therefore be noted as $N_{j,t}^k$. In closed economy, there is no demographic change due to migration or population growth so it is N_j^k . The γ parameter can be thought of as inherited talent or intelligence but also as any family-related additional dimension affecting educative output other than cultural capital and efforts. For instance, ethnicity or social class can affect the quality of schooling available to a family. The education investment can therefore be assimilated to an effort in education (and not education credentials).¹⁰

From a modelling standpoint, such human capital production function has the advantage to be analogous to physical capital accumulation. It is also closer to the function used in Beine, Docquier, and Rapoport (2001).¹¹ Other

⁸Human capital and skills are here used interchangeably and so are education investment and education effort.

⁹Provided that the initial level of human capital is the same for everyone of that it is already ordered by talent, it will not be possible for families of different γ to be of the same skill type.

¹⁰With that function, students who are smarter or with a better background can reach the same human capital level as students without such luck. Two individuals can therefore reach the same level of human capital and skills but have different mixes of effort, intelligence and inherited cultural capital.

¹¹In our case, the level of education investment is not directly interact with previous generation human capital and future human capital is a linear function of education. While

non-linear functions can also be considered. A simple case would be a purely multiplicative function of the form $h_{2,t+1}^i = e_{1,t}^i h_{1,t}^i$. This case is devoid of any dynamics for $e_{1,t}^i$ and there is no steady-state to which the system converge and that can be taken as an anchor to study the effect of labour mobility. Another alternative is to use a Cobb-Douglas function as in Moussault et al. (2017) : $h_{2,t+1}^i = B \left(e_{1,t}^i \right)^\eta \left(h_{1,t}^i \right)^{1-\eta}$. B is a technology parameter and η is the responsiveness of human capital to a change in the education efforts. Again, there is no dynamics for e here, but it leads to a steady-state similar to the linear function case. An advantage of the linear human capital function is the capacity to distinguish between the sensitivity of $h_{2,t+1}^i$ to $h_{1,t}^i$ (δ) and to $e_{1,t}^i$ (γ^i) which are condensed in the unique η parameter for the Cobb-Douglas function.

As in Levhari and Weiss (1974), the agent allocates his total labour supply between work and education in first period and similarly as in Stark, Helmenstein, and Prskawetz (1997), agent i maximises its inter-temporal utility by choosing how much to consume at each period and its education investment. The utility V^i is an additive and separable function of the individual's consumption in both periods, meaning that present and future consumptions are independent goods. There is no altruism as V^i does not depend on the next generation's consumption. Instead, the link between generations comes from the inheritance of the parent's human capital, as described by equation 1.2.

$$\begin{cases} \text{Max} & V^i = E \left[U(c_{1,t}^i) + \beta U(c_{2,t+1}^i) \right] \\ \text{st.} & c_{1,t}^i = (1 - e_{1,t}^i) w_{1,t}^i \\ & c_{2,t+1}^i = w_{2,t+1}^i \end{cases} \quad (1.4)$$

Within a generation, education establishes a link between periods. Agents can allocate part of their labour supply to education effort in the first period whereas in the second period they only work for a wage function of their human capital. Hence :

$$l_{1,t}^{i,supply} = (1 - e_{1,t}^i) \quad (1.5)$$

$$l_{2,t}^{i,supply} = 1 \quad (1.6)$$

introducing the former feature would only bring minor changes to transition and steady-state education and human capital levels, the latter would reduce tractability beyond necessity. It would introduce additional non-linearities which are useful in Beine, Docquier, and Rapoport (2001) but not in our model as we use a non-linear utility function.

Substituting the budget constraint in the inter-temporal utility function, one can compute the derivative with respect to $e_{1,t}^i$ and deduce the following Euler condition :

$$w_{1,t}^i U'(c_{1,t}^i) = \beta E_{1,t} \left[U'(c_{2,t+1}^i) w_{2,t+1}^{i'}(e_{1,t}^i) \right] \text{ with } w_{2,t+1}^{i''}(e_{1,t}^i) = \frac{\partial w_{2,t+1}^i}{\partial e_{1,t}^i} \quad (1.7)$$

There is an equality between the loss of utility in first period due to the education investment and the expected gains in the second period. The first period wage plays a part here : it is the opportunity cost of additional education efforts. The gains correspond to a return on investment, in other words, by how much will utility increase in the second period for an additional unit of education effort in the first period. We will denote this return $R_{2,t+1}^i$, such that :

$$R_{2,t+1}^i = U'(c_{2,t+1}^i) w_{2,t+1}^{i'}(e_{1,t}^i) \quad (1.8)$$

Proposition 1: If the utility and the wage functions are increasing and concave with respect to the education effort, the solution of equation 1.7 is a global maximum of the consumer program.

Proof : The second order condition of our problem is :

$$\frac{\partial^2 U}{\partial e_{1,t}^{i2}} = (w_{1,t}^i)^2 U''(c_{1,t}^i) + \beta E_{1,t} \left[U''(c_{2,t+1}^i) (w_{2,t+1}^{i'})^2 + U'(c_{2,t+1}^i) w_{2,t+1}^{i''} \right]$$

It is negative if $U''(c_{1,t}^i) < 0$ is negative and $w_{2,t+1}^{i''} \leq 0$. \diamond

It is a common assumption for the utility function to be increasing and concave. The wage function should be increasing and either linear or concave with respect to the education effort for the proposition to be verified. This is not a particularly strong hypothesis : the wage is going to be linked to the education effort through the human capital level, which we assume to be linear in equation 1.3. A linear or concave relationship between the wage and human capital is sufficient for Proposition 1 to be satisfied.

1.3.2 Firm

The representative firm uses labour of the different skill types to produce the consumption good. Labour efficiency is improved by individual human capital (the skill) and also by a Hick-neutral aggregate shock A_t . The production

function for the representative firm is :

$$Y_t = F \left(A_t, l_{j,t}^i, h_{j,t}^i \right) \text{ with } l_{j,t}^i = l_{j,t}^1 \dots l_{j,t}^N \quad (1.9)$$

$$h_{j,t}^i = h_{j,t}^1 \dots h_{j,t}^N \text{ and } j = 1, 2$$

As human capital is individual to each agent, this function aggregates individual labour from all agents. Hence, although it uses both labour and human capital to produce, the firm can only choose the amount of labour it needs. The firm maximizes its profit with respect to each individual labour demand:

$$\text{Max}_{l_{j,t}^i} \Pi_t = p_t Y_t - \sum_{j=1}^2 \sum_{i=1}^N l_{j,t}^i w_{j,t}^i$$

The derivative of the profit gives the solution of this problem :

$$\forall i, j, w_{j,t}^i = F' \left(A_t, l_{j,t}^i, h_{j,t}^i, l_{j,t}^k, h_{j,t}^k \right) \text{ with } l_{j,t}^k = l_{j,t}^1 \dots l_{j,t}^N \quad (1.10)$$

$$h_{j,t}^k = h_{j,t}^1 \dots h_{j,t}^N \text{ and } j = 1, 2$$

The wage of agent i is therefore a function of the productivity shock and the labour demands and human capital stocks of all workers. The relationship between those variables is determined by the functional form of Y_t . One could expect a certain level of substitutability between the workers. It does not need to be constant : agents with similar levels of human capital could have higher elasticity of substitution.

However, having a positive relationship between aggregate productivity and wages is a necessary condition for our migration channel to work. If wages are unaffected by productivity shocks, there is no wage differential between countries and no individual incentives to migrate.¹²

The most convenient technology in this case is a production function that is linear with respect to each skill and age group labour $l_{j,t}^k$:

$$Y_t = A_t \sum_{j=1}^2 \int_h l_{j,t}^k h_{j,t}^i dh \text{ with } l_{j,t}^k = \left(\sum_{i=1}^{N_j^k} (l_{j,t}^i)^\alpha \right)^{\frac{1}{\alpha}} \quad i \in k \quad (1.11)$$

¹²In that light, a Cobb-Douglas production function would be adequate, while a CES would not. See Section A2.2 and A2.3 of the Appendix.

With constant return to scale and a linear production function there is a possibility that the firm has no interest to produce : we suppose $Y_t > 0$. The labour market is segmented : each agent is paid an individual wage specific to each skill group and generation.¹³ Within a skill group h , agents are substitutable and the wage will be affected by the population of the group. When labour mobility will be introduced, a convergence of wages between the two countries will occur.

The derivative of the profit function gives :

$$w_{j,t}^i = A_t h_{j,t}^i (l_{j,t}^k)^{1-\alpha} (l_{j,t}^i)^{\alpha-1} \quad (1.12)$$

Here, all agents within a skill group are identical, such that $l_{j,t}^k = l_{j,t}^i (N_j^k)^{\frac{1}{\alpha}}$. In that situation, the wage does not depend of the aggregate labour supply but only on the mass of agents in the same skill group and generation in the considered period N_j^k :

$$w_{j,t}^i = A_t h_{j,t}^i (N_j^k)^{\frac{(1-\alpha)}{\alpha}} \quad (1.13)$$

Many studies in the migration literature emphasize the small or insignificant effect of migrations on natives wages. In their survey of the literature on immigration and wages, Dustmann, Schönberg, and Stuhler (2016) emphasizes that the variability in the results are due to different methods looking at different types of elasticities of wages to immigration. Studies looking at the effect of spatially differentiated immigration shocks usually find positive effects. For instance, Dustmann, Frattini, and Preston (2013) find for the UK a positive but small overall effect and a small negative effect for the lower end of the wage distribution only. But studies focusing on skill or education-specific shock, such as Borjas (2003), usually find negative effect of immigration on wages within the group.¹⁴ Our model can replicate that finding assuming $\alpha > 1$, such that the higher the mass of agent of a given skill type, the lower the wage in that group.

¹³This feature is reliant on the separability of the production function with respect to the different groups. With a CES production function, individual wages would not be independent with respect to each others. The final wage would however still be increasing and concave with the human capital level.

¹⁴As Ottaviano and Peri (2012) underlines, such estimates are partial and do not mean that overall effects by education groups are negative once the aggregate effect are taken into account. They simulate for the US the total effect by education group and find small positive result overall, although less so or even negative for individuals with a low level of education.

1.3.3 Dynamics Effects

Considered together, the Euler condition and the wage function (equations 1.7 and 1.13) highlight the dynamic effects of the productivity shock on the education decision. The revenue is linked to productivity in opposite ways in each period, through the education decision that acts as saving. Higher productivity in the first period raises the opportunity cost of education, as working is better paid, but also increases incentives to educate more to redistribute revenues over both periods. In the other hand, higher productivity in the second period has the opposite substitution and revenue effects : each unit of education effort is better paid¹⁵ so that education return on investment is higher but it is also possible to reduce it to increase first-period revenue. The presence of this dynamic effect is interesting : both current and expected future productivity affect the level of education. Short-term fluctuations in the first period will extend their effect on future revenues. However, showing the existence of this direct link between productivity and education is not our objective. We want to assess the link between labour mobility (resulting from productivity shock) and education investment. Our main mechanism will rely on productivity expectation and the presence of these dynamic effects could lead us to confuse the direct effect of future productivity on education effort with the indirect effect that goes through migrations. From now on, we will assume a log utility function :

$$U(c_{j,t}^i) = \ln(c_{j,t}^i) \quad (1.14)$$

As the second derivative of the log function is negative, it satisfies the conditions defined in Proposition 1. The Euler condition given by equation 1.7 becomes :

$$\frac{1}{1 - e_{1,t}^i} = \beta E_{1,t} \left[\frac{w_{2,t+1}^{i'}(e_{1,t}^i)}{w_{2,t+1}^i(e_{1,t}^i)} \right] \quad (1.15)$$

The final choice in the absence of migration only depends on the wage function. Plugging the wage equation into the Euler equation shows that the returns to education does not depend on the productivity shock :

¹⁵If $\frac{\partial w_{2,t+1}^i}{\partial e_{1,t}^i \partial A_t} > 0$, which is verified in our linear production function framework described in Section 1.3.2.

$$R_{2,t+1}^i = \frac{w_{2,t+1}^i(e_{1,t}^i)}{w_{2,t+1}^i(e_{1,t}^i)} = \frac{h_{2,t+1}^i(e_{1,t}^i)}{h_{2,t+1}^i(e_{1,t}^i)} \quad \text{with} \quad h_{2,t+1}^i(e_{1,t}^i) = \frac{\partial h_{2,t+1}^i}{\partial e_{1,t}^i}$$

The two opposite effects of a productivity shock on education incentives described earlier ultimately cancel out. As the stochastic shock does not enter the return anymore, the expectation notation becomes superfluous. The resolution of the problem is simplified. This greater tractability is a first advantage. Moreover, the productivity shock altogether disappears from the closed economy problem. Without dynamic effects, we can solve easily the consumer's decision and find a solution where the shock does not affect utility.¹⁶ This result originates both from the log utility function and the use of education as a way of saving. With an additional vehicle to transfer value from one period to the next, the agent would not reduce its education effort to the same extent and the final effect would be different.¹⁷

1.3.4 Autarkic General Equilibrium

This subsection present the dynamic general equilibrium and solves the model to reach a steady-state equilibrium. We need to add two conditions defining the equilibrium on the goods and the labour market and the condition of the distribution of the population :

$$Y_t = \sum_{i=1}^N c_{1,t}^i + \sum_{i=1}^N c_{2,t}^i \quad (1.16)$$

$$\forall i, j, l_{j,t}^i = l_{j,t}^{i, supply} \quad (1.17)$$

$$N = \int_h N_j^k dh \quad (1.18)$$

$$N_j^k = N_{j,0}^k \quad (1.19)$$

¹⁶A Cobb-Douglas utility function would also allow to derive a solution, but the optimal choice of the agent would be affected by the first period shock. See Section A2.1 of the Appendix.

¹⁷Beyond increased realism, this case would bring additional insights regarding the comparison of two different ways to save and their respective merits in this framework. But, it would also obfuscate the effect of the shock on migration and add a great deal of complexity reducing the possibility to solves analytically the model and some propositions that are presented later. See Levhari and Weiss (1974) for a useful analysis of the trade-off between saving and education under uncertain returns.

Dynamic general equilibrium

First, we present the definition of the dynamic general equilibrium of the model, that is the solution of the model over all periods.

Dynamic GE Given a sequence of shocks $\{A_t\}_{t=-\infty}^{\infty}$, the dynamic general equilibrium is the sequence of vectors $\left\{ \left\{ w_{j,t}^i, e_{1,t}^i, h_{2,t}^i, N_{2,t}^k \right\}_{i,j,h} \right\}_{t=-\infty}^{\infty}$, defined as the set of wages $w_{j,t+1}^i$, the set of education choices $e_{1,t}^i$ and the final population distribution $N_{2,t+1}^k$ of all agents young in period t and old in period $t + 1$ in both countries and belonging to skill groups k , given the productivity shocks, the inherited levels of human capital $h_{2,t}^i$ and the inherited distribution of population of each skill type such that :

1. The individual decision is optimal and the budget constraint fulfilled (equations 1.15 and 1.4).
2. The representative firms decision is optimal (equation 1.13).
3. The dynamics of human capital fulfils equations 1.2 and 1.3.
5. The resource and technological constraints satisfy equations 1.18, 1.19 and 1.11.
6. The goods and labour markets clear (equations 1.16, 1.17, 1.5, 1.6).

Using the relationship between education investment and future human capital (equations 1.2, 1.3) and the first-order condition (1.15), the human accumulation process can be deduced :

$$e_{1,t}^i = \frac{\beta\gamma^i - (1 - \delta)h_{2,t}^i}{\beta\gamma^i + \gamma^i} \text{ and } h_{2,t+1}^i = \gamma^i e_{1,t}^i + (1 - \delta)h_{2,t}^i \quad (1.20)$$

The education effort is affected in two ways by the heterogeneity parameter. First a higher γ^i means that education efforts are more rewarding as they lead to a higher human capital in the following period. More talented agents are therefore expected to make more efforts. Second, in the dynamics γ^i is positively linked to the inherited human capital level, which reduces the need for education efforts to reach a certain level of human capital in the next period. In that respect, a higher γ^i results in a lower education investment as it also resulted in higher inherited human capital since the γ^i is also inherited. The two previous equations can be combined to obtain the transition function giving the evolution of the human capital over successive generation :

$$h_{2,t+1}^i = \frac{\beta\gamma^i + \beta(1-\delta)h_{2,t}^i}{\beta + 1} \quad (1.21)$$

Stationary general equilibrium

As we are interested in knowing the long-run education and human capital level of the economy, we now look at the stationary equilibrium.

Stationary GE The autarkic stationary equilibrium is a steady-state without shock, that is, a stationary sequence of wages which fulfils :

1. The individual optimality conditions for all agents,

$$\frac{1}{1 - e_1^i} = \beta E_1 \left[\frac{w_2^{i'}(e_1^i)}{w_2^i(e_1^i)} \right] \quad (1.22)$$

2. The budget constraints of all agents,

$$c_1^i = (1 - e_1^i)w_1^i \quad (1.23)$$

$$c_2^i = w_2^i \quad (1.24)$$

3. The market clearing conditions for the goods and the labour markets,

$$Y = \sum_{i=1}^N c_1^i + \sum_{i=1}^N c_2^i \quad (1.25)$$

$$w_j^i = Ah_j^i(N_j^k)^{\frac{(1-\alpha)}{\alpha}} \quad (1.26)$$

$$\forall i, j, l_j^i = l_j^{i, supply} \quad (1.27)$$

$$l_1^{i, supply} = (1 - e_1^i) \quad (1.28)$$

$$l_2^{i, supply} = 1 \quad (1.29)$$

4. The resource and technological constraints,

$$Y = A \sum_{j=1}^2 \int_h l_j^k h_j^i dh \quad (1.30)$$

$$l_j^k = \left(\sum_{i=1}^{N_j^k} (l_j^i)^\alpha \right)^{\frac{1}{\alpha}} \quad i \in h \quad (1.31)$$

$$h_1^i = (1 - \delta)h_2^i \quad (1.32)$$

$$h_2^i = \gamma^i e_1^i + h_1^i \quad (1.33)$$

$$N = \int_h N_j^k dh \quad (1.34)$$

$$N_j^k = N_{j,0}^k \quad (1.35)$$

Solving that system of equation is relatively straightforward and allows us to derive the steady-state equilibrium.

Proposition 2: At the steady-state equilibrium, the private education effort and human capital levels are :

$$e_{SS}^i = \frac{\beta\delta}{1 + \beta\delta} < 1 ; h_{1,SS}^i = \frac{(1 - \delta)\gamma^i\beta}{1 + \beta\delta} \text{ and } h_{2,SS}^i = \frac{\gamma^i\beta}{1 + \beta\delta} \quad (1.36)$$

The aggregate production is:

$$Y_{SS} = \sum_{i=1}^N c_{1,SS}^i + \sum_{i=1}^N c_{2,SS}^i \text{ with } c_{1,SS}^i = (1 - \lambda^{i,SS})h_{1,SS}^i \quad (1.37)$$

$$c_{2,SS}^i = A_t h_{2,SS}^i$$

And the individual wage is :

$$w_{j,SS}^i = h_{j,SS}^i N_{j,SS}^k \quad i \in h \text{ and } N_{j,SS}^k = N_{j,0}^k \quad (1.38)$$

The steady-state education level does not hinge on the parameter γ^i linking education and human capital : all agents choose the same education effort. This steady-state $e^{i,SS}$ corresponds to the level of education investment needed to replace depreciated human capital.¹⁸ Similar education efforts for all can be perceived as counter-intuitive, however it should be reminded that during the transition to the steady-state, more gifted agent are better

¹⁸In the absence of human capital depreciation ($\delta=0$), $e^{i,SS}$ is 0.

rewarded for their effort and therefore put more effort in education, while at the steady-state agents only need to replace depreciated human capital and the depreciation rate is not agent-specific. Moreover, the actual number of added human capital at the steady-state $\gamma^i e^{i,SS}$ is different for each agent.¹⁹ The heterogeneity of agents only reveals itself in the human capital level at the steady-state. The higher γ^i and the lower δ are, the higher the steady-state level of human capital will be. Although every agent makes the same steady-state education choice, more talented agents have more human capital. An increase in the depreciation rate would reduce the human capital level as it has to be replaced more often but would increase the education effort at the steady-state as more human capital should be replaced at each period. An increase in β , corresponding to an increase in the value of future consumption for the agent, would increase both human capital and education effort as the agent raises her future consumption relative to the present. Due to the choice of utility function, the productivity shock does not affect the education level of the closed economy.

Interestingly, the steady-state human capital level is a linear function of γ^i . Therefore, the distribution of human capital over the entire population will be easily derived from the distribution of γ^i . The probability distribution followed by this parameter is the determinant of inequality in the model.

1.4 The Open Economy Framework

Now that we have established the conditions under which our model has a solution and the distribution of education efforts and skills at the steady-state, we can introduce labour mobility. This section first develops the modality of labour mobility in the model. It then proceeds to give results regarding the link between migration and education and how it is shaped by uncertainty and migration costs.

1.4.1 Introduction of Migrations

Let assume a second identical country indexed by $*$. The only link between the two countries is migration as the goods market stays closed. There are also N families in the foreign country. The probability distribution of the γ is identical and because we are at the steady-state, distributions of human

¹⁹As explained in more detail in Section 1.3.1, education effort is different from education outcome in our model.

capital of agents will also be similar. The production functions of both representative firms are identical. The difference in productivity shocks is the only thing that sets the two countries apart. The production function of the domestic country is not modified, only the mass of agents in each skill group $N_{j,t}^k$ will be affected by migrations. Population in each country and skill group will fluctuate and it is therefore necessary to index it with respect to time. The production and wage functions becomes :

$$Y_t = A_t \sum_{j=1}^2 \int_h l_{j,t}^k h_{j,t}^i dh \quad \text{with} \quad l_{j,t}^k = \left(\sum_{i=1}^{N_{j,t}^k} (l_{j,t}^i)^\alpha \right)^{\frac{1}{\alpha}} \quad i \in k \quad (1.39)$$

$$w_{j,t}^i = A_t h_{j,t}^i (N_{j,t}^k)^{\frac{(1-\alpha)}{\alpha}} \quad (1.40)$$

Labour mobility is allowed, but only for middle-aged workers of each country. They can migrate from their native country to the other at the beginning of their second period, after observing the productivity shocks. They compare their potential utility in both countries and they decide to move if the utility differential between the two countries exceeds the cost of migration. This cost includes the direct, out-of-pocket expenses (packing, moving van) due to relocating. It is similar to a forced consumption. Since the only source of utility in the second period of life is the wage, through consumption, individuals are going to look at the wage differential and compare it to the cost of migration c , which is paid by each individual migrant.²⁰ For now, we suppose this cost to be fixed and identical for all agents. An agent migrates from the domestic to the foreign country if :

$$w_{2,t+1}^{i*} - w_{2,t+1}^i \geq c \quad \text{if} \quad w_{2,t+1}^{i*} > w_{2,t+1}^i \quad (1.41)$$

And from the foreign to the domestic country if :

$$w_{2,t+1}^i - w_{2,t+1}^{i*} \geq c \quad \text{if} \quad w_{2,t+1}^{i*} < w_{2,t+1}^i \quad (1.42)$$

We can define $Share_{t+1}^{\Delta A, h}$, the share of agents of skill type h that migrate ex-post for a given productivity gap $\Delta A_{t+1} = A_{t+1}^* - A_{t+1}$, using the wage equation 1.13. That is the share of agents of skill type h of a country for whom :

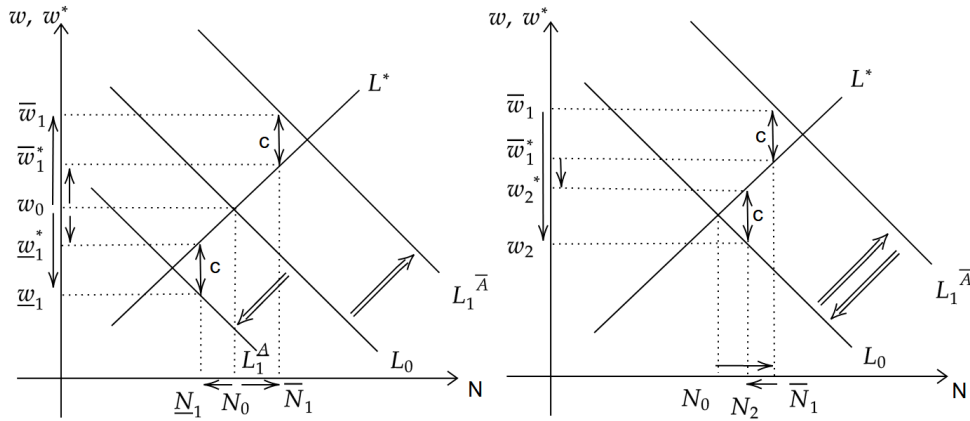
²⁰That cost can be interpreted as forced consumption in the destination country. Although it results from consumption of the agent, it will be taken into account by the agent when deciding whether to move or not.

$$(A_{t+1}^*(N_{j,t+1}^{k*})^{\frac{(1-\alpha)}{\alpha}} - A_{t+1}(N_{j,t+1}^k)^{\frac{(1-\alpha)}{\alpha}})h_{2,t+1}^i(e_{1,t}^i) > c \quad (1.43)$$

Clearly, with a positive migration cost and identical population in both countries, that expression is satisfied only if the foreign country has a higher productivity level following the shock. Hence, only migration resulting from economic fluctuations are studied, in line with Mundell (1961) argument that in case of asymmetric shock between countries sharing a currency, labour mobility helps with the adjustment. Migration will only occur if a country is hit by a negative shock and the more negative is the relative shock ΔA , the larger $Share_{t+1}^{\Delta A, h}$ will be. As the share of migrants vary with the relative productivity shock, economic fluctuations generate migration fluctuations. This result fits the second pattern described in Section 1.2. For a given productivity gap between the two countries, the condition is also more likely to be satisfied if human capital is higher or if the migration cost is lower. As the wage is decreasing with the number of agent in a skill group, the migration flow will continue until the wages in both countries *almost* equalize. The migration cost constitutes a wedge that prevent full equalization once the two countries diverge.

Graphical illustration This intuition is developed in Figure 1.3. The left panel presents the effects of an increase or a fall of domestic productivity on wages in both countries. The original wage w_0 is common to both countries and is at the intersection of curves L_0 and L^* that correspond to the wage equation 1.40. For the domestic country it is increasing as higher population (resulting from immigration) reduces wages. L_0^* is decreasing as migration toward the domestic country results in a reduction in foreign population that raises wages abroad. The shift from L_0 to $L_0^{\bar{A}}$ corresponds to a positive productivity shock in the domestic country (it raises wages for any population level). The direct effect of this shock is to raise wages, creating a large wage differential between the two countries, that correspond to the vertical distance between curves L^* and $L_0^{\bar{A}}$ at the original population level N_0 . It will be partly resorbed by migration to the domestic country, until equation 1.42 is not satisfied anymore, that is until the wage gap is equal to the migration cost c . Domestic population rises from N_0 to \bar{N}_1 while wages increase to \bar{w}_1 and \bar{w}_1^* with $\bar{w}_1 > \bar{w}_1^*$. Similarly, if a negative productivity shock in the domestic country shifts the curve L_0 to $L_0^{\underline{A}}$, the domestic population and wages in both countries decreases and the wage gap does not vanish.

Figure 1.3. Migration and Wage adjustment



The right panel of Figure 1.3, illustrate that if the positive productivity shock disappears in the next period, the population and wages level do not converge back to N_0 and w_0 . We suppose the curve L_0^A reverts back to its original position in L_0 . However, population and wages level need not to come back to their previous level N_0 and w_0 . The decrease in productivity leads to the reversal of the wage gap (distance between L_0 and L^* in \bar{N}_1). Therefore migration flows are from the domestic to the foreign country until condition 1.41 binds, that is until the wage gap is equal to c . Wages in both countries decrease to w_2 and w_2^* which surround w_0 . Even though the productivity is back at its original level, the ending equilibrium differs from the original one. In the domestic country wages have decreased overall as the population N_2 is higher than N_0 due to the migration cost that limits wage adjustment. Productivity shocks have persistent effects due to presence of a migration cost. Based on the strength of the productivity shock and the shape of the L_0 and L^* curves, it is possible that the population stays at the \bar{N}_1 level. Such possibility is more likely for a small initial shock or for low skill agents and is illustrated in Section 1.6 for different skill types using a simulation of the model.

Direction of flows Flows are going only one-way : from the country with the lowest productivity shock to the country with the highest productivity. We note N_t and N_t^* the population of the two countries at time t .

If $A_{t+1}^* > A_{t+1}$, then the number of migrants from the domestic to the foreign country depends on γ^i 's distribution, through the existence of the different skill groups :

$$M_{t+1}^{k,to*} = N_{j,t}^k \times Share_{t+1}^{\Delta A, h} \quad (1.44)$$

If $A_{t+1}^* \leq A_{t+1}$, there are no migrant flows from the domestic to the foreign country :

$$M_{t+1}^{to*} = 0 \quad (1.45)$$

The next generation is born in the country of migration. Moreover, we do not consider the possibility that some of the agents that left in the previous period could come back in the next. To allow for return migration, the model would need to be modified in one of the two following ways : add extra periods or give the possibility to migrate in the first period of life (before education). This is consistent with the first stylized fact described in section 2 showing that net inflows do not become significantly negative when the economic situation worsens relative to the rest of the EA.²¹

Migration distribution The share of migrants can be formalized further when the population is distributed in the same way in both countries. The three elements necessary to compute it are a given realized productivity gap ΔA , a fixed migration cost and a agent-specific human capital. As the human capital is ultimately a function of the parameter γ^i , whose values are randomly chosen in a distribution. Hence we can express a distribution of wage gaps based on the randomly chosen γ^i and for a given productivity gap ΔA :

$$X^A = \Delta A_{t+1} h_{2,t+1}^i (\gamma^i) (N_{j,t+1}^k)^{\frac{(1-\alpha)}{\alpha}} \quad (1.46)$$

And we can express the share of migrants as :

$$Share_{t+1}^{\Delta A, h} = F_{X^A}(c) \quad (1.47)$$

where $F_{X^A}(c)$ would therefore give the share of agents that would stay in the domestic countries for given productivity shocks and population distribution.

Such formulation relies on the existence of a known distribution of X^A and particularly on the γ^i parameter that determines final human capital levels. As we assume here that this parameter is taken from a given distribution,

²¹Considering this possibility could also add complexity : if two agents with an identical level of human capital, should they be thought of as competing for the same job. In that case, the wage would be affected but more importantly, the expected return of education if the domestic country has a high productivity would be lower.

it should be possible to describe it with a c.d.f., provided that it is continuous. First, the number of families needs to be large enough.²² Second, there should not be discontinuities due to past migration flows.²³ These two conditions are satisfied if migrating becomes possible when the closed economy is at its steady-state. It is also an interesting starting point, as in the absence of any asymmetric shock, the closed economy steady-state is the first best of this economy : no agent can be better-off by migrating if the productivity shock is the same in both countries. A migrating agent would have to pay a migration cost for the same wage, hence it would not be an optimal choice.

1.4.2 The Optimal Individual Decision

The consumer's program is modified to include the possibility to migrate :

$$\left\{ \begin{array}{l} \text{Max} \quad V^i = E \left[U(c_{1,t}^i) + \beta U(c_{2,t+1}^i) \right] \\ \text{st.} \quad c_{1,t}^i = (1 - e_{1,t}^i) w_{1,t}^i \\ \quad \quad c_{2,t+1}^i = w_{2,t+1}^i \quad \text{if agent } i \text{ stays.} \\ \quad \quad c_{2,t+1}^{i*} = w_{2,t+1}^{i*} - c \quad \text{if agent } i \text{ migrates.} \end{array} \right. \quad (1.48)$$

The agent is making the decision regarding its education without knowing with certainty its migration status in the next period as it will depend of the realized productivity gap between the two countries. The only information accessible is the ex-ante probability to migrate of agent i , defined by :

$$P_{t+1}^{i,migr} = P \left[w_{2,t+1}^{i*} - w_{2,t+1}^i > c \right] \quad (1.49)$$

We suppose here that this probability is considered as exogenous by the agent : $P_{t+1}^{i,migr}$. The agent therefore does not take into account the effect of its education decision on his probability to migrate.²⁴ Having defined the ex-ante probability to migrate, we can use the law of total expectations to split the second period utility in two cases : the agent stays or the agent migrates.

²²If we assume a given mean and variance of the distribution from which γ s are drawn, then according to the Central Limit Theorem, X^A should follow a Normal distribution.

²³ $F_{XA}(c)$ would therefore only be a valid description of migration flows in the period of introduction of freedom of movement.

²⁴We make that hypothesis to simplify and avoid a situation where optimization conditions could not be well computed due to the presence of a non-existent expectation term : our FOC would comprise the expectation of a ratio distribution of normal distribution which does not have finite moments. See Section A2.4 of the Appendix.

The total inter-temporal utility becomes :

$$V^i = U(c_{1,t}^i) + \beta P^{i,migr} E \left[U(c_{2,t+1}^{i*}) \right]_{Migrate} + \beta(1 - P^{i,migr}) E \left[U(c_{2,t+1}^i) \right]_{Stay} \quad (1.50)$$

And the first order condition is :

$$\frac{1}{1 - e_{1,t}^i} = \beta P^{i,migr} E_1 \left[R_{2,t+1}^{i*} \right]_{Migrate} + \beta(1 - P^{i,migr}) E_1 \left[R_{2,t+1}^i \right]_{Stay} \quad (1.51)$$

$$\text{with } R_{2,t+1}^i = \frac{w_{2,t+1}^{i'}(e_{1,t}^i)}{w_{2,t+1}^i(e_{1,t}^i)} \quad \text{and} \quad R_{2,t+1}^{i*} = \frac{w_{2,t+1}^{i*'}(e_{1,t}^i)}{w_{2,t+1}^{i*}(e_{1,t}^i) - c}$$

The left-hand side is unchanged compared to the closed economy situation. But the right-hand side is now split in two component as the agent has to consider expected education investment returns in two cases : migration and staying in the domestic country.

Proposition 3: The solution of equation 1.51 is a global maximum if the utility and the wage functions are increasing and concave with respect to the education effort.

Proof : The second order condition of the closed economy problem is :

$$\frac{\partial^2 U}{\partial e_{1,t}^i} = (w_{1,t}^i)^2 U''(c_{1,t}^i) + \beta E_{1,t} \left[U''(c_{2,t+1}^i) (w_{2,t+1}^i)^2 + U'(c_{2,t+1}^i) w_{2,t+1}^{i''} \right]$$

It is negative if $U''(c_{1,t}^i) < 0$ is negative and $w_{2,t+1}^{i''} \leq 0$. In open economy only the second component changes and become :

$$(1 - P^{i,migr}) \frac{\partial E_1 \left[R_{2,t+1}^i \right]}{\partial e_{1,t}^i} + P^{i,migr} \frac{\partial E_1 \left[R_{2,t+1}^{i*} \right]}{\partial e_{1,t}^i} \quad (1.52)$$

As $0 < P^{i,migr} < 1$ and the two partial derivatives are negative, equation 1.52 is negative and the solution a global maximum. \diamond

1.4.3 Interaction between Labour Mobility and Education

We will now look at the way in which the introduction of migration affects some of the closed economy results. To limit the size of the equations and

keep some clarity, hereafter the returns on education abroad will be noted $R_{2,t+1}^{i*}$, the returns in the domestic country $R_{2,t+1}^i$ and the total returns on education $TR_{2,t+1}^i$.

Proposition 4 : For given shocks $\{A_t, A_t^*\}$ and migration cost c , and if the pre-migration population of each skill groups in both countries are equal, then there exists a threshold value of human capital level $\bar{h}_{2,t}$ such that no agents belonging to a skill group k with a human capital level below the threshold will migrate.

Proof: An agent migrates if equations 1.41 or 1.42 are satisfied. For a given couple of shocks $\{A_t, A_t^*\}$, it is possible to find the individual level threshold $\bar{h}_{2,t}^i$ over which agents choose to migrate. It will be identical for all agents of the same skill group k , but will depend on the level of population by skill in both countries. As $N_{2,t-1}^k$ increases during the migration process, $\bar{h}_{2,t}^i$ increases as well until the end of migrations. Hence, it is the previous period population level that defines if no agent of given group will be able to migrate. Therefore, we need to suppose equal inherited population level $N_{2,t-1}^{k*} = N_{2,t-1}^k \forall k$ in both countries, to be able to define :

$$\bar{h}_{2,t} = \frac{c}{A_{t+1}^* (N_{2,t-1})^{\frac{(1-\alpha)}{\alpha}} - A_t (N_{2,t-1})^{\frac{(1-\alpha)}{\alpha}}}$$

No agent belonging to skill group k for which the associated human capital is lower than this threshold will migrate at any point of period t , while some agents of other groups will be able to migrate until equation 1.41 or 1.42 are saturated. \diamond

According to this proposition, only the least educated share of agents will not migrate. As a consequence, the model predicts migrants to be more educated on average than stayers, as shown in the second stylized fact. The skill distribution explains the migration pattern. As the threshold is increasing with the migration cost s , we expect that above a certain level of cost, nobody migrates and if it is low enough, all skill types will participate to migration flows.

Proposition 5: If there is a migration cost c , then the introduction of migrations increases the education investment chosen by agents : $e_{1,t}^{i, closed\ eco} < e_{1,t}^{i, open\ eco} \quad \forall i$.

Proof : Indeed, from the Euler condition $E_{1,t} [TR_{2,t+1}^i]$ can be written differently to highlight the migration decision. Using the law of iterated expectation :

$$E_{1,t} [TR_{2,t+1}^i] = E_1 [R_{2,t+1}^{i*} | Migrate] p^{i,migr} + E_1 [R_{2,t+1}^i | Stay] (1 - p^{i,migr})$$

The agent's expected returns of education investment is the sum of returns in cases of migration and non-migration weighted by their respective probabilities of occurrence.

$$E_{1,t} [TR_{2,t+1}^i] = p^{i,migr} (E_{1,t} [R_{2,t+1}^{i*} - R_{2,t+1}^i]) + E_{1,t} [R_{2,t+1}^i]$$

Hence, if $R_{2,t+1}^{i*} \neq R_{2,t+1}^i$ the education investment level is shaped by the possibility to migrate. Assuming a migration cost c , the returns of education in case of migration is:

$$R_{2,t+1}^{i*} = \frac{w_{2,t+1}^{i*'}(e_{1,t}^i)}{w_{2,t+1}^{i*}(e_{1,t}^i) - c}$$

Therefore $R_{2,t+1}^{i*} > R_{2,t+1}^i$, so $E_{1,t} [TR_{2,t+1}^i] > E_{1,t} [R_{2,t+1}^i]$, meaning that the returns on education are greater in open economy for a given education effort. It can therefore easily be deduced from equation 1.7 that $e_{1,t}^{i,closed\,eco} < e_{1,t}^{i,open\,eco}$. \diamond

This proposition describes a skill upgrade effect : allowing labour mobility leads to higher education efforts. It is important to notice that this proposition does not rely on the specific utility and production function that we chose earlier. The only necessary condition is that the expected return of education is greater abroad for the migrating agent. Here, migration is an option allowing to reduce loss of revenue due to low productivity in the origin country. Taking this option entails paying a fee c which can be more easily afforded by highly skilled agents as they are more likely to have increase their revenue by migrating to the high productivity country. This skill upgrade effect works for every agent. But it does not necessarily lead to a brain gain for the economy as a whole, since the most educated individuals are also those who leave if the economy is hit by a negative productivity shock. A lower migration cost (facilitating labour mobility) reduces the value of education efforts but increases the likelihood of migration. The weight given to that

possibility increases. The overall effect of a reduction in the migration cost is undetermined.

The skill upgrade effect brought forward in Proposition 5 relies explicitly on the presence of uncertainty : it is not the shock *per se* that leads to increased education effort. This raises the question of the robustness of that effect to the absence of uncertainty. In particular, we would like to know if agents would make a different education effort decision if they could perfectly forecast shocks and their future migration status.

Proposition 6: For given shock $\{A_t, A_t^*\}$ and migration cost c , heterogeneity of human capital between low and high skill agents is lower if agents can perfectly future shocks and migration status.

Proof : As seen in Proposition 5, $e_{1,t}^{i\,closed\,eco} < e_{1,t}^{i\,open\,eco}$.

Assuming that $\{A_t, A_t^*\}$ is perfectly known, each agent can directly determine if she should migrate in the following period, given its education choice and its inherited human capital level. There will be a human capital level \bar{h} over which agents will migrate. Those for which $h^i > \bar{h}$, know they will migrate at the following period and will therefore take into account only the returns of education in the other country. For them $TR_{2,t+1}^i = R_{2,t+1}^{i*}$: they will choose a higher level of education investment than if they had no information on the future productivity shocks. If $h^i < \bar{h}$, then $TR_{2,t+1}^i = R_{2,t+1}^i$ and the agent will remain at the closed economy level of education effort and human capital. Heterogeneity between different types of agents are reduced in the uncertain case. \diamond

The mechanism by which the skill upgrade works for everybody in the economy involves the presence of uncertainty on the aggregate productivity and the future decision to migrate. Agents have to hedge on the different possible realizations of the shock. In the perfect forecast case, this need disappears : agents can perfectly predict their future return on education, increasing divergence between them.

1.4.4 Lump-sum Subsidies

We now introduce a system of tax and subsidies to study how it affects the individual's decision. Indeed, such instrument would come into play if a central government where to implement a common fiscal policy in Europe.

Our goal here is not to delve into all the implication of such construction but only to focus on the way fiscal instruments would affect the mechanisms seen previously.²⁵

We assume the two countries decide to tax agents in the high productivity country and subsidize those in the low productivity country, after migrations took place. We will look at the effect of a lump-sum tax/subsidy on middle-age individual (those that migrate) as it has the advantage of simplicity. Only middle-aged agents contributes or benefits from those subsidies.

$$c_{2,t+1}^i = w_{2,t+1} - \theta \quad (1.53)$$

where a positive value of θ correspond to a contribution and a negative value a subsidy. In order to understand the effect of such mechanism on the education incentives, it is necessary to know how the lump-sum subsidies changes the denominator of the domestic returns on education ratio :

$$R_{2,t+1}^{i,\theta} = \frac{w_{2,t+1}'(e_{1,t}^i)}{w_{2,t+1}^i(e_{1,t}^i) - \theta} \quad (1.54)$$

For simplicity, we will denote the two broad cases where agents contribute paying a tax T (positive θ) or receive a subsidy S (negative θ) as follows :

$$R_{2,t+1}^{i,+} = \frac{w_{2,t+1}'(e_{1,t}^i)}{w_{2,t+1}^i(e_{1,t}^i) + S}$$

$$R_{2,t+1}^{i,-} = \frac{w_{2,t+1}'(e_{1,t}^i)}{w_{2,t+1}^i(e_{1,t}^i) - T}$$

A subsidy reduces the returns and leads to lower education efforts and a tax increases the returns and education efforts.

²⁵Some form of common budget is often proposed as an improvement of the Eurozone structure. It would provide an additional adjustment mechanism in case of asymmetric shock. The basic goal is to transfer funds from the better-off countries to the most depressed in order to limit the strength of the recession in that country (Farhi and Werning, 2017). It could take the form of direct inter-country transfers, of investment directed at depressed countries at the area or it could consist in the creation of an European automatic stabilizer, such as a European unemployment insurance scheme. Against this proposition it is generally argued that as long as differences in the economic structure of the various members of the Eurozone persists, a federal budget would results in permanent transfers from some members to others and that it could create moral hazard issues (Feld and Osterloh, 2013). A reduction in risks all over the area would be a necessary prior step. The democratic accountability regarding a federal European budget is also questioned : who would be responsible for the use of these funds, European institutions, national parliaments ?

Agents cannot predict exactly the size of the tax/subsidy that will be implemented. They only know that if productivity is higher in their country they will contribute, while if productivity is lower they will benefit from the subsidy. Hence, we can write the expected return in the absence of migrations :

$$E_{1,t} \left[TR_{2,t+1}^i \right] = P(\Delta A < 0) E_1 \left[R_{2,t+1}^{i,-} \right]_{\Delta A < 0} + P(\Delta A > 0) E_1 \left[R_{2,t+1}^{i,+} \right]_{\Delta A > 0} \quad (1.55)$$

The total return is higher if the productivity is high in the domestic country and lower if the productivity is low there. It should be compared to the normal return $R_{2,t+1}^i$ to understand the effect of subsidies.

Proposition 7: In the absence of migrations, the presence of taxes and subsidies increase individual education effort, if the education return is an increasing and convex function of the contribution and $E[\theta] \geq 0$.

Proof : Denoting $\alpha = P(\Delta A < 0)$ and applying Jensen's inequality to equation 1.55 :

$$E_{1,t} \left[TR_{2,t+1}^i \right] \geq \alpha R_{2,t+1}^{i,-} [E_{1,t}(T)_{\Delta A < 0}] + (1 - \alpha) R_{2,t+1}^{i,+} [E_{1,t}(S)_{\Delta A > 0}]$$

This assume the function $R_{2,t+1}^{i,\theta}$ is increasing and convex. The latter property also allows us to write that :

$$E_{1,t} \left[TR_{2,t+1}^i \right] \geq E_{1,t} \left\{ R_{2,t+1}^{i,\theta} [\alpha E_{1,t}(T)_{\Delta A < 0} + (1 - \alpha) E_{1,t}(S)_{\Delta A > 0}] \right\}$$

Using the law of total expectations, the component inside the return function is found to be $E_{1,t}(\theta)$. Hence, if the mean of the subsidy variable θ is greater or equal to 0, the right-hand side of the expression will be greater than the expected return in the absence of subsidies:

$$E_{1,t} \left[TR_{2,t+1}^i \right] \geq E_{1,t} \left[R_{2,t+1}^i \right]$$

It can therefore be deduced from equation 1.7 that the education effort will be increased by this policy in a close economy. \diamond

The condition of convexity of the education return with respect to the subsidies is satisfied with lump-sum subsidies and the functional hypothesis

made here.²⁶ If on average the productivity gap between the two countries is zero, then we expect $E[\theta] = 0$. The tax/subsidy still increases education effort if on average the productivity in the domestic country is higher than in the foreign country, such that on average domestic citizens contribute more often to the system. A persistent shock over several periods would result in such situation. The effect on citizens of the other country is undetermined.

Let's now consider the situation where migrations are possible. We should also consider the return on education when the agent migrate :

$$R_{2,t+1}^{i,*-} = \frac{w_{2,t+1}'(e_{1,t}^i)}{w_{2,t+1}^i(e_{1,t}^i) - c - T}$$

We can then rewrite the returns on education by decomposing with respect to the different case : productivity shock higher in one country or the other, the agent stays or migrates. It gives us the following expression for the returns of education when there is no subsidies:

$$\begin{aligned} E_{1,t} [TR_{2,t+1}^i] &= P(\Delta A < 0) E_1 [R_{2,t+1}^i]_{\Delta A < 0} \\ &+ P(\Delta A > 0) \left\{ E_1 [R_{2,t+1}^{i,*-}]_{Migrate} P_{t+1}^{i,migr} + E_1 [R_{2,t+1}^i]_{Stay} (1 - P_{t+1}^{i,migr}) \right\}_{\Delta A > 0} \end{aligned} \quad (1.56)$$

And if they are present :

$$\begin{aligned} E_{1,t} [TR_{2,t+1}^i] &= P(\Delta A < 0) E_1 [R_{2,t+1}^{i,-}]_{\Delta A < 0} \\ &+ P(\Delta A > 0) \left\{ E_1 [R_{2,t+1}^{i,*-}]_{Migrate} P_{t+1}^{i,migr} + E_1 [R_{2,t+1}^{i,+}]_{Stay} (1 - P_{t+1}^{i,migr}) \right\}_{\Delta A > 0} \end{aligned} \quad (1.57)$$

Comparing these expressions allows to know how these lump-sum subsidies modify private incentives to education. There are two channels and the final effect is undetermined.

²⁶Throughout the previous demonstration, we condition on the sign of A , such that our return function only depends on θ . The first derivative of that function is : $R_{2,t+1}^{i,\theta'} = \frac{w_{2,t+1}'}{[w_{2,t+1}^i - \theta]^2}$.

The second derivative is : $R_{2,t+1}^{i,\theta''} = \frac{2 w_{2,t+1}'}{[w_{2,t+1}^i - \theta]^3}$. Both are positive as long as the wage function is greater than θ .

Proposition 8: Lump-sum taxes positively affect the education investment level by raising the expected returns of agents paying the tax while lump-sum subsidies negatively affect the education investment.

Proof : If $\Delta A < 0$ then the agents of the domestic country will be paying a tax as their productivity is higher than in the other country. They will pay an additional tax that increases the returns of education as:

$$E_1 \left[R_{2,t+1}^i \right]_{\Delta A < 0} < E_1 \left[R_{2,t+1}^{i,-} \right]_{\Delta A < 0}$$

If $\Delta A > 0$, then the movers will also have to pay the tax in the better-off country, which will similarly increase their incentive to education. Second, when the agent stay in its country it receives a subsidy T.

$$E_1 \left[R_{2,t+1}^i \right]_{\Delta A > 0} < E_1 \left[R_{2,t+1}^{i,+} \right]_{\Delta A > 0}$$

In the same way that paying a migration cost of a lump-sum tax raises the education returns, receiving a subsidy reduces it. \diamond

Proposition 9 : Lump-sum subsidies negatively affect migration flows.

Proof: The presence of subsidies affect condition 1.41 which becomes more binding :

$$w_{2,t+1}^{i*} - c - T > w_{2,t+1}^i + S$$

Within a skill group, this condition will be saturated faster, reducing the amount of migration within that group. The migration cut-off will also be higher, meaning that the agent indifferent between migrating or staying will be more skilled. \diamond

1.4.5 Open Economy General Equilibrium

In this framework, the segmentation of the labour market, the lack of a bonds market and the absence of altruism between generation means that there is no strong link between the generations. Young individuals will inherit a human capital level and location from their predecessors and make their choices considering those as exogenous. We can therefore describe the equilibrium as being generation-specific for a given inherited capital and population distribution.

Dynamic general equilibrium

GE Given a sequence of shocks $\{A_t, A_t^*, A_{t+1}, A_{t+1}^*\}_{t=-\infty}^{\infty}$, the dynamic general equilibrium is the sequence of vectors $\left\{ \left\{ w_{j,t}^i, w_{j,t}^{i*}, e_{1,t}^i, e_{1,t}^{i*}, h_{2,t}^i, h_{2,t}^{i*}, N_{2,t}^k, N_{2,t}^{k*} \right\}_{i,j,h} \right\}_{t=-\infty}^{\infty}$ defined as the set of wages $w_{j,t+1}^i$, the set of education choices $e_{1,t}^i$ and the final population distribution $N_{2,t+1}^k$ of all agents young in period t and old in period $t+1$ in both countries and belonging to skill groups h , given the productivity shocks, the inherited levels of human capital $h_{2,t}^i$ and the inherited distribution of population of each skill type such that :

1. The individual decision is optimal and the budget constraint fulfilled (equations 1.51 and 1.48).
2. The representative firms decision is optimal (equation 1.40).
3. The dynamics of human capital fulfils equations 1.2 and 1.3.
4. No migration occurs as equations 1.41 and 1.42 are binding.
5. The technological constraint satisfy equation 1.39 and the post-migration population distribution across countries is such that:

$$\int_h N_{2,t+1}^{k*} dh + \int_h N_{2,t+1}^k dh = 2N \quad (1.58)$$

$$N_{2,t+1}^{k*} + N_{2,t+1}^k = N_{2,0}^{k*} + N_{2,0}^k \quad (1.59)$$

6. The labour market (equations 1.17, 1.5 and 1.6) and the goods market clear :

$$Y_t = \int_h N_{2,t}^k w_{1,t}^i dh + \int_h N_{2,t-1}^k w_{2,t}^i dh + \int_h (N_{2,t}^{k*} - N_{2,t}^k) (w_{2,t}^i - c) dh + \int_h (N_{2,t}^k - N_{2,t}^{k*}) c dh \mathbb{1}_{\text{if } N_{2,t}^k - N_{2,t}^{k*} > 0} \quad (1.60)$$

Stationary general equilibrium

The system will reach a stationary general equilibrium when human capital stop accumulating and nobody has any incentive to migrate. At that point the education decision will be identical from one generation to the next as it will only serve to replace depreciated human capital. Regarding migration,

this imply a situation with identical productivities and population distribution of skill types in both countries.

Stationary GE The autarkic equilibrium is a steady-state without migration and shock, that is, a stationary sequence of wages which fulfils in both economies

1. The individual optimality conditions for all agents,
2. The budget constraints of all agents,
3. The market clearing conditions for the goods and the labour markets, including the no-migration condition,
4. The resource and technological constraints.

For the home economy : Equations 1.23 to 1.35 for the closed economy stationary equilibrium and the open economy optimality condition :

$$\frac{1}{1 - e_1^i} = \beta P^{i,migr} E_1 \left[\frac{w_2^{i*'}(e_1^i)}{w_2^{i*}(e_1^i) - c} \right]_{Migrate} + \beta(1 - P^{i,migr}) E_1 \left[\frac{w_2^{i*'}(e_1^i)}{w_2^{i*}(e_1^i)} \right]_{Stay} \quad (1.61)$$

For the foreign economy

$$\frac{1}{1 - e_1^{i*}} = \beta P^{i,migr} E_1 \left[\frac{w_2^{i*'}(e_1^{i*})}{w_2^{i*}(e_1^{i*}) - c} \right]_{Migrate} + \beta(1 - P^{i,migr}) E_1 \left[\frac{w_2^{i*'}(e_1^{i*})}{w_2^{i*}(e_1^{i*})} \right]_{Stay} \quad (1.62)$$

$$c_1^{i*} = (1 - e_1^{i*})w_1^{i*} \quad (1.63)$$

$$c_2^{i*} = w_2^{i*} \quad (1.64)$$

$$Y^* = \sum_{i=1}^N c_1^{i*} + \sum_{i=1}^N c_2^{i*} \quad (1.65)$$

$$w_j^{i*} = Ah_j^{i*} (N_j^{k*})^{\frac{(1-\alpha)}{\alpha}} \quad (1.66)$$

$$\forall i, j, l_j^{i*} = l_j^{i*,supply*} \quad (1.67)$$

$$l_1^{i*,supply*} = (1 - e_1^{i*}) \quad (1.68)$$

$$l_2^{i,supply*} = 1 \quad (1.69)$$

$$Y_{t*} = A^* \sum_{j=1}^2 \int_h l_j^{k*} h_j^{i*} dh \quad (1.70)$$

$$l_j^{k*} = \left(\sum_{i=1}^{N_j^{k*}} (l_j^{i*})^\alpha \right)^{\frac{1}{\alpha}} \quad i \in h \quad (1.71)$$

$$h_1^{i*} = (1 - \delta) h_2^{i*} \quad (1.72)$$

$$h_2^{i*} = \gamma^i e_1^{i*} + h_1^{i*} \quad (1.73)$$

$$N = \int_h N_j^{k*} dh \quad (1.74)$$

$$N_j^{k*} = N_{j,0}^{k*} \quad (1.75)$$

The no-migration condition

$$\left| w_2^{i*} - w_2^i \right| \leq c, \forall i \quad (1.76)$$

The resolution is made difficult by the consumer program's FOC for two reasons. First, in the open economy case, the education return takes a relatively complex form and the presence of the expectation operator prevents to simply extract the variable of interest e_1^i . Using the integral definition of the expectation operator does not allow to reach a simpler expression. Second, the presence of the migration cost introduces non-linearities in the problem. Even though we know the condition under which a solution can be found, deriving it is cumbersome. Adding hypothesis aiming at reducing the complexity, such as reducing the productivity shock to a high or a low value, does not help because it only removes the first of the two issues.²⁷ As can be seen in Section A2.5 of the Appendix, it bring us to the resolution of a second order polynomial but the sign of the determinant can hardly be determined due to the intractability of the expression. Due to these difficulties, a full resolution of the stationary general equilibrium is not yet available but

²⁷Assuming that agents adapts their expectations to the observed past situation would actually radically simplify the problem at the steady-state : as there is no migration agents would assume a zero probability to migrate. However this would only bring u back to the closed economy steady-state, which is not an interesting equilibrium in open economy.

will be added in the future. Indeed, we would expect the consumer's program to have a solution, based on Proposition 3. The simulation presented in Section 1.6 also shows the convergence of human capital level toward a steady-state different from the closed economy.

1.5 Empirical Evidence

The first stylized fact presented in Section 1.2 points towards the existence of a positive correlation between the economic cycle and migration in Europe. The model replicates this observation and extend the insight in Section 1.4.1. It shows that productivity shocks lead to temporary wage gaps inciting migration and that this wage-migration relationship should be stronger when migration costs are lower. This section will use econometric techniques in order to test those two elements of the model presented before.²⁸ Using OECD country-level migration data, we aim to bring theory to empirics by using an econometric specification that looks at the role of economic cycles in driving migration flows and the way in which migration costs affect this relationship.

1.5.1 Data

We obtain population inflows and outflows by nationality from the OECD migration database for 13 European countries from 1997 to 2017.²⁹ There are limitations to our data. Indeed, the collection and sharing of migration data is far from being homogeneous over the sample. The first and last years of the series and the number of nationalities of migrants are not the same for each country. Therefore our main panel is unbalanced. To account for macroeconomic fluctuations, we use the OECD average wage data, as this variable is an explanatory component of migrations. Since we are interested in fluctuations, we compute its yearly percentage change in constant 2018 prices.

²⁸We would like to test other results of our models, however, most of them would require to use jointly education and migration data. However, such dataset usually is at the 10-year level and not the yearly level, which prevent us from using short-term shock as a predictor.

²⁹The countries are Belgium, Czech Republic, Germany, Spain, Estonia, Finland, United Kingdom, Italy, Lithuania, Netherlands, Portugal, Slovakia and Sweden. We drop France and Latvia as they only appear as potential nationalities, and not as destination countries.

1.5.2 Empirical Strategy

To test empirically the link between migration and economic cycles, we base our specification on equation 3.21. It states that the probability to migrate is an increasing function of the productivity gap and human capital. Moreover, for a given wage gap a lower migration cost will increase the migration probability.

Therefore we are going to regress bilateral migration flows on wage variations that stand for our asymmetric shock and a set of controls. Indeed, our identification strategy relies on the use of two set of fixed-effects, origin-destination and origin-year fixed effects that control for all the structural peculiarities of the relationship between two countries and the shocks affecting the origin countries. The resulting variation concern only short-term gap in economic fluctuations. We regress the following specification using a Poisson Pseudo-Maximum Likelihood³⁰ (PPML) estimator that facilitates the inclusion of observations without bilateral flows:

$$Flows_{ijt} = \beta_1 + \beta_2 \Delta Wage_{it} + \beta_3 D_{ijt} + \beta_4 X_{it} + \mu_{ij} + \mu_{jt} + \epsilon_{ijt} \quad (1.77)$$

with $Flows_{ijt}$ being either inflows or outflows of nationals from origin country j in or out of destination country j in year t , $\Delta Wage_{ijt}$ is the percentage change in earnings in destination country i and year t , X_{it} is a set of controls (inflation and population) of country i in period t and D_{it} a set of dummies associated to membership to the EU and the Schengen area.³¹ Membership entails closer relationship between the different economies and lower migration costs. Thus we control for membership of the destination country and also for the dual memberships of the origin and the destination countries, which are likely to reflect both structural differences between country groups and changes in migration costs.

The μ_{ij} set of fixed-effects controls for all the long-term factors that might explain specific bilateral migration patterns, such as difference in relative levels of development and wages, historic relationships and common language. Hence, using growth rate as proxy for the relative wages shock makes sense : all long-term differences between the origin and destination countries are

³⁰The PPML estimator allows to deal with migration flows equal to 0 and deals better with heteroscedasticity than the OLS estimator as shown in Fally (2015) who demonstrated it is efficient for gravity estimation.

³¹Our sample starts in 1997, before several countries joined these agreements.

accounted for, such that any wage increase corresponds to a difference in relative wages. The origin-year fixed-effects μ_{jt} controls for factors that could explain migrations from a given source each year : an asymmetric shock, the size of the country or cultural reasons. Our identification works through comparison between countries of destination : does a higher growth of wages in one destination country leads to more inflows coming from a given origin country ? We expect larger migration flows going toward the country with the largest wage growth.³² Due to these fixed-effects, all explanatory variables are at the it level.³³

Second, another element developed in Section 1.4.1 is that any reduction in migration costs should increase the sensitivity of migration flows to the wage gap. In order to test this result, we compare the wage-migration link in pairs of country with different levels of migration costs. We estimate the following variation of the previous specification, using membership to the Schengen area and to the Euro Area to approximate migration costs :

$$\begin{aligned} Flows_{ijt} = & \beta_1 + \beta_2 \Delta Wage_{it} \times [Schengen_{ijt}^2 = 0] \\ & + \beta_3 \Delta Wage_{it} \times [Schengen_{ijt}^2 = 1] + \beta_4 D_{ijt} + \beta_5 X_{it} + \mu_{ij} + \mu_{jt} + \epsilon_{ijt} \end{aligned} \quad (1.78)$$

where $Schengen_{ijt}^2$ is the dummy equal to 1 if both destination and origin countries are member of the Schengen area. We consider this dummy to be reflective of the lower migration cost inside the area. This specification allows to split the average relationship between wage growth and migration between flows happening within Schengen and the rest of them, allowing use to clearly see the difference of the effects between the two groups.

We use two dependent variables aiming at capturing different aspects of migrations : (i) inflows of foreigners and (ii) outflows of foreigners.³⁴ We expect inflows to react positively to wage growth : migrants from a given origin should be more likely to move to the country where wages increased the most, as in our specification it implies higher wage differential between the country of origin and the destination. Similarly, outflows should react

³²Optimally, we would like to compare individuals who chose to migrate with those who chose not to and then the difference in potential wages in both countries. As this is not possible, we compare the wages between different countries of destination using fixed effects to control for all origin country specificities.

³³Only the dummy for dual membership to the EA is at the ijt level.

³⁴Only foreigners are included in this analysis : we do not know the outflow of domestic citizens, except through the inflows in other countries.

negatively to wage growth : among citizens originating from the same country and living abroad, those who are settled in a country with a higher wage growth should be less likely to leave.

It is important to notice that we do not have certainty that those inflows are actually coming from the country of origin j . For example, a Spanish national could arrive in Germany from Sweden, but we would try to explain it using the differences between Spain and Germany. However, it is quite likely that this kind of migration patterns mostly concern Eastern Europeans (see Bertoli, Brücker, and Moraga, 2013) and this should be taken into account by the EU membership dummy and the origin-year FE as it controls for the nationality of the migrants. Another possibility would be to introduce destination-year fixed effects μ_{it} : this specification explains migration flows by comparing economic outcomes in the country of origin of migrants. However, in the case of inflows, we would be trying to explain migration in country i looking at differences between two other countries j and j' . There might be a fourth country j'' more attractive to these potential migrants and therefore no effect on flows to country i . This specification makes more sense for outflows : we explain migration out of i by comparing wages in countries j and j' . It is based on the assumption that the higher the wages in the origin country j , the more likely its citizens are to leave their country of residence i . Even though we do not have certainty that outflows of citizen from country j are directed to the home country. Therefore we only use this specification for outflows.

1.5.3 Results

Results of the empirical specification testing the link between migration and economic cycles are presented in Table 1.1 for the two specifications mentioned above and for three different samples. The first three columns correspond to the full sample of 13 EU countries which are both countries of origin and destinations, over the 1997-2017 period. Column (1) uses inflows as dependent variable, while columns (2) and (3) looks at the outflows. Our main effect is positive and significant at the 5% level for inflows, but not for outflows with origin-year fixed-effects. The effect of wages on outflows is negative and significant at the 10% level in the specification with destination-year fixed-effects. Even there, the coefficient is clearly smaller than for inflows, indicating a large sensitivity of inflows to changes in wages. A 1% point higher growth in wages implies that inflows increase by 2.6%.

Table 1.1. Migrations and wage variations in Europe

Specification Dep. Variable	Baseline			Schengen ² interaction			EA ² interaction		
	Inflows	Outflows		Inflows	Outflows		Inflows	Outflows	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Δ Wage	0.026** (0.013)	0.004 (0.016)	-0.013* (0.007)						
Δ Wage x (Inter = 0)				0.024 (0.017)	0.026 (0.025)	-0.012 (0.011)	0.025* (0.015)	0.014 (0.020)	-0.015* (0.009)
Δ Wage x (Inter = 1)				0.027** (0.014)	-0.006 (0.014)	-0.013 (0.008)	0.039*** (0.014)	0.003 (0.014)	-0.008 (0.009)
EU (1/0)	0.227 (0.354)	-0.515 (0.490)	0.373*** (0.093)	0.225 (0.353)	-0.477 (0.485)	0.373*** (0.093)	0.233 (0.311)	-0.418 (0.466)	0.369*** (0.093)
Schengen (1/0)	-0.080 (0.110)	-0.767** (0.315)	-0.599*** (0.202)	-0.086 (0.112)	-0.702** (0.299)	-0.600*** (0.204)	0.098 (0.094)	-0.664*** (0.236)	-0.598*** (0.207)
Schengen ² (1/0)	0.240* (0.131)	0.856*** (0.204)	0.615*** (0.201)	0.244* (0.125)	0.808*** (0.197)	0.613*** (0.200)	0.152 (0.131)	0.835*** (0.180)	0.628*** (0.202)
Log of pop	1.528 (0.948)	10.031*** (1.490)	-1.085 (0.709)	1.517 (0.960)	10.217*** (1.517)	-1.079 (0.721)	0.960 (0.928)	9.678*** (1.534)	-1.110 (0.725)
Inflation	0.135*** (0.039)	-0.211*** (0.042)	0.004 (0.016)	0.134*** (0.039)	-0.202*** (0.043)	0.004 (0.016)	0.131*** (0.038)	-0.202*** (0.042)	0.004 (0.016)
EA (1/0)							-1.006*** (0.124)	-0.834*** (0.246)	0.009 (0.260)
EA ² (1/0)							0.522*** (0.094)	0.403* (0.234)	-0.011 (0.255)
Fixed effects :									
Origin-destination	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Origin-year	Yes	Yes		Yes	Yes		Yes	Yes	
Destination-year			Yes			Yes			Yes
Observations	2062	2062	2062	2062	2062	2062	2062	2062	2062
Adj. R ²	0.962	0.960	0.974	0.962	0.960	0.974	0.964	0.961	0.974

Note: Dependent variables are inflows or outflows defined at year-destination-origin(nationality) level. There two types of specification : one with origin-year FE (columns 1, 2, 4, 5, 7, and 8) and one with destination-year FE (columns 3, 6 and 9). In the first case, the independent variables control for the destination country. In the other case, they concern the origin country. Standard errors (in parentheses) are adjusted for clustering by year and country of destination when there are origin-year fixed effects and by year and country of origin when the specification comprises destination-year fixed effects. ***, **, * significantly different from 0 at the 1%, 5%, and 10% levels respectively.

More populated destination countries should have larger flows, this effect is encountered only in the case of inflows here. Inflation in the destination country increases inflows and decreases outflows. This is expected as inflation controls for the position of the country in the cycle : countries in an economic boom have higher inflation than countries in a downturn. EU and EA membership dummies are important inasmuch that they control capture change in migration costs within Europe. The EU dummy is only significant and positive when it applies to the origin country, in the specification of column 3 with destination-year fixed-effects. Whether the destination country is part of the EU does not seem to have any significant effect on migration. This not necessarily surprising if one considers that in Europe and regarding labour mobility and other forms of migration, EU citizenship is what really matters. EU citizens move with much more ease than non-citizens, whatever the country of destination. Such increase in outflows is likely to be indicative that a drop in migration costs increases all flows. Belonging to the Schengen area does not seem to have a significant impact on inflows by itself. It is the

dual membership of the origin and destination countries that significantly increase inflows at the 10% level. The centrepiece of the Schengen agreement being the removal of border controls between parties, we indeed expect a positive effects on movements between them as migration costs are reduced. The impact on bilateral flows between a country member of Schengen area and a non-member are not so clear. On one hand, citizens coming from a non-Schengen country might be incentivized to migrate to the Schengen area as it allows unimpeded circulations between several countries. On the other hand, membership to the Schengen area entails specific requirements regarding controls of the common external borders, which might become harder to cross. These two ideas might jointly explain why the direct effect of destination membership to the area significantly and negatively affects outflows : immigrants from non-Schengen countries are de-incentivized to both settle in a Schengen country and then also to leave it. Reverse causality is possible : if we consider that inflows would reduce wage growth in the country of destination, our estimated coefficient would be biased downward. Therefore it has to be taken as a lower bound of the real effect and is unlikely to change our main conclusion given that our coefficient of interest is already positive.

Columns (4), (5) and (6) present the estimates of equation 1.78, where the migration cost is taken into account. The coefficients of interest are those corresponding to variables $\Delta Wage \times (Inter = 0)$ and $\Delta Wage \times (Inter = 1)$, where here "Inter" is $Schengen_{ijt}^2$. For inflows, the effects of wages is significant only for within Schengen flows. Although the point estimates are quite close, the variance of the non-Schengen coefficient is higher. Regarding outflows, none of the coefficients are significant, even though the standard errors are lower for within Schengen flows.

In order to ensure the heterogeneity of the wage-migration relationship, we use an alternative variable to account for migration cost : membership to the Euro Area. Columns (7), (8) and (9) of Table 1.1 present the result of this specification. We add two new controls for membership to the EA. They avoid that interaction coefficients capture the direct effect of EA membership on migration flows. They control for membership of the destination country in columns (7) and (8) and for membership of the origin country in column (9) and also for the dual memberships of origin and destination countries. Similarly as for the Schengen area controls, dual membership to the Euro increases inflows and outflows. The effect of membership for the destination country is negative and harder to interpret. However, the joint effect with the growth in wage is similar as when using the Schengen area dummy as proxy

for migration costs : inflows within the area are more sensitive to wages (an 1% point higher wage growth increases inflows by 3.9%). In column (7), wages also affects inflows if only one or none of the two countries are part of Schengen, but only the coefficient is lower and only significant at the 10% level.

In order to check that these results are not due to the unbalanced nature of the sample and the choice of countries, Table A2 in the Appendix, presents the results of similar regressions with a balanced sample. It only keeps 6 destination countries for which we can have data on inflows and outflows from 13 origin for all years from 2002 to 2015.³⁵ We find similar results as those presented above. The point estimates of the wage growth variable are however usually higher (a 1% point faster wages growth leads to 4.6% increase in inflows). The difference between within Schengen and Euro areas inflows and other inflows is also reinforced in that sample. As in table 1.1, outflows are not sensitive to wage growth.

1.5.4 Discussion

Overall, results presented in this section seem to support hypothesis and results of the previous theoretical section. Indeed, we find that wage differences do correlate with migrations : a 1% point increase in wage growth leads to a 2.6% increase in inflows. Due to the presence of destination-origin and origin-year fixed-effects, all wage growth can be considered a wage divergence from an international steady-state wage level. In agreement with the theoretical model, migration cost matters : a decrease in migration cost, such as removal of border controls, does increase inflows in destination countries. Moreover, the result of the model establishing a joint probability function linking wage differences and migration costs is validated in empirical results. Indeed, we find that, with a variety of sample and migration costs proxy, inflows in destination countries are more sensitive to wage gaps if migration cost are lower. The model only considers flows from the origin country when a adverse shock occurs and not inflows of domestic workers living abroad and foreigners in case of positive shock. The empirical results seem to hint a certain level of settlement persistence. The outflows variable that we use correspond to individuals who are already living abroad.³⁶ In columns

³⁵The 6 destination countries are Germany, Spain, Finland, Italy, Netherlands and Sweden. The 13 origin countries are Belgium, Czech Republic, Germany, Spain, Estonia, Finland, United Kingdom, Italy, Lithuania, Netherlands, Portugal, Slovakia and Sweden.

³⁶Inflows comprises both individuals migrating directly from their home country and those who were already living in a foreign country.

(2), (5) and (8) individuals living abroad are not more likely to leave their country of settlement if wages are lower. Similarly, columns (3), (6) and (9) present very weak evidence of immigrants being more likely to come back to their origin country in case of positive shock there. The magnitude of the effect is also smaller than for the inflows columns. Obviously, due to limitation in our data, we do not have any certainty on the country to which those outflows are directed. As some individuals are probably moving from one destination country to the next without going back to their origin country, their migration is not well accounted for in the specification with destination-year fixed-effects. However, these flows are taken into account by the other specification where there is no effect of wages on outflows. Part of the discrepancy could be due to a higher likelihood for immigrants from some specific countries to move between different destinations, as outlined by Bertoli, Brücker, and Moraga (2013) in the case of Eastern European workers in Germany. As such, the introduction of a origin fixed-effects capture this kind of specificity. This is further confirmed by the results obtained using the balanced panel (see table A2 in the Appendix) : when only Western European countries are considered, the significance of the wage coefficient regarding outflows totally disappears.

1.6 Simulation

Simulating the model developed in the previous sections has two main advantages. First, it allows us to solve the model which is not feasible analytically. We can then conduct comparative statics analysis and observe the dynamics of the model. Second, we can here complement the empirical results that did not allow to reach conclusions regarding the education and skill part of the model but did confirm the relevance of some of our assumptions and results, such as the role of migration cost. Based on this strengthened confidence in our model, this section presents some results of a simulation (with arbitrary parameter values) to illustrate clearly some of our theoretical propositions. To that end, it presents three scenarios and then focuses on the impulse response function resulting from a one-time productivity shock. The first one is the closed economy dynamics. It will show the role of the innate talent γ in shaping the distribution of human capital in the economy. The second scenario concerns the dynamics in open economy, in order to illustrate the skill upgrade effect of migrations. The third scenario will also

be in open economy but with a different value of the migration cost. Comparing scenarios 2 and 3 will provide some insight on the trade-off between the level of migration flows and the skill upgrade effect. Finally, the impulse response functions offer a useful illustration of the mechanics of the model and in particular of the persistent nature of the consequences of productivity shocks.

As explained in the equilibrium section, the model is solved generation by generation. First, we determine the optimal decision of the young agent based on its expectation and its inherited human capital and location. Then, we compute the actual migration decision and the distribution of the population in the two countries. The algorithm that we implement is the following :

1. Chose values for the parameters and initial values $h_{2,0}^i$, $N_{2,0}^{k*}$ and $N_{2,0}^k$.
2. Solve the consumer's program for a given inherited human capital level and constant population level using grids. We obtain $h_{2,t}^i$
3. Draw a random shock values A_{t+1} and A_{t+1}^* from a normal distribution $\mathcal{N}(\mu_A; \sigma_A)$.
4. Compute the migration equilibrium using the realized shock, the human capital from step 2 and saturated equations 1.41 and 1.42. Inserting 1.59, we obtain a expression that can be solved by software to give the domestic population level at which migrations stop based on the migration conditions of the domestic and the foreign country : $N_{2,t+1}^{k,to\ foreign}$ and $N_{2,t+1}^{k,to\ domestic}$ ³⁷.
 - (a) If $N_{2,t}^k > N_{2,t+1}^{k,to\ foreign}$, then there is a migration flow from the domestic to the foreign country and we set $N_{2,t+1}^k = N_{2,t+1}^{k,to\ foreign}$
 - (b) If $N_{2,t}^k < N_{2,t+1}^{k,to\ domestic}$, then there is a migration flow from the foreign to the domestic country and we set $N_{2,t+1}^k = N_{2,t+1}^{k,to\ domestic}$
 - (c) If none of these conditions is verified, agents do not migrate and $N_{2,t+1}^k = N_{2,t}^k$.
5. Input $t = t + 1$. Go back to step 2 if $t < T$.

³⁷*Nota Bene* : both elements are the population level in the domestic country, but while $N_{2,t+1}^{k,to\ foreign}$ is computed assuming that migrants go from domestic to foreign, $N_{2,t+1}^{k,to\ domestic}$ is the population in domestic if migrants go from the foreign to the domestic country as wages are higher in the latter.

6. We can now compute wages, consumption, production at any period t .

We make several assumptions with regard to the calibration that are presented in Table 1.2.³⁸ There are 100 time periods. We suppose that 1000 families in each country distributed equally over 7 different possible values for the abilities parameter γ ranging from 1.9 to 3.6. All families start from the same initial level of human capital in the first scenario while they start from the closed economy steady-state level in scenarios 2 and 3. We suppose a depreciation rate δ of 20%, a discount factor β of 0.9 and a substitution parameter α of 2 for the production function.³⁹ As we will focus on the domestic country and only relative productivities matters for migration flows, we normalize the productivity of the foreign country to 1 over all periods. The domestic productivity is given by a normal distribution of mean of 1 and standard deviation 0.1. The migration cost is set at 0.2 in the first two scenarios and is reduced to 0.025 in the third one to see how the model reacts to a decrease in migration costs.

Table 1.2. Calibration

Parameter		Values		
Innate talent	γ	[1.9-3.6]		
Production substitution parameter	α	2		
Depreciation rate	δ	0.8		
Discount factor	β	0.9		
Number of periods	T	100		
Foreign productivity shock	A^*	1		
Domestic productivity shock	μ_A	1		
	σ_A	0.1		
Initial population distribution	$N_{2,0}^{k*}, N_{2,0}^k$	$\frac{1000}{7}$		
		Scenario 1	Scenario 2	Scenario 3
Migration cost	c	0.25	0.25	0.025
Initial human capital	$h_{2,0}^i$	1	$h_{2,SS}^{closed}$	$h_{2,SS}^{closed}$

Notes: $h_{2,SS}^{closed}$ corresponds to the steady-state level of human capital computed in equation 1.36. γ takes 7 values, by step of 0.3. The domestic productivity shock follows $\mathcal{N}(\mu_A; \sigma_A)$.

1.6.1 Scenario 1 : Convergence in Closed Economy

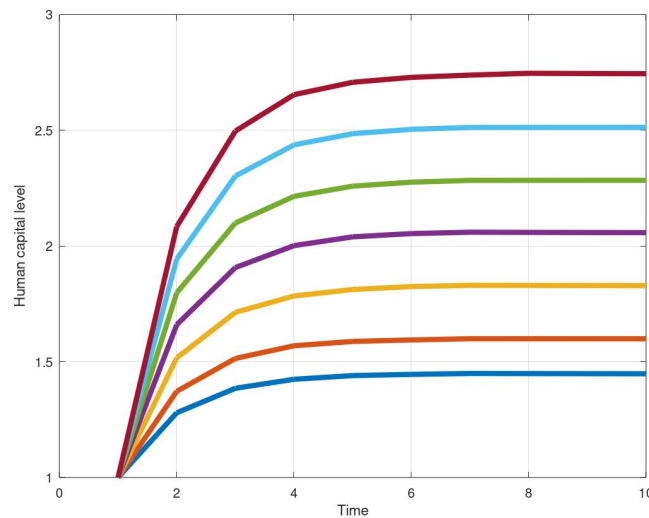
First, we present the dynamics of the level of old agents human capital that is represented in Figure 1.4. Each line represent the human capital level of families of different abilities γ . Lowest ability is in blue and highest in dark

³⁸Parameters value are mostly arbitrary and should be improved in order to make actual policy recommendations.

³⁹As mentioned earlier, this parameter should be greater than 1 to ensure that wages decrease with the number of workers of the same skill type.

red. We observe a greater rate of increase of human capital for high ability agents and also a greater level of final human capital for the skill group with the highest ability. Around $t = 6$, the human capital level of all types reach a plateau that corresponds to the steady-state. The simulated dynamics therefore match the one outlined in equation 1.21 and the values of the human capital once the convergence is over actually correspond to the analytically computed expression described in equation 1.36.

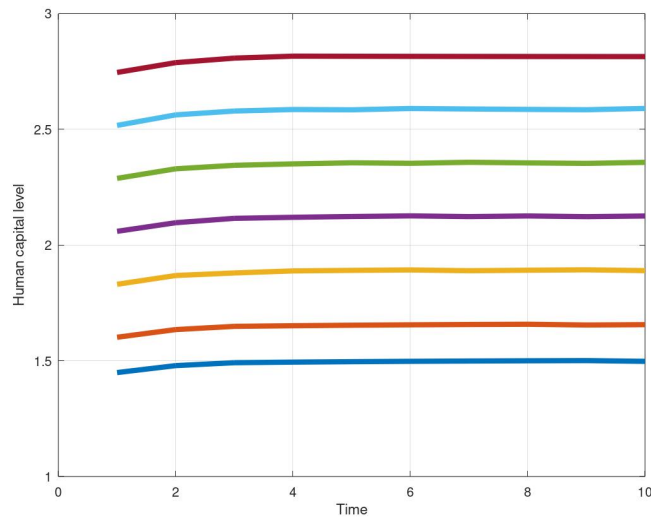
Figure 1.4. Transition to closed economy steady-state



1.6.2 Scenario 2 : Dynamics in Open Economy

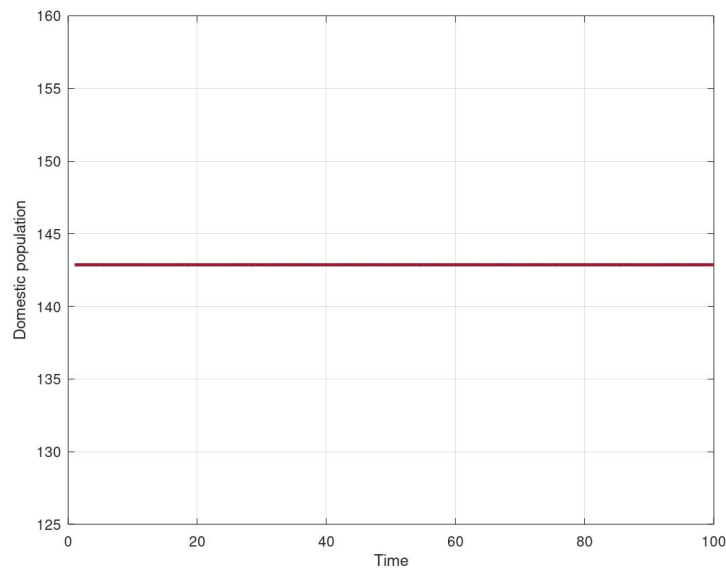
In this second scenario, we open the economy to migration. Moreover, agents do not start from the same human capital level anymore but from the closed-economy steady-state. This allows to check if there is a transition to a new steady-state. Figure 1.5 presents the evolution of old individuals human capital with each colour describing a different type of agent, i.e. agents that differ in terms of their γ and therefore human capital levels.

Figure 1.5. Transition from closed to open economy steady-state



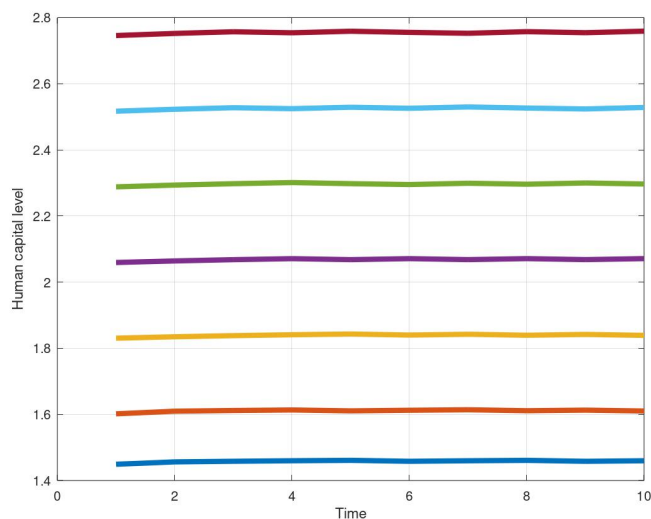
It can be clearly seen that in the first period, the human capital level increases for all agents and then stays constant. This increase over the closed-economy steady-state corresponds to the skill upgrade effect mentioned in Section 1.4. The opportunity to migrate, and the necessity to afford a cost for that, incentivizes agents to invest more in education to be able to afford migration. Agents hedge against the risk of receiving low wages in the future in presence of a productivity shock. As all agents expect to be able to migrate for a large enough shock, the entire population benefits from that skill upgrade effect.

More importantly, the presence of that effect relies on the existence of migration costs. If those cost are large enough, then migration flows will be much smaller. Here the evolution of the population of each skill type in the domestic country can be seen in Figure 1.6. This situation results in an absence of migration for any group due to the relatively high migration cost.

Figure 1.6. Population variation with high migration cost

1.6.3 Scenario 3 : Dynamics in Open Economy

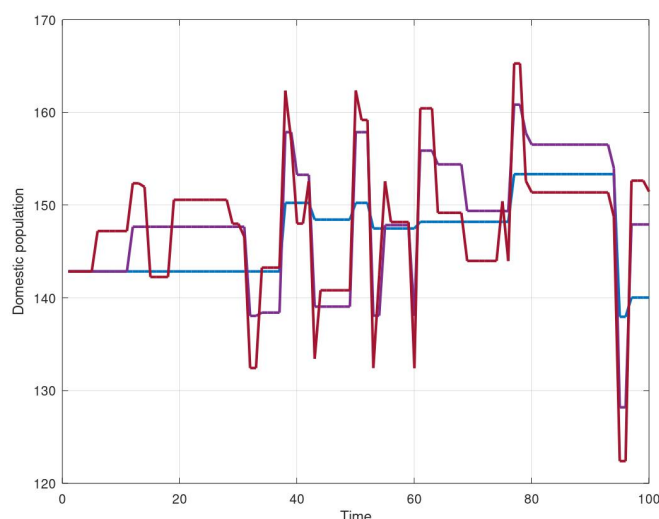
In this last example, we substantially lower the migration cost (from 0.25 to 0.025). All other parameters stay identical to those of scenario 2. Figure 1.7 illustrates clearly that when migration costs become low, any skill upgrade effect disappears.

Figure 1.7. Transition from closed to open economy steady-state

However, lower migration cost involve more actual migration, as it can

be observe in Figure 1.8. Each colour line represents the evolution of the population of a different skill type. The population varies due to the relative productivity shocks in both countries that raise the wages for some skill types. As more and more people take advantage of the wage gap, wages converge until the gap becomes equalizes to the cost of migration. The domestic population of the less skilled agents is clearly the most stable. By contract, the domestic population of the highest ability type, in dark red, is much more variable, as the wage gap is more sensitive to the relative productivity for higher wages. This can also be verified by comparing the variance of the population of the highest and the lowest types over the period. It is around 50% greater for highest type. As low ability agents migrate less, the migrant population is skewed toward the high skilled.

Figure 1.8. Population variation for selected skill groups with low migration cost



Note: Only the lowest (in blue), medium (in purple) and highest (in dark red) skill types populations are represented. See the Figure A3 of the Appendix for the entire distribution.

Another comparison between Scenarios 2 and 3 that is possible relates to inequality. The objective is to compare this outcome in a case where migration is basically closed (because the migration cost c is too high) with a system of relatively free migration. We compute a wage inequality measure similar to an inter-quantile range : the ratio of wages of the top and bottom skill types. This allows us to see if there is some divergence between the different groups within a country by telling how much more high skill agents earn compared to low skill individuals. We also compute the same ratio but bundling the two countries together. This is a measure of inequality in the entire area. We then compute the mean over all 100 periods, in order to have an

overall perspective on the two scenarios. Indeed, inequality will vary period by period depending on the shock incurred by the countries. These statistics are presented in Table 1.3. A first observation is that within country inequality (column 1) is systematically smaller than when considering together the entire population (column 2). This is expected as the shock itself is a source of inequality between the countries. Second, for both measure, inequality is greater in the Scenario where migrations actually occur. First, on the international scale the most skilled individuals are more mobile and therefore more likely to work in the high productivity country. Low skill individual do not earn less due to migrations, but are less likely to benefit from it. Additionally, the fact that in the low productivity country, high skill individual leave in greater number disproportionately raises the wages of stayers compare to other skill groups. The former effect is however clearly large than the latter as the difference between the ratio of column 2 are clearly greater than in column 1 of Table 1.3.

Table 1.3. Ratio of wages

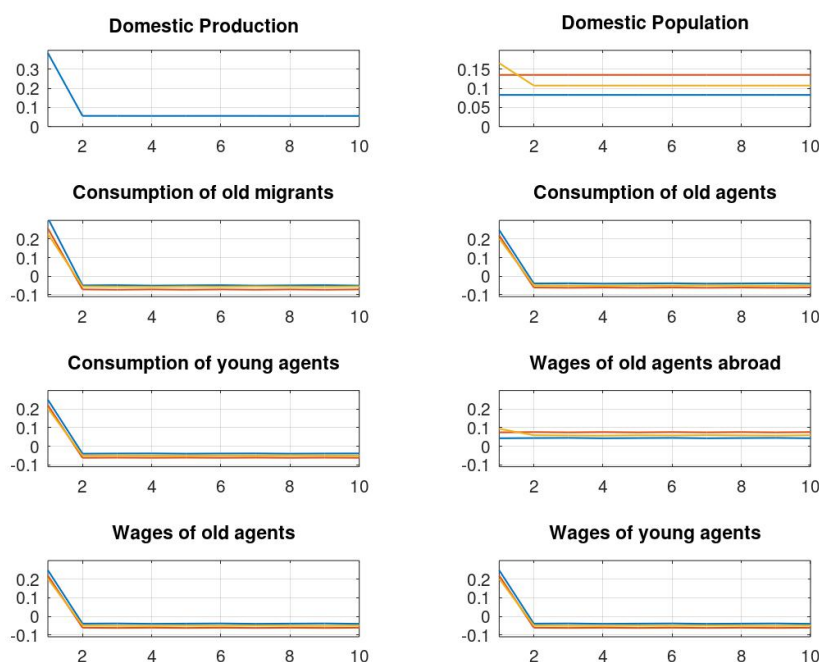
	Within country (1)	Overall (2)
Scenario 2 : No migration	1,88	2,02
Scenario 3 : Migration	1,89	2,05

1.6.4 Impulse Response Functions

To delve in more details in the inner working of the model, we now focus our analysis on the response of domestic production, population, wages and consumption to a productivity shock. We use the same calibration as in Scenario 3, but instead of having a random shock hitting the domestic economy at each period, the domestic productivity is raised by 3 standard-deviations in one period and brought back to its average level afterwards.⁴⁰ We investigate the effect of this shock on domestic production and population, the consumption of both foreign and native old agents living in the domestic country, of young agents, the wages of young and old agents living in the domestic country and of old agents in the foreign country. Each of these variables is normalized to its long-run level in the absence of productivity shock such that our baseline is actually 0. These results are presented in Figure 1.9.

⁴⁰Although the initial level of human capital is the closed-economy steady-state, we implement the shock only after all types of agents have reached their long-run human capital level in $t=50$, so that this dynamics, even if small, does not affect our impulse response functions.

Figure 1.9. Impulse response functions for a 3 standard deviation productivity shock



Note: Only the lowest (in blue), medium (in red) and highest (in orange) skill types populations are represented.

The upper left graph shows the evolution of domestic production. The productivity shock leads to a sharp increase in the first period, as each agent is more productive, that persists over the following period. This can be explained by the dynamics of the domestic population (upper right corner of Figure 1.9). The shock leads to an increase in population of all types as agents migrate from the foreign to the domestic country, due to higher wages for old agents (lower left plot). However, when productivity comes back to its average level the population level does not decrease back to its original level. This is due to the presence of the migration cost that allows a certain level of wage disparity to persist between the two countries as explained in Section 1.4.1 and illustrated by Figure 1.3. Because the population stays higher than its original level over the long-run, so does production. By contrast, wages, higher when the shock hit, become lower than their original level when it disappears. Indeed, the population being higher, there is more competition within each type of workers and wages decrease below their original level. Wages abroad increase over the long-run as the population is smaller. Young agents being born in the country where older agents settle, the dynamics of their wages follows the one of their predecessors'. Consumption being a

function of wages, the dynamics is similar. The initial increase in consumption for migrants is slightly higher than for natives due to the normalization : the initial level was lower due to the migration cost while the increase is similar to other agents.

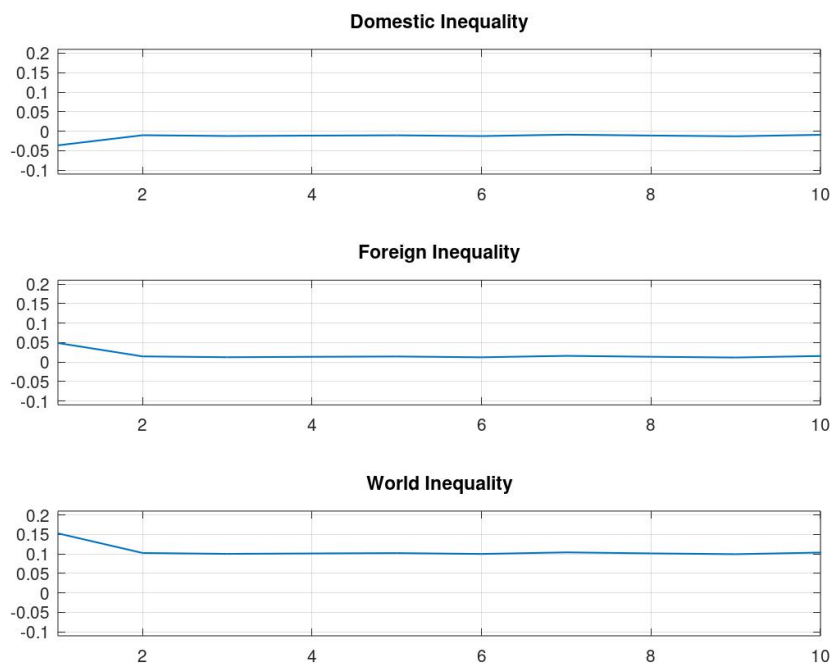
The presence of the migration cost is central to the persistence of the shock consequences : wages are prevented from equalizing across countries and the initial population distribution to be reached. The persistence would therefore disappear in the absence of this cost. It would also disappear in the absence of migration, for instance if the migration cost were too high or the shock too small to make it interesting for any agent to migrate.⁴¹ The presence of different skill types also determine the strength of the persistence. As it can be seen in the upper-right graph, agents of the most skilled type are more responsive to changing conditions : when the shock hits they are more likely to migrate to the domestic country and when productivity reverts to its original level, they are also the only group to migrate to foreign country (which is coherent with the pattern observed in Figure 1.8). This allows them to mitigate the long-run drop in wages. Over the long-run, medium-skilled agents seem to be the biggest losers in terms of wages in the receiving country, while they are the winners in the sending country.

The heterogeneity in agents' reactions to the shock also translate into changes in inequality. In Figure 1.10, we present the impulse response function of the inequality measure described earlier : the ratio of wages between highest paid and lowest paid agents. The top panel clearly shows that the positive shock occurring in the domestic country reduces inequality there. Indeed, all skill groups benefit from the shock in term of increased productivity and wages, but the higher skill types are more affected by immigration that reduces wages. In the following period, inequality almost reverts to its original level although it stays slightly smaller than before the shock the population and wages never go back to their original level and there is a gradient of that long-run effect that relatively benefits low skilled agent (see left-down panel in Figure 1.9). In the foreign country, the opposite effect happens, as can be seen in the middle panel. The most skill agents are more likely to migrate and their population diminishes, leading to a disproportionate increase in wages compared to the other groups, that persists over the following periods. The last panel shows the effect of the shock on world inequality,

⁴¹The latter case is presented in Figure A4 of the Appendix. The shock is not strong enough to foster any migration and all the variables revert back to their original level after the productivity shock disappears.

meaning that we bundle together all agents in both countries and we compare the highest and lowest wages at each period. It increases both in the short and the medium-run as we compare high skilled agents living in the high productivity country with low skill agents living in the other country during the period of the shock. However, in the following periods, inequality is higher than what it used to be due to the long-run increasing in wages in the foreign country and decrease in the domestic country, as explained before. The same pattern of persistence of the effects of the productivity shock can be observed in the case of inequality that comes from the slight differences of IRF by skill group that can already be seen in Figure 1.9 and the the long-run trend which is detrimental to the domestic country that was initially hit by the positive productivity shock.

Figure 1.10. Impulse response functions for a 3 standard deviation productivity shock



1.7 Discussion

How does this analysis complement the traditional view on the role of labour mobility in a currency area? First, we should note that, in accordance with the first stylized fact in Section 1.2, the model predicts the occurrence of *persistent* migration flows only with sufficiently *large* asymmetric shocks. In that regard, labour mobility is allowed to play a role in economic smoothing at

considerable costs as the shock should be quite strong and the effects are lasting.

Second, according to the model labour mobility is unambiguously good for agents as it procures them a way to smooth the effects of a negative productivity shock and it increases the human capital and education investment of the entire population. There are two caveats to that result. With agglomeration effects or with a production function with increasing returns to scale, the departure of the most skilled agent would reduce the welfare of stayers, and would accrue welfare in the destination country, hence leading to international divergences. Moreover, the skill upgrade effect on the whole population relies on the presence of a risk regarding the future economic condition. If agents are able to have a clearer view of the future, then inequality might increase. Introducing other adjustment instrument that would reduce uncertainty would also weaken the labour mobility externality in terms of skill upgrade. Taxes and subsidies are such a mechanism as they reduce the consequences of the shocks on agent's revenues.

Third, the question of the persistence of the asymmetric shocks matters. The behaviour of the skill upgrade effect would not be the same if an initial shock tends to perpetuate on the medium or long-term. The skill upgrade effect will act toward an generalized human capital increase within that country, at the risk of increased international divergences and inequality.

Fourth, the skill upgrade effect results from the need to smooth a shock of revenue and the willingness of the agent to pay to do so. If migrating become costless, too accessible, then there is no need to pursue additional education efforts in order to be mobile. Increasing labour mobility by lowering migration costs would therefore reduce the human capital level. Hence, there is a trade-off between short-term adjustment to a shock and long-run productivity. However, a lump-sum tax in the country with the highest productivity acts similarly to a migration cost. Indeed, agents that migrate have to internalize in their education effort decision that they will only migrate if the other country is better off and as such they will not receive a subsidy at home but pays a tax in the foreign country.

1.8 Conclusion

This papers contributes to the literature by bringing migration concepts within the analysis of labour mobility as an adjustment mechanism. We propose an

OLG model of brain drain caused by asymmetric shocks between two countries of comparable level of development. The model reproduces two stylized facts presented in this paper : economic cycles lead to migration cycles and EA nationals that migrate are more educated than those who do not. Empirical evidence confirming some of the results is provided. This framework shows how labour mobility can lead to a skill upgrade externality and potentially a brain gain that should be taken into consideration when discussing its importance for the EA. It also delves into the consequences on inequality and the pattern of migration that could be expected and shows that subsidies have a mostly positive effect on education in the absence of labour mobility, while weakening the skill upgrade externality. Finally, the model and its simulation underline the trade-off between using labour mobility as an adjustment mechanism and its efficiency in fostering education.

Chapter 2

European Integration and the Trade-off between Offshoring and Immigration

This chapter is joint work with Enxhi Tresa. ¹

2.1 Introduction

Freedom of movement of goods and workers are two important pillars of the European Union (EU). The consequences of their interaction is still a topic of debate, particularly in Western Europe. The Brexit process is a recent example that embodies these discussions. The original negotiation objective of the United Kingdom to limit immigration from the EU while keeping freedom of movement of goods was the result of a political platform capitalizing on the hostility to Central and Eastern European immigration following the EU enlargements of 2004 and 2007.² As far-right parties have been shown to benefit from both trade liberalization (Colantone and Stanig, 2018; Dippel et al., 2020), due to its labour market effects, and immigration (Otto and Steinhart, 2014; Barone et al., 2016; Harmon, 2018; Edo et al., 2019) across Europe, it seems important to improve our understanding of how both phenomenon interact in Europe.

In this paper, we provide evidence of substitutability between offshoring and immigration, using the progressive opening of Western European labour markets to Eastern European workers after the EU enlargements. Adhesion to the Common Market in 2004 corresponds to the final step in the liberalization of trade in goods, at a period where trade links became more global and

¹We owe a debt of gratitude to Pamela Bombarda, Julia Grübler, Sébastien Laffitte, Lionel Fontagné, Gianluca Orefice, Cem Özgüzel, Baptiste Souillard and Farid Toubal for the very useful discussions we had. We are also thankful to the participants of the 12th FIW Research Conference in Vienna, the THEMA Internal Seminar, CES-Cachan Lunch Seminar and GSIE. The authors wish to thank Eurostat for providing the underlying data making this research possible. The responsibility for all conclusions drawn from the data lies entirely with the authors.

²More precisely, 10 Central and Eastern European countries joined the EU in 2004 and then Romania and Bulgaria in 2007, followed by Croatia in 2012.

fragmented.³ In the following years, workers from new Member States progressively obtained the right to work in all of the EU, i.e. Western European countries liberalized access to their labour markets in turns. A large increase of immigration of Central and Eastern European citizens ensued (Kahanec et al. 2013, Holland et al. 2011). We exploit the differences in the timing of labour markets' openings to capture the impact of post-opening inflows of Eastern European workers in offshoring decisions (i.e. imports of domestic value added in intermediate goods) towards Eastern countries at sectoral level for 11 Western European economies. The timing of the integration process, i.e. trade liberalization first and labour markets' opening in a sequential fashion, limits the risk of endogeneity of the relationship we aim to estimate. To lessen even more that concern, we also use an instrumental variable strategy based on a shift-share instrument constructed at the sectoral level.

We provide evidence that labour market opening in the West shifted the trade-off between offshoring production and employing immigrants involved in manual tasks, resulting in lower offshoring by Western Europeans sectors. Differently from the existing literature, our measure of offshoring consists in imported *value added* in intermediate goods, rather than just gross imports.⁴ In the trade-migration nexus literature, one of the mechanisms through which migrants induce trade is the reduction of information frictions, differently known as the network effect (e.g., Gould 1994, Head and Ries 1998, Rauch and Trindade 2002, Felbermayr and Toubal 2012 and Wagner, Head, and Ries 2002).⁵ As a consequence, the established link between trade and migration is bilateral and usually stronger for skilled workers.⁶

³As stated by De Backer and Miroudot (2014) more than half of world manufactured imports are intermediate goods (primary goods, parts and components, and semi-finished products), whereas more than 70% of world services imports are intermediate services.

⁴Indeed, gross imports from Eastern European countries might contain re-exported foreign value. As a consequence, a reduction of gross imports would simply capture a reduction in trade effect, but not a decision to produce less in Eastern countries.

⁵Indeed, migrants play an important role using established networks with their origin country or might create new networks using their comparative advantage of better knowledge of language, legal and institutional arrangements. They could be initiators of new trade chains (in the extensive margin) or enforce the existing ones (intensive margin).

⁶For instance, in Burchardi, Chaney, and Hassan (2017) US counties with a higher share of the population declaring ancestry from a given country will have more FDI links with that country of origin. In micro-level studies, Hatzigeorgiou and Lodefalk (2016) use firm level data for Sweden and find that there are mostly small firms that benefit from hiring foreign-born workers and that workers' skill is necessary to boost a firm's export performance. Marchal and Nedoncelle (2019) using French firm level data show an overall positive effect, induced mostly by skilled foreign workers.

This study does not focus on such effect. Instead, our hypothesis is that unfilled labour needs in Western Europe might explain both recourse to immigration or offshoring and our analysis brings confirmation in two ways. First, we show that sectors employing more Eastern European workers in the post-opening period make a smaller use of overtime hours by natives. As overtime work is more likely to required in case of difficulties to hire, we interpret this result as immigrants coming to occupy unfilled jobs. Second, the post-opening immigration shock does not only reduces offshoring to Eastern Europe but also to other regions of the world. This is expected as we do not consider our main findings to be the result of a network effect and Eastern European workers have no specificity beyond their capability to freely move to Western Europe. Rather, evidence suggests it is caused by the relaxing of a constraint on the recruitment of adequate manual workers, thanks to the opening of Western Europe labour markets to Eastern European workers.

Hence, our work relates strongly with the literature on the trade-off between offshoring and immigration. In a classic article Ramaswami (1968) discusses the choice between exporting capital to produce abroad or importing foreign workers to produce domestically. More recently, this relationship has been formalized by Olney (2012) and then extended to native workers by Ottaviano, Peri, and Wright (2013) in a task-based model. However, in the latter work the effect on trade is not explored and offshoring is measured through production input (i.e. number of overseas workers) rather than imported value. Using country-level data, Kugler and Rapoport (2005) and Javorcik et al. (2011) find complementarity between the presence of immigrants and foreign direct investment on the long-term through the effect of migrant networks.⁷ Similarly to those studies, we distinguish between different types of workers, but rather than education, we focus on occupations as they are stronger indicators of the actual economic role. More importantly, we use sectoral-level data: this greater level in dimension allows to precisely check the existence of substitutability for a given sector in production. Barba Navaretti, Bertola, Sembenelli, et al. (2008) uses firm-level data to answer the same question and find that immigrants and offshoring are substitutes. However, in industry-related sectors, within firm analysis is likely to miss a part of the picture as we could expect that the shift from offshoring to domestic production takes the form of replacing a foreign supplier by a domestic one.⁸ Such change can be better dealt with, by using sectoral-level data.

⁷This is the case particularly for immigrants with higher levels of education.

⁸Olney (2013) finds that the presence of immigrants stimulates firm creation and expansion at the city level, particularly for low-skill intensive industries.

Another value added of this paper relies on the use of the imports of value added in intermediate goods as our measure of offshoring, rather than considering trade in gross terms.⁹ More precisely, this is equivalent to tracking value added produced in NMS countries incorporated in Western Europe's imports and allows to really understand the effect of the presence of immigrants in a given sector and country on the Eastern European production directed at the same sector-country. To our knowledge, there are very few papers that relate trade under the angle of global value chains with migration. Egger, Erhardt, and Lassmann (2019) combine firm level data with precise information on the foreign suppliers of Swiss firms with municipal-level data on the number of foreigners. They find that exposure to immigrants from a given country decreases the number of suppliers from that country and that it increases the stability of the relationship with the supplier and also the volume of imports. These effects are higher for some products which are more relationship dependent (the median number of suppliers is lower). Ariu (2019) look at the role that immigrants in certain Swiss localities had on the supplying side of inputs coming from the origin countries of immigrants. They conclude that migrants reduce trade frictions and help in importing higher quality products from the upstream providers. This paper contributes in this literature, by exploiting a particular context (the EU enlargement) and delving into the mechanisms that relate migrants' presence in different sectors and offshoring decisions.

The integration in European Union of new member states (NMS) has been studied in several aspect: welfare effects (Caliendo et al., 2017), integration in GVCs (Hagemeyer and Ghodsi, 2017) or movement of workers in EU (Kahanec et al., 2013). To the best of our knowledge, this work is the first to provide evidence on the effect of labour mobility on European value chains, and therefore brings insight regarding the interaction between trade liberalization and freedom of movement of workers. A related work to the context of this paper is Caliendo et al. (2017) that evaluate the effects of the 2004 enlargement on migration and welfare using the EU Labour Force Survey database. To do so, they propose a multi-country general equilibrium model and also make use of the timing of Western Europe labour markets' openings. They find that the enlargement increased the migration of low-skilled worker more than high-skilled individuals. Migration would also have been

⁹Recall that looking only at imports of intermediate goods can be misleading in terms of the magnitude of what has truly been offshored in New member states (NMS-10), whereas tracing the value that was locally produced by the exporting country provides a clearer picture of what has been truly offshored.

larger with change in trade policy (joining the single market). By exploring the implication of the liberalization of the movement of workers in terms of offshoring, our work usefully complements the findings of Caliendo et al. (2017).

Finally, this paper relates to a strand of literature that digs into finer effects of migration through occupations (e.g., Borjas 1999, Ortega and Peri 2014, Ottaviano and Peri 2006, Docquier and Lodigiani 2010, D'Amuri, Ottaviano, and Peri 2010, D'Amuri and Peri 2014 or Mitaritonna, Orefice, and Peri 2017). We complement the existing literature by exploiting the presence of foreign workers in small cells : sector, origin and occupation. Peri (2016) exposes the main aspects of the impact of immigration on labour markets, illustrating the different effects at local and national level and emphasizes that the level of substitutability among nationals and migrants could change depending on the skill group. Bauer and Kunze (2004) analyze firm level data and find that most workers from EU countries are used to complement high skilled domestic labour, but non-EU migrants are hired to address shortages of high-skilled labour. In this debate, defining the cell used in the analysis is quite important. As suggested by Chiswick and Miller (2009), occupations (rather than education level) provide a better information about the types of jobs that migrants do, given than often their level of education might not coincide with their occupation in the receiving country.

The remainder of this paper is organized as follows. In Section 2.2 we describe data and some stylized facts. Section 2.3 explains the empirical strategy. Section 2.4 presents the main results. In Section 2.5 we analyse the mechanisms behind the trade off between immigration and offshoring. Section 2.6 concludes.

2.2 Data and Stylized Facts

2.2.1 World Input-Output Tables

In the context of production fragmentation using gross trade data provides limited information. Indeed, gross exports contain parts from foreign suppliers or domestic value that has been re-exported. We use the World Input Output table (WIOD) to trace different value added components in trade flows. This database contains information about all input-output entries for 43 main economies and the rest of the world (2000-2014) in 56 sectors. Several metrics have been developed to measure trade in value added. In order to decompose gross exports in multiple components, we use the breakdown

of Wang, Wei, and Zhu (2013). It splits bilateral gross exports into 16 value added components which can broadly be divided into domestic and foreign value added: domestic value added (hereafter DVA) absorbed abroad, DVA in intermediate exports absorbed by direct importers, DVA in intermediate exports re-exported to third countries, DVA in intermediate exports used to produce final goods in third countries, intermediate exports re-exported to third countries as final goods, intermediate goods re-exported to third countries to be exported afterwards, DVA returning home, foreign value added (in final and intermediate exports), pure double counting from domestic and foreign source. From these data one can trace intermediate good exports from NMS-10 to EU-11 (backward linkages) and more particularly one can distinguish domestic value added from NMS-10 countries contained in imports of intermediate goods of EU-11 countries. More information about the decomposition methodology can be found in the Appendix B1.

2.2.2 Labour Force Survey

In order to merge input-output information with migration data, we need a data source on foreign workers by origin in Western Europe at the sectoral level. We use the European Labour Force Survey (EU-LFS) provided by Eurostat.¹⁰ The LFS is a representative survey of households conducted on a yearly-basis in all EU countries. It contains demographic information (region of birth, age, gender, education) and information related to jobs (employment status, occupation, economic sector of the company). We start the sample in 2004 because there is no sufficiently precise information on the country of birth of foreign workers before that date.¹¹ We include a set of 11 Western European countries.¹² We remove four countries due to limited data availability. Germany is excluded from the sample because there is no information for the country of birth of foreign workers.¹³ Similarly, Italy does not provide this information in 2004. We also exclude Sweden and Finland because foreign workers originating from NMS-3 or NMS-10 countries

¹⁰See <https://ec.europa.eu/eurostat/web/microdata/european-union-labour-force-survey>

¹¹Before 2004, most countries only differentiate foreign-born individuals between those from the EU-15 and those from the rest of the world, without providing precisely the place of origin of the workers.

¹²Austria, Belgium, Denmark, Finland, France, Ireland, Luxembourg, Netherlands, Portugal, Spain and United Kingdom.

¹³There is only a national/foreigner distinction available for Germany. The consequence of the EU enlargement of 2004 on the German economy and the development of value chains in Central Europe has been highlighted by the literature. Germany might constitute an outlier as its geographical situation could explain both immigration and value chain developments.

are grouped in one category. We also drop all observations without information on the country of birth of foreign workers¹⁴ and cases of inactive population or when there is no information on the professional status of the worker.¹⁵ The total number of worker-level observations is 7,698,273 for the period 2004-2013.

We use foreign-born workers as our measure of migrant's stock, therefore including naturalized citizens in the foreign workforce. Foreign born workers in EU countries originate from different countries which are grouped in 9 blocs: EU-15, NMS-10 (new member states from the 2004 enlargement), NMS-3 (New member states from the 2007 and 2013 enlargements), Europe outside EU28, East Asia, South and South-East Asia, Latin America, North America and Australia as shown in Table B1.¹⁶ We use such information to compute the share of individuals born in a specific region of the world (foreign-workers) over all workers of a specific country and industry. We add 0 for all sectors with missing information on foreign workers from a specific origin country.¹⁷

Although the EU-LFS also makes it possible to look at migration flows before 2004, we prefer to concentrate on stocks for two reasons.¹⁸ First, immigrant stocks seem a more pertinent indicator when looking at trade as any effect should come from the presence of foreigners. In addition, it seems more precise to use stock because flows can vary a great deal every year and do not necessary have a lasting impact on the workforce. Second, for some countries, flows decomposed by economic sector and region of origin are

¹⁴Only 1.16% of the observations of the raw sample do not contain any information on the country of birth of foreign workers.

¹⁵The share of foreign workers that we will create later, will be based on the total active population so we do not need the inactive one. We should make a decision whether to consider the missing values, but as we cannot be sure whether these individuals are active or not, we decide to drop them.

¹⁶This is also a drawback due to data limitation. As it has been illustrated by several works, integration of Eastern countries in GVCs has been quite heterogeneous. Kersan-Škabić (2017) show that Hungary has been the most integrated country where a huge part of value added originates from the EU member states. But we are restricted due to data composition to use NMS countries as a single block.

¹⁷We make the assumption that the information in the survey is quite representative and the missing foreign workers are a sign of no workers from a specific origin. One concern with the EU-LFS survey has to do with the cells to which the weights given corresponds. We look at relatively precise information (country-origin-sector-year level). and it could be possible that some of those categories are missing due to the imprecision of the survey and that weights could not adequate redress those imperfections. Table B5 shows that the number of Easter European workers present in our survey is not too remote from what is expected, even before weight are applied.

¹⁸Considering migration flows in this context can be found works like (Caliendo et al., 2017).

very small in the EU-LFS and a slight variation might greatly affect the ratios we are looking at. This is of particular concern as recent arrivals are likely to be less well surveyed, leading to greater noise if we were to use that variable.

We explore data on occupations of workers to look at a finer cell when linking immigration and trade. We compute the share of foreign-born in several occupations, based on the ISCO-88 and ISCO-08 classifications. Indeed, the change of classification in 2011 forces us to design a concordance between the two versions. We aggregate those occupations in three groups : high (managers and professionals), medium (associate professionals and clerks) and low (crafts workers, labourers and plant workers).¹⁹ Merging trade and migration data has the caveat of aggregating several sectors. We end up with 13 sectors mainly based on the NACE rev.1 classification.²⁰ We end up with a balanced panel of 1,287 triplets importer-exporter(block)- NACE sector and a total number of 12,870 observations.²¹

2.2.3 Stylized Facts

Fact 1: Backward and forward linkages differ in their response to the 2004 EU enlargement. Countries may participate in global value chains through imports of foreign inputs, differently characterized as *backward participation* or *offshoring*. They incorporate the foreign value to produce final goods or other inputs, that are further used in the chain of production. In a forward looking perspective, participation in global value chains is identified through exports of value, further used to produce other goods in the importing country. Using value added decomposition of trade flows, the creation of value chains between EU-11 and NMS-10 can be traced through value added that is imported by EU-11 sectors from NMS-10 or exported from EU-11 sectors to NMS-10 for the production of final goods. We focus on imports of value originating from NMS-10 imported by EU-11 (backward participation) and exports of value added produced in EU-11, exported in NMS-10 to produce final goods (forward participation), at the sectoral level. In order to have a clearer understanding, Figure 2.1 shows the direction in which European

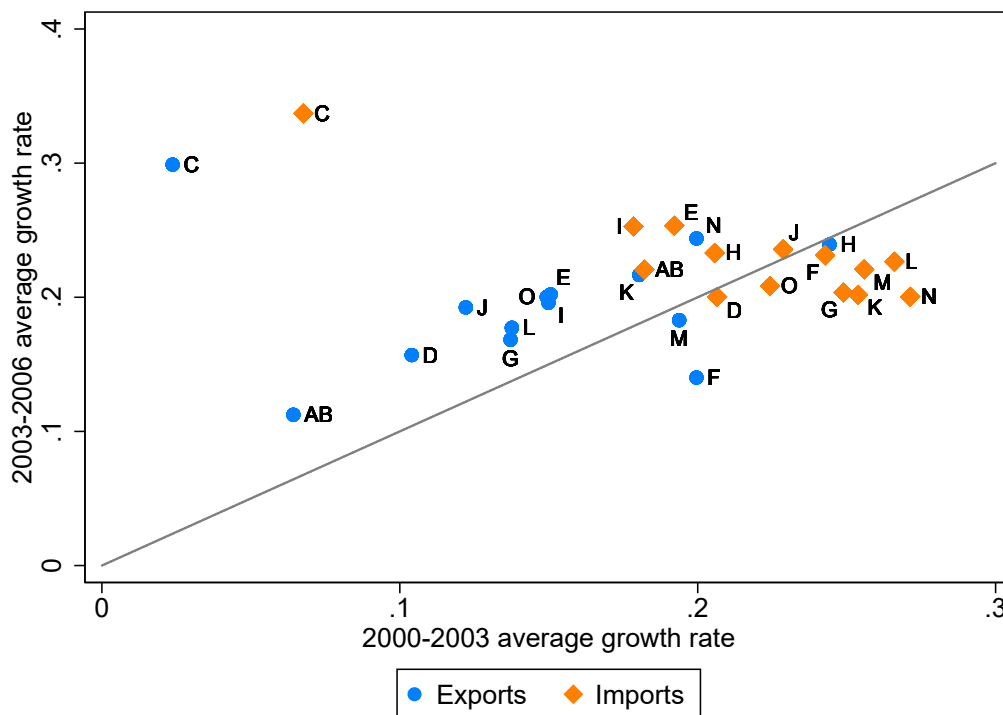
¹⁹For 5.17% of our individual level sample, information on occupation is missing. Such individuals are therefore not considered in the construction of the ratio of foreign worker by occupation.

²⁰See Table B2. We aggregate some NACE rev.1 sectors to account for the change in classification in 2008 and we drop sectors P ("*Activities of private households as employers and undifferentiated production activities of private households*") and Q ("*Extraterritorial organizations and bodies*") from our sample as these are considered non-tradable in most countries.

²¹Descriptive statistics of the main variables are available in Table B3, both for the full sample and the restricted sample we use for our regressions.

value chains between West and East countries have evolved after the integration of NMS-10 countries in the EU in 2004. It presents the growth of imports of value added (in orange) and exports of value added (in blue) at the sectoral level for the 4 years preceding and the 4 years following the enlargement. For all sectors above the 45° line, growth has been higher after 2004 than before. Clearly, imports grew faster than exports over the whole period for most sectors. This figure also pinpoints to the observation that the enlargement made a much greater difference for exports.²² It seems that the benefits brought by the enlargement regarding trade were largely anticipated by EU-11 firms aiming at importing goods from Central and Eastern Europe and less so for exports.²³

Figure 2.1. EU enlargement and value added trade of intermediate goods



Source: Authors' computation using WIOD data.

Fact 2: An increasing and heterogeneous participation of NMS-10 economies in GVCs and of NMS-10 nationals in EU-11 labour markets. The increase

²²The 2004 enlargement firstly materializes itself by the inclusion of NMS-10 in the common market, which abolished all customs and most differences in regulation. Due to initial restrictions by most EU-11 countries, freedom of movement came later for NMS-10 citizens.

²³Tariffs were already reduced substantially for most sectors in the years preceding the actual enlargement and regulations were progressively brought to EU-11 standards during the negotiation process.

in imports and immigration from NMS-10 countries to the EU-11 is established since the start of the century. However, information about the heterogeneity in this growth is less abundant. This paragraph presents the evolution of trade and migration between these two groups of countries at the sector level. Overall, it assesses an increasing importance of Eastern Europe in EU-11 economy and the relevance of country and sector-level data in examining this trend.

GVC participation looks at the extent to which a country provides/supplies value from/to other countries of the production chain (Hummels, Ishii, and Yi, 2001). The presence of exported foreign value is an evidence of production sharing, for instance through imports of foreign inputs.²⁴ In order to look at the participation of NMS-10 in European value chains, we consider the share of exported foreign value added and returned domestic value added of NMS-10 over all imports of EU-11. The left-hand side of Figure 2.2 presents the evolution of the share of foreign and returned value of NMS-10 in EU-11 imports for selected percentiles defined in terms of EU-11 countries-sectors. The blue line shows the evolution of NMS-10 foreign and returned (hereafter RDV) value added in total imports of EU-11.²⁵ It has been steadily increasing until the Great Recession and stagnating afterwards, in line with the view that GVCs grew strongly over most of the 2000-2011 period. As the participation in GVCs can be heterogeneous depending on sectors, we compute this ratio at the country-sector level. The orange, green and red lines presents the distribution of these country-sectors at the 25th, the 50th, 90th percentiles for each year. It is clear that most of the increase of the participation of NMS-10 in GVCs when exporting to EU-11 comes from the very top of the distribution of country-sectors : for the 10% of sectors with the highest ratio, the level of integration is largely higher than for the median country-sector and the variations are also more acute.

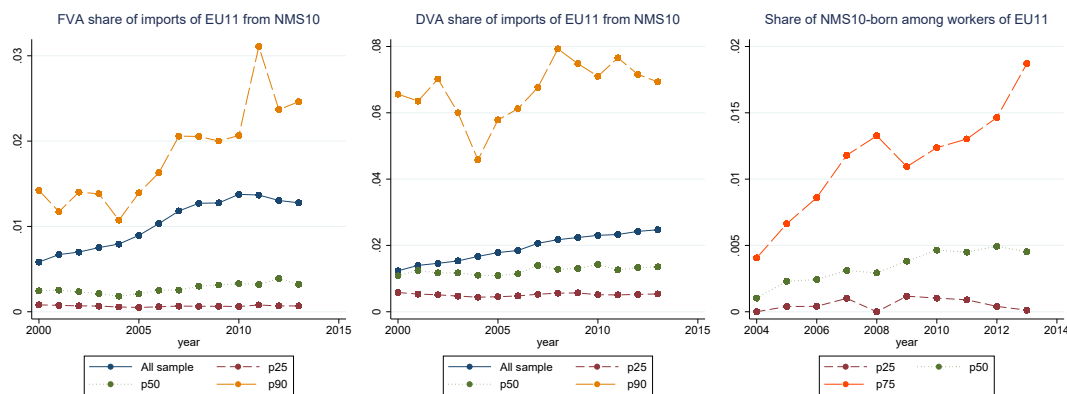
We want to be sure that this increase in integration is not only due to NMS-10 countries acting as simple hub for exporting to Western Europe, but to actual value originating in NMS-10 and being exported to EU-11. Hence, the middle graph of Figure 2.2 reproduces a similar exercise, but now we

²⁴Whereas the presence of exported returned domestic value added, proves the forward integration in global value chains, by providing value that crosses borders and returns back home. To illustrate this, we can recall the example of the iPhone. Most of the value added in the device stems are from US design and Japanese technology but it is ultimately assembled in China.

²⁵The returned value added in exports of NMS-10, makes reference to NMS-10 domestic value added that has been exported, then returned and is being re-exported again, in this case to EU-11.

restrict EU-11 imports of domestic value added in intermediate goods from NMS-10, therefore excluding the share of imports' value that was first imported by NMS-10 countries and then re-exported.²⁶ Hence, the blue line represents the share of NMS-10 DVA in intermediate goods in all imports of DVA of the EU-11, whereas the orange, green and red line represent the same ratios for different percentiles of country-sectors. A similar pattern as in the left-hand side graph appears: in the aggregate, imported value added originating from NMS-10 to EU-11 increases, but most of the variation concentrates at the top of the distribution of country-sectors. For the bottom half of the country-sectors, the rise in imports of value added from NMS-10 is very modest and for the bottom 25% of the sample it stagnates.

Figure 2.2. Global value chain's participation and NMS-10 migrant's distribution



Notes: Authors' computation from WIOD and EU-LFS data.

The heterogeneous participation in GVCs of EU-11 countries and specific sectors could be a result of bilateral historic trade relations: some EU-11 countries simply trade more with NMS-10. Indeed, a substantial part of the country-sectors present in the top 10% of the distribution are Austrian. However, the pattern still holds when excluding Austria from the sample altogether. Sectoral specificity could also be an explanation: for some sectors trade is more intense whatever the country, due to comparative advantages

²⁶We focus on value added traded through intermediate goods, as they are more characteristic of GVCs.

for instance. The construction sector is one likely suspect.²⁷ Again, if we exclude both the construction sector for all countries and Austria, the pattern presented in the two left hand side panels holds: a general increase in imports from NMS-10 which mostly comes from a minority of country-sector pairs. The sectors do not behave in the same way in each and every country.

Migration might be a possible explanation for this country-sector heterogeneity. The right-hand side of Figure 2.2 shows the evolution of the share of NMS-10 workers in country-sectors in EU-11.²⁸ In order to trace the same sector-countries in specific percentiles throughout the period in Figure B1 we repeat the same graphs but we fix the sector-countries of certain percentiles in 2000 and follow them in time. Results show that indeed, in the top distribution there is more variability in terms of country-sectors concerning the presence of value added originating from NMS-10 exported through intermediate goods in EU-11. Likewise, most of the increase is due to a minority of country-sectors hiring a large share of NMS-10 in their workforce. We control for this possibility in the next section, using econometric techniques.

Fact 3: Increasing presence of NMS-10 workers in EU-11 labour market

As presented in the previous sub-section, the increase in the share of NMS-10-born among EU-11 workforce was steady over the period 2004-13, but heterogeneous with respect to the concerned countries and sectors. NMS-10 migrants could be directed toward a specific sector where they have an advantage over other workers, both native and foreign. To take into account these possibilities and detect the evolution of NMS-10 workers presence in EU-11, we estimate the following equation:

$$Migrant_{jst} = \gamma_{js} + \sum_{t=05}^{t=13} \beta_t \mathbb{1}(t) + \varepsilon_{jst} \quad (2.1)$$

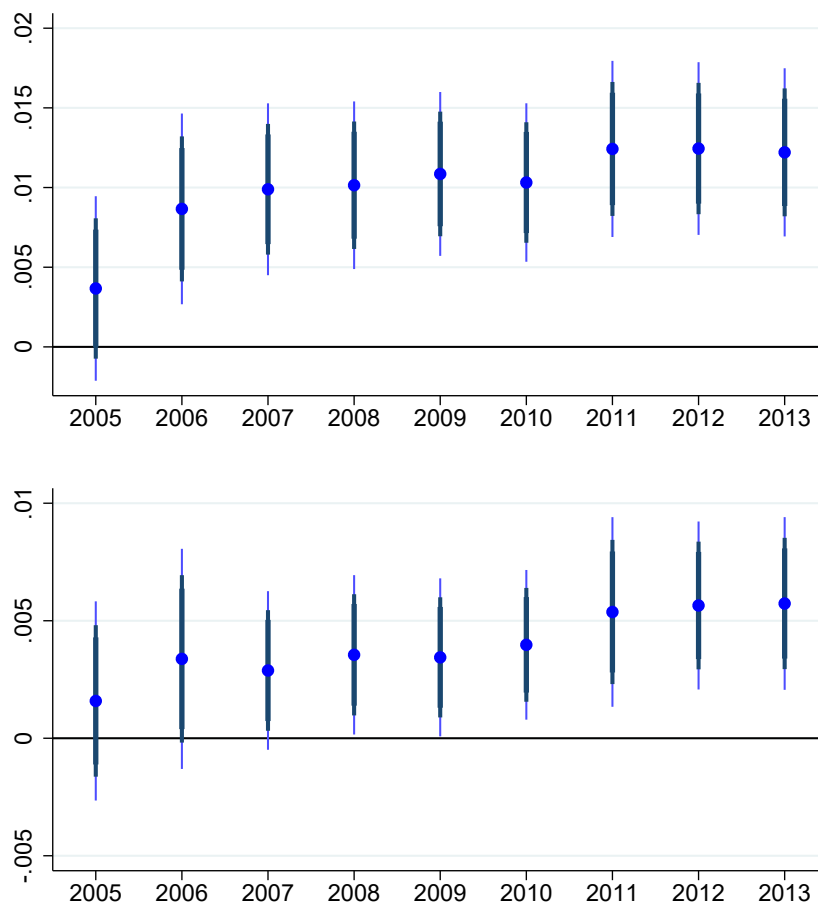
The dependent variable is the share of workers from NMS-10 block in country j in sector s and year t . $\mathbb{1}(t)$ is an indicator function taking the value of

²⁷It is the only sector which appears at least once in the top 10% of the distribution in combination with all countries. Remember that we are working here with country-sector pairs. In the top 10% of these pairs in terms of ratio of intermediate DVA imports from NMS-10 over all DVA imports, the manufacturing sector of Belgium never appears. Nor does the agricultural sector of Spain for instance. But the construction sector for all countries is part of the top 10% for one year or another.

²⁸Differently from the two previous graphs, the considered period in this case is 2004-2013, as we use data from the EU Labour Force Survey. LFS does not contain information about birthplace of individuals before 2004. The orange line corresponds here to the 75th percentile. The evolution of the 90th percentile is similar but the share of NMS-10 workers in these country-sectors is so large that it tends to tamp down the other lines and reduces the readability of the graph.

1 in each year. The coefficient of interest β shows the change in migration share of NMS10 migrants in EU-11 countries compared to the base year 2004. δ_{js} is a fixed-effect that takes into account the sectoral distribution of NMS-10 workers in each EU-11 countries.

Figure 2.3. Progressive increase of the share of NMS-10 workers in EU-11 (top) and EU-9 (down) after 2004



Notes: Authors' computation from EU-LFS data. The upper figure shows migration flows from NMS regressed on sector and year fixed effects. It includes 12 European countries. The bottom graph excludes United Kingdom and Ireland.

Figure 2.3 presents the coefficients β_t and their interval of confidence. The upper part shows the evolution of the share of NMS-10 workers compared to the year 2004 in EU-11 countries, after removing the impact of sector-destination specificities. Following the enlargements, there was a significant increase in the presence of NMS-10 workers, irrespective of the sector and the bilateral link. The increase is progressive after 2004 and really kicks in after the removal of movement restrictions by countries that implemented them. Indeed, the liberalization of movement for Eastern Europeans was subject to restrictions implemented by most EU-11 countries. In our sample, only

Ireland and the United Kingdom did not implement such restrictions, and they witnessed larger flows than other EU-11 countries. Restrictions were progressively removed over the following year. The bottom graph of Figure 2.3 presents the same exercise but with UK and Ireland removed from the regression sample and allows to see more clearly the impact of the difference in timing of labour market opening. The increase in the share of NMS-10 in the workforce starts later as the two countries that opened in 2004 are not included. It is still significant and progressively increasing as more countries liberalize their labour market.²⁹

This exercise confirms that immigration of NMS-10 workers following the EU enlargement of 2004 took place in several sectors and suggests that the timing of the removal of labour market restrictions for NMS-10 citizens matters. More precisely, migrants from NMS-10 countries went to work in different sectors according to the country. Part of the reason behind such heterogeneity between countries could be differences with respect to the type of NMS-10 citizens migrating. In that light, we use the information on the occupation of workers contained in the LFS to create 3 occupation groups.³⁰

Table 2.1 shows the share of citizens from NMS-10 among the high, medium and low occupation groups of workers of each EU-11 country and for the aggregate zone in 2004 and 2013. As it can be noticed, the comparison of the situation at the beginning and the end of our sample shows clearly an increase in the share of NMS workers among every skill group on average. Even if this increase is quite present in all skill groups, the surge concerns foremost low-skilled workers on aggregate. The increase is however different for each country and occupation group.

These facts are evidence of an increase of both trade and East-West migration that are country-sector specific and heterogeneous with respect to occupations, but they cannot tell us much about the link that might exist among them. As presented by stylized facts 2 and 3, the share of NMS-10 workers progressively increased in the workforce of EU-11 and this increase was particularly important for low occupation jobs. This increase was not specific to one country or one sector, hinting that immigrants from NMS-10

²⁹We can also compute similar coefficients for migrants from the rest of the world. On both samples, the coefficients attached to the rest of the world are small and not significant, showing that there was no general increase in immigration from the rest of the world in the period following 2004.

³⁰High occupations gathers managers and professionals, medium occupations are associate professionals and clerks and low occupations bring together all other occupations (sales and services workers, craft-workers, etc...). LFS data span over a change of ISCO classification. Therefore we use 3-digit occupation group to harmonize both version of ISCO and create these three coherent groups.

Table 2.1. Share of migrants from NMS-10 by occupation and country (in %)

Country	2004			2013		
	High	Medium	Low	High	Medium	Low
Austria	1.58	1.05	1.46	2.13	1.40	2.91
Belgium	0.12	0.11	0.25	0.48	0.45	1.58
Denmark	0.25	0.27	0.13	0.68	0.78	1.26
France	0.19	0.07	0.23	0.16	0.05	0.28
Greece	0.34	0.18	0.47	0.17	0.13	0.43
Ireland	0	0	0	2.07	3.68	11.75
Luxembourg	0.32	0.16	0.33	3.43	0.74	1.35
Netherlands	0.19	0.19	0.21	0.49	0.51	0.88
Portugal	0	0	0	0.03	0.01	0.01
Spain	0.11	0.01	0.36	0.17	0.11	0.35
United Kingdom	0.42	0.30	0.50	0.94	1.78	4.47
EU-11	0.28	0.19	0.36	0.61	0.74	1.87

Source: Authors' computation from WIOD data.

went to work in different sectors in each country, possibly according to local labour needs. Moreover, Figure 2.1 highlights the lack of shift in the trend of intermediate imports' growth after the 2004 enlargement. That variable is commonly used as a proxy for offshoring and therefore brings support to the assumption that sectors that offshored did so in part due to a lack of an available labour force in EU-11 before the opening of their labour markets to NMS-10 migrants. Our hypothesis is that once the restrictions were removed, it became easier for firms to import workers rather than goods and this translated in a rise of presence of low occupation NMS-10 workers in EU-11. Low occupations worker are more likely to be involved in offshorable activities. The opening of Western Europe labour markets would therefore affect the substitutability between offshoring and employing immigrants. To the purpose of testing this idea, we turn to an econometric approach.

2.3 Empirical Specification

Our empirical analysis tries to shed light on the link between the increasing presence of Eastern workers in Western Europe labour markets and the development of West-East value chains between 11 European countries and the 10 new members of the EU (NMS-10). The empirical analysis is conducted at the importer-exporter-sector-year level, matching migration stock from survey information with value added trade data. We make use of the differences

in the timing of labour market openings of EU-11 countries to understand the role of NMS-10 workers in East-West trade. Finally, we delve into the different mechanisms that could explain our results, using data on occupations and labour market needs.

2.3.1 Timing of the Labour Market Opening and Offshoring

The enlargement of 2004 is a major change of policy on the two aspects we are concerned with : trade and immigration. In fact the change of immigration policy was staggered compared to trade policy as temporary labour market restrictions continued to be applied for Eastern European migrants.³¹ Even if the principle of free movement for EU workers was one of the pillars of EU integration, in practice countries that directly removed controls on employment of NMS-10 citizens in 2004 were very few. Only the UK, Ireland and Sweden opened their labour markets as they totally liberalized trade with NMS-10. As a consequence, these countries experienced a significant increase in immigration from Eastern Europe, although all countries were concerned to some extent as shown by the third stylized fact presented above. Other old members of the EU chose different dates to remove their restrictions on NMS-10.³² This gap between increased liberalization of trade and freedom of movement allows us to look at the way in which immigration affected trade after the total liberalization of movement. Therefore, we focus on the sample workers in EU-11 from NMS that joined the EU after 2004 and exploit the heterogeneity of destination countries regarding the opening of their labour markets to NMS citizens.

As aforementioned, due to data restrictions, information about the origin of foreign workers is provided in country blocks. One weakness of a specification with only one country-block of origin is the absence of any country of origin controls, despite the fact that one could expect most of the effect to come from NMS-10 countries. It could be that countries entering the EU in 2004 were simultaneously affected by a shock that concerned both migration and trade. To this purpose, we consider another origin related to the particularities of the European context that is NMS-3 country block.³³ This block of

³¹We refer indistinctly to freedom of movement or labour market liberalization in the paragraph as we interested in the freedom of movement of workers.

³²In our sample, the UK and Ireland do not impose any restrictions. Others removed their restrictions progressively over the following year : Greece, Portugal, Spain in 2006; Luxembourg and Netherlands in 2007; France in 2008; Belgium and Denmark in 2009; Austria in 2011.

³³NMS-3 countries are Romania, Bulgaria and Croatia that joined the EU respectively in 2007 and 2013.

origin provides the advantage to blend easily in our method of identification based on the timing of labour market liberalization. Indeed, similar restrictions to the employment of NMS-3 workers were implemented after the 2007 enlargement as for NMS-10 countries.³⁴

To look at the effect of migrant's presence from NMS after labour market liberalization, on imported value added in intermediates originating from NMS to EU-11 countries, we estimate the following equation:

$$\ln(Y)_{ijst} = \beta_0 + \beta_1 Mig Sh_{ijst} + \beta_2 Lib_{ijt} + \beta_3 Lib_{ijt} \times Mig Sh_{ijst} + \gamma_{ij} + \delta_{ist} + \lambda_{jst} + \varepsilon_{ijst} \quad (2.2)$$

The dependent variable, Y_{ijst} , indicates the imports of domestic value added in intermediate goods originating in NMS countries. This variable captures the real value contained in intermediate goods imports that has been produced in the exporting country i in sector s , serving as our measure of *offshoring*. The exporters of value added i can be either NMS-10 or NMS-3 workers. Lib_{ijt} is now a dummy equal to 1 starting in year t when country j liberalized its labour market for citizens of i . It shows how a change in migration stock before and after labour market liberalization, captured by the interaction $Lib_{ijt} \times Mig Sh_{ijst}$, induces a change in domestic value added intermediate goods imports of sectors of EU-11 countries. In order to account for specific immigration relationship between countries and potential sector-level shocks we introduce importer-exporter (γ_{ij}) that captures any particularity related to bilateral links that we do not control for, importer-sector-year (λ_{jst}) and exporter-sector-year (δ_{ist}) fixed effects control for exporter and importer unobserved characteristics.

This method tackles potential endogeneity in the trade-migration relationship: the liberalization of the labour market constitute a migration shock, that is largely exogenous to trade matters. Indeed countries implemented these restrictions due to fear of immigration and not on commercial considerations. Because trade liberalization had already largely occurred in 2004 our method is able to separate trade from migration shocks. Even though before the integration of NMS-10 tariffs were close to 0, in most sectors (as also

³⁴EU-11 imposed some restrictions on Romanian and Bulgarian workers after the 2007 enlargement (Croatia integrated the EU in 2013 and is not taken into account here). Restrictions were removed in 2009 by Greece, Denmark and Portugal; in 2012 by Ireland. Spain removed its restriction in 2009 but reintroduced them for Romania in 2011 and kept them until 2014. As most NMS-3 workers present in Spain are Romanian we consider the dummy to be equal to 1 in 2009 and 2010 and 0 otherwise.

seen in Table 2.1) the enlargement did not lead to a shift in the trend of intermediate imports' growth (as for exports). Firms importing from NMS-10 likely anticipated largely the enlargement while the removal of labour market restrictions was more uncertain because individual EU-11 countries had large leeway in the choice of the date and their potential reintroduction afterwards.³⁵

Heterogenous Effects of Labour Market Liberalization As presented by stylized facts 2 and 3, the share of NMS-10 workers progressively increased in the workforce of EU-11. This increase did not only concern one specific country or sector, suggesting that immigrants from NMS-10 went to work in different sectors in each country, likely according to local labour needs. Moreover, Figure 2.1 highlights the lack of shift in the trend of intermediate good imports' growth after the 2004 enlargement. That variable is commonly used as a proxy for offshoring and therefore brings support to the hypothesis that sectors that offshored did so in part due to a lack of an available labour force in EU-11 before the opening of their labour markets to NMS-10 migrants. Most of the increase in the presence of NMS-10 workers concerns low occupations, that are more likely to be offshored in the first place. Our hypothesis is that labour market liberalization reduced the cost of using immigrant workers compared to offshoring and therefore led to a *substitution* between imports of value added in intermediates (offshoring) and employment of NMS-10 workers in low occupation jobs in EU-11.

To straighten out the mechanism linking trade and immigration we extract data on occupations and compute the share of foreign-born workers in given occupations. Indeed, it is unlikely that different types of workers affect trade in the same way. As white and blue collar workers accomplish different types of tasks, they are expected to have different effects on trade, depending on their occupation type. We re-estimate equation (2.2) but by considering the share of migrants from zone i in a specific occupation for a given sector, year and EU-11 country. There are three main occupation blocks that we consider: high-skilled (professionals), medium skilled occupations (associate professionals and clerk) and low-skilled occupations (all the rest) using the ISCO-88 and ISCO-08 classifications that are used in the EU-LFS. This allows to capture the effects of migration in specific occupations on trade.

³⁵Only one country re-introduced restrictions after removing them : Spain liberalized its labour market to Bulgarian and Romanian workers in 2009 but came back on its decision in 2011. It was liberalized again in 2014.

2.3.2 Endogeneity Issues: Shift-share IV Strategy

Even though the structure of fixed effects proposed in equation (2.2) is quite restrictive, there are two potential sources of endogeneity for the share of migrants. First, despite the use of several combinations of fixed effects, the estimation might still suffer from potential omitted variables bias. In this case the estimates would be affected if an unobserved factor explains both migration and trade. An unobserved positive productivity shock in a country for instance may simultaneously raise trade flows and attract migrants, which induces a correlation between the error term and the main explanatory variable, biasing the result upward. Another omitted variable problem would arise if there are conflicts in the origin countries which may simultaneously increase migration to EU-11 countries and reduce trade. This induces a correlation between the error term and the main explanatory variable and OLS estimates would be biased downwards.

A second empirical concern regarding the link between presence of foreign-born workers and trade is the direction of causality. The development of trade links between Eastern and Western Europe can be both cause and result of the presence of Eastern Europeans in Western Europe. Migrants might *ex ante* predict sectors where there are more employing opportunities. Also, firms integrating into European value chains might decide to recruit Eastern Europeans for logistical or marketing reasons, to ease their integration in the foreign market or to facilitate the use of foreign inputs in their production process. This would lead the coefficient to be biased upwards.

In order to address potential endogeneity we employ a shift-share instrument as in Card (2001a) that is based on past migration distribution in the receiving countries:

$$\widehat{M}_{ijst} = \frac{M_{ij,00}}{\sum_j M_{ij,00}} * \frac{M_{js,98}}{\sum_s M_{j,98}} * M_{it} \quad (2.3)$$

The instrument for migration stock in a sector s country j originating from block country i is computed as the product of three elements that employ lagged geographic distribution of immigrants in countries and sectors and control for the fact that the decision to migrate in a certain place is linked to existing networks. The first is the share of migrants in a destination country j originating from block country i in 2000 to control for pre-migration trends. The second element of the shift share is the share of migrants in sector s and

destination country j in 1998³⁶ and finally the number of migrants per year of the considered period in destination country j . Indeed, \widehat{M}_{ijst} is a prediction of the number of migrants from block i that would be working in sector s of country j if the distribution of migrants by origin and country of destination had stayed the same as in 2000 and if the distribution of foreigners between sectors had stayed as in 1998.³⁷

This is a hypothetical number of foreigners based on past trends. It is affected by current trade and should explain a substantial share of today's migrant distribution. In order to use this shift-share in our estimations, we need to construct an instrument similar to the main explanatory variable of the econometric specification. To this purpose we construct the share of the instrumented migrants over total workers' population, by considering that the number of native workers as fixed and equal to that of 2004 as showed below:

$$\widehat{\text{Mig Sh}}_{ijst} = \frac{\widehat{M}_{ijst}}{\sum_j \widehat{M}_{ijst} + \text{Nat}_{js04}} \quad (2.4)$$

Keeping constant the number of native workers, ensures that local labour market dynamics do not interfere in the link that we are exploring. For instance, an increase in the employment of native workers would reduce the share of migrants. In the end, the instrument is the "predicted" share of migrants from country i in sector s of destination j in year t over all migrants of in country j and sector s in year t and domestic workers of 2004. We instrument Mig sh_{ijst} and its interaction with Lib_{ijt} by $\widehat{\text{Mig Sh}}_{ijst}$ and by its interaction with Lib_{ijt} , as showed below :

$$\ln(Y)_{ijst} = \beta_0 + \beta_1 \widehat{\text{Mig Sh}}_{ijst} + \beta_2 \text{Lib}_{ijt} + \beta_3 \text{Lib}_{ijt} \times \widehat{\text{Mig Sh}}_{ijst} + \gamma_{ij} + \delta_{ist} + \lambda_{jst} + \varepsilon_{ijst} \quad (2.5)$$

2.4 Timing of the Labour Market Opening Estimation Results

Integration in the European Union for NMS countries had the specificity of a difference in the timing of trade and labour market liberalization. Given

³⁶In order to be closer to the sectoral distribution of Eastern Europeans, we exclude foreign workers from EU-15 countries from the computation. Including all migrants does not change the results.

³⁷There is no information on the number foreigners at the sectoral level for all countries of the sample for preceding years of the LFS.

this context, we investigate the role of NMS workers in value chains of EU-11 countries, more specifically their offshoring decisions. We use differences in the timing of labour market liberalization for the different EU-11 countries and split the sample into three main occupation groups. Together with this specification that exploits a difference-in-difference method, we use an instrumental variable strategy that allows to control for all unobserved differences in the sample for a country-sector-year triplet and avoid endogeneity issues. We present results by looking at the sample of NMS-10 and NMS-3 workers as described by equation (2.5).

Table 2.2. Labour market liberalization and DVA imports of intermediate goods from NMS

Dependent variable (in log): Occupation group	Domestic value added imports of intermediate goods					
	All workers			High	Medium	Low
	(1)	(2)	(3)	(4)	(5)	(6)
<i>Migrant_{ijst}</i>	0.143*** (0.037)	0.323*** (0.058)	1.203*** (0.450)	-9.112 (12.158)	0.359 (4.345)	0.748*** (0.173)
<i>Lib_{ijt}(1/0)</i>	-0.002 (0.082)	0.154 (0.117)	0.785** (0.310)	-4.347 (6.398)	0.113 (1.489)	0.685*** (0.219)
<i>Migrant_{ijst} × Lib_{ijt}(1/0)</i>	-0.131*** (0.038)	-0.414*** (0.057)	-1.310*** (0.332)	7.535 (12.256)	-1.013 (4.498)	-0.712*** (0.182)
Observations	2,860	2,860	2,860	2,860	2,860	2,860
R-squared	0.969	0.933	-	-	-	-
KP F-stat	-	-	20.67	0.313	0.215	6.491
Model	OLS	OLS	2SLS	2SLS	2SLS	2SLS
Fixed effects:						
Exporter-year	No	Yes	Yes	Yes	Yes	Yes
Exporter-sector-year	Yes	No	No	No	No	No
Importer-sector-year	Yes	Yes	Yes	Yes	Yes	Yes
Importer-exporter	Yes	Yes	Yes	Yes	Yes	Yes

Notes: The dependent variable is equal to the logarithm of domestic value added in imports of intermediate goods to importer j in sector s from country i in year t . $Migrant_{ijst}$ is the share of workers of sector s in country j and year t that are born in country-block i . $Lib_{ijt}(1/0)$ is a dummy equal to 1 for all years following the opening of the labour market of country j to citizens of NMS-10 or NMS-3. Sectors are at the 1-digit level of NACE rev 1. Robust standard errors are in parentheses. ***, **, * significantly different from 0 at the 1%, 5%, and 10% levels respectively.

Table 2.2 reports the main results, considering domestic value added in intermediate goods imports as the dependent variable. Columns (1) and (2) show results on the full sample of NMS migrants, before splitting it by occupation. Including the full range of fixed effects in column (1), we find that on average throughout the considered period there is a statistically significant positive effect of migrants on imports. But the sign of the coefficient is reversed when we look at the interaction with the liberalization dummy. The direct coefficient is a hint of a network effect, while the interaction coefficient points toward substitution between imports of intermediates goods and employing NMS-10 workers, after the liberalization occurred. The total effect of migration is nonetheless positive. We allow for more variability between

origin sectors in column (2) : instead of adding an exporter-sector-year fixed effect, we look at within exporter-year estimates. The negative effect of the interaction becomes stronger than the direct effect, meaning that on average migration reduces imports after the liberalization. In column (3), we use the 2SLS estimator. To ensure a sufficiently high explanatory power to the instrument, as for column (2), we slightly relax the fixed-effects structure.³⁸ Results are similar : after the labour market liberalization an increase of the NMS workers by 1% point induces a decrease of imports of intermediate goods by 10.7%.

To dig deeper into this result, we split the sample in three occupational groups and estimate our specification for each of them separately implementing the IV strategy (columns 4 to 6). We find significant coefficients only for low occupation workers. This is not surprising, considering that most of the increase in the share of NMS workers in EU-11 labour market comes from low skill workers (see Table 2.1). High and medium skilled occupations do not seem to play a role in imports of intermediate goods (column 4 and 5).

These results confirm our hypothesis that labour market liberalization reduced the cost of using immigrant workers compared to offshoring and therefore led to a substitution between imports and employment of NMS-10 immigrants in low occupation jobs.

Quantification exercise In order to have a more precise idea of the results suggested by the baseline estimation, we undertake a quantification exercise where we measure the net effect (in dollars) that labour market liberalization had on offshoring. Indeed, it could be that sectors with the largest increase in foreign workers were not offshoring a lot. Hence, we compute, separately for each country-sector pair, the variation of the share of NMS-10 workers between the first of liberalization and 2013. Then, we use estimates of column 3 of Table 2.2 to obtain the change of DVA imports expressed in dollars, that resulted from the migration change in the post-liberalization period. We sum the results of the different sectors and countries to have an estimate of the impact of the migration wave on offshoring at the EU-11 level. We find that imports of DVA in intermediate goods from NMS-10 were reduced by 3.4

³⁸Compared to column (1), this fixed-effects structure does not control for a shock that would affect trade of all EU-11 countries with only one origin block in a specific sector and year. Adding this fixed-effect limits greatly the explanatory power of our instrument, represented by a low Kleinberg-Paap F-statistics.

billion \$ due to the labour market opening. A decomposition at the country-level is available in Table B4 of the Appendix.³⁹ As it can be noticed, there is a large heterogeneity : while trade is reduced by almost 2 billion \$ in Great Britain it actually increases slightly for France.⁴⁰

Alternative shift-share instrument Even though the proposed shift-share instrument in Section 2.3.2 tackles the problem of endogeneity, one potential weakness would be the reference year (2000) of bilateral migration structure which is close to the considered period of the analysis. Indeed, migration patterns of 2000 explain well actual migration flows, without interfering with trade flows, thus respecting the exclusion restriction hypothesis. Nevertheless, in order to dig deeper into an instrumental variable strategy that ensures more powerful results and a stronger explanatory instrument, we use migration patterns of the UN database, in years other than 2000. Results are presented in the first four columns of Table 2.3. We find that the baseline instrument is stronger and provides similar results to the alternative instrumental variables that consider years 1990 and 1980, as in columns (2) and (3).

Furthermore, we exploit another database that allows us to use sectoral level distribution of migrants prior to 1998.⁴¹ We use the sectoral level distribution of migrants in 1991, provided by IPUMS⁴² and re-construct the shift-share instrument as in equation 2.4.⁴³ IPUMS-International offers harmonized census data from various countries and years. Results are presented in the last four columns of Table 2.3. As it can be noticed by the values of the

³⁹The second column present the yearly change. As we only look at the post-liberalization period, the number of year over which the variation in imports is assumed to happen is not identical for each country. It ranges from 10 years for Great-Britain and Ireland to 2 years for Austria.

⁴⁰Over the period, the share of NMS-10 worker in France increased progressively and then decreased in the aftermath of the Great Recession, such that in 2013 the share is lower than in the year of liberalization.

⁴¹In LFS database information about the sectoral level distribution of migrants starts in 1998. Migration databases are often limited in terms of sectoral level information, a caveat that impends us to exploit different constructions of the shift-share.

⁴²The authors wishes to acknowledge the statistical offices that provided the underlying data making this research possible: National Bureau of Statistics, Austria; National Institute of Statistics and Economic Studies, France; National Statistical Office, Greece; Central Statistics Office, Ireland; Statistics Netherlands, Netherlands; National Institute of Statistics, Portugal; National Institute of Statistics, Spain; and Office of National Statistics, United Kingdom.

⁴³For France, IPUMS survey is available for 1990, but it is not for 1991. While in the baseline estimations, the instrument includes all non-EU-15 migrants, here we are able to be slightly more precise. We compute the sectoral distribution of Eastern Europeans including only NMS-10, NMS-3 and *Other Europe*.

Kleinbergen-Paap test, the instrument has a stronger power of explanation when considering the bilateral migration patterns of 2000. The significant negative coefficient of the interaction term between migration share and liberalization timing still holds for other years.

These results confirm our findings that liberalization of the labour market in EU-11, led to substitution from offshoring toward employing migrants.

Table 2.3. Alternative instrument: Labour market liberalization and DVA imports of intermediate goods from NMS

Dependent variable (in log): Sectoral distribution	Domestic value added imports of intermediate goods							
	1998				1991			
	2000	1990	1980	1970	2000	1990	1980	1970
Mig. destination distribution	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
<i>Migrant_{ijst}</i>	1.203*** (0.450)	-0.364 (2.034)	2.081 (1.486)	8.565 (68.692)	1.253** (0.555)	0.708 (1.637)	-0.825 (0.738)	0.315 (0.726)
<i>Lib_{ijt}(1/0)</i>	0.785** (0.310)	0.047 (0.939)	1.208 (0.770)	4.442 (33.636)	0.904* (0.467)	0.494 (1.062)	-0.584 (0.613)	0.373 (0.598)
<i>Migrant_{ijst} × Lib_{ijt}(1/0)</i>	-1.310*** (0.332)	-1.146*** (0.394)	-1.440*** (0.510)	-2.799 (12.083)	-1.240** (0.488)	-0.885** (0.417)	-0.193 (0.469)	-1.322** (0.652)
Observations	2,860	2,860	2,860	2,860	1,820	1,820	1,820	1,820
KP F-stat	20.67	0.417	0.672	0.00687	10.20	0.411	3.561	4.163
Model	2SLS	2SLS	2SLS	2SLS	2SLS	2SLS	2SLS	2SLS
Fixed effects :								
Exporter-Year	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Importer-Exporter	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Importer-Sector-Year	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Notes: The dependent variable is equal to the logarithm of the imports of intermediate goods imported by importer j in sector s exported by country i in year t . $Migrant_{ijst}$ is the share of workers of sector s in country j and year t that are born in block i . $Lib_{ijt}(1/0)$ is a dummy equal to 1 for all years following the opening of the labour market of country j to citizens of NMS-10 and NMS-3. In columns (1) to (4), we use the sectoral distribution of migrants of the year 1998 (LFS data). In columns (5) to (8), we use the sectoral distribution of migrants of the year 1991 (1990 for France) from IPUMS data. The destination migration year corresponds to the way migrants from a given origin orient themselves towards specific destination countries. Sectors are at the 1-digit level of NACE rev 1. Robust standard errors are in parentheses. ***, **, * significantly different from 0 at the 1%, 5%, and 10% levels respectively.

2.4.1 Robustness Checks

We conduct several robustness checks to ensure that the main results hold. First, we test the validity of liberalization timing variable by applying it to other country blocks similar to a placebo test. Second, we look at different samples, excluding some countries or years.

Applying the liberalization timing to other country blocks First, we test the validity of the liberalization timing. In other words, we test whether instead of being specific to NMS-10 block, this variable would not just reflect a general immigration policy of EU-11 countries. We conduct an estimation of equation 2.2 where we apply the labour market liberalization of NMS-10 block to another country block.⁴⁴ This is equivalent to making the hypothesis

⁴⁴We exclude NMS-10 workers from the estimations. NMS-3 migration and labour liberalization timing remain unchanged.

that EU-11 liberalized their labour market in the same way for EU entrants and other countries.

Results are reported in Table 2.4. In column (1) we inverse the liberalization scheme of NMS-3 and NMS-10: the effect of the interaction is positive and significant. Columns (2) to (8) we apply the NMS-10 labour liberalization timing to other blocks of countries and look at how the share of migrants after the "fictive" liberalization, affects trade in value in intermediate goods between that country-block and EU-11. The interaction coefficient is never statistically significant. This result ensures that liberalization variable captures efficiently the specificity of labour markets opening to NMS-10 workers.

Table 2.4. Robustness check : The liberalization timing variable only works for NMS

Dependent variable (in log): NMS-10 replaced by :	Domestic value added imports of intermediate goods							
	Reverse	EU-15	Other Europe	East Asia	S-E Asia	Latin Am.	North Am.	RoW
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
$Migrant_{ijst}$	0.005 (0.019)	0.022*** (0.008)	-0.001 (0.016)	-0.069 (0.056)	0.129* (0.067)	0.041 (0.056)	0.120** (0.052)	-0.016 (0.033)
$Lib_{ijt}^{placebo}(1/0)$	0.019 (0.082)	0.007 (0.082)	-0.061 (0.079)	-0.181 (0.127)	0.059 (0.122)	-0.134 (0.133)	0.097 (0.092)	0.125 (0.092)
$Migrant_{ijst} \times Lib_{ijt}^{placebo}(1/0)$	0.075*** (0.028)	-0.009 (0.007)	-0.026 (0.017)	0.044 (0.077)	-0.025 (0.074)	0.004 (0.057)	0.041 (0.085)	-0.036 (0.031)
Observations	2,860	2,860	2,860	2,857	2,860	2,860	2,860	2,860
R-squared	0.969	0.979	0.973	0.947	0.950	0.943	0.966	0.978
Model	OLS	OLS	OLS	OLS	OLS	OLS	OLS	OLS
Fixed effects :								
Exporter-Sector-Year	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Importer-Exporter	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Importer-Sector-Year	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Notes: The dependent variable is equal to the logarithm of the imports of intermediate goods imported by importer j in sector s exported by country i in year t . $Migrant_{ijst}$ is the share of workers of sector s in country j and year t that are born in block i . $Lib_{ijt}(1/0)$ is a dummy equal to 1 for all years following the opening of the labour market of country j to citizens of NMS-10 and NMS-3. The sample includes NMS-3 and a different country-block as source of immigrants and exports in each column. In column (1), we reverse the liberalization schemes of NMS-10 and NMS-3. For the sake of clarity, the *South & S-E Asia* and *North Am. & Australia* country-blocks are referred as *S-E Asia* and *North Am.* in the second line of the table. Sectors are at the 1-digit level of NACE rev 1. Robust standard errors are in parentheses. ***, **, * significantly different from 0 at the 1%, 5%, and 10% levels respectively.

Effect of migrants considering different sub-samples Second, we look at post-liberalization migration shock excluding Ireland and UK – the two countries that liberalized trade and labour market at the same time, to make sure that the results of the baseline estimation are not magnified by these two countries. Column (1) of Table 2.5 presents all occupations results and column (2) only includes low-skilled workers. As can be noticed, results of the baseline estimation still hold. In columns (3) to (6), we divide the sample in two periods: before and after the crisis of 2009. Again, the results continue to hold, ensuring that the main findings are not a result of the Great Recession of 2009.

PPML estimation Finally, we also use a different estimator for our baseline regression. In the trade literature, Poisson Pseudo Maximum Likelihood

Table 2.5. Robustness check : Without Ireland and UK and before/after the Great Recession

Dependent variable (in log): Sample	Domestic value added imports of intermediate goods					
	W/o Ireland & UK		2004-2008		2009-2013	
Occupation group	All (1)	Low (2)	All (3)	Low (4)	All (5)	Low (6)
$Migrant_{ijst}$	1.153** (0.534)	0.672*** (0.166)	1.458* (0.811)	0.501** (0.195)	1.658* (0.860)	1.287*** (0.451)
$Lib_{ijt}(1/0)$	0.968*** (0.321)	0.532 (0.392)	0.087 (0.601)	-0.566 (0.408)	1.962** (0.834)	2.224** (1.046)
$Migrant_{ijst} \times Lib_{ijt}(1/0)$	-1.318*** (0.345)	-0.528* (0.269)	-1.917*** (0.726)	-0.987*** (0.280)	-1.494*** (0.506)	-1.086** (0.445)
Observations	2,340	2,340	1,430	1,430	1,430	1,430
KP F-Stat	9.406	1.779	3.674	5.086	5.958	5.077
Model	2SLS	2SLS	2SLS	2SLS	2SLS	2SLS
Fixed effects:						
Exporter-Year	Yes	Yes	Yes	Yes	Yes	Yes
Importer-Exporter	Yes	Yes	Yes	Yes	Yes	Yes
Importer-Sector-Year	Yes	Yes	Yes	Yes	Yes	Yes

Notes: The dependent variable is equal to the logarithm of the imports of intermediate goods imported by importer j in sector s exported by country i in year t . $Migrant_{ijst}$ is the share of workers of sector s in country j and year t that are born in block i . $Lib_{ijt}(1/0)$ is a dummy equal to 1 for all years following the opening of the labour market of country j to citizens of NMS-10 and NMS-3. The sample includes only NMS-10 and NMS-3 country-blocks as exporters and source of immigrants. Sectors are at the 1-digit level of NACE rev 1. Robust standard errors are in parentheses. ***, **, * significantly different from 0 at the 1%, 5%, and 10% levels respectively.

(PPML) is commonly used to address the zero trade issue and as a more robust estimator in the face of heteroscedasticity compared to OLS OLS. Although the former issue is not a concern for us, the latter might be and we therefore reproduce Table 2.2 using the PPML estimator. Results are presented in Table 2.6 and very close to our baseline.

2.5 Mechanism

Results in the baseline estimation suggest that there is a substitutability between offshoring and hiring immigrants. The main hypothesis is that immigrants go to work in sectors that mostly need them.⁴⁵ The reasons behind this allocation could be due to a lack of native workers with adequate skills or to high wages that prevent local firms to hire native labour and give them incentives to offshore a part of their production. In both cases, we expect NMS-10 workers to be complementary rather than substitutes with native workers after the labour market opening. We test these mechanisms in Table 2.7.

⁴⁵We already explained how the migration shock was not directed toward a single country or sector but to specific sectors in each country in the third stylized fact.

Table 2.6. Robustness check: Baseline estimations with Poisson Pseudo Maximum Likelihood estimator

Dependent variable (in log): Occupation group	Domestic value added imports of intermediate goods							
	All workers		High		Medium		Low	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
$Migrant_{ijst}$	0.191*** (0.036)	0.164*** (0.059)	-0.012 (0.032)	0.014 (0.041)	0.064 (0.046)	0.031 (0.058)	0.059*** (0.020)	0.106*** (0.024)
$Lib_{ijt}(1/0)$	0.149** (0.064)	0.084 (0.080)	-0.029 (0.060)	-0.042 (0.076)	-0.006 (0.058)	0.013 (0.077)	0.057 (0.060)	0.078 (0.076)
$Migrant_{ijst} \times Lib_{ijt}(1/0)$	-0.188*** (0.037)	-0.110* (0.060)	0.018 (0.043)	0.031 (0.069)	-0.031 (0.050)	-0.125* (0.070)	-0.052*** (0.020)	-0.066** (0.027)
Observations	2,860	2,860	2,860	2,860	2,860	2,860	2,860	2,860
R-squared	0.984	0.972	0.984	0.972	0.984	0.972	0.984	0.973
Model	OLS	OLS	OLS	OLS	OLS	OLS	OLS	OLS
Fixed effects:								
Exporter-Year	No	Yes	No	Yes	No	Yes	No	Yes
Exporter-Sector-Year	Yes	No	Yes	No	Yes	No	Yes	No
Importer-Exporter	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Importer-Sector-Year	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Notes: The dependent variable is equal to the logarithm of the imports of intermediate goods imported by importer j in sector s exported by country i in year t . $Migrant_{ijst}$ is the share of workers of sector s in country j and year t that are born in block i . $Lib_{ijt}(1/0)$ is a dummy equal to 1 for all years following the opening of the labour market of country j to citizens of NMS-10 and NMS-3. The sample includes only NMS-10 and NMS-3 country-blocks as exporters and source of immigrants. Sectors are at the 1-digit level of NACE rev 1. Robust standard errors are in parentheses. ***, **, * significantly different from 0 at the 1%, 5%, and 10% levels respectively.

First, we look at the effect of the migration shock on labour needs. This exercise also allows us to verify whether the migration shock was detrimental to EU-11 workers. As before, we use a specification based on the timing of labour market liberalization but with the number of overtime hours worked by native workers in a given sector s of country i and year t . A sector where native workers are working a large number of overtime hours is likely to be constrained in terms of available workforce, due to a lack of skills or high wages. In order to avoid endogeneity, we instrument our explanatory variables with the shift-share instrument. We use a different set of fixed-effects due to the loss of the origin dimension in the dependent variable: we only look at native workers' overtime hours.⁴⁶ Since it is impossible to control for importer-sector-year shocks we introduce the full set of bilateral fixed-effects. Results are presented in the two first columns of Table 2.7. We find a negative coefficient associated to the migration shock, meaning that the presence of NMS workers after the enlargement reduces the use of overtime hours done by native workers. This effect is robust to the type of workers (all of them or only low occupations). Such effect is in line with our expectation.

Second, we look at the substitutability/complementarity between all workers (all foreign groups of workers and natives). The dependent variable is

⁴⁶Looking at the total number of overtime hours would have included hours done by immigrants and therefore risk mixing our shock with the result. Matching overtime hours by origin is meaningless if the goal is two uncover some recruitment constraint.

now the share of native/foreign workers among low occupations in a given sector, EU-11 country and year. Again, the results are reported in Table 2.7. In column (3) we check whether native workers are substitute or complement to NMS workers. The coefficient for the post-liberalization migration shock is statistically significant and positive, therefore pointing toward complementary between NMS-10 and native workers.⁴⁷ This result is coherent with the hypothesis that NMS-10 immigrants were directed toward sectors with labour force needs. It is also worth noting that the coefficient of the direct effect is negative, hinting to substitutability before the liberalization.

In subsequent columns, we check the relationship between employment of NMS-10 workers and workers of other origins. We use the share of low occupation worker from other country blocks as dependent variable. We find negative coefficients for the interaction when looking at workers from *Other Europe* (comprising Russia, Turkey and the Balkans), *South and South-East Asia* and the *Rest of the World* (African and Middle-Eastern workers), three blocks that constitutes the origin of a substantial number of immigrants in Western Europe. For immigrant workers to be substitutable with one another hints that there is nothing specific to NMS workers *per se* in our results. Rather, what matters is the migration shock that followed the liberalization. From the point of view of Western European companies, NMS workers became cheaper to import or more abundant in supply. The positive and significant coefficient associated to the direct effect of NMS-10 migration also supports the idea that before the liberalization, the employment of immigrants of a given origin was positively correlated to the employment of other immigrant workers.

A corollary of the non-specificity of NMS workers is that offshoring towards other locations should also be affected. The liberalization offers an abundant and cheaper labour force to Western European companies that can reduce, *ceteris paribus*, their use of offshoring elsewhere. To test that idea we estimate our baseline specification but matching the share of immigrants from NMS-10 with the imports from another blocks. Results are presented in Table 2.8. Different columns correspond to a different matching of NMS-10 workers and EU-11 trade with other blocks. The coefficient associated to the interaction is significant and negative in columns (2), (4), (5) and (6). The

⁴⁷We are using shares as dependent and explanatory variables, therefore we should be cautious in our interpretation of the resulting coefficients. An increase in the number of NMS-10 workers should mechanically lead to a decrease of the share of other origins, *ceteris paribus*. Therefore a negative coefficient does mean with certainty there has been substitution by itself. The magnitude of the coefficient will also depend on the share of the origin of workers.

Table 2.7. Effect on overtime hours and Complementarity/substitutability with native and other immigrant workers after the liberalization

Dependent variable : Origin of workers Occupation group	Overtime		Share of workers _{ijst}							
	Natives		Natives	EU-15	Other Europe	East Asia	S-E Asia	Latin Am.	North Am.	RoW
	All	Low				Low				
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
<i>Migrant_{ijst}</i>	0.076 (0.100)	0.062 (0.051)	-1.981*** (0.240)	-0.136 (0.130)	0.575*** (0.214)	-0.003 (0.007)	0.166** (0.069)	0.221*** (0.068)	-0.010* (0.006)	0.307*** (0.110)
<i>Lib_{ijt}(1/0)</i>	0.174** (0.084)	0.115 (0.076)	-0.018** (0.008)	-0.001 (0.006)	0.006 (0.004)	-0.000 (0.000)	0.002 (0.001)	0.002 (0.002)	-0.000 (0.000)	0.004 (0.002)
<i>Migrant_{ijst} x Lib_{ijt}(1/0)</i>	-0.225** (0.093)	-0.097* (0.056)	1.310*** (0.295)	-0.066 (0.153)	-0.498** (0.232)	0.018* (0.010)	-0.148** (0.068)	-0.223*** (0.069)	0.011* (0.006)	-0.365*** (0.110)
Observations	2,272	2,272	2,860	2,860	2,860	2,860	2,860	2,860	2,860	2,860
R-squared	-	-	0.725	0.804	0.507	0.558	0.497	0.648	0.248	0.523
KP F-Stat	13.56	18.03	-	-	-	-	-	-	-	-
Model	2SLS	2SLS	OLS	OLS	OLS	OLS	OLS	OLS	OLS	OLS
Fixed effects :										
Sector-Year	Yes	Yes								
Importer-Sector	Yes	Yes								
Exporter-Sector	Yes	Yes								
Exporter-Year	Yes	Yes								
Importer-Year	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Importer-Exporter	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Exporter-Sector-Year			Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Notes: The dependent variable is in turn: (i) the number of overtime hours worked by native employees of country j , sector s and year t ; (ii) the share of workers of sector s in country j and year t that are born in block i . $Migrant_{ijst}$ is the share of workers of sector s in country j and year t that are born in block i . $Lib_{ijt}(1/0)$ is a dummy equal to 1 for all years following the opening of the labour market of country j to citizens of NMS-10 and NMS-3. The sample includes only NMS-10 and NMS-3 country-blocks as exporters and source of immigrants. For the sake of clarity, the *South & S-E Asia* and *North Am. & Australia* country-blocks are referred as *S-E Asia* and *North Am.* in the second line of the table. Sectors are at the 1-digit level of NACE rev 1. Robust standard errors are in parentheses. ***, **, * significantly different from 0 at the 1%, 5%, and 10% levels respectively.

NMS-10 migration shock led to a reduction of European offshoring in non-EU Europe, Latin America, North America and other EU-15 countries. The arrival of Eastern European workers therefore reduced offshoring in all of Europe and the Americas. The effect on trade with Asian countries is not significant. Offshoring to that block is encouraged by the very large labour cost gap between Europe and Asia and is unlikely to be filled by the existence of as slightly cheaper workforce in EU-11.

Table 2.8. Immigration from NMS and offshoring towards the rest of the world

Dependent variable (in log): NMS-10 migrants matched with	Domestic value added imports of intermediate goods					
	East Asia (1)	Other Europe (2)	S-E Asia (3)	Latin Am. (4)	EU-15 (5)	North Am. (6)
$Migrant_{ijst}$	-0.235* (0.141)	1.276*** (0.241)	0.045 (0.167)	0.479** (0.216)	1.019*** (0.193)	1.812*** (0.355)
$Lib_{ijt}(1/0)$	-0.403** (0.199)	1.205*** (0.324)	0.019 (0.240)	0.488 (0.319)	0.974*** (0.258)	1.922*** (0.441)
$Migrant_{ijst} \times Lib_{ijt}(1/0)$	0.171 (0.242)	-1.121*** (0.276)	0.077 (0.204)	-0.725*** (0.280)	-0.820*** (0.214)	-1.488*** (0.387)
Observations	2,854	2,860	2,860	2,860	2,860	2,860
KP F-Stat	6.514	6.491	6.491	6.491	6.491	6.491
Model	2SLS	2SLS	2SLS	2SLS	2SLS	2SLS
Fixed effects :						
Importer-Sector-Year	Yes	Yes	Yes	Yes	Yes	Yes
Importer-Exporter	Yes	Yes	Yes	Yes	Yes	Yes
Exporter-Year	Yes	Yes	Yes	Yes	Yes	Yes

Notes: The dependent variable is equal to the logarithm of the imports of intermediate goods imported by importer j in sector s exported by country i in year t . $Migrant_{ijst}$ is the share of workers of sector s in country j and year t that are born in block i . $Lib_{ijt}(1/0)$ is a dummy equal to 1 for all years following the opening of the labour market of country j to citizens of NMS-10 and NMS-3. The sample includes only NMS-10 and NMS-3 country-blocks as exporters and source of immigrants. Sectors are at the 1-digit level of NACE rev 1. Robust standard errors are in parentheses. ***, **, * significantly different from 0 at the 1%, 5%, and 10% levels respectively.

2.6 Conclusion

The literature linking trade and migration is quite rich and exploits several channels such as productivity through skills, complementarity depending on tasks, networks effect, etc. In this paper we exploit the differences in the timing of Western Europe labour markets liberalization to Eastern European workers, to understand the consequences of the migration shock that followed, on European value chains. Exploiting sectoral level data in the context of global value chains and occupation data for foreign workers, we contribute to the literature by providing evidence of a substitution between offshoring and employing immigrant workers in Europe after the labour market liberalization. We find that low occupation Eastern European workers that migrated to Western Europe after labour markets liberalization contributed to reducing offshoring to Eastern Europe. Indeed, immigrants directed primarily towards sectors who could not satisfy domestically their labour needs. The liberalization of labour market reduced the cost of using immigrants relative to offshoring production abroad. Finally, we find that this migration shock was likely detrimental to other immigrants but not to native Western European workers.

Chapter 3

Trade Liberalization, Trade Unions and Workers: Wages and Working Conditions

This chapter is joint work with Gianluca Orefice and Farid Toubal.¹

3.1 Introduction

There is a popular perception that globalization has generated greater inequality making the majority of workers worse off. The extent to which this sentiment rises and affects the political debate is significantly different across countries.² While in some countries popular concerns over the effects of trade liberalization are widespread and have generated marked protectionist responses by governments, in other cases opposition to trade liberalization has been much less intense (Colantone and Stanig, 2018; Dippel et al., 2020).³ These differences across countries stresses the importance of assessing how trade liberalization affects workers' welfare and whether the evolution of countries' labor market institutions mitigates its effects.

In this paper, we take a fresh look at the labor market consequences of trade and labor markets liberalization by analyzing the accession of Eastern European countries in the European Union in 2004 and 2007.⁴ The process of accession represents an important economic event as these countries faced large reduction in import tariffs vis-à-vis the rest of the world as well as a

¹We are grateful to participants to the ENS Cachan internal seminar and ETSG conference. This study is based on data from Eurostat Structure of Earnings Survey (2002-2014). We thanks the WTO and Adam Jakubik for kindly providing MFN tariffs data for the period 1997-2014. The responsibility for all conclusions drawn from the data lies entirely with the authors.

²The global attitudes survey conducted by the PEW Research Center in 2018 reveals a negative sentiment towards trade liberalization across E.U. countries (https://ropercenter.cornell.edu/CFIDE/pewglobal/question_view.cfm?qid=1890&cntIDs=&stdIDs=).

³Colantone and Stanig (2018) and Dippel et al. (2020) show that a high exposure to trade causes the increase in support for nationalist, extreme right and isolationist parties.

⁴The accessions to Eastern members concerned Czech Republic, Estonia, Hungary, Latvia, Lithuania, Poland, Slovakia, and Slovenia in 2004 and Bulgaria and Romania in 2007.

strong liberalization of their labor market. Eastern European countries experienced a marked erosion of trade unions during the accession process. We focus on the evolution of union density rates as trade unions have a strong influence on wages and employment.⁵ We exploit the large variations in the reduction of MFN applied tariff across industries and countries and the differences in the evolution of union density rates across Eastern European countries to examine the consequences of trade and labor market liberalizations on wages and working conditions of workers. While most of the empirical related literature focuses on wages and employment, the effects of trade and labor market liberalizations on working conditions have received far less attention.

Our empirical analysis makes use of a very large cross-section of about 2.8 millions of Eastern European workers in 2014 across 9 countries and 20 regions. We follow a broad definition of working conditions that are hours worked during “non-standard” working hours, including shift, weekend and night work.⁶ The data gives also precise details about workers’ hourly wages and the number of overtime hours and other individual’s attributes such as education, age, occupation, gender or type of contract. We also observe some information about firms, such as their size, sector of activity, and the statutory regime (i.e. private or state-owned).

Our empirical strategy follows Dix-Carneiro and Kovak (2019) and exploits the fact that regions with different industry mix are differently affected by the MFN tariff liberalizations that occurred in 2004 and 2007. We compare the wages and working conditions of workers with similar characteristics in regions that have faced large tariffs declines during the accession process to those in regions that have faced milder tariffs declines. We examine whether these effects are magnified by the changes in union density rates across Eastern countries as these vary substantially. The trade liberalization index is constructed as in Kovak (2013) and Dix-Carneiro and Kovak (2017, 2019) and inform on the weighted average change in region specific applied MFN import tariffs cuts between 1997 and 2014 – the first and last years of

⁵The literature exploring union effects on workers outcomes is one of most extensive in economics. See the classic book of Freeman and Medoff (1984) and the discussion by Blanchflower and Bryson (2004). Barth, Bryson, and Dale-Olsen (2020) provide a very interesting discussion of the effects on union density on wages. While the literature on the effects of union density has mostly focuses on wages, wage inequality and employment, its influences on working conditions has received less attention (Hagedorn et al., 2016).

⁶Atypical working time is a key aspect of the “*Quality of the working environment*” component of the Job Quality Index developed by the OECD (OECD, 2017).

our dataset.⁷ The applied MFN tariff scheme that Eastern European countries had to adopt in such a circumstance was already implemented (and designed) by old member states and therefore hardly affected by the lobbying activities of Eastern European firms.⁸ The typical scheme of a pre-accession preferential trade agreement implied zero-tariffs for a (very) narrow set of products and a progressive tariffs reduction for the rest of industries. In most of cases, the vast majority of products were unaffected by pre-enlargement bilateral preferential trade agreements. Importantly, the pre-accession preferential trade agreements does not modify the external tariff scheme of Eastern European countries vis-à-vis the rest of the world.

We find that workers employed in regions that have faced larger tariffs declines experience a hardening of their working conditions characterized by a higher prevalence of atypical working and overtime hours and a significant reduction of their hourly wages.⁹ Our results also confirm non-neutral effects of trade liberalization across firms and workers of different type. We find larger negative effects of trade liberalization on wages in private firms while the likelihood of having shift work in job increases in larger firms. While the effect of trade liberalization on wages is comparable across sectors, its impact on workers' working condition is slightly larger for manufacturing than for service sectors. The negative effect of trade liberalization on wages is much more pronounced for workers employed in elementary occupations than for managers. All these effects are magnified by the erosion of trade unions which is particularly pronounced in some Eastern European countries during the period of analysis.

This paper is related to the broad literature that has looked at the impact of globalization on labor markets. Over the 1990s, many empirical studies found trade liberalization having a mild effect on wages and employment, attenuating the common concern that globalization may have a negative impact on labor market outcomes (see Richardson (1995) for a survey). However, recent empirical evidence - conducted mainly at local labor market

⁷Country-sector specific MFN tariff shocks are allocated across regions using the seminal approach developed in Kovak (2013).

⁸All Eastern European countries had preferential trade agreements (PTAs) with the EU-15 before the Enlargement (see for example the 1993 Slovak E.U. Agreement, or the 1991 Poland Interim Agreement signed in 1991). However, all these bilateral PTAs covered tariffs reductions between the EU-15 and candidate country, but i) only for a sub-sample of products and ii) did not affect the external tariff scheme of Eastern European countries (vis-a-vis the rest of the world, i.e. MFN applied tariff).

⁹This result is particularly interesting if one considers the mental health problems (i.e. depression) caused by working conditions (Cottini and Lucifora, 2013; Robone, Jones, and Rice, 2011), and notably by effort-reward imbalances among Central and Eastern countries populations (Pikhart et al., 2004).

level - revamped this debate by showing strong evidence of the negative impact of trade liberalization episodes on employment in both developed (Autor, Dorn, and Hanson, 2013; Dauth, Findeisen, and Suedekum, 2014) and developing countries (Topalova, 2007; Dix-Carneiro and Kovak, 2017; Dix-Carneiro and Kovak, 2019).¹⁰ We contribute to this literature by studying the consequences of exogenous trade liberalization episodes on the working conditions of Eastern European workers. Our findings contribute to a more accurate picture of the impact of trade liberalization on individual's welfare which include working conditions as well. Moreover, this is the first paper that uncovers the role of trade unions in shaping the labor market consequences of a trade liberalization episode. We use large-scale data across several countries to examine the effects of trade and labor market liberalization on individuals' wages and working conditions.¹¹

This paper is also related to the literature that examines the effects of trade unions on workers' wage and wage inequality (i.e. *union wage premium* debate). This question has attracted renewed interest thanks to the recent availability of linked employer-employee data and increasing within-industry wage inequalities across workers.¹² While previous studies confirmed the positive role of unions in reducing inequalities in the private sectors (Freeman, 1984), more recent studies examine the role of unions on wage inequalities focusing on workers' characteristics (such as gender, education and employer sector). DiNardo, Fortin, and Lemieux (1996) show that the de-unionization experienced by the U.S. in the 1980s accounted for the 10-15 percent of the overall rise in wage inequality between men workers, with very little impact on women workers. Similar results have been found by Card (2001b) who also uncovered a different role of unions in affecting wage

¹⁰Topalova (2007) and Dix-Carneiro and Kovak (2017) find significant negative impact of trade liberalization episodes on employment in India and Brazil respectively. Autor, Dorn, and Hanson (2013) specifically test the effect of Chinese imports penetration on manufacturing employment across US local labor markets. By comparing two commuting zones over the period 2000 through 2007, one at the 25th percentile and one at the 75th percentile of exposure to Chinese import growth, Autor, Dorn, and Hanson (2013) find that the more exposed commuting zone experiences a differential 4.5 percent fall in the number of manufacturing employees.

¹¹Existing studies examine these effects using individual-level data from a single country.

¹²Trade unions are commonly assumed to limit downward wage flexibility in case of negative demand shocks, and thus boosting the union wage premium (Blanchflower and Bryson, 2002). However, the threat for becoming unionized may lead non-unionized employers to increase wages and thus dampening the union wage premium (Freeman and Medoff, 1981). Moreover, in countries where wages are collectively bargained (as in many Western European countries) unions are likely to influence wages also in non-unionized sectors leading to null wage premium. So, whether unions increase or decrease country-wide wage inequality is an empirical and still open question.

inequalities in private and public sector.¹³ Card (1996) shows that unions raise wages more for workers with lower levels of observed skills. We contribute to this literature by showing that the drop in unions density rates across Eastern European countries has worsened the wage and working conditions of workers. The erosion of trade unions has magnified the negative effects of trade liberalization on workers' welfare.

By providing a direct link between trade liberalization and de-unionization on the worsening of individuals' working conditions, our paper also contributes to the emerging literature that investigates the health effects of trade liberalization or trade unions (Fan, Lin, and Lin, 2020; Colantone, Crinò, and Ogliari, 2019). Exploiting variations in input tariff shocks across Chinese prefecture, Fan, Lin, and Lin (2020) find that input tariff reductions following China's WTO accession adversely affect worker health through increased working hours. We show that the reduction of applied MFN import tariffs in Eastern European countries has increased the likelihood of overtime hours and of working on atypical hours.¹⁴ Researches at the American Public Health Association have highlighted the links between unions, working conditions, and public health (Hagedorn et al., 2016; Malinowski, Minkler, and Stock, 2015).¹⁵

The rest of the paper is organized as follows. Section 3.2 describes the history and the institutional environment of EU enlargements in 2004 and 2007. Section 3.3 presents the main data sources employed in the empirical section and some descriptive statistics aiming at motivating the research question. Section 3.4 describes the econometric strategy and section 3.5 discusses the results. In section 3.6 we present a counterfactual exercise aimed at quantifying the econometric results. Section 3.7 concludes.

¹³In a recent study, Card, Lemieux, and Riddell (2020) shows that unions reduce economy-wide wage inequality by less than 10%, but with a much larger effect in the public than in private sector.

¹⁴Colantone, Crinò, and Ogliari (2019) find robust evidence of a negative impact of import competition on many indicators of individual mental distress – such as anxiety and depression, social dysfunction and loss of confidence.

¹⁵The worsening of working conditions has been shown to be causal to mental distress (Cottini and Lucifora, 2013; Robone, Jones, and Rice, 2011; Marchand, Demers, and Durand, 2005). In particular, Cottini and Lucifora (2013) investigate the link between working conditions and mental health across 15 European countries and show evidence of a positive causal effect of adverse working conditions on mental health distress. In the same vein, using British Household Panel Survey, Robone, Jones, and Rice (2011) show overwhelming evidence of the working conditions effect on health and psychological well-being. Marchand, Demers, and Durand (2005) analyze the contribution of working conditions to the probability of experiencing single or repeated episodes of psychological distress find evidence of a causal relationship between job insecurity and psychological distress events.

3.2 Historical Background

3.2.1 European Enlargement and Tariffs Liberalization

The 2004 and 2007 European Enlargement represents the largest expansion of the European Union, in terms of states and number of workers involved.¹⁶ The process of integration started in the mid-1990s as many of the new Eastern European members engaged in preferential trade agreements with EU-15 aimed at progressively reducing tariff barriers between old and new candidate EU member countries.¹⁷ The official accession to the EU occurred in 2004 and 2007 implied not only a substantial reduction in the Eastern European countries' import tariffs with respect to other members of the European community, but also a drastic trade liberalization *vis-à-vis* the rest of the world (through the adaptation of their external tariff scheme to that of old member states). Between 1994 and 1999 each Eastern European candidate country signed a bilateral Interim agreement containing trade related provisions with old E.U. member states.¹⁸ These provisions were specific and varied according to particular sectors and countries. In 2004 and 2007, with the official access to the European custom union, the new member states became even more integrated into the internal market and incorporated the rules of the common trade policy. By imposing the compliance to the European Union MFN bound and applied tariffs on external trade relationships, the 2004 and 2007 enlargements represent important and exogenous trade liberalization episodes for new member states.¹⁹ Indeed, most of the applied MFN tariffs reductions among Eastern European countries occurred during the post-enlargement period.²⁰ Our empirical strategy exploits this exogenous source of variation to identify the effect of trade liberalization on workers' working conditions and wages.

¹⁶The enlargements involve the integration of almost 100 millions of Eastern European citizens.

¹⁷The Europe Accession negotiations started officially in March 1998 with Czech Republic, Estonia, Hungary, Poland, Slovenia and Cyprus and in October 1999 with Bulgaria, Latvia, Lithuania, Malta, Romania and Slovakia.

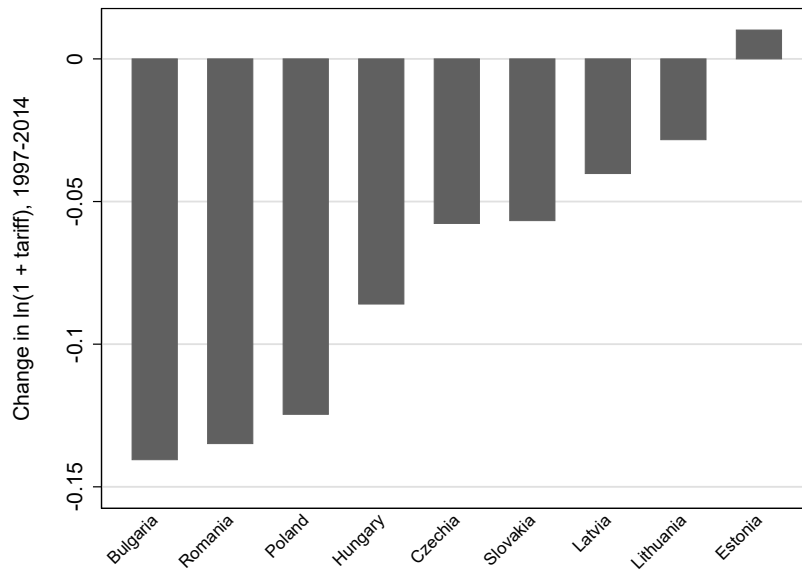
¹⁸Tariffs liberalization with the European members was gradual and asymmetric with faster liberalization on the EU side than on the side of the candidate countries. The Interim Agreements defined few sectors such as in the food, textiles and clothing industries that were excluded from the immediate trade liberalization granted by the European Community The European Commission (2006).

¹⁹As showed in Appendix table C1, the Eastern European shares of imports from the rest of the world (non-EI) were important in 1997 (the starting year of our analysis). This confirms the economic relevance of the drastic change in MFN applied tariff induced by the EU-accession

²⁰The contribution of the change in MFN tariffs pre-enlargement to the overall variation of MFN tariffs between 1997-2014 is about 20%.

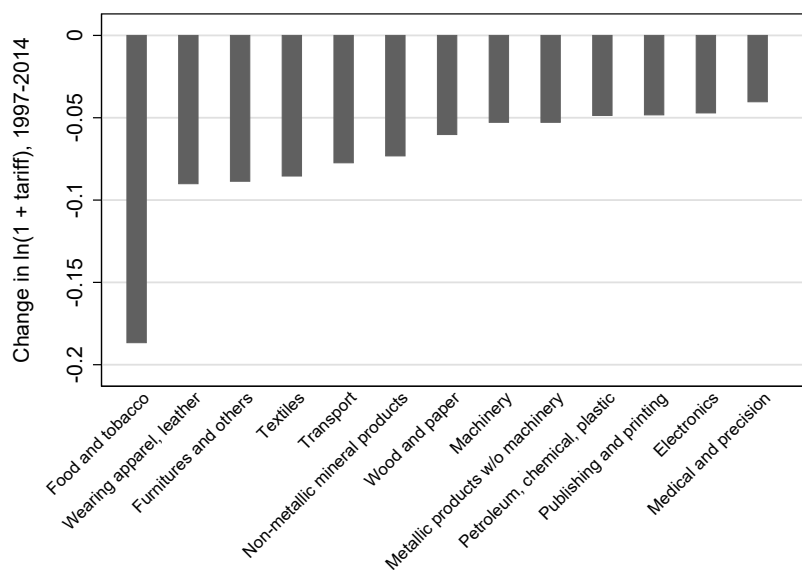
Over our sample period which spans from 1997 to 2014, the reduction in Eastern European countries' applied MFN tariffs across countries is significant as visualized in Figure 3.1, and compares in magnitude with other trade liberalization episodes analyzed in the previous literature (such as the Brazilian or Indian ones described respectively in Dix-Carneiro and Kovak, 2019 and Topalova 2010).

Figure 3.1. Change in Applied MFN Tariffs between 1997 and 2014 by Country



Source: Authors calculations.

Figure 3.2. Change in Applied MFN Tariffs between 1997 and 2014 by Sector



Source: Authors calculations.

The large average decline in applied MFN import tariff showed in Figure 3.1 comes with a substantial heterogeneity in tariffs cuts across industries, with some industries such as medical and precision facing small tariffs changes, and others such as food and tobacco facing declines of more than 18 percentage points (See Figure 3.2).

3.2.2 The Evolution of Labor Markets in Eastern European Countries

Beyond trade liberalization, the enlargement of the EU towards Eastern European countries induced a series of structural reforms in new members states that had important consequences on labor markets (Riboud, Sanchez-Paramo, and Silva-Jauregui, 2002). The changes in labor market regulations across Eastern European countries have important repercussions on the type of employment contracts, the boundaries for wages and benefits, hours worked and working conditions, and the rules for collective representation and bargaining of Eastern European Workers (Cazes, 2002; Fialová and Schneider, 2009). Union density is an important indicator of the ability of unions to negotiate collective agreements and key to understand the labor market transition in Eastern European countries (Richard, 1994). In Central and Eastern European countries, the decline in union density has been particularly intense, due to the collapse of the union affiliation rate after the fall of central planning. In Table 3.1, we summarize the key feature of union density processes over the pre and post-enlargement period.

Since 1990, the numbers of trade-union members has decreased substantially to reach a level of union density which varies between 10% and 15% across Eastern European countries in 2014. Bulgaria, Estonia, Czech Republic, Romania and Slovakia which have the highest figures in 1998 have experienced the largest decrease in the number of members of trade unions over the sample period.²¹ The erosion of trade union can be explained by numerous factors such as high levels of unemployment, privatization, growing numbers of small and medium-sized companies and the expansion of service and flexible jobs over manufacturing and traditional permanent jobs – where the trade unions are more represented. The decline of trade union density has been

²¹The pervasive fall in union density among Eastern European countries observed here (during the period 1998-2004) fits into the historical transition pattern of post-Communist countries started in the late eighties. As reported in Richard (1994), Table 8.2, as of 1991 the union density in Czechoslovakia, Hungary, Bulgaria and Romania was respectively the 70%, 60%, 45% and 64%.

Table 3.1. Change in Union Density in Eastern European Countries

	Union Density in 2014 (%)	Δ relative to pre-enlargement period (pp)
Bulgaria	14	-15.7
Czech Rep.	12.9	-19.2
Estonia	5.5	-11.6
Hungary	10.2	-17
Lithuania	8.1	-6.5
Latvia	12.7	-18.3
Poland	12.8	-6.4
Romania	22.1	-23
Slovakia	12.8	-23.4

Source: data extracted from the ICTWSS database, except for Latvia for which we use national sources. Because of data availability, we use 1998 as pre-enlargement year, except for Lithuania (1999) and 2012 instead of 2014 for Romania.

particularly steep in Slovakia, Latvia, Czech Republic and Bulgaria. The liberalization of labor markets in Eastern European countries also reflects in the decrease of the share of workers covered by collective bargaining. In the pre-enlargement period, collective agreements are mostly conducted at the firm level.²²

The marked changes in the labor market institutions discussed above may have offset or magnified the labor market responses to the trade shock induced by the accession of Eastern European countries into the European custom union. Indeed, in increasingly less regulated labor markets the effects of trade liberalization (i.e. import competition) are likely to be exacerbated. This is at the core of the empirical test conducted in what follows.

3.3 Data and Definition of Variables

To investigate the effects of European enlargement on workers' wages and working conditions, we use detailed cross-sectional data at individual level

²²See Gebel (2008) or Bronstein (2003) for an interesting survey of the country specific features of the wage bargaining systems before and during the Transition.

from the Eurostats Structure of Earnings Survey (SES) dataset. This information is matched with seven different sources to test the heterogeneous responses of workers located into different local labor markets.²³

3.3.1 Individual Worker's Wages and Working Conditions

Our main data source is the Eurostat Structure of Earnings Survey (SES) dataset. The SES is a collection of detailed individual-level and harmonized surveys on earnings and other individual workers characteristics conducted among a large panel of European countries in years 2002, 2006, 2010 and 2014. Each survey is addressed to firms and collected for those with at least 10 employees operating in all areas of the economy except agriculture and public administration defined in Statistical Classification of economic activities in the European Community (NACE). The SES surveys report information on the worker's wage, the number of hours and overtime hours worked and the "*premium payments during the reference month for shift work, night work or weekend work where these are not treated as overtime*". While overtime hours can be voluntary or mandated by the worker's company, shift and night work is usually considered to be a risk factor for health, safety and social well being (Harrington, 1994; Costa, 2003; Cottini and Lucifora, 2013). This information on the likelihood of working during "non-standard" working hours, including shift, weekend and night work is used here to construct our main proxy of individual's working condition.

The worker's total wage include the payments of "*regular*" and "*overtime*" hours of work.²⁴ The information collected relates to the earnings paid to each "job holders", without collecting information on earnings by the same employee elsewhere in a second or third job. It also contains useful individual characteristics such as the worker's level of education, occupation, age and gender. Age is available in 5-year intervals. To reduce measurement error we keep the active population of individuals aged 20 to 59 years old. Concerning the education variable, we use the 4 categories already present in the SES and based on the 2011 version of the International Standard Classification of Education (ISCED).²⁵ We use the 2008 International Standard

²³A detailed presentation of the data and of the construction of the main variables of interest is presented in the online appendix.

²⁴Overtime hours are paid at higher rates of wages. This rate varies across countries.

²⁵The first category includes individuals with lower secondary education, the second category contains individuals with higher secondary education and post-secondary non-tertiary education, the third category includes graduates and the fourth category is post-graduate education.

Classification of Occupations (ISCO) at the 1-digits level to classify the occupation of workers.²⁶ Moreover, the survey reports limited but important information on the worker's employer; such as the firm's size category, the broad sector of activity, her private-owned status and the type of labor contract between the employer and the worker (part time vs full time contract and job-spell).²⁷

The SES has the advantage to cover cross-sectional information at individual level for the vast majority of European countries prior and after the two last enlargements of the European Union to the Eastern European countries. For each of the 4 years, our sample contains harmonized information for 9 countries and 20 NUTS 1-digit level regions including Bulgaria, Czech Republic, Estonia, Hungary, Latvia, Lithuania, Poland, Romania, Slovakia.²⁸ Our final dataset consists on a cross-section of 2,765,815 Eastern European workers aged 25-59 employed in the formal sector of each country in 2014.

These data have various advantages relative to previous studies on the effects of trade liberalization on individual workers' earnings and working conditions. Compared to Autor, Dorn, and Hanson (2013), Kovak (2013) and Dix-Carneiro and Kovak (2019), our data cover a wide range of countries with different labor market institutions. This allows us to analyse how the labor market consequences of the EU enlargement spread across Eastern European countries with different labor market institutions. The dataset provides also detailed information at firm and worker levels that allows investigating the effect of liberalization across firms, occupations, job spells and different types of contract. This allows a deeper comprehension with respect to other similar studies conducted at the local labor market level (Autor, Dorn, and Hanson, 2013) on who are the *winners* and the *losers* from trade liberalization.

3.3.2 Tariffs Liberalization in Eastern European Countries

We follow the recent literature on the labor market consequences of trade liberalization, and measure the effect of trade liberalization on individuals' labor outcomes using a *weighted* average of changes in tariffs across sectors

²⁶We exclude agricultural, army workers, and all the education-system related occupations from the sample as due to the lack of the agricultural, education and army sectors in our data, these are very few observations that are not present in each and every country.

²⁷Countries adopt different sectoral aggregation in the original SES files, but all are based on the NACE Rev.2 classification. So we harmonized the sector of activities to allow cross-country comparison. Our harmonization results in 14 sectors spanning over manufacturing and services. See online appendix D1.3 for more details on sector classification in SES data.

²⁸Croatia, Malta and Slovenia are excluded from the estimation sample as we only have data in 2010 for Croatia and in 2014 for Malta and Slovenia. For these countries we could not compute the change in the weighted tariff liberalization – see section 3.3.2.

in any given region of our sample (Kovak, 2013; Edmonds, Pavcnik, and Topalova, 2010; Dix-Carneiro and Kovak, 2017; Dix-Carneiro and Kovak, 2019; Topalova, 2007; Topalova, 2010).²⁹ The weights are based on the industrial composition of employment in each region. Under the assumption that changes in import tariffs are (fully or partially) passed into prices, any variation in the applied MFN tariff represents a good proxy for variation in domestic price and degree of competition in each industry.³⁰ Our proxy for trade-liberalization induced change in price is as follow:³¹

$$RTR_{rc} = - \sum_k \beta_{rck} \Delta \ln(1 + \tau_{ck}) \quad \text{with} \quad \beta_{rck} = \frac{\lambda_{rck} \frac{1}{\phi_{ck}}}{\sum_{k'} \lambda_{rck'} \frac{1}{\phi_{ck'}}} \quad (3.1)$$

where $\Delta \ln(1 + \tau_{ck})$ is the difference in the applied MFN tariffs between the pre-enlargement year 1997 and the post-enlargement year 2014 for a given sector k and country c .³² We took 1997 as pre-enlargement year because this is the oldest available year in the WTO tariffs dataset covering an exhaustive set of countries and sectors.³³ We use applied MFN to capture specifically the spirit of the EU enlargement, i.e. the fact that Eastern European Countries had to adopt the MFN applied tariffs scheme of old-member states following the accession to the EU.³⁴

As discussed in Kovak (2013), the region-specific labor market response to a common (region-invariant and sector specific) tariff shock depends on i) the importance of each sector k in region r of country c in terms of employment share (λ_{rck}), and ii) on the importance of non-labor factors in the sector

²⁹Autor, Dorn, and Hanson (2013) also investigate the impact of trade liberalization at sub-national level using U.S. data. However, they study the effect of *import penetration* from China rather than a reduction in MFN tariffs as in our case.

³⁰This assumption has been widely used in the literature on export supply elasticity (Romalis, 2007; Fajgelbaum et al., 2020). By focusing on applied MFN import tariffs, when Preferential Trade Agreements between the EU and a given non-EU country imply a full use of preferential rates, our measure of trade liberalization may underestimate the effective trade liberalization episode. However the use of MFN tariff strongly reduce endogeneity concern that might rise if one uses applied preferential rates.

³¹Details on the computation are given in the online Appendix section C2.1.

³²We provide a robustness check in the appendix Table (C2) in which we use 2010 as post-enlargement year. The main results remain.

³³Except for Slovakia and Romania for which the base years are respectively 1998 and 1999 due to lack of data for 1997.

³⁴Since we focus on MFN applied tariffs, the bilateral tariff rates are invariant across partner countries (i.e. the same applied MFN rate is repeated across partner countries). However, we want to account also for the large tariff liberalization implied by the zeroing of tariff towards EU-partners after the accession to the common EU market. To this end, for the post-accession year 2014, we set to zero the MFN applied towards EU partners and took the weighted average rate across EU and non-EU partners (with import share in 1997 used as a weight).

specific production technology ($1/\phi_{ck}$). These aspects are summarized by the weighting parameter β_{rck} in equation 3.1.³⁵ Information on the cost-share of non-labor factors (ϕ_{ck}) is not available at regional level. In line with Kovak (2013), we assume this technology to be constant across regions within the same country.³⁶ In order to compute β_{rck} , we need information on λ_{rck} and ϕ_{ck} . λ_{rck} is the share of region r 's workforce initially employed in sector k of country c . We use the SES 2002 data for Poland and Bulgaria, and the Eurostat Structural Business Survey at the regional level for Romania (in 2002) and Hungary (in 2001) to compute λ_{rck} as this information is not available in the SES dataset.³⁷ We use the HS 6-digit country-product import share to aggregate applied MFN tariff data from HS 6-digit to NACE level. ϕ_{ck} is the cost share of non-labor factors in industry k and country c obtained from Eurostat data for the years preceding the enlargement (Eurostat Structural Business Survey).³⁸

Since the original source of variation in tariff changes is country-sector specific – the regional variation being *de-facto* induced by λ_{rck} – we also construct a trade-liberalization variable RTR_c , which varies across countries (not regions) that we use in a robustness check in the next section. λ_{ck} is then the share of country c workforce initially employed in sector k using the Eurostat SES data in 2002 and the European sector classification NACE Rev1. This robustness check alleviates the friction emerging from combining region-specific labor share with region-invariant non-labor cost share in equation 3.1.

3.3.3 Trade Unions

We collect data on the evolution of Eastern European labor market institutions, and study the role of union density on individual wage and working conditions. The union density variable is the share of workers with union membership and is obtained from the ICTWSS database. We compute the change in union density rates between 1998, the earliest available data in ICTWSS database and 2014. By interacting this variable with the regional

³⁵See Kovak (2013) for the theoretical derivation of the weighted tariff change and β_{rck} .

³⁶Being an intrinsic measure of the technology of sector's production process we can fairly assume ϕ_{ck} to be constant across regions of a given country. This is in line with the specific factor model proposed in Kovak (2013) where all regions in a country have access to the same technology.

³⁷Regional disaggregated data are not available for Czech Republic, Estonia, Lithuania, Latvia, Slovakia. So for this set of countries we use SES 2002 data to compute *country* specific labor shares λ_{ck} .

³⁸See online appendix C2.2 and C2.3 for more details on the construction of non-labor cost share and tariff shocks respectively.

tariff change RTR variables, we analyze whether the erosion of trade unions magnifies the impact of trade liberalization.

3.3.4 Other Controls

The EU enlargements in 2004 and 2007 had several economic consequences. They not only promoted goods and services trade, but also intensified Foreign Direct Investment and other capital flows, and reinforced labor mobility between EU countries. We therefore add in our econometric specification country-level controls to take into account various shocks that correlate with both the tariffs liberalization variable and the labor market outcomes. Such shocks are computed as the log difference of the variable between 1997 and 2014. We account for productivity shocks by including the log-difference of the GDP per capita.³⁹ The underlying data on GDP and population are taken from the World Bank's World Development Indicator (WDI) database. We also control for foreign labor supply shocks by including the net migration flows from 1997 to 2014 over the total population of Eastern European countries as provided by Eurostat. We use the Eurostat dataset on the net foreign property income over GDP to compute the foreign capital shocks aimed at controlling for the change in the presence of multinational corporations between 1997 to 2014. The net foreign property income, as computed by Eurostat national accounts, is the difference between the property income received by domestic agents from abroad and the income received by foreign agents from domestic agents (i.e. the property incomes distributed abroad). Finally, we also control for the dynamics of prices across countries by taking the difference in the Consumer Price Index between 1997 and 2014. The information is taken from the World Development Indicator dataset.

The other individual-level control variables are taken from the SES data. Namely, to control for the differences in worker's labor market outcomes based on the type of contract, we always include a dummy variable that takes the value of one for workers under short term contracts. We also add an indicator for the gender which takes the value of one for women workers; and a control for the employer' size by including a dummy variable equal to one for firms with more than 50 employees. Table 3.2 provides the descriptive statistics of the variables used in the econometric exercise.

³⁹As reported in Rogerson (2008), one of the main determinants of changes in labor demand over time (and of the marked reduction in hours worked in rich EU countries) is productivity dynamics.

Table 3.2. Descriptive Statistics

	Mean	Std. dev.
Hourly wage (log)	1.51	0.60
Shift, weekend, night work (1/0)	0.43	0.50
RTR_{rc} (Normalized)	55.13	25.26
RTR_c (Normalized)	57.65	26.19
LMI_c (Union density)	0.18	0.06
LMI_c (Coverage rate)	0.28	0.18
LMI_c (Minimum wage)	5.13	7.67
Temporary	0.19	0.39
Large firm	0.87	0.33
Women	0.44	0.50
Δ_{97-14} Productivity	0.52	0.14
Δ_{97-14} Net migration	0.07	3.96
Δ_{97-14} Capital flows	-0.05	0.02
Δ_{97-14} CPI index	0.75	0.48

3.4 Empirical Specification

Our empirical strategy exploits the differences in the reduction of import MFN applied tariffs across regions with different industry mixes, to compare the wages and working conditions of workers with similar characteristics. We examine whether the outcomes of workers in regions that have faced large declines in tariffs during the accession process are significantly different than those of workers in regions that have faced milder tariffs declines.

Over the post-enlargement period, Eastern European countries also experienced a marked erosion of trade unions, hence we also examine how the labor market institutional changes affected workers' outcomes and how they shaped the impacts of trade liberalization. The baseline equation includes therefore measures of trade and labor market liberalization that we also interact in most specifications. The estimation is defined as follows:

$$\begin{aligned}
 y_{i,f,c,r} &= \alpha_0 + \alpha_1 RTR_{rc} + \alpha_2 LMI_c + \alpha_3 (RTR_{rc} \times LMI_c) \\
 &+ \mathbf{\Phi}'_i \alpha + \mathbf{X}'_c \gamma + \eta_i + \xi_{i,f,c,r}
 \end{aligned} \tag{3.2}$$

where the dependent variable $y_{i,f,c,r}$ is the labor market outcome of worker i employed in firm f of region r in country c in 2014. We focus on workers' hourly wage and the likelihood of working on "atypical" working time (shift,

weekend and night work) in the main body of the text. The likelihood to work overtime and the share of overtime hours worked are reported in the appendix table C3.

RTR_{rc} and LMI_c are our main explanatory variables which describe the reductions in region specific tariffs and the erosion of union density. We consider the interaction between the two variables, RTR_{rc} and LMI_c in order to study how the interplay between trade and labor market liberalization affect workers' wage and working conditions.⁴⁰

The wages and working conditions of Eastern European workers do not solely depend on the changes in specific tariffs and in labor market regulations. Worker-specific characteristics and country-specific shocks may affect individual wage and working conditions. Hence, we include in equation 3.2 a set of worker (Φ'_i) and country specific controls (X'_c) to reduce any concern regarding potential bias from omitted variables. The set of worker specific controls (Φ'_i) includes a dummy for the size of the employing company which takes the value of one when firms are larger than 50 employees, an indicator for the type of contract which takes the value of one if the worker has a temporary contract, and a gender dummy variable that takes the value of one for women.

In order to isolate the effect of trade liberalization from other factors such as migration and capital flows, in the set of country controls (X'_c) we include the change in the country's net migration and a control for change in capital flows. Since the wages and working conditions might reflect changes in productivity or prices, in X'_c we also control for productivity shocks approximated by changes in country's per capita GDP and changes of the country specific CPI index. All these controls are computed as log difference between 1997 and 2014.

We include four set of worker-attribute fixed effects, η_i : (i) worker-firm match-specific factors (i.e., job-spell fixed effects), (ii) the age interacted by the level of education of workers (Education \times Age fixed effects), (iii) 2-digits occupation specific fixed effects, and (iv) a fixed effect for the sector of the employing company.⁴¹

⁴⁰For the sake of simplicity in the interpretation of interaction coefficient α_3 , variables RTR_{rc} and LMI_c are centered on their sample mean. So, for countries having experienced "average" trade and labor institution shocks, the contribution of the interaction term α_3 vanishes, and the coefficient attached to RTR_{rc} and LMI_c indicates respectively the average effect of trade and labor market institution changes.

⁴¹Notice that this strategy is more conservative than controlling for the observable characteristics only. It requires a large number of workers within a cell to identify the effect of liberalization on the wage and employment of workers within cell across country.

$\epsilon_{i,f,c}$ is the error term. The baseline equation is estimated using OLS on a sample of 2,765,815 workers. The standard errors are allowed to be adjusted for clustering at the country and NUTS regional level to account for heteroskedasticity and non-independence across repeated observations within countries and regions.

3.5 Results

3.5.1 Baseline Results

Table 3.3 shows the results of the baseline specification. The first two columns report results regarding the hourly wage of workers. The last two columns present the results on the worker's likelihood to work at night, during weekend or work in jobs that require shift schedules. Each specification includes specific workers characteristics and sector fixed effects. We therefore use the variation within sector and across regions between workers with similar characteristics to identify the effects of trade and labor market liberalization.⁴²

The impact of tariffs liberalization on hourly wages is negative and significant at the 99 percent confidence level. Given workers, firms and country characteristics, this result suggests that workers in regions which faced larger import tariff reductions have lower relative wages. This finding is in line with the results of Dix-Carneiro and Kovak (2017, 2019) who find a negative effect of trade liberalization on wages of Brazilian workers. The coefficient estimate of -0.005 in column (1) indicates that the average worker in regions facing 10 percentage points larger weighted tariff reduction has an hourly wage in 2014 which is about 5% smaller relative to observationally equivalent workers in other regions. We do not find any statistical evidence on the impact of the reduction of union density on workers' hourly wage. A recent paper by Knepper (2020), suggests that trade unions and more generally collective bargaining agreements target employee benefits rather than wages. The coefficient of the LMI_c variable is negative as expected but falls below the conventional 90 percent level of significance.

In column (2), we interact the labor market institution and the trade liberalization variable to analyze whether the erosion of trade union modifies the impact of import tariff reductions. We find a negative and significant effect of the interacted coefficient, which suggests that labor markets liberalization

⁴²For the sake of readability we omit from the tables of results the coefficients of controls (X'_c). These are reported in the appendix table D5.

Table 3.3. Baseline Results

Dep. Variable	Wages		Night-Weekend-Shift Work	
	(1)	(2)	(3)	(4)
RTR_{rc}	-0.005*** (0.001)	-0.014*** (0.002)	-0.000 (0.000)	0.007*** (0.002)
LMI_c	-0.512 (0.399)	-1.515*** (0.318)	0.955*** (0.249)	1.877*** (0.324)
$RTR_{rc} \times LMI_c$		-0.116*** (0.029)		0.106*** (0.030)
Large firm	0.248*** (0.018)	0.254*** (0.018)	0.147*** (0.020)	0.141*** (0.021)
Temporary	-0.127*** (0.017)	-0.123*** (0.016)	0.003 (0.015)	-0.000 (0.016)
Women	-0.175*** (0.013)	-0.175*** (0.013)	-0.050*** (0.008)	-0.050*** (0.008)
Δ_{97-14} Productivity	Yes	Yes	Yes	Yes
Δ_{97-14} Net migration	Yes	Yes	Yes	Yes
Δ_{97-14} Capital flows	Yes	Yes	Yes	Yes
Δ_{97-14} CPI index	Yes	Yes	Yes	Yes
Education x Age	Yes	Yes	Yes	Yes
Occupation	Yes	Yes	Yes	Yes
Sector	Yes	Yes	Yes	Yes
Job Spell	Yes	Yes	Yes	Yes
Observations	2,765,815	2,765,815	2,765,815	2,765,815
Adj. R^2	0.599	0.601	0.413	0.415
Countries	9	9	9	9
Regions	20	20	20	20

Note: Dependent variable is the log (hourly) wages and dummy variable equal to 1 if the individual works in shift, during weekend or at night in 2014. RTR_{rc} is the change in the weighted regional tariffs between 1997 and 2014. LMI_c is the change in the percentage of unionized workers between 1998 and 2014. Standard errors adjusted for clustering by NUTS regions and country are in parentheses. ***, **, * significantly different from 0 at the 1%, 5%, and 10% levels respectively.

magnifies the negative impact of trade liberalization on wages. Interestingly, the direct effect of the LMI_c variable becomes statistically significant with a sign that is in line with our intuition. This finding suggests that the decline in trade unions has a significant and negative effect on wages only once we account for the interplay with changes in the scale of trade liberalization across regions.

In columns (3) and (4), we examine the impacts of trade and labor market liberalizations on workers' likelihood of working on atypical working time (shift, weekend and night work). In column (3), trade liberalization does not influence the likelihood of working on atypical working time whereas the erosion in trade union rate has a positive and statistically significant impact. The latter finding suggests that the erosion of trade unions has pushed more workers to work on atypical working hours. In column (4), the change in

magnitude and significance of the trade liberalization coefficient indicates the importance of examining the cross-effect of trade and labor market liberalization in affecting working conditions. We find that both the erosion of the union rates and trade liberalization deteriorate workers' working conditions. These effects reinforce each other - see interaction term in column (4).⁴³

Trade liberalization is the largest of the influences on workers' wages and working conditions. Based on standardized beta coefficients computed from specifications (2) and (4), its impact on wages is -0.6 percent, that of union density is -0.15 percent. Its effects on working conditions is 0.35 percent, that of union density is 0.23 percent.

The results concerning the other covariates are in line with the findings of previous studies. Women are paid less than male workers with similar characteristics— a result in line with the gender wage gap showed by Blau and Kahn (1994) for the US and Brainerd (2000) for Eastern European countries.⁴⁴ We find evidence of a wage penalty for individuals working under a temporary contracts. This result is in line with Blanchard and Landier (2002), Booth, Francesconi, and Frank (2002) and Perugini and Pompei (2017) respectively for French, UK and EEC workers.⁴⁵ We however do not find a degradation of working conditions for workers with temporary contracts. As expected large firms pay higher wages than smaller firms even after controlling for the quality of a worker – as we include a set of specific individual effects. Workers in large firms are also more exposed to atypical working time. These latter results suggest that workers employed in firms having more than 50 employees earn and work more than observationally equivalent workers in smaller firms.

The SES surveys report information on the number of overtime hours worked. The availability of this information allows us to examine whether the decrease of union density rates and trade liberalization yield a change in

⁴³In Table C2, we reproduce the baseline specifications using the cross section of workers available in 2010. The results remain mostly unchanged. The coefficient of the interaction term in column (4) is however insignificant. Together with the baseline results, this finding suggests that the cross-effect of trade and labor market liberalization on working conditions occurs rather in the long run.

⁴⁴In particular, Brainerd (2000) show the increasing pattern of gender wage inequality in Eastern European countries after the fall of the Iron Curtain.

⁴⁵Perugini and Pompei (2017) investigate the determinants of wage inequality in Central-Eastern European countries by employing EU-SILC microdata over the period 2007-2012, and show that workers with temporary contracts suffer from a statistically significant wage penalty compared to workers having permanent positions.

the number of workers working overtime or a change in the number of overtime hours worked by individuals. In Table C3, we therefore use the probability of working over time and the individual shares of overtime hours worked as dependent variables. Trade liberalization is associated with a higher probability of doing overtime work and a lower share of overtime hours worked by workers. These findings are consistent with the idea that many more individuals working on average less overtime hours following trade liberalization and the changes in union density rates.

In Table 3.4 we use the country specific measure of trade liberalization (RTR_c). We therefore identify the effect of tariffs liberalization across countries. Importantly, the estimations using the country-specific index produce the same qualitative results as before. We find negative and significant effect of trade liberalization on wages and on working conditions which is magnified by the erosion of trade unions. Not surprisingly, the order of magnitude are also similar to those presented in Table 3.3.⁴⁶

To assess the reliability of our results and interpretations, we conduct a series of placebo experiments. We randomly assign to regions r the values of the liberalization variables (RTR_{rc} and LMI_c) and their interaction. We estimate specifications (2) and (4) of Table 3.3 using the permuted variables and repeat the exercise 3,000 times in total. The distribution of coefficients obtained from estimation of equation 3.2 on *randomized* RTR_{rc} and LMI_c variables are reported in figure 3.3. As expected, the average coefficients of the placebo variables distribute around zero. This findings indirectly confirm the influences of the *observed* RTR_{rc} and LMI_c shocks on wages and working conditions of workers.

3.5.2 Non-neutral Effects of Trade Liberalization and Changes in Union Density

Trade and labor market liberalization episodes are almost never neutral. By nature, they never benefit all workers equally, and they have distributional consequences. Both create economic opportunities for some activities, while reducing opportunities for others. As long as the expanding activities do not employ factors of production in the same proportion as contracting activities, relative demand for factors will change. And as long as supply reacts slower than demand, changes in demand imply important distributional outcomes.

⁴⁶To take into account the different timing in the EU-accession of Bulgaria and Romania, in the online appendix Table D6 we reproduce the baseline estimations without Bulgaria and Romania and show that the main results remain unchanged.

Table 3.4. Using Country-Specific Measure of Trade Liberalization

Dep. Variable	Wages		Night-Weekend-Shift Work	
	(1)	(2)	(3)	(4)
RTR_c	-0.005*** (0.001)	-0.015*** (0.002)	-0.000 (0.000)	0.009*** (0.003)
LMI_c	-0.522 (0.435)	-1.774*** (0.264)	0.968*** (0.285)	2.244*** (0.390)
$RTR_c \times LMI_c$		-0.132*** (0.028)		0.135*** (0.037)
Large firm	0.247*** (0.020)	0.255*** (0.020)	0.147*** (0.024)	0.139*** (0.024)
Temporary	-0.128*** (0.022)	-0.124*** (0.022)	0.003 (0.024)	-0.001 (0.024)
Women	-0.175*** (0.016)	-0.175*** (0.016)	-0.050*** (0.009)	-0.050*** (0.009)
Δ_{97-14} Productivity	Yes	Yes	Yes	Yes
Δ_{97-14} Net migration	Yes	Yes	Yes	Yes
Δ_{97-14} Capital flows	Yes	Yes	Yes	Yes
Δ_{97-14} CPI index	Yes	Yes	Yes	Yes
Education \times Age	Yes	Yes	Yes	Yes
Occupation	Yes	Yes	Yes	Yes
Job Spell	Yes	Yes	Yes	Yes
Sector	Yes	Yes	Yes	Yes
Observations	2,765,815	2,765,815	2,765,815	2,765,815
Adj. R^2	0.599	0.600	0.413	0.415
Countries	9	9	9	9

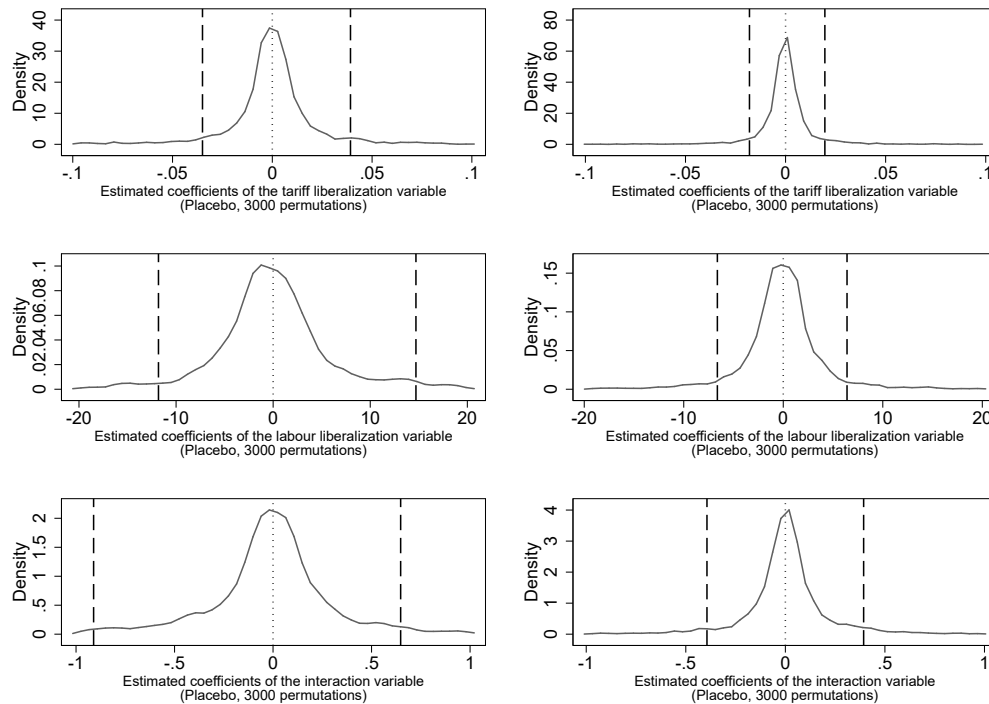
Note: Dependent variable is the log (hourly) wages and dummy variable equal to 1 if the individual works in shift, during weekend or at night in 2014. RTR_c is the weighted tariffs reduction variable between 1997 and 2014. LMI_c is the fall in the percentage of unionized workers between 1998 and 2014. Standard errors adjusted for clustering by country are in parentheses. ***, **, * significantly different from 0 at the 1%, 5%, and 10% levels respectively.

For this reason in what follows we report a set of sample stratification exercises aimed at testing the non-neutral effect of trade and labor market liberalization across sectors, firm and worker types.

In Table 3.5, we investigate the effects of trade and labor market liberalization on both wages and working conditions in manufacturing and in services industries.⁴⁷ Tables D7 and D8 report the results for each 2-digits industries. We expect the baseline results to be particularly important for

⁴⁷Services sectors are all sectors included in our sample with the exception of those affected by tariffs changes, i.e. the manufacturing and the mining and quarrying sectors as defined in the NACE rev2 classification.

Figure 3.3. Trade and Labour Market Liberalization Coefficients Estimated with Permuted Values on Wage (left) and Shift-work (right) Outcomes



workers in the manufacturing sector because the trade liberalization variable is based on tariffs changes of tradable (i.e. manufacturing) products. Interestingly, our results suggest that tariffs-induced trade liberalization also affects workers in service sectors. The negative effects on wages across industries support the results of Dix-Carneiro and Kovak (2019). It also suggests that the tradable and non-tradable labor markets are sufficiently integrated that trade shocks affect workers in both industries. This integration may occur through changes in consumer demand for local non-tradables or because workers compete for jobs in both the tradable and non-tradable sectors.⁴⁸ Demand shocks and competition among workers affect their working conditions. Our result suggest that the negative effects of trade liberalization on workers' wages and working conditions in both sectors are exacerbated by the erosion of trade unions.

In Table 3.6, we examine whether changes in wages and working conditions are different across different population of workers. We define three broad categories of occupations according to the ISCO classifications: (i) high

⁴⁸Increase in import competition among manufacturing sectors might have implied a long-run movement of workers toward services sectors with the consequent reduction in wages also in non-tradable sectors that were not directly exposed to trade liberalization shocks.

Table 3.5. Manufacturing and Services Industries

Sector	Manufacturing		Services	
	Wages (1)	Night–Weekend–Shift Work (2)	Wages (3)	Night–Weekend–Shift Work (4)
RTR_{rc}	-0.012*** (0.002)	0.008*** (0.003)	-0.015*** (0.002)	0.006*** (0.002)
LMI_c	-1.466*** (0.367)	2.023*** (0.387)	-1.512*** (0.323)	1.658*** (0.311)
$RTR_{rc} \times LMI_c$	-0.088** (0.031)	0.110*** (0.036)	-0.130*** (0.030)	0.097*** (0.027)
Large firm	0.298*** (0.020)	0.201*** (0.024)	0.233*** (0.019)	0.113*** (0.022)
Temporary	-0.104*** (0.014)	-0.008 (0.010)	-0.128*** (0.023)	0.010 (0.021)
Women	-0.213*** (0.011)	-0.054*** (0.007)	-0.148*** (0.016)	-0.048*** (0.009)
Δ_{97-14} Productivity	Yes	Yes	Yes	Yes
Δ_{97-14} Net migration	Yes	Yes	Yes	Yes
Δ_{97-14} Capital flows	Yes	Yes	Yes	Yes
Δ_{97-14} CPI index	Yes	Yes	Yes	Yes
Education x Age	Yes	Yes	Yes	Yes
Occupation	Yes	Yes	Yes	Yes
Sector	Yes	Yes	Yes	Yes
Job Spell	Yes	Yes	Yes	Yes
Observations	1,271,154	1,271,154	1,494,661	1,494,661
Adj. R^2	0.617	0.395	0.597	0.402
Countries	9	9	9	9
Regions	20	20	20	20

Note: Dependent variable is the log (hourly) wages and dummy variable equal to 1 if the individual works in shift, during weekend or at night in 2014. RTR_{rc} is the change in regional tariffs between 1997 and 2014. LMI_c is the fall in the percentage of unionized workers between 1998 and 2014. Manufacturing gather all workers in the mining and quarrying sector and the manufacturing sector, as defined in the NACE rev2 classification. Services gather all workers from other sectors included in our analysis. Standard errors adjusted for clustering by NUTS regions and country are in parentheses. ***, **, * significantly different from 0 at the 1%, 5%, and 10% levels respectively.

skilled jobs such as managers (H : ISCO 1), (ii) medium skilled jobs covering technical, administrative and skilled production workers (M : ISCO 2-8), and (iii) low skilled jobs or elementary occupations (L : ISCO 9).⁴⁹ All workers see a deterioration of their wages and working conditions due to trade and labor market liberalization, with a significantly stronger wage effect for low skilled job. Point estimates on RTR_{rc} and LMI_c for low skilled workers are three times bigger than that for high skilled.

We also investigate the effects of trade and labor market liberalization on workers' wages and working conditions by firms' type and size. The results are reported in Table 3.7. Since about 90% of Eastern European workers are

⁴⁹ISCO classification developed by the ILO available here <https://www.ilo.org/public/english/bureau/stat/isco/docs/publication08.pdf>.

Table 3.6. Results by Type of Occupation

Type of occupation Dep. Variable	Low		Medium		High	
	Wages	Night-Weekend Shift Work	Wages	Night-Weekend Shift Work	Wages	Night-Weekend Shift Work
	(1)	(2)	(3)	(4)	(5)	(6)
RTR_{rc}	-0.021*** (0.001)	0.007*** (0.002)	-0.016*** (0.002)	0.008*** (0.002)	-0.008** (0.004)	0.006*** (0.001)
LMI_c	-2.801*** (0.320)	1.869*** (0.306)	-1.811*** (0.372)	2.086*** (0.333)	-0.962* (0.529)	1.481*** (0.155)
$RTR_{rc} \times LMI_c$	-0.199*** (0.024)	0.110*** (0.028)	-0.141*** (0.033)	0.122*** (0.029)	-0.063 (0.047)	0.089*** (0.015)
Large firm	0.166*** (0.014)	0.154*** (0.022)	0.240*** (0.020)	0.154*** (0.021)	0.470*** (0.030)	0.050*** (0.008)
Temporary	0.002 (0.021)	0.032* (0.017)	-0.153*** (0.017)	0.017 (0.021)	-0.233*** (0.043)	-0.006 (0.007)
Women	-0.131*** (0.017)	-0.043*** (0.010)	-0.181*** (0.012)	-0.062*** (0.009)	-0.217*** (0.039)	0.017*** (0.005)
Δ_{97-14} Productivity	Yes	Yes	Yes	Yes	Yes	Yes
Δ_{97-14} Net migration	Yes	Yes	Yes	Yes	Yes	Yes
Δ_{97-14} Capital flows	Yes	Yes	Yes	Yes	Yes	Yes
Δ_{97-14} CPI index	Yes	Yes	Yes	Yes	Yes	Yes
Education x Age	Yes	Yes	Yes	Yes	Yes	Yes
Occupation	No	No	No	No	No	No
Sector	Yes	Yes	Yes	Yes	Yes	Yes
Job Spell	Yes	Yes	Yes	Yes	Yes	Yes
Observations	217,816	217,816	2,368,812	2,368,812	179,187	179,187
Adj. R^2	0.595	0.407	0.506	0.369	0.391	0.285
Countries	9	9	9	9	9	9
Regions	20	20	20	20	20	20

Note: Dependent variable is the log (hourly) wages and dummy variable equal to 1 if the individual works in shift, during weekend or at night in 2014. RTR_{rc} is the change in regional tariffs between 1997 and 2014. LMI_c is the fall in the percentage of unionized workers between 1998 and 2014. "High" occupations are managers, "Low" occupation are elementary occupations, as defined in the ISCO-08 classification, and "Medium" occupations are all other occupations. Standard errors adjusted for clustering by NUTS regions and country are in parentheses. ***, **, * significantly different from 0 at the 1%, 5%, and 10% levels respectively.

employed in private firms, we keep the sample of private firms and run the baseline regressions. We also investigate whether the results are different in large firms that have more than 50 employees or in smaller firms. The results suggest that trade liberalization and the change in union density have significant influences across the different types of firms. Our baseline results remain. We find negative effects of trade liberalization and de-unionization on workers' wages and working conditions. Finally, in table 3.8 we show that workers with part-time contracts are much more negatively affected in terms of both hourly wage and working conditions by trade and de-unionization shocks than colleagues in full-time positions.

In the online appendix, we propose several additional tests to examine the non-neutrality of our results across other workers attributes. In Table D9, we examine whether our main findings vary across workers with different lengths of experiences within firms. We show that newly hired workers are more affected in terms of hourly wage. In Tables D10 and D11, we examine whether our baseline results are similar across workers' age and education.

Table 3.7. Private, Small and Large Firms

Sector	Private firms		Small firms		Large firms	
	Wages	Night-Weekend Shift Work	Wages	Night-Weekend Shift Work	Wages	Night-Weekend Shift Work
Dep. Variable	(1)	(2)	(3)	(4)	(5)	(6)
RTR_{rc}	-0.015*** (0.002)	0.007** (0.002)	-0.014*** (0.002)	0.004*** (0.001)	-0.013*** (0.002)	0.007*** (0.002)
LMI_c	-1.554*** (0.333)	1.862*** (0.351)	-1.267** (0.524)	1.185*** (0.269)	-1.379*** (0.339)	1.854*** (0.307)
$RTR_{rc} \times LMI_c$	-0.136*** (0.031)	0.099*** (0.032)	-0.105*** (0.031)	0.066*** (0.015)	-0.115*** (0.033)	0.104*** (0.030)
Large firm	0.267*** (0.019)	0.142*** (0.024)				
Temporary	-0.116*** (0.015)	0.004 (0.016)	-0.072*** (0.020)	0.008 (0.008)	-0.122*** (0.017)	-0.001 (0.017)
Women	-0.175*** (0.014)	-0.048*** (0.009)	-0.079*** (0.012)	-0.014*** (0.004)	-0.188*** (0.009)	-0.058*** (0.007)
Δ_{97-14} Productivity	Yes	Yes	Yes	Yes	Yes	Yes
Δ_{97-14} Net migration	Yes	Yes	Yes	Yes	Yes	Yes
Δ_{97-14} Capital flows	Yes	Yes	Yes	Yes	Yes	Yes
Δ_{97-14} CPI index	Yes	Yes	Yes	Yes	Yes	Yes
Education x Age	Yes	Yes	Yes	Yes	Yes	Yes
Occupation	Yes	Yes	Yes	Yes	Yes	Yes
Sector	Yes	Yes	Yes	Yes	Yes	Yes
Job Spell	Yes	Yes	Yes	Yes	Yes	Yes
Observations	2,440,093	2,440,093	351,568	351,568	2,414,247	2,414,247
Adj. R^2	0.609	0.425	0.553	0.154	0.585	0.388
Countries	9	9	9	9	9	9
Regions	20	20	20	20	20	20

Note: Dependent variable is the log (hourly) wages and dummy variable equal to 1 if the individual works in shift, during weekend or at night in 2014. RTR_{rc} is the change in regional tariffs between 1997 and 2014. LMI_c is the fall in the percentage of unionized workers between 1998 and 2014. Private firms are firms whose private ownership is more than 50%. Small firms have less than 50 employees, large firms have more than 50 employees. Standard errors adjusted for clustering by NUTS regions and country are in parentheses. ***, **, * significantly different from 0 at the 1%, 5%, and 10% levels respectively.

We find that young and low-skilled workers are particularly affected by de-unionization shocks in terms of hourly wage. In Table D12 we show the non-neutral wage effect of liberalization shocks based on worker's gender. We find a stronger wage penalty for women workers than for (observationally equivalent) men workers.⁵⁰

3.6 Quantitative Exercise

The empirical analysis discussed so far shows that trade liberalization has a negative impact on wages and working conditions of Eastern European workers, which is reinforced by the erosion of trade unions across Eastern European countries. To gauge the quantitative relevance of our model, we propose two hypothetical scenarios (counterfactual) in which trade liberalization or the change in union density rates did not occur. We recognize the simplistic nature of this exercise which remains, nevertheless, informative on the economic magnitudes of the trade and de-unionization shocks analyzed

⁵⁰Other sample stratification exercises are reported in the online appendix tables D13 (permanent vs temporary contract) and D15 (private vs public owned firms.)

Table 3.8. By Work Schedule

Work schedule	Full-time		Part-time	
	Wages (1)	Night-Weekend-Shift Work (2)	Wages (3)	Night-Weekend-Shift Work (4)
RTR_{rc}	-0.012*** (0.003)	0.006** (0.002)	-0.035*** (0.002)	0.010*** (0.002)
LMI_c	-1.105*** (0.350)	1.717*** (0.326)	-5.285*** (0.390)	2.612*** (0.426)
$RTR_{rc} \times LMI_c$	-0.088** (0.034)	0.093*** (0.030)	-0.398*** (0.027)	0.150*** (0.029)
Large firm	0.255*** (0.017)	0.145*** (0.022)	0.203*** (0.030)	0.099*** (0.020)
Temporary	-0.121*** (0.015)	0.001 (0.016)	-0.110*** (0.034)	-0.015 (0.012)
Women	-0.181*** (0.011)	-0.050*** (0.008)	-0.054*** (0.016)	-0.033* (0.018)
Δ_{97-14} Productivity	Yes	Yes	Yes	Yes
Δ_{97-14} Net migration	Yes	Yes	Yes	Yes
Δ_{97-14} Capital flows	Yes	Yes	Yes	Yes
Δ_{97-14} CPI index	Yes	Yes	Yes	Yes
Education x Age	Yes	Yes	Yes	Yes
Occupation	Yes	Yes	Yes	Yes
Sector	Yes	Yes	Yes	Yes
Job Spell	Yes	Yes	Yes	Yes
Observations	2,621,268	2,621,268	144,547	144,547
Adj. R^2	0.609	0.413	0.488	0.351
Countries	9	9	9	9
Regions	20	20	20	20

Note: Dependent variable is the log (hourly) wages and dummy variable equal to 1 if the individual works in shift, during weekend or at night in 2014. RTR_{rc} is the change in regional tariffs between 1997 and 2014. LMI_c is the fall in the percentage of unionized workers between 1998 and 2014. Standard errors adjusted for clustering by NUTS regions and country are in parentheses. ***, **, * significantly different from 0 at the 1%, 5%, and 10% levels respectively.

so far. We therefore compare the predicted labor market outcomes delivered by the baseline econometric model in equation 3.2 with the predicted individual's wage and working condition either assuming no trade liberalization ($RTR_{rc} = 0$) or assuming no changes of union density rates ($LMI_c = 0$) across countries. These two counterfactual scenarios are computed as follows:

$$\hat{y}_{i,f,c,r}^{RTR=0} = \hat{\alpha}_0 + \hat{\alpha}_2 LMI_c + \Phi'_i \hat{\alpha} + \mathbf{X}'_c \hat{\gamma} + \hat{\eta}_i + \zeta_{i,f,c,r} \quad (3.3)$$

$$\hat{y}_{i,f,c,r}^{LMI=0} = \hat{\alpha}_0 + \hat{\alpha}_1 RTR_{rc} + \Phi'_i \hat{\alpha} + \mathbf{X}'_c \hat{\gamma} + \hat{\eta}_i + \zeta_{i,f,c,r} \quad (3.4)$$

where coefficients $\hat{\alpha}$, $\hat{\gamma}$ and $\hat{\eta}$ are obtained from the baseline estimation of equation 3.2. In Table 3.9, for each region in the sample, we show the difference in the predicted wage and working condition between the *counterfactual* scenario (obtained as in equation 3.3 and 3.4 respectively) and the *real*

scenario (based on observed values of RTR_{rc} and LMI_c).⁵¹

Table 3.9. Counterfactual Changes in Wages and Work at Atypical Hours

Counterfactual		No tariff liberalization		No labour market liberalization	
Country	Region	Wages	Night-Weekend Shift Work	Wages	Night-Weekend Shift Work
Bulgaria	North and East	113.6%	-4.7%	103.3%	-9.6%
	South West and Central	103.3%	-3.7%	86.9%	-7.0%
Czechia	-	63.9%	-26.2%	-2.1%	-5.4%
Estonia	-	-0.1%	0.0%	-56.8%	42.3%
Hungary	Central Hungary	76.6%	-5.8%	33.0%	-5.9%
	Transdanubia	78.7%	-10.2%	36.1%	-10.7%
	Great Plain and North	85.4%	-10.2%	46.2%	-12.1%
Lithuania	-	2.8%	13.3%	-6.7%	2.5%
Latvia	-	42.0%	-1.1%	-27.6%	15.7%
Poland	Centralny	7.0%	42.5%	41.7%	-4.3%
	Południowy	6.3%	32.9%	34.1%	-7.7%
	Wschodni	7.0%	38.9%	41.0%	-7.0%
	Północno-Zachodni	7.1%	40.8%	42.3%	-6.2%
	Południowo-zachodni	6.1%	32.8%	32.5%	-6.9%
Północny		6.8%	39.4%	39.7%	-5.7%
Romania	Macroregion one	190.7%	-16.0%	142.6%	-18.6%
	Macroregion two	199.2%	-16.3%	154.0%	-19.4%
	Macroregion three	193.0%	-18.5%	145.7%	-21.5%
	Macroregion four	191.2%	-17.2%	143.2%	-19.9%
Slovakia	-	85.7%	-19.8%	-0.2%	-4.0%

Note: This table shows how the log (hourly) wages and the share of workers doing shift, night or weekend work would be affected if there had been no tariffs liberalization or labor market liberalization. The table contains percentage changes for hourly wages and percentage point change for the shift work variable. The specification used for these results is presented in 3.3, columns 2 and 4. Regions for each country are based on the 2014 NUTS classification at the 1-digit. The number corresponds to the official number used to describe a given region in that classification. For Czechia, Estonia, Lithuania, Latvia and Slovakia, there is no subdivision at the 1-digit level : it corresponds to the entire country.

The two first columns indicate the country and region considered.⁵² The two following columns give the predicted change in hourly wage (in %) and the predicted change in the share of workers doing atypical hours (in pp)⁵³ in the absence of tariff liberalization. For most regions, wages would have been higher and the share of workers doing shift-work lower in the

⁵¹By using the fit of the estimated equation 3.2 and forcing the indices RTR_{rc} and LMI_c to be zero, we assume that all other factors and shocks to be unaffected by the RTR_{rc} and LMI_c indexes.

⁵²For countries where there is no regional decomposition at the NUTS 1-digit level, then the counterfactual correspond to the entire country and the region field is left blank.

⁵³We transform the predicted change in *probability* to work in shift (as delivered by the estimation of equation 3.2) into the change in the *share* of the population doing this shift-work by multiplying this counterfactual change with the share of the workforce concerned by atypical work. For instance, if the counterfactual change in probability is -30% , workers who were already working in shifts will see their probability to do so decrease from 100% to 70%. If they represent half of the workforce, the counterfactual change in the share of shift-workers is therefore -15% points. If the counterfactual change is positive, only some of the workers not working in shifts will start to do so.

absence of tariff liberalization.⁵⁴ In particular, in absence of trade liberalization, the hourly wage of Hungarian workers would have been from 77% to 85% higher (depending on the region). An interesting exception is Poland, that would have experienced higher shares of shift-workers in absence of the EU-induced trade liberalization. Romanian workers would have been much better off in the absence of both tariff and labor market liberalization shocks. Interestingly, Estonian workers would have lower hourly wages in that situation. The peculiarity of the Estonian case comes from the total free-trade approach that Estonia had before the EU enlargement, meaning that tariffs actually increased when the country joined the European Union in 2004 (see figure 3.1). The two last columns shows the changes in labor market outcomes when union densities are considered unchanged over the period. In all regions, with constant labor market institutions the share of workers doing shift (night or weekend) work would have been lower, and wage higher. In particular, in absence of trade union erosion, the hourly wage of Hungarian workers would have been from 33% to 46% higher (depending on the region). Interestingly, working conditions in the Baltic states would have been worse off in the absence of labor market liberalization. These counterfactual exercises highlights the relevance of looking at the interplay between trade and labor market liberalizations in the baseline econometric exercise by isolating in turn the role of trade shocks and de-unionization.

3.7 Conclusion

We use a novel worker-level Eurostat dataset containing precise information on earnings and individual characteristics to study the impact in terms of wages and working conditions of the tariffs liberalization that accompanied the EU enlargements in Eastern European countries over the period 1997-2014. We also make use of the multi-country aspect of our dataset to understand the link between tariffs liberalization and the labor market liberalization that characterized the Eastern European countries over the same period. We find that tariffs liberalization had a negative effect on hourly wages and

⁵⁴At first glance, the *positive* changes in the share of workers doing atypical hours may appear of greater magnitude than *negative* changes in the share. This effect is mechanical. Since in most of the regions the majority of workers are not involved by atypical work (night or shift), even a small positive change in the probability of doing shift-work (induced by trade or de-unionization shock) reflects into a large change in the share of workers doing atypical work, simply because a large share of workers are concerned. Conversely, when the probability of doing shift-night work decreases, only the minority of workers already doing atypical work is concerned, and the resulting change in the share of workers is small in magnitude.

increased the share of workers doing shift-work and overtime hours. Labor market liberalization, here approximated by trade unions erosion, exacerbated this loss of wages and degradation in working conditions. Then we proceed to test the non-neutrality of firm and individual characteristics. We find that low skilled occupations were more affected by trade and labor market liberalization, and that the wage and working condition erosion effect of trade liberalization were more pronounced for individuals employed in part-time jobs. Finally we conduct a range of scenarios analysis in order to quantify our findings. In particular, there had not been any labor market liberalization, hourly wages in Poland would be from 32.5% to 42.3% higher (depending on the region), and the share of workers doing shift work from 18.6% to 21.5% less in Romania.

General Conclusion

The variety of subjects treated in this thesis does not allow to draw a simple all encompassing conclusion. But it is possible to review the main results described earlier and point out in which way they might shape the debates to which the three chapters relate.

The first chapter emphasizes the relevance of interactions between labour mobility and education in Europe. As long as migrating is somewhat costly, opportunities abroad can lead to an increase in the education investment in order to hedge against potential negative economic shocks. As a result, migration flows are disproportionately composed of highly skilled agents, as it is increasingly observed in Europe. On the downside, this effect only occurs in presence of a migration cost, whose most direct effect is to desincentivize migrations. Hence, the skill upgrade effect is substitute with labour mobility as an adjustment mechanism. This trade-off can be illustrated with the simulated model. This exercise also shows quite clearly that the presence of the migration cost is at the source of the persistence in the effects of the productivity shocks : small gaps in productivity will not lead to migrations likely to equalize wages across countries. Hence, a one-time shock might lead to a durable, but small, gap in wages. As such, labour mobility certainly acts as an adjustment mechanism when a sufficiently large shock occurs but might lock countries in a permanent state of inequality (if no other shock hits randomly one of the two countries). The solution is of course to lower the migration cost. During the Euro crisis, calls to increase labour mobility were frequent. As the model predicts that more educated agents are also more mobile, another solution would consist in investing in education. A increase in European university exchange funding or greater facility for international mobility during studies might tick both boxes.

There are some limitations to this chapter however. It remains to be seen where different European countries locate on the previously mentioned trade-off. A more comprehensive simulation with a calibration fitted on some European countries might help in this regard. In a more fundamental way, this chapter assume a relatively comparable development level of both countries. There is no certitude regarding the long-term convergence of

the European economies however. In the model a similar tension between the mechanism of adjustment and the persistent effects of shock is actually present. Arguments presenting the Euro as a source of divergences have been made and the Euro crisis certainly did not disprove them.

The second chapter shows that the opening of Western Europe labour markets to immigration from Central and Eastern Europe actually reduced offshoring, *ceteris paribus*. The rationale being that Western Europe companies arbitrate between offshoring production and pay a transport cost or keeping production at home and pay higher wages, but that this trade-off has been shifted in favour of domestic production by the arrival of Eastern European workers that brought either the right set of skills or lower wage expectations. That effect is not restricted to Eastern European workers, since offshoring to other areas of the world seem to have been reduced in the process. These results certainly give food for thought as in East-West European relations, trade liberalization was implemented a few years before labour market opening. If trade liberalization is somewhat detrimental to domestic workers (as seen in the Chapter 3 and in part of the literature) and leads to offshoring and opening the labour market to foreign workers reduces that offshoring, then the trade-off seems to accept foreigners at home or see production flee abroad. Our results tend to show that actually, the process was not necessarily harmful to native workers as the arrival of Eastern European workers might mostly concentrate in sectors having trouble recruiting in Western countries. The evidence points more toward a detrimental effect on other foreign workers. The notion, incorporated in the EU accession process, that the removal of trade barriers should precede the removal of labour market restrictions still seems slightly depreciated from the point of view of Western European countries. Firms' production location decisions are made on a medium to long-term horizon and it might not be so easy to bring back production after it has left. Accepting foreign workers before some production is offshored might help root it at home.

More research should however be conducted on the way the arrival of Eastern European workers might have affected native worker to draw definitive conclusion of any welfare effect. The empirical evidence that we offer is of also limited on a very particular type of trade and the global effect of post-integration migrations might be somewhat different when looking at the export side for instance. To generalize the results, the use of labour market openings to some foreign workers could be interesting to implement in

other set-ups where the countries of origin and destination are also linked by significant levels of offshoring. Finally, it would be interesting to distinguish different kinds of work-related migrations. In Europe, the use of posted workers from Eastern European countries is quite widespread and gives rise to strong debates related to the concept of social dumping. However, Western European companies also post many workers in other countries in the context of their international strategies. It would be interesting to puzzle out the role of posted workers in offshoring and European trade.

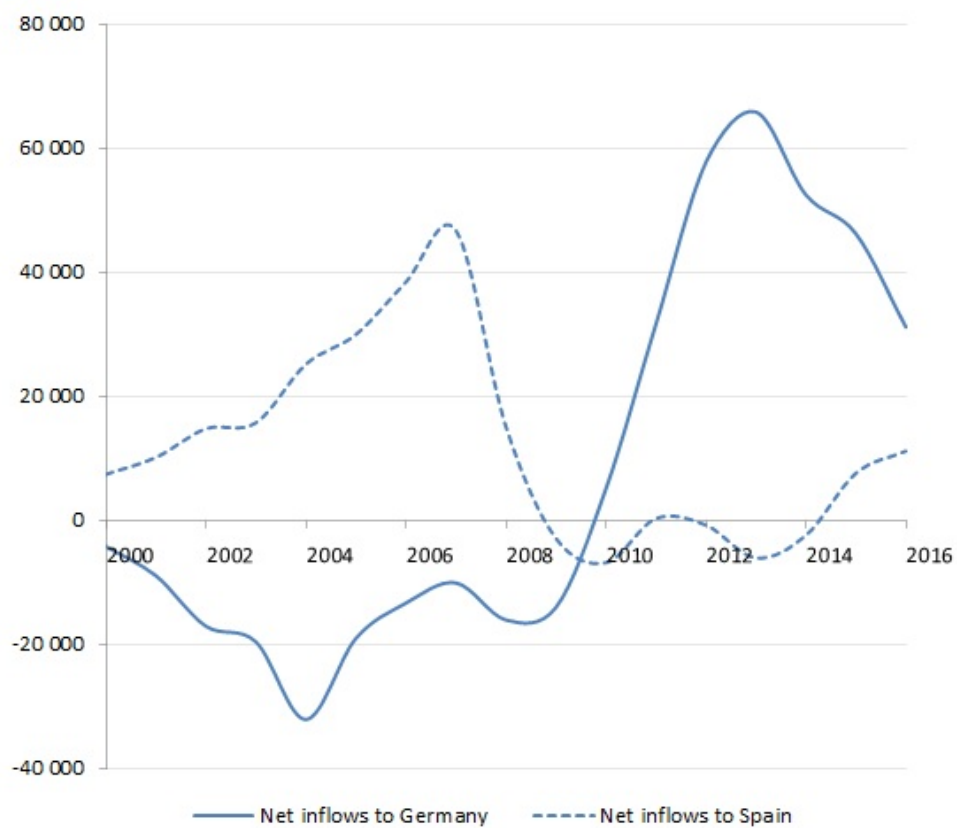
The last chapter extends the trade liberalization literature to effects on working conditions and the interaction with labour market institutions. The drop in tariffs that resulted from EU accession reduced hourly wages and deteriorated working condition, in the sense that working arrangement known to be harmful to health became more prevalent in regions that witnessed larger tariffs shocks. The role of the erosion of union density is instrumental in that respect since it aggravated the effects of trade liberalization and played its part in the adverse effects on wages and working conditions. The non-neutrality of these effects is also to bear in mind : low skill and part-time workers were more affected by liberalization and there is also evidence that large firm were more likely to reduce working condition quality in response to tariff and labour market liberalization. Of course, estimates should not be interpreted out of context : the methodology used here isolate the tariff liberalization aspect of EU integration. FDI, migration flows and technology transfers have all been controlled for, such that our results are really partial equilibrium results. Any general judgment on the effect of EU accession on workers should bear this in mind.

As this theme is relatively novel, more research is needed on working conditions to have a clearer picture of its interaction with wages and liberalization. The way in which trade and labour market liberalization occurred in the entire area. This study is one of the first to try to elucidate the role of other country-level policies and dynamics in shaping out reactions to trade liberalization. Research focusing on similar interactions would greatly contribute to the literature. Finally, it would be useful to investigate the role of wages and working conditions deterioration in the post-accession period on the emigration of Central and Eastern European workers.

Appendix A

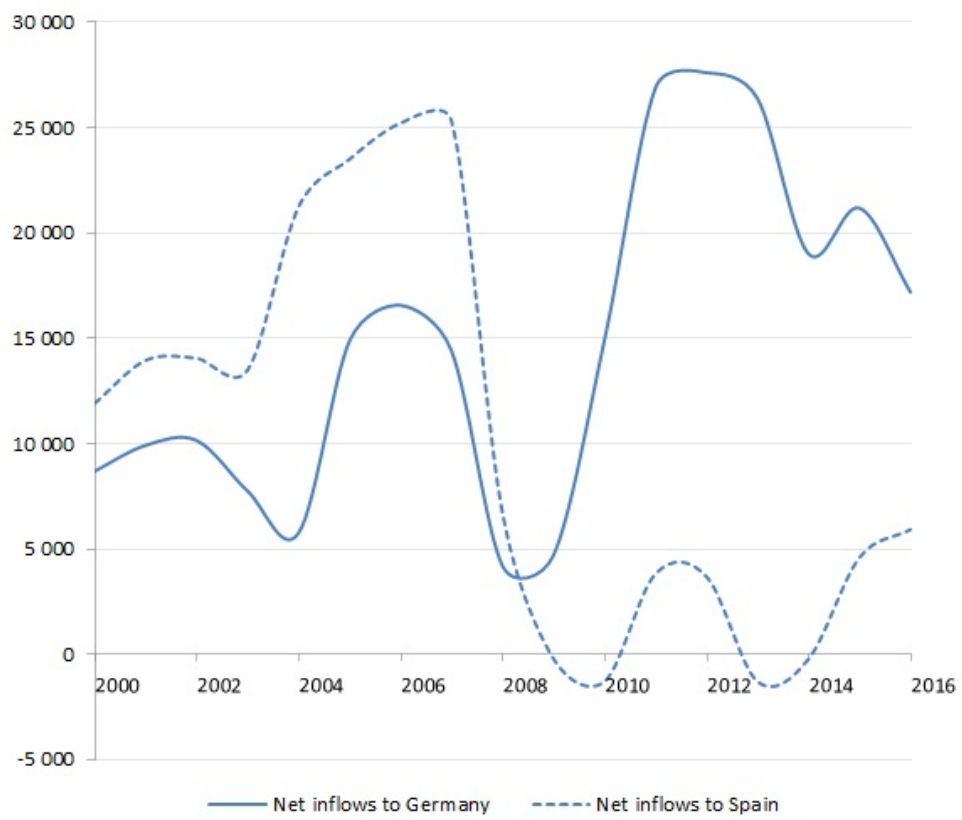
A1 Figures and Tables

Figure A1. Net inflows of nationals from Spain, Portugal, Ireland, Italy, Cyprus and Greece (in thousands)



Source: OECD migration database.

Figure A2. Net inflows of nationals from the rest of the Euro Area (in thousands)



Source: OECD migration database.

Table A1. Net inflows of Euro Area nationals to selected countries by year (in thousands)

From PIIGSC																			
Destination	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	Sum 2000-08	Sum 2010-16
Germany	-4.3	-9.0	-17.1	-19.6	-32.2	-19.1	-13.4	-10.1	-16.1	-14.1	5.0	31.5	57.5	65.7	52.4	46.1	31.1	-141.0	289.3
Spain	7.5	10.2	14.9	15.8	25.2	30.0	38.4	46.7	15.2	-2.8	-6.7	0.4	-0.6	-5.9	-2.3	7.7	11.3	204.0	3.8
Netherlands	3.2	2.4	1.5	0.7	0.0	0.2	0.1	1.7	3.9	3.4	3.4	4.4	5.3	5.3	4.9	5.6	6.7	13.6	35.6
Italy	1.8	0.0	1.8	1.8	1.9	1.6	1.5	2.3	2.1	1.8	1.9	2.2	2.5	2.2	1.9	2.1		14.9	12.9
From rest of EA																			
Destination	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	Sum 2000-08	Sum 2010-16
Germany	8.7	9.9	10.1	7.7	5.8	14.9	16.6	14.4	4.2	4.7	14.9	26.9	27.6	26.4	19.0	21.2	17.2	92.3	153.1
Spain	11.9	13.9	14.0	13.5	21.2	23.5	25.2	25.3	6.6	-0.3	-1.3	3.8	3.7	-1.3	-0.3	4.6	5.9	155.1	15.0
Netherlands	4.5	3.3	2.3	1.6	1.8	2.6	2.6	4.1	6.8	5.1	6.9	4.9	2.3	1.8	3.0	4.2	6.2	29.6	29.3
Italy	3.7		3.3	3.9	3.7	4.6	4.7	7.2	5.3	3.9	3.5	3.0	2.7	2.2	1.7	1.9		36.3	15.1
From all EA																			
Destination	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	Sum 2000-08	Sum 2010-16
Germany	4.4	0.9	-7.0	-11.9	-26.4	-4.2	3.1	4.2	-11.9	-9.4	19.9	58.3	85.1	92.1	71.4	67.3	48.3	-48.7	442.3
Spain	19.4	24.2	28.9	29.3	46.4	53.5	63.6	72.0	21.9	-3.0	-8.0	4.2	3.0	-7.2	-2.6	12.2	17.1	359.1	18.8
Netherlands	7.6	5.7	3.8	2.4	1.8	2.8	2.7	5.7	10.8	8.5	10.3	9.2	7.6	7.1	7.9	9.9	12.9	43.2	64.9
Italy	5.5		5.1	5.7	5.5	6.2	6.2	9.5	7.4	5.7	5.4	5.3	5.2	4.4	3.6	4.0		51.2	28.0

Notes: PIIGSC are Portugal, Italy, Ireland, Greece, Spain and Cyprus. Source OECD migration database

Table A2. Migrations and wage variations in Europe (balanced panel)

Specification Dep. Variable	Baseline			Schengen ² interaction			EA ² interaction		
	Inflows	Outflows		Inflows	Outflows		Inflows	Outflows	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Δ Wage	0.046*** (0.014)	0.006 (0.009)	-0.002 (0.004)						
Δ Wage x (Inter = 0)				0.020 (0.020)	-0.012 (0.021)	0.002 (0.008)	0.034** (0.016)	0.004 (0.015)	-0.002 (0.005)
Δ Wage x (Inter = 1)				0.055*** (0.013)	0.011 (0.009)	-0.003 (0.005)	0.053*** (0.014)	0.008 (0.009)	-0.003 (0.007)
EU (1/0)			0.062 (0.090)			0.065 (0.090)			0.065 (0.091)
Schengen (1/0)			0.060 (0.052)			0.042 (0.057)			0.092* (0.054)
Log of pop	-2.532 (1.576)	19.318*** (1.921)	-1.621** (0.755)	-2.522 (1.570)	19.304*** (1.926)	-1.567** (0.763)	-2.561 (1.579)	19.361*** (1.919)	-1.627** (0.754)
Inflation	0.238*** (0.043)	-0.155*** (0.040)	0.021 (0.013)	0.237*** (0.043)	-0.155*** (0.040)	0.022* (0.013)	0.235*** (0.043)	-0.155*** (0.040)	0.023* (0.012)
EA (1/0)							-1.006*** (0.124)	-0.834*** (0.246)	0.575*** (0.111)
EA ² (1/0)							-0.012 (0.092)	0.446*** (0.126)	-0.663*** (0.104)
Fixed effects :									
Origin-destination	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Origin-year	Yes	Yes		Yes	Yes		Yes	Yes	
Destination-year			Yes			Yes			Yes
Observations	1008	1008	1008	1008	1008	1008	1008	1008	1008
Adj. R ²	0.976	0.982	0.988	0.976	0.982	0.988	0.976	0.982	0.988

Note: Dependent variables are inflows or outflows defined at year-destination-origin(nationality) level. There two types of specification : one with origin-year FE (columns 1, 2, 4, 5, 7, and 8) and one with destination-year FE (columns 3, 6 and 9). In the first case, the independent variables control for the destination country. In the other case, they concern the origin country. Standard errors (in parentheses) are adjusted for clustering by year and country of destination when there are origin-year fixed effects and by year and country of origin when the specification comprises destination-year fixed effects. ***, **, * significantly different from 0 at the 1%, 5%, and 10% levels respectively.

Figure A3. Population variation with low migration cost

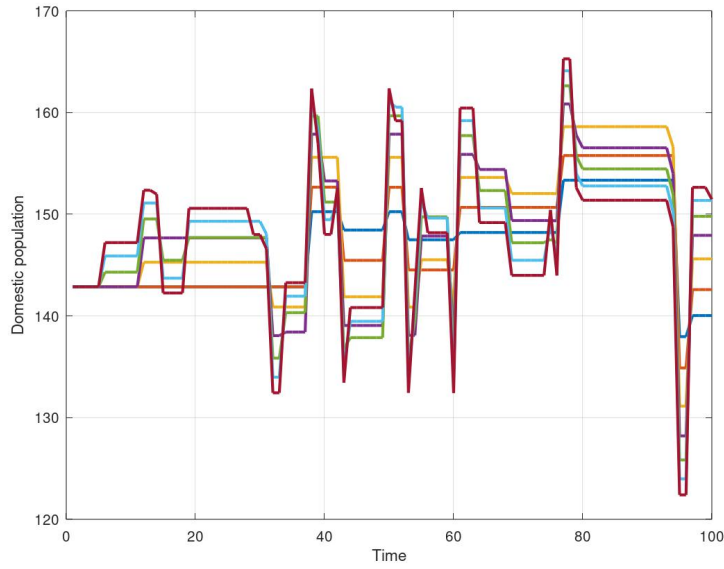
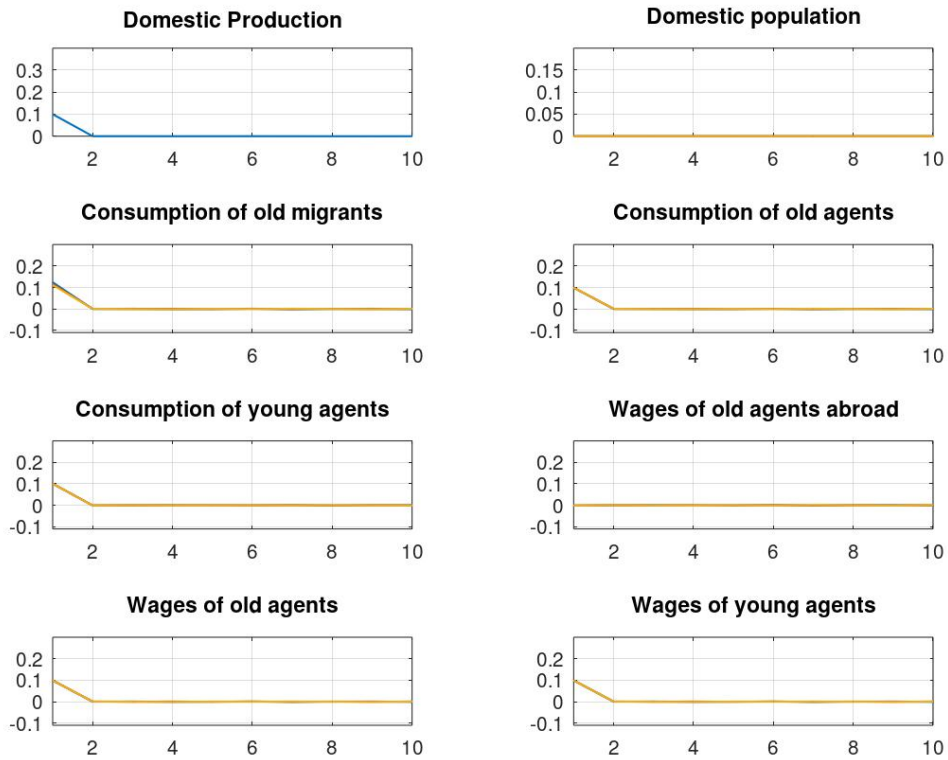


Figure A4. Impulse response functions for a 1 standard deviation productivity shock



Note: Only the lowest (in blue), medium (in red) and highest (in orange) skill types populations are represented.

A2 Mathematical Appendix

A2.1 Alternative Utility Function : Cobb-Douglas

We suppose here a Cobb-Douglas utility function :

$$U(c_{j,t}^i) = (c_{j,t}^i)^\alpha \quad (3.5)$$

Hence Euler equation 1.7 becomes :

$$\frac{(w_{1,t}^i)^\alpha}{(1 - e_{1,t})^{1-\alpha}} = \beta E_{1,t} \left[\frac{w_{2,t+1}^{i'}}{(w_{2,t+1}^i)^{1-\alpha}} \right] \quad (3.6)$$

We know this expression has a solution if $w_{2,t+1}^{i''} \leq 0$. With the wage function defined in equation 1.13, the productivity shocks appears in the education effort's decision :

$$\frac{(A_t h_{1,t}^i)^\alpha}{(1 - e_{1,t})^{1-\alpha}} = \beta E_{1,t} \left[\frac{A_{t+1} h_{2,t+1}^{i'}}{(A_{t+1} h_{2,t+1}^i)^{1-\alpha}} \right] \quad (3.7)$$

It can be shown that the consumer i will choose :

$$e_{1,t}^i = \frac{W - Z (1 - \delta) h_{2,t}^i}{W + \gamma^i} \quad \text{with } W = [\beta \gamma E((A_{t+1}^\alpha))]^{\frac{1}{1-\alpha}} \quad \text{and } Z = [A_t h_{1,t}^i]^{\frac{\alpha}{1-\alpha}} \quad (3.8)$$

This result is analogous to equation 1.20 with the log utility function. The productivity shocks of both periods enter the education effort choice. Here, with a higher productivity in the first period the revenue effect is greater than the substitution effect as :

$$\frac{\partial e_{1,t}^i}{\partial A_t} > 0 \quad \text{and} \quad \frac{\partial^2 e_{1,t}^i}{\partial (A_t)^2} < 0 \quad (3.9)$$

Proposition 5 is also still valid for given first period shock, as the return of education is greater when the agent migrates than we when staying home, due to the migration cost.

A2.2 Alternative Production Function : Cobb-Douglas

We suppose that equation 1.9 takes the shape of a Cobb-Douglas function:

$$Y_t = A_t \prod_{j=1}^2 \prod_{i=1}^N (l_{j,t}^i h_{j,t}^i)^\alpha \quad (3.10)$$

Maximization of the profit gives the equality between individual wage and marginal productivity :

$$\forall i, j \quad w_{j,t}^i = \alpha Y_t (l_{j,t}^i)^{-1} \quad (3.11)$$

Hence the relative wage with respect to agent i' is :

$$\frac{w_{j,t}^i}{w_{j,t}^{i'}} = \frac{l_{j,t}^{i'}}{l_{j,t}^i} \quad (3.12)$$

This expression can be plugged back in equation 3.11 for each agent i' to give the wage equation of the agent :

$$\forall i, j \quad w_{j,t}^i = \left[\alpha \frac{A_t}{\prod_{i=1; i \neq i'}^N w_{j,t}^{i'}} (l_{j,t}^i)^{\alpha N - 1} (h_{j,t}^i)^\alpha \right]^{1 - \alpha(N-1)} \quad (3.13)$$

Substituting equation 3.13 back inside it to have the expression cleared of other agents' wages would show that $A_t^{\frac{\alpha(N-1)}{1-\alpha(N-1)}}$ remains in the wage. Migration should therefore exist with a Cobb-Douglas production function.

A2.3 Alternative Production Function : Constant Elasticity of Substitution

We suppose that equation 1.9 takes the shape of a CES function:

$$Y_t = A_t \left(\sum_{j=1}^2 \sum_{i=1}^N (l_{j,t}^i h_{j,t}^i)^{\frac{\eta-1}{\eta}} \right) \quad (3.14)$$

Maximization of the profit gives the equality between individual wage and marginal productivity :

$$\forall i, j \quad w_{j,t}^i = (A_t)^{\frac{\eta-1}{\eta}} (Y_t)^{\frac{1}{\eta}} (l_{j,t}^i)^{\frac{-1}{\eta}} (h_{j,t}^i)^{\frac{\eta-1}{\eta}} \quad (3.15)$$

Hence the relative wage with respect to agent i' is :

$$\frac{w_{j,t}^i}{w_{j,t}^{i'}} = \left(\frac{l_{j,t}^{i'}}{l_{j,t}^i} \right)^{\frac{1}{\eta}} \left(\frac{h_{j,t}^{i'}}{h_{j,t}^i} \right)^{\frac{1-\eta}{\eta}} \quad (3.16)$$

Relative skills is the only determinant of wage differentials for agents of the second-period. From the budget constraint $Z = \sum_{j=1}^2 \sum_{i=1}^N l_{j,t}^i w_{j,t}^i$, we can write that :

$$\forall i, j \quad l_{j,t}^i = \frac{Z (h_{j,t}^i)^{\eta-1} (w_{j,t}^i)^{-\eta}}{\sum_{j=1}^2 \sum_{i'=1}^N \left(\frac{w_{j,t}^{i'}}{h_{j,t}^{i'}} \right)^{1-\eta}} \quad (3.17)$$

By substituting it back in equation 3.14, we obtain the natural wage index :

$$W_t = \frac{1}{A_t} \left(\sum_{j=1}^2 \sum_{i'=1}^N \left(\frac{w_{j,t}^{i'}}{h_{j,t}^{i'}} \right)^{1-\eta} \right)^{\frac{1}{1-\eta}} \quad (3.18)$$

Now, using equation 3.16 with Z , and using that $Z = WY$ we can rewrite the labour demand :

$$\forall i, j \quad l_{j,t}^i = \frac{Y}{A_t^{1-\eta}} \left(\frac{w_{j,t}^i}{W_t} \right)^{-\eta} (h_{j,t}^i)^{\eta-1} \quad (3.19)$$

Replacing the natural wage index with its expression in 3.18 would show that A_t disappears from the labour demand of agent i and hence its wage. There would not be any migration in our framework using a CES production function.

A2.4 Probability to Migrate and the Education Decision

The ex-ante probability to migrate can be rewritten as a function of relative productivity, the human capital level of the agent and the mass of agents in the skill group by inserting the wage equation 1.40. As the wage is influenced by $N_{j,t+1}^k$ and $N_{j,t+1}^{k*}$, we make the assumption that agents consider the population of both countries to be identical and not time specific.⁵⁵

$$P \left[(A_{t+1}^* - A_{t+1}) h_{2,t+1}^i (e_{1,t}^i) N_j^k > c \right] = 1 - P \left[\Delta A_{t+1} h_{2,t+1}^i (e_{1,t}^i) N_j^k < c \right] \quad (3.20)$$

where $\Delta A_{t+1} = A_{t+1}^* - A_{t+1}$ is the productivity gap between the two coun-

tries. As this probability is specific to each agent, the only stochastic element is the productivity gap ΔA_{t+1} . Therefore we can express the ex-ante probability to migrate as a cumulative distribution function :

$$P_{t+1}^{i,migr} = 1 - F_{X^i}(c) \quad \text{with} \quad X^i = \Delta A_{t+1} h_{2,t+1}^i (e_{1,t}^i) N_{j,t+1}^k \quad (3.21)$$

X^i corresponds to the raw gain from migration for a given individual i with

human capital level $h_{2,t+1}^i$ when a random productivity gap ΔA occurs. We can define the derivative of this probability with respect to the individual decision, which is positive :⁵⁶

$$P_{t+1}^{i,migr'} = -P_{t+1}^{i,stay'} = -\frac{\partial(1 - P_{t+1}^{i,migr})}{\partial e_{1,t}^i} > 0 \quad (3.22)$$

The issue with that formulation reveals itself when looking at optimization

conditions. Assuming that $P_{t+1}^{i,migr}$ is a function of $e_{1,t}^i$ the FOC would be :

$$\begin{aligned} \frac{1}{1 - e_{1,t}^i} = & \beta P_{t+1}^{i,migr} E_1 \left[R_{2,t+1}^{i*} \right]_{Migr} + \beta (1 - P_{t+1}^{i,migr}) E_1 \left[R_{2,t+1}^i \right]_{Stay} \\ & + \beta P_{t+1}^{i,migr'} E_1 \left[U(c_{2,t+1}^{i*}) \right] - P_{t+1}^{i,migr'} E_1 \left[U(c_{2,t+1}^i) \right] \end{aligned} \quad (3.23)$$

⁵⁵This hypothesis is credible if migration flows are relatively small between countries. Small migration flows should not affect substantially the relative population of both countries over the long-run and agents would not consider that aspect while thinking about the probability of migrating in the future.

⁵⁶It can be shown, using the Leibniz Rule that $\frac{\partial(1 - P_{t+1}^{i,migr})}{\partial e_{1,t}^i} = f(h_{2,t+1}^i) \frac{\partial \frac{c}{h_{2,t+1}^i N_j^k}}{\partial e_{1,t}^i}$ with $f(\cdot)$ the density function of X^i . Hence the reverse sign for the derivative of $P_{t+1}^{i,migr}$.

With some simplifications and inserting equation 1.40, the right-hand side becomes :

$$P_{t+1}^{i,migr} E_1 \left[R_{2,t+1}^{i*} \right]_{Migr} + (1 - P_{t+1}^{i,migr}) E_1 \left[R_{2,t+1}^i \right]_{Stay} + P_{t+1}^{i,migr} E_1 \left[\ln \left(\frac{A_t^*}{A_t} - \frac{c}{w_{2,t+1}^i} \right) \right] \quad (3.24)$$

The last term of the previous expression is problematic : as $A_t, A_t^* \sim \mathcal{N}(1, \sigma_A^2)$,

the ratio of those random variables would not have any moment and it could be associated to a normal distribution only through approximation (Díaz-Francés and Rubio, 2013). To avoid issues on the convexity of our problem, we assume the ex-ante probability to migrate is exogenous to the agent.

A2.5 Solving the Stationary General Equilibrium in Open Economy : Additional Hypothesis

In order to simplify further the consumer's decision we make additional assumptions :

- (i) the productivity A in each country can only take two value with equal probability : a low productivity \underline{A} or a high productivity \bar{A} .
- (ii) there is only one agent of each skill type : $N_j^k = 1$

These hypotheses allows should ensure the convexity of the problem and remove the issue related to the expectation operator since only two cases remain. Hence, equation 1.51 can be rewritten as to make apparent the probability of the productivity being higher in the domestic or in the foreign country :

$$E_{1,t} [TR_2^i] = P(\Delta A < 0) E_1 [R_2^i]_{\Delta A < 0} + P(\Delta A > 0) \left\{ E_1 [R_2^{i,*}]_{Migrate} P^{i,migr} + E_1 [R_2^i]_{Stay} (1 - P^{i,migr}) \right\}_{\Delta A > 0} \quad (3.25)$$

Considering that productivity distributions are identical in both countries and hypothesis (ii), we deduce that $P(\Delta A < 0) = P(\Delta A > 0) = \frac{1}{2}$. Hence the equation to solve is :

$$\frac{1}{1 - e_1} = \beta \frac{1}{2} \left[R_2^i + R_2^{i,*} P_{migr}^i + R_2^i (1 - P_{migr}^i) \right] \quad (3.26)$$

$$\text{with } R_2^i = \frac{h_2^{i'}}{h_2^i} \text{ and } R_2^{i,*} = \frac{\bar{A} h_2^{i'}}{\bar{A} h_2^i - c} \quad (3.27)$$

In order to be faster in the resolution, we use equation 1.3 to deduce that at the steady-state $h_2^{i,SS} = \frac{\gamma^i}{\delta} e^{i,SS}$. We can then find that the previous expression corresponds to the following polynomial of order 2 :

$$0 = A \left(e^{i,SS} \right)^2 + B e^{i,SS} + C \quad \text{with } A = \beta \bar{A} \gamma + \bar{A} \frac{\gamma}{\delta} \\ \text{with } B = \beta \left[\frac{1}{2} P_{migr}^i \delta c - \bar{A} \gamma - c \right] - c \quad (3.28) \\ \text{with } C = \beta \left[c - \frac{1}{2} P_{migr}^i \delta c \right]$$

This expression can be solved using the determinant method but it is unfortunately completely unclear what would be its sign.

Appendix B

B1 Global value chain decomposition

For the computation of exports in several components, we use the decomposition of Wang, Wei, and Zhu, 2013, which proposes a framework in country-sector level. The following decomposition is equal to equation 22 in Wang, Wei, and Zhu, 2013 work. The exports of country k in sector l are decomposed in 16 components as follows:

$$\begin{aligned}
E^{kl} &= (V^k B^{kk})^T * F^{kl} + (V^k L^{kk})^T * (A^{kl} B^{ll} F^{ll}) \\
&+ (V^k L^{kk})^T * (A^{kl} \sum_{t \neq k, l}^G B^{lt} F^{tt}) + (V^k L^{kk})^T (A^{kl} B^{ll} \sum_{t \neq k, l}^G F^{lt}) \\
&+ (V^k L^{kk})^T * (A^{kl} \sum_{t \neq k, l}^G \sum_{u \neq k, t}^G B^{lt} F^{tu}) + (V^k L^{kk})^T (A^{kl} B^{ll} F^{lk}) \\
&+ (V^k L^{kk})^T * (A^{kl} \sum_{t \neq k, l}^G B^{lt} F^{tk}) + (V^k L^{kk})^T (A^{kl} B^{lk} F^{kk}) \\
&+ (V^k L^{kk})^T * (A^{kl} \sum_{t \neq k, l}^G B^{lt} F^{tk}) + (V^k B^{kk} - V^k L^{kk})^T * (A^{kl} X^l) \\
&+ (V^l B^{lk})^T * F^{kl} + (V^l B^{lk})^T * (A^{kl} L^{ll} F^{ll}) + (V^l B^{lk})^T \\
&\quad + (A^{kl} L^{ll} E^{l*}) + (\sum_{t \neq k, l}^G V^t B^{tk})^T * F^{kl} \\
&+ (\sum_{t \neq k, l}^G V^t B^{tk})^T * (A^{kl} L^{ll} F^{ll}) + (\sum_{t \neq k, l}^G V^t B^{tk})^T * A^{kl} L^{ll} E^{l*}
\end{aligned} \tag{3.29}$$

The first terms correspond to the domestic value added in final goods' and intermediate exports. The rest of components correspond to domestic value added re-exported to third countries as intermediate or final use, foreign value added in exports, domestic value added returning home and double counting components. The decomposition has been computed using the algorithm in R provided by Quast and Kummritz, 2015. Through this decomposition, we are able to look at exported domestic value added in intermediate goods' exports.

B2 Figures and Tables

Table B1. Block of countries included in the sample

Country block	Countries from WIOD
EU15	EU11, Germany, Italy, Finland, Sweden.
NMS10	Cyprus, Czech Republic, Estonia, Hungary, Latvia, Lithuania, Malte, Poland, Slovakia, Slovenia.
NMS3	Romania, Bulgaria, Croatia
Other Europe	Russia, Turkey, Switzerland, Norway
East Asia	China, Japon, Taiwan.
South & South-East Asia	Korea, Indonesia, India.
North America & Australia	USA, Canada, Australia.
Latin America	Mexico, Brazil.
Rest of the World	North Africa, Other Africa, Near & Middle East.
Destination countries (EU11)	Austria, Belgium, Denmark, Spain, France, Great Britain, Greece, Ireland, Luxembourg, Netherland, Portugal.

Notes: The rest of the World in the WIOD is defined as all the rest of the countries apart those represented in the WIOD. In the LFS, we define the rest of the world as an agglomeration of data from North and other Africa, Near middle east.

Table B2. Industries included in the sample

Industry code	Industry description
AB	Agriculture, hunting and forestry ,Fishing.
C	Mining and quarrying.
D	Manufacturing.
E	Electricity, gas and water supply.
F	Construction.
G	Wholesale and retail trade; repair of motor vehicles, motorcycles and personal and household goods.
H	Hotels and restaurants.
IK	Transport, storage and communication; Real estate, renting and business activities.
J	Financial intermediation.
L	Public administration and defence; compulsory social security.
M	Education.
N	Health and social work.
O	Other community, social and personal service activities.

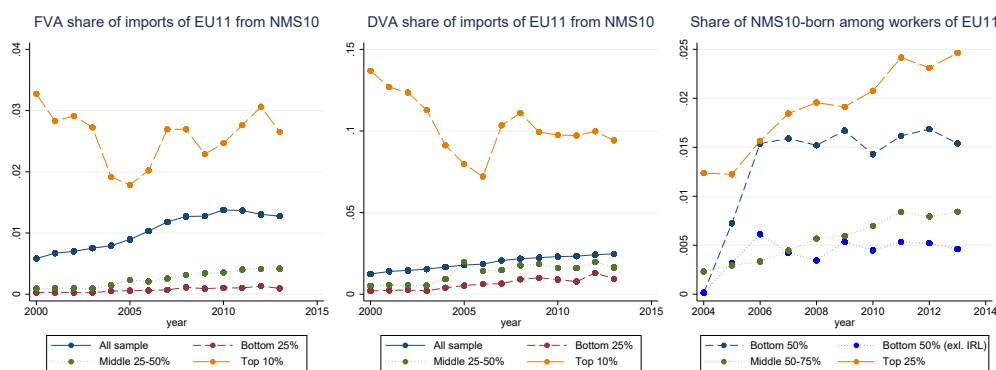
Notes : This classification is based on the need to establish a correspondance between NACE Rev1, used until 2008, and NACE Rev2 at the 1-digit level. The number of 2-digits lines that moved from a 1-digit line to another is quite limited, except in the case of telecommunication and business activites. Therefore this two industries had to be merged to avoid discrepancy over time.

Table B3. Sample descriptive statistics

Variable	Mean	Sd	Min	Max
NMS-10 and NMS-3 sample				
DVA imports (in log)	2,4	2,9	-7,9	9
$Lib_{ijt}(1/0)$	0,4	0,5	0	1
$Migrant_{ijst} : \text{All}$	0,8	1,6	0	18,5
$Migrant_{ijst} : \text{H}$	0,4	0,9	0	18,7
$Migrant_{ijst} : \text{M}$	0,4	1,3	0	26,6
$Migrant_{ijst} : \text{L}$	1,2	3,1	0	61,9
All origins				
DVA imports (in log)	3,2	3,6	-19,9	11,8
$Lib_{ijt}(1/0)$	0,1	0,3	0	1
$Migrant_{ijst} : \text{All}$	1,6	4,7	0	100
$Migrant_{ijst} : \text{H}$	1,4	4,5	0	100
$Migrant_{ijst} : \text{M}$	1,1	3,3	0	63,6
$Migrant_{ijst} : \text{L}$	1,9	5,7	0	100

Notes: Authors' computation from WIOD and EU-LFS data

Figure B1. Global value chain's participation and NMS-10 migrant's distribution



Notes: Authors' computation from WIOD and EU-LFS data.

Table B4. Predicted variation in imported DVA in inputs from NMS-10 due to labour market openings (in millions of \$)

Country	Total variation	Yearly variation
Austria	-341.37	-170.68
Belgium	-195.63	-48.90
Denmark	-119.58	-29.89
Spain	-15.27	-2.18
France	34.56	6.91
Great-Britain	-1894.76	-210.52
Greece	2.50	0.35
Ireland	-612.39	-68.04
Luxembourg	-22.08	-3.68
Netherlands	-207.07	-34.51
Portugal	-1.13	-0.16
EU-11	-3372.25	-

Notes: The yearly variation is base on a different number of years for each country. Hence, it cannot be computed at the aggregate EU-11 level.

Table B5. Number of observations per country

Country	All workers	Eastern Europeans	Share of EEC workers	
			in nb of obs	using weights
Austria	837,512	20,975	2.50	3.33
Belgium	399,275	3,745	0.94	0.89
Denmark	488,909	2,351	0.48	0.72
Spain	636,604	5,223	0.82	2.00
France	1,495,207	4,570	0.31	0.31
Great-Britain	507,790	8,544	1.68	2.03
Greece	957,513	9,580	1.00	1.09
Ireland	848,549	43,552	5.13	5.92
Luxembourg	126,889	971	0.77	1.07
Netherlands	731,379	2,132	0.29	0.51
Portugal	659,646	1,511	0.23	0.23
Total	7,689,273	103,154	1.34	1.40

Notes: Information from Labor Force Survey database.

Appendix C

C1 Tables

Table C1. Eastern European Countries' share of total imports originating from non-EU 15 countries. Years 1997, 2014 and percentage change

Country	Import Share 1997 (in %)	Import Share 2014 (in %)	% Change
Bulgaria	65	60	-8
Czech Republic	39	53	35
Estonia	42	60	43
Hungary	39	50	29
Lithuania	55	65	16
Latvia	55	67	23
Poland	39	51	32
Romania	48	50	3
Slovakia	58	66	14

Source: Authors' calculation on BACI (CEPII) data.

Table C2. Baseline Results using the SES 2010

Dep. Variable	Wages		Night-Weekend-Shift Work	
	(1)	(2)	(3)	(4)
RTR_{rc}	-0.005** (0.002)	-0.011*** (0.001)	0.002*** (0.000)	0.003*** (0.001)
LMI_c	-1.273 (0.855)	-1.566*** (0.274)	1.636*** (0.211)	1.686*** (0.265)
$RTR_{rc} \times LMI_c$		-0.119*** (0.016)		0.020 (0.013)
Large firm	0.258*** (0.016)	0.255*** (0.016)	0.133*** (0.024)	0.134*** (0.024)
Temporary	-0.120*** (0.019)	-0.125*** (0.018)	0.003 (0.009)	0.004 (0.009)
Women	-0.168*** (0.015)	-0.167*** (0.015)	-0.044*** (0.010)	-0.044*** (0.010)
Δ_{97-10} Productivity	Yes	Yes	Yes	Yes
Δ_{97-10} Net migration	Yes	Yes	Yes	Yes
Δ_{97-10} Capital flows	Yes	Yes	Yes	Yes
Δ_{97-10} CPI index	Yes	Yes	Yes	Yes
Education x Age	Yes	Yes	Yes	Yes
Occupation	Yes	Yes	Yes	Yes
Sector	Yes	Yes	Yes	Yes
Job Spell	Yes	Yes	Yes	Yes
Observations	2,647,554	2,647,554	2,647,554	2,647,554
Adj. R^2	0.614	0.622	0.411	0.411
Countries	9	9	9	9
Regions	20	20	20	20

Note: Dependent variable is the log (hourly) wages and dummy variable equal to 1 if the individual works in shift, during weekend or at night in 2010. RTR_{rc} is the change in the weighted regional tariffs between 1997 and 2010. LMI_c is the change in the percentage of unionized workers between 1998 and 2010. Standard errors adjusted for clustering by NUTS regions and country are in parentheses. ***, **, * significantly different from 0 at the 1%, 5%, and 10% levels respectively.

Table C3. Results on Overtime Hours

Dep. Variable	Overtime Work		Overtime as Share of Hours Worked	
	(1)	(2)	(3)	(4)
RTR_{rc}	0.000 (0.000)	0.005*** (0.001)	0.000 (0.001)	-0.019*** (0.005)
LMI_c	0.442*** (0.137)	0.992*** (0.218)	-1.220** (0.523)	-1.476*** (0.249)
$RTR_{rc} \times LMI_c$		0.063*** (0.018)		-0.224*** (0.058)
Large firm	0.091*** (0.007)	0.087*** (0.007)	-0.002 (0.018)	0.008 (0.015)
Temporary	0.011* (0.005)	0.009 (0.005)	0.030* (0.015)	0.031** (0.015)
Women	-0.046*** (0.008)	-0.046*** (0.008)	-0.177*** (0.029)	-0.176*** (0.029)
Δ_{97-14} Productivity	Yes	Yes	Yes	Yes
Δ_{97-14} Net migration	Yes	Yes	Yes	Yes
Δ_{97-14} Capital flows	Yes	Yes	Yes	Yes
Δ_{97-14} CPI index	Yes	Yes	Yes	Yes
Education x Age	Yes	Yes	Yes	Yes
Occupation	Yes	Yes	Yes	Yes
Sector	Yes	Yes	Yes	Yes
Job Spell	Yes	Yes	Yes	Yes
Observations	2,765,815	2,765,815	797,987	797,987
Adj. R^2	0.228	0.229	0.0570	0.0578
Countries	9	9	9	9
Regions	20	20	20	20

Note: Dependent variable is a dummy variable equal to 1 if the individual works overtime and the share of overtime hours over all hours worked in 2014. The number of observation is reduced with the second dependent variable as only individuals working overtime are considered. RTR_{rc} is the change in regional tariffs between 1997 and 2014. LMI_c is the change in the percentage of unionized workers between 1998 and 2014. Standard errors adjusted for clustering by NUTS regions and country are in parentheses. ***, **, * significantly different from 0 at the 1%, 5%, and 10% levels respectively.

C2 Data Construction

C2.1 Construction of the tariff liberalization variable

Following Dix-Carneiro and Kovak, 2017, we build the tariff liberalization variable of each region by combining countries' industry-level tariffs and region-industry weights β_{rck} :

$$RTR_{rc} = - \sum_k \beta_{rck} \Delta \ln(1 + \tau_{ck}) \quad \text{with} \quad \beta_{rck} = \frac{\lambda_{rck} \frac{1}{\phi_{ck}}}{\sum_{k'} \lambda_{rck'} \frac{1}{\phi_{ck'}}} \quad (3.30)$$

The cost share of non-labor factors ϕ_{ck} and tariffs changes τ_{ck} are at the sector-country level.⁵⁷ In contrast, the labor shares λ_{rck} are at the sector-region level and obtained from two different sources. For most countries and regions, we can extract that information from the 2002 wave of the Structure of Earnings Survey.⁵⁸ For Poland and Bulgaria, information on the region where the surveyed individuals live had been removed by national authorities in 2002 due to anonymization reasons. We were able to retrieve indication on Polish Voivodeships and Bulgaria NUTS-1 regions in the local unit and employee identifiers of the survey.⁵⁹ For Hungary and Romania, regional information is not available in 2002 SES. Instead, we use the regional level Structural Business Survey of 2001 and 2002, respectively.

The sector classification in the SES data (Eurostat) is a decomposition made by Eurostat to harmonize SES data for different countries. It is slightly more aggregated than the 2-digit level NACE Rev. 1.

We obtain our tariff liberalization variable expressed in percentage points.⁶⁰ Finally, we standardize that variable to be between 0 (lowest value) and 100 (highest value). The final regional tariff liberalization variable exists for 20 regions spanning 9 countries.

As a robustness check, we use a country-level tariff liberalization variable. The only difference is that the labor share is at country-level and is obtained for all countries from the SES 2002.

C2.2 Construction of cost share of non-labor factors of production

In Dix-Carneiro and Kovak, 2019, the cost-share of non-labor factors ϕ_{ck} is computed using the beginning of period gross operating surplus and total remuneration. For each sector k :

⁵⁷See sections C2.2 and C2.3 for additional details on their construction.

⁵⁸The Czech Republic, Estonia, Latvia, Lithuania and Slovakia do not have any NUTS 1-digit regional decomposition. Therefore their tariff liberalization is at the country-level. We have 6 regions in Poland, 4 in Romania, 3 in Hungary and 2 in Bulgaria.

⁵⁹For Bulgaria in both 2002 and 2014 SES, about 5% of the observations are dropped as we cannot allocate them to a region.

⁶⁰Only Estonia has a negative value for the tariff liberalization variable. It is the only country that had to increase its MFN tariffs when joining the EU.

$$\phi_{ck} = \frac{gos_{ck}}{gos_{ck} + rem_{ck}} \quad (3.31)$$

with gos_{ck} the gross operating surplus of sector k in country c and rem_{ck} the total amount of remuneration payed in the same sector.⁶¹ Associated with the labor share λ_{rck} , it allows to account for the importance of the labor factor in the production function of each sector k .

We obtain the two components of ϕ_{ck} from Eurostat's Structural Business Survey (SBS). Optimally, we would only use 2002 data, to match the year of the labor share. However, at the 2-digit level they are several missing values for 2002 and surrounding years. Therefore, we compute an average of gos_{ck} and rem_{ck} over the 2000-2003 period, for each 2-digits NACE Rev. 1 sector. Then we aggregate the 2-digit sectors averages to match the ad-hoc classification used in the SES.⁶² Finally we compute ϕ_{ck} as in equation 3.31.

C2.3 Construction of tariff changes

The main component of the tariff liberalization variable is the sectoral change in applied MFN tariff from 1997 to 2014. We choose 1997 as base year for two reasons. First, it helps to avoid any anticipation effect of trade to the perspective of the European integration of Eastern Europe. Second, the product-level WTO data we use to construct tariff changes is limited for the years before 1997.⁶³

Sector level tariffs are a weighted sum of all product line belonging to the same sector. Weights ω_{ocpk}^{1997} correspond to the share of product p originating from country o in the total imports of a given sector k in a given country c in 1997.

$$\tau_{ck} = \sum_p \sum_o \omega_{ocpk}^{1997} \tau_{ocpk} \quad \text{with} \quad \omega_{ocpk}^{1997} = \frac{Imp_{ocpk}^{1997}}{\sum_{p'} \sum_{o'} Imp_{ocpk}^{1997}} \quad (3.32)$$

We keep the weighting scheme of 1997 to build 2014 sector level tariffs. Keeping the weights constant removes the issue of trade being endogenous to tariffs reduction. Imports flows are taken from the BACI database. For the post-accession year 2014, although formally higher than zero, we set the MFN applied towards EU partners to zero and took the weighted average rate across EU end non-EU partners (with import share in 1997 used as a weight). It allows to account for the huge tariff liberalization implied by the zeroing of tariffs towards EU-partners after the accession to the common EU market. Ignoring this aspect of the heterogeneity in the drop in tariff would

⁶¹An alternative measure could use the wage-bill of the sector instead of the remunerations, but we try to be as close to possible to Dix-Carneiro and Kovak, 2019 who used "Remuneracoes" from Brazilian data sources.

⁶²For Slovakia and Latvia, missing data forces us to use an even slightly more aggregated sectoral classification.

⁶³For Slovakia and Romania we use respectively 1998 and 1999 due to a lack of information before.

understate the extent of the liberalization. Once we have the sectoral level tariffs, we compute the log-difference by sector and country between 1997 and 2014.

Going from product level data in 1997 and 2014 to a change in sectoral tariffs involves several steps of aggregations. First, we use two different WTO files for the year 1997 and 2014. The former is at the HS 6-digit level while the later is at the 8-digit level. Among all 8-digit lines present in a 6-digit line, we only keep the one with the highest tariff rate.⁶⁴ Second, the HS classification used in the 1997 and 2014 WTO files and in BACI are not the same (resp. HS96, HS2012 and HS92). Therefore, we harmonize by converting everything to HS96. Only 7 product lines from are lost at this occasion, amounting to 0.01% of BACI observations at this point. We lose an additional 0.14% of BACI observations when merging with tariffs, due to lines for which we do not have assorted tariffs. Third, to allocate each product line to a sector, we use a conversion table from HS96 to ISIC Rev. 3 classification.⁶⁵ No observation is lost in that process. Finally, we need to have the exact same sectors as for the other components of the tariff liberalization variable.⁶⁶

⁶⁴The year 2011 being present in both dataset, we use it as a point of comparison to choose the adequate method of aggregation. Ultimately, the average difference between our reconstructed tariffs and the original 6-digit tariffs is only 0.05% for all products and 0.005% for non-agricultural products in 2011.

⁶⁵ISIC Rev. 3 is the UN equivalent to the NACE rev1 classification. They are are full comparable at the 2-digits level.

⁶⁶We use a slightly different decomposition for Slovakia and Latvia. See section C2.2.

Appendix D

“Trade Liberalization, Wages and Working Conditions” Supplementary Material not for Publication

D1 Data Construction

D1.1 Overview of Variables

Dependent variables :

- Log of hourly wage : average gross hourly earnings in the reference month. It is expressed in € and contains the wage of both regular and overtime hours. Source : SES.
- Night-Weekend-Shift work : a dummy equal to 1 if the worker received premium payments during the reference month for shift work, night work or weekend work where these are not treated as overtime. Source : SES.
- Overtime hours : a dummy equal to 1 if the observation worked overtime during the reference month. Source : SES.
- Overtime hours as a share of total hours : the number of overtime hours divided by the total number of hours worked during the reference month. Source : SES.

Explanatory variables :

- Tariff liberalization : we follow Dix-Carneiro and Kovak, 2017 to compute a regional level and a country-level index of tariff liberalization between 1997 and 2014. It combines data from the WTO for the product tariffs, BACI to allocate weights to tariffs lines, Eurostat’s Structural Business Survey for the computation of the cost-share of non-labor factors and the share of workers by industry for Romania and Hungary and the SES for the share of workers by industry for the rest of the sample. Details on the construction of each part is available in Section C2.
- Union density : it is expressed as the change in the share of unionized workers between 1998 and 2014. As it negative for all countries of the

sample, we change its sign such it represents union erosion. For Lithuania we use 1999 instead of 1998 and for Romania 2012 instead of 2014. The main data source is the ICTWSS database. For Latvia, we use national data for the number of unionized workers in 1998.

- A note on centering : the tariff liberalization and union density variables are both centered on their baseline sample mean. This allows to express the effect as average sample effect when introducing the interaction term. For all specification on sub-samples, the mean used to center is the same as in the baseline in order to facilitate comparison between coefficients. Using sample-specific means for those regression usually does not alter significantly the results.

SES controls :

- Size of the firm : dummy equal to 1 if the company of the local unit of the observation has more than 50 employees.
- Temporary contract : dummy equal 1 if the observation has a temporary work contract.
- Sex : dummy equal to 1 if the observation is a woman, 0 if a man.

Country-level controls :

- GDP/capita : the log-difference of GDP/capita between 1997 and 2014 serves to control for aggregate demand shocks. Source : WDI.
- Immigration rate : % of immigrants in the total population and is given for every 5-years. We compute its log-difference between 1997 and 2014 and use it as a control for migration shocks that could affect wages and labor supply. Source : UN.
- Exposure to multinationals : there are two possible variables to account for the importance of multinational firms in the country : net foreign property income / GDP . We use the log-difference from between 1997 and 2014 of that variables to control for a shock of multinational implantation in the country. This is particularly relevant for Eastern countries which become production hub in European value chains during the decade of their European integration. Source : Eurostat national accounts.
- CPI : log-difference of the consumer price index, between 1997 and 2014 controls for price evolution due to the fall in tariffs. Source : WDI.

Other SES variables used as fixed-effects or for extensions :

- Age : individuals are split in 3 categories : 20-29, 30-49 and 50-59. Individuals over 59 and under 20 are excluded altogether from the sample. It is used for the extensions of Section D2.3.
- Occupation : we use the occupations based on ISCO-08 at the 1-digit level as a fixed-effect. We aggregate in 3 groups when looking at the role of occupations.
- Job spell : 3 categories are used : workers in the company for less than year, in the company from 1 to 4 years and 5 years or more. It is used for the extensions of Section D2.3.
- Education : 4 categories based on the ISCED 2011 classification. It is used as fixed-effects and for the extensions of Section D2.3.
- Ownership : dummy equal to 1 if the company is publicly-owned. It is used for the regression by sample where we only keep workers from privately-owned companies.
- Sector : 14 categories based on NACE rev2 classification for the fixed-effects and 2 categories (manufacturing and mining and quarrying versus all other sectors) for the table presenting results by sector.
- Part-time or full-time : dummy equal to 1 if the observation works part-time (that is less than 100% of the full-time hours).

D1.2 Construction of the Union Density Variable

We measure union erosion with the change in union density, computed in the following way :

$$\Delta UD_c = - \left(\frac{Unionized_c^{2014}}{Workforce_c^{2014}} - \frac{Unionized_c^{1998}}{Workforce_c^{1998}} \right) \quad (3.33)$$

with $Unionized_c^t$ being the number of union members among employed workers in year t and $Workforce_c^t$ the total number of employed workers. As it negative for all countries of the sample, we change its sign. We use data from the ICTWSS dataset that does not provide data on a yearly basis. Therefore we use the most complete year as base, that is 1998, with a few exceptions: due to lack of data we use Latvian national data for the number of unionized workers in 1998 and we use 1999 as base year for Lithuania and 2012 as final year for Romania.

D1.3 Classifications used for education, sectors and occupations

This part presents the different classification used for sectors, education levels and occupations that we need to conduct our study. In the case of occupation, we had we keep the ISCO-08 classification used in the SES 2014 but

removed some specific occupation, as can be seen in Table D3. Another issue is that the SES data spans over a period of 12 years during which many international classifications were updated and transformed more or less substantially. In particular the NACE classification for sector was updated to its second revision (Rev. 2) in 2008 and the ISCED classification for education level was modified in 2011.⁶⁷ As Eurostat decided to keep a certain level of comparability between the different SES waves, they had to create their own versions of sectoral and educational classification. This is explained below in Table D1 for sectors in 2002 and Table D4 for education in 2014. On top of that, to ensure the anonymity of survey participants, Eurostat required some national agency to reduce the level of precision of sector data. A harmonization is therefore necessary and is presented below in Table D2.

Sectors

The aggregation of manufacturing sub-sectors is not the same for all countries in the SES or SBS data, hence two correspondences were designed. The first one to match sectors from SES 2002 with the SBS. It is used to construct the tariff liberalization variable and is presented in table D1. Only Slovakia and Latvia use a different classification due to the missing values in the Structural Business Survey.

Table D1. Sector correspondance between SBS and SES

Nace Rev1	Most countries	Slovakia and Latvia
15	DA	DA
16	DA	DA
17	17	17
18	18, 19	18, 19, DF to DH
19	18, 20	18, 19, DF to DH
20	20, 21	20, 21
21	20, 21	20, 21
22	22	22
23	DF to DH	18 19 DF to DH
24	DF to DH	18 19 DF to DH
25	DF to DH	18 19 DF to DH
26	DI	DI
27	DJ	DJ
28	DJ	DJ
29	DK	DK
30	30 to 32	30 to 32
31	30 to 32	30 to 32
32	30 to 32	30 to 32
33	33	33
34	DM	DM
35	DM	DM
36	DN	DN
37	DN	DN

The second correspondence only concerns the SES 2014, where the classification for sectors is not the same for all countries. The most common

⁶⁷The ISCO classification for occupation went from ISCO-88 to ISCO-08 in 2008 but this does not affect us.

classification is an intermediate between 1 and 2 digits of NACE Rev. 2. It was devised by Eurostat in order to ensure comparability of sectors over the different SES surveys : as they took place in 2002, 2006, 2010 and 2014, they encompass the change of NACE classification in 2008. The intermediate level of aggregation ensure sufficient comparability over the whole 2002-2014 period, even though this is not necessary in our study.

We need to harmonize the country-specific classifications in order to put sector fixed-effects in our regressions. Our correspondence, presented in table D2, results in 14 sectors.

Table D2. Sector harmonization in SES 2014

Industry codes	Composition
B	Mining and quarrying
Manufacturing :	
10 to 12	Food, beverages and tobacco
13 to 15	Textile, wearing apparel and leather
16 to 18, 58 to 60	Wood, paper and publishing and media activities
19 to 23, 26, 27, 29 to 33	Coke, chemicals, rubber, plastic, electronics and transport equipment
24, 25, 28	Metals and machinery
35, 36	Electricity, gas and water
F	Construction
45, 46	Wholesale and retail trade of motor vehicles
47	Other wholesale and retail trade
I	Hotels and restaurants
49 to 52	Transport and support activities
53, 61 to 66, 69 to 71, 78, 80 to 82	Telecommunication, ICT, financial services, other business activities
68, 72 to 74, 77, 95	Real estate, R&D, marketing

Occupations

The SES data provides information on occupation of individuals at the 2 and 3-digits levels depending on the country and the year. Moreover there is a change of ISCO classification between the years 2006 and 2010. As we do not need the occupation information for 2002, we base our classification on what is available for the SES 2014. We aggregate at the 1-digits level as some occupations at the 2 or 3-digits level are not present in each and every country. However, we drop the occupation corresponding to drivers due to the mobile nature of the job, and also professors and educators, agriculture-related job and army personnel due to the absence of the corresponding sectors in our survey (education, agriculture and government employees). We therefore have 8 occupation categories that are going to be used as fixed-effects in our regression.

Table D3. Occupation classification

ISCO-08	High, medium and low	Occupation title
1	High	Managers
2	Medium	Professionals
3		Technicians and associate professionals
4		Clerical support workers
5		Service and sales workers
7		Craft and related trades workers
8		Plant and machine operators, and assemblers
9	Low	Elementary occupations
Occupations removed from the sample :		
0		Army personnel
6		Agricultural occupations
23		Teaching professionals
83		Drivers

Three categories are created to be used in the regressions on different occupation samples. High-skill occupation (ISCO 1) are gathering managers (7.9% of the full sample). Medium-skill occupations (ISCO 2-8) are professionals, associate professionals, clerks, service workers and salespersons, craft and trade workers and plant and machine operators (85.7% of the full sample). Low-skill workers (ISCO 9) are elementary occupations (6.5% of the full sample).

Education

We keep the 4 education categories provided by the SES 2014 as they are and use them as fixed effects. We also regroup two of those in order to have a decomposition in high, medium and low education level to use for the regression by sample in Section D2.3. The classification is based on ISCED-2011.

Table D4. Education classification

High, medium and low	SES 2014	ISCED-2011	Education category
Low	1	0-1	Primary education
		2	Lower secondary education
Medium	2	3	Upper secondary education
		4	Post-secondary education
	3	5	Short-cycle tertiary education
High	4	6	Bachelor or equivalent
		7	Master or equivalent
		8	PhD or equivalent

D2 Supplementary Results

This section presents additional results, that were not included in the main text of the paper, due to limitations of space. First, Table D6 reproduce the baseline estimations but without Romanian and Bulgarian regions to ensure

the stability of our results on a sample containing only countries that joined the EU in 2004. The baseline effects are not affected by this change. Table D5 reproduced the baseline table but also includes coefficient of macroeconomic controls that were hidden in other tables to save space and clarity. It can be seen that according to our estimations larger productivity increase lead to higher wages and less atypical hours. Net migration is the difference between total immigration and emigration over the 1997-2014 period. It has a positive impact on wages. The capital flows shocks correspond to the difference between property income sent received from abroad and those sent abroad. A negative values means that foreign agents invested a lot in the country and correspond to higher FDIs. Here, foreign investment results in higher wages and an increase in the probability to work in shift. This last elements gives some insight regarding the role of foreign companies in the evolution of working conditions. As expected, the change in CPI index is positively associated with wages. It is also negatively correlated with shift-work.

Then Section D2.3 contains extensions of our baseline on a wide variety of samples. We look at the effect of tariff and trade liberalizations on individual working for different length of time in the same company in Table D9. Wages of workers present in the same company for a long period of time (more than 5 years) are clearly less affected, while there is no difference regarding atypical hours. Table D10 splits the sample by age groups and shows that older workers are less affect by the liberalization. Table D11 compares the effect on workers of different education levels. No significant differences between groups is found. Table D12 shows that women's wages were more affected by the liberalizations than men's. Table D13 presents results by type of contract (permanent versus temporary). Finally, Table D14 test the differences between different occupation groups, using interaction rather than specific sample, as in Table 3.6. This is a more restrictive way of looking at the non-neutrality of occupation.⁶⁸ It confirms that union erosion plays a lesser role for high occupation individuals as the associated coefficient is not significant for managers regarding hourly wages.

Finally Section D2.4 extends some of our results related to the ownership and the sector of firms. First, we compare public and private companies in Table D15. It seems that the adjustment is relies more on the wage channel for privately owned companies while the atypical hours channel is more prevalent in the public sector. We also test whether or not manufacturing industries react differently to services industries in Table D16, using interaction with a manufacturing dummy. Here, we look at marginal effect of manufacturing as we also include the on-interacted variables of interest. The results, in accordance with Table 3.5, show that manufacturing workers are more likely to work in shift that service workers, for the same decrease in unionization, highlighting the heterogeneity of the role of union across the economy. Finally, Table D7 and D8 present results similar to Table 3.5 but

⁶⁸Table 3.6 would be equivalent to Table D14 if all controls variables had also been interacted with occupation dummies.

for each and every individual industry considered in this study.⁶⁹ This decomposition allows to see for instance, that in the "Electricity, gas and water" industry the adjustment goes all through the use of atypical hours. Considering the large role of public providers in that sector, the result is consistent with what was found in Table D15.

⁶⁹See Table D2 for the list of sector and associated Nace Rev2 codes.

D2.1 Baseline with Macroeconomic control variables Coefficients

Table D5. With the coefficients of macroeconomic control variables

Dep. Variable	Wages		Night-Weekend-Shift Work	
	(1)	(2)	(3)	(4)
RTR_{rc}	-0.005*** (0.001)	-0.014*** (0.002)	-0.000 (0.000)	0.007*** (0.002)
LMI_c	-0.512 (0.399)	-1.515*** (0.318)	0.955*** (0.249)	1.877*** (0.324)
$RTR_{rc} \times LMI_c$		-0.116*** (0.029)		0.106*** (0.030)
Large firm	0.248*** (0.018)	0.254*** (0.018)	0.147*** (0.020)	0.141*** (0.021)
Temporary	-0.127*** (0.017)	-0.123*** (0.016)	0.003 (0.015)	-0.000 (0.016)
Women	-0.175*** (0.013)	-0.175*** (0.013)	-0.050*** (0.008)	-0.050*** (0.008)
Δ_{97-14} Productivity	1.914*** (0.200)	0.146 (0.429)	-0.958*** (0.172)	0.668 (0.402)
Δ_{97-14} Net migration	0.079*** (0.007)	0.031** (0.013)	-0.014* (0.008)	0.030** (0.013)
Δ_{97-14} Capital flows	-5.286*** (0.942)	-1.982** (0.914)	-4.389*** (0.845)	-7.428*** (0.632)
Δ_{97-14} CPI index	0.123** (0.055)	0.379*** (0.070)	-0.084*** (0.028)	-0.320*** (0.076)
Education x Age	Yes	Yes	Yes	Yes
Occupation	Yes	Yes	Yes	Yes
Sector	Yes	Yes	Yes	Yes
Job Spell	Yes	Yes	Yes	Yes
Observations	2,765,815	2,765,815	2,765,815	2,765,815
Adj. R^2	0.599	0.601	0.413	0.415
Countries	9	9	9	9
Regions	20	20	20	20

Note: Dependent variable is the log (hourly) wages and dummy variable equal to 1 if the individual works in shift, during weekend or at night in 2014. RTR_{rc} is the change in the weighted regional tariffs between 1997 and 2014. LMI_c is the change in the percentage of unionized workers between 1998 and 2014. Net migration¹⁴⁻⁹⁷ is the difference between entry and exit of residents in the country over the whole period divided by the population in 1997. Δ^{14-97} Net property income is the log-difference between 1997 and 2014 of the net property income as a share of GDP. An increase of that variable means that the country is becoming less dependent on foreign capital or that it is investing more abroad. Standard errors adjusted for clustering by NUTS regions and country are in parentheses. ***, **, * significantly different from 0 at the 1%, 5%, and 10% levels respectively.

D2.2 Baseline without Romania and Bulgaria

Table D6. Without Romania and Bulgaria

Dep. Variable	Wages		Night–Weekend–Shift Work	
	(1)	(2)	(3)	(4)
RTR_{rc}	-0.003*** (0.000)	-0.013** (0.005)	0.001** (0.000)	0.009*** (0.003)
LMI_c	-0.115 (0.111)	-1.184** (0.540)	1.377*** (0.156)	2.278*** (0.331)
$RTR_{rc} \times LMI_c$		-0.130* (0.066)		0.109*** (0.036)
Large firm	0.232*** (0.018)	0.231*** (0.018)	0.149*** (0.027)	0.150*** (0.027)
Temporary	-0.133*** (0.020)	-0.133*** (0.020)	-0.006 (0.018)	-0.006 (0.018)
Women	-0.188*** (0.008)	-0.188*** (0.008)	-0.055*** (0.008)	-0.055*** (0.008)
Δ_{97-14} Productivity	Yes	Yes	Yes	Yes
Δ_{97-14} Net migration	Yes	Yes	Yes	Yes
Δ_{97-14} Capital flows	Yes	Yes	Yes	Yes
Δ_{97-14} CPI index	Yes	Yes	Yes	Yes
Education x Age	Yes	Yes	Yes	Yes
Occupation	Yes	Yes	Yes	Yes
Sector	Yes	Yes	Yes	Yes
Job Spell	Yes	Yes	Yes	Yes
Observations	2,474,104	2,474,104	2,474,104	2,474,104
Adj. R^2	0.519	0.519	0.407	0.407
Countries	7	7	7	7
Regions	14	14	14	14

Note: Dependent variable is the log (hourly) wages and dummy variable equal to 1 if the individual works in shift, during weekend or at night in 2014. RTR_{rc} is the change in the weighted regional tariffs between 1997 and 2014. LMI_c is the change in the percentage of unionized workers between 1998 and 2014. Standard errors adjusted for clustering by NUTS regions and country are in parentheses. ***, **, * significantly different from 0 at the 1%, 5%, and 10% levels respectively.

Table D7. Manufacturing Industries

Sector	Mining and quarrying		Food, beverages and tobacco		Textile, wearing apparel and leather		Wood, paper and publishing and media activities		Coke, chemicals, rubber, plastic, electronics and transport equipment		Metals and machinery	
	Wages	Night-Weekend Shift Work	Wages	Night-Weekend Shift Work	Wages	Night-Weekend Shift Work	Wages	Night-Weekend Shift Work	Wages	Night-Weekend Shift Work	Wages	Night-Weekend Shift Work
Dep. Variable	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
RTR_{rc}	0.005 (0.007)	0.017*** (0.005)	-0.015*** (0.002)	0.009* (0.004)	-0.010*** (0.003)	0.006** (0.003)	-0.013*** (0.003)	0.012*** (0.003)	-0.015*** (0.003)	0.005* (0.003)	-0.012*** (0.001)	0.010*** (0.002)
LMI_c	-0.690 (1.037)	2.213** (0.850)	-2.232*** (0.377)	2.343*** (0.580)	-1.306** (0.559)	1.965*** (0.359)	-1.843*** (0.515)	2.474*** (0.443)	-1.618*** (0.419)	1.699*** (0.372)	-1.044*** (0.283)	2.656*** (0.360)
$RTR_{rc} \times LMI_c$	0.110 (0.102)	0.228*** (0.070)	-0.135*** (0.032)	0.125** (0.057)	-0.055 (0.049)	0.093** (0.037)	-0.105** (0.039)	0.161*** (0.038)	-0.125*** (0.042)	0.072* (0.037)	-0.064*** (0.021)	0.135*** (0.028)
Large firm	0.330*** (0.070)	0.155*** (0.045)	0.293*** (0.028)	0.202*** (0.029)	0.173*** (0.024)	0.089** (0.023)	0.373*** (0.026)	0.169** (0.027)	0.305** (0.027)	0.234*** (0.024)	0.263*** (0.025)	0.209*** (0.037)
Temporary	-0.182** (0.066)	-0.119*** (0.027)	-0.099*** (0.017)	0.014 (0.027)	-0.033 (0.023)	0.033 (0.027)	-0.133*** (0.030)	-0.093*** (0.014)	-0.093*** (0.017)	-0.010 (0.009)	-0.098*** (0.010)	-0.008 (0.008)
Women	-0.204*** (0.019)	-0.161*** (0.035)	-0.185*** (0.018)	-0.013 (0.010)	-0.192*** (0.023)	-0.086*** (0.010)	-0.168*** (0.020)	-0.066*** (0.018)	-0.2220*** (0.008)	-0.050*** (0.009)	-0.204*** (0.011)	-0.061*** (0.016)
Δy_{7-14} Productivity	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Δy_{7-14} Net migration	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Δy_{7-14} Capital flows	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Δy_{7-14} CPI index	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Education x Age	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Occupation	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Sector	No	No	No	No	No	No	No	No	No	No	No	No
Job Spell	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	52,680	52,680	118,871	118,871	76,831	76,831	89,619	89,619	670,065	670,065	263,088	263,088
Adj. R^2	0.515	0.340	0.639	0.369	0.681	0.439	0.558	0.387	0.597	0.371	0.548	0.410
Nb of countries	9	9	9	9	9	9	9	9	9	9	9	9
Nb of regions	20	20	20	20	20	20	20	20	20	20	20	20

Note: Dependent variable is the log (hourly) wages and dummy variable equal to 1 if the individual works in shift, during weekend or at night in 2014. RTR_{rc} is the change in regional tariffs between 1997 and 2014. LMI_c is the fall in the percentage of unionized workers between 1998 and 2014. See Table D2 for the precise composition of each sector in term of NACE Rev2 classification. Standard errors adjusted for clustering by NUTS regions and country are in parentheses. ***, **, * significantly different from 0 at the 1%, 5%, and 10% levels respectively.

Table D8. Services Industries

Sector	Electricity, gas and water		Construction		Wholesale and retail trade of motor vehicles		Other retail trade		Hotels and restaurants		Transport and support activities		Telecommunication, ICT financial services, other business activities		Real estate R&D marketing	
	Wages (1)	Night-Weekend Shift Work (2)	Wages (3)	Night-Weekend Shift Work (4)	Wages (5)	Night-Weekend Shift Work (6)	Wages (7)	Night-Weekend Shift Work (8)	Wages (9)	Night-Weekend Shift Work (10)	Wages (11)	Night-Weekend Shift Work (12)	Wages (13)	Night-Weekend Shift Work (14)	Wages (15)	Night-Weekend Shift Work (16)
RTR_{rc}	-0.005 (0.005)	0.009*** (0.001)	-0.012*** (0.001)	0.009*** (0.001)	-0.016*** (0.004)	0.005** (0.002)	-0.018*** (0.003)	0.005 (0.004)	-0.017*** (0.001)	0.007** (0.003)	-0.016*** (0.003)	0.007*** (0.002)	-0.018*** (0.002)	0.008*** (0.002)	-0.018*** (0.003)	0.008*** (0.001)
LM_L	-0.363 (0.790)	1.000*** (0.205)	-1.627*** (0.343)	1.599*** (0.220)	-1.481** (0.580)	1.515*** (0.345)	-1.567*** (0.309)	2.637*** (0.599)	-2.098*** (0.246)	1.892*** (0.452)	-2.484*** (0.357)	1.884*** (0.295)	-1.894*** (0.235)	1.664*** (0.219)	-0.831 (0.565)	1.567*** (0.178)
$RTR_{rc} \times LM_L$	-0.031 (0.068)	0.134*** (0.017)	-0.080*** (0.018)	0.138*** (0.018)	-0.143** (0.057)	0.073** (0.026)	-0.189*** (0.035)	0.080 (0.054)	-0.162*** (0.018)	0.103** (0.036)	-0.131** (0.048)	0.106*** (0.032)	-0.170*** (0.022)	0.115*** (0.019)	-0.096** (0.042)	0.108*** (0.015)
Large firm	0.225*** (0.034)	0.072* (0.036)	0.312*** (0.024)	0.073** (0.033)	0.221*** (0.030)	0.095*** (0.028)	0.222*** (0.022)	0.168*** (0.046)	0.185*** (0.019)	0.111*** (0.019)	0.332*** (0.027)	0.205*** (0.014)	0.258*** (0.026)	0.062*** (0.020)	0.191*** (0.030)	0.032*** (0.010)
Temporary	0.039 (0.097)	-0.022 (0.030)	-0.066*** (0.018)	0.018 (0.016)	-0.125*** (0.039)	0.028** (0.012)	-0.070*** (0.004)	-0.044* (0.018)	-0.016 (0.019)	0.012 (0.014)	-0.116*** (0.036)	0.018 (0.022)	-0.133*** (0.026)	0.067** (0.028)	-0.171*** (0.021)	-0.061 (0.035)
Women	-0.178*** (0.015)	-0.167*** (0.040)	-0.135*** (0.018)	-0.068 (0.039)	-0.159*** (0.025)	0.009** (0.004)	-0.173*** (0.031)	0.015 (0.011)	-0.095*** (0.015)	-0.038*** (0.008)	-0.151*** (0.024)	-0.118*** (0.018)	-0.160*** (0.013)	-0.055*** (0.011)	-0.100*** (0.013)	0.004 (0.017)
Δ_{97-14} Productivity	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Δ_{97-14} Net migration	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Δ_{97-14} Capital flows	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Δ_{97-14} CPI index	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Education x Age	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Occupation	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No
Sector	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Job-Spell	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	91,309	91,309	117,997	117,997	164,230	164,230	269,650	269,650	64,013	64,013	141,583	141,583	561,652	561,652	84,227	84,227
Adj. R ²	0.612	0.304	0.591	0.344	0.574	0.336	0.550	0.550	0.606	0.385	0.507	0.343	0.615	0.364	0.518	0.255
Nb of countries	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9
Nb of regions	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20

Note: Dependent variable is the log (hourly) wages and dummy variable equal to 1 if the individual works in shift, during weekend or at night in 2014. RTR_{rc} is the change in regional tariffs between 1997 and 2014. LM_L is the fall in the percentage of unionized workers between 1998 and 2014. See Table D2 for the precise composition of each sector in term of NACE Rev2 classification. Standard errors adjusted for clustering by NUTS regions and country are in parentheses. ***, **, * significantly different from 0 at the 1%, 5%, and 10% levels respectively.

D2.3 Extensions regarding Individual Characteristics

Table D9. By Job Spell

Job spell in years	(<1)		(1-5)		(5+)	
	Wages (1)	Night-Weekend Shift Work (2)	Wages (3)	Night-Weekend Shift Work (4)	Wages (5)	Night-Weekend Shift Work (6)
RTR_{rc}	-0.017*** (0.002)	0.007** (0.003)	-0.015*** (0.002)	0.007*** (0.002)	-0.011*** (0.003)	0.007*** (0.002)
LMI_c	-2.069*** (0.247)	1.902*** (0.397)	-1.516*** (0.299)	1.961*** (0.331)	-1.211*** (0.391)	1.770*** (0.292)
$RTR_{rc} \times LMI_c$	-0.157*** (0.022)	0.102** (0.036)	-0.126*** (0.027)	0.110*** (0.030)	-0.089** (0.036)	0.102*** (0.027)
Large firm	0.201*** (0.019)	0.137*** (0.023)	0.254*** (0.019)	0.134*** (0.022)	0.280*** (0.021)	0.144*** (0.019)
Temporary	-0.088*** (0.016)	0.023*** (0.007)	-0.117*** (0.015)	0.007 (0.017)	-0.128*** (0.038)	-0.052*** (0.016)
Women	-0.125*** (0.008)	-0.026*** (0.006)	-0.146*** (0.013)	-0.038*** (0.007)	-0.214*** (0.017)	-0.065*** (0.010)
Δ_{97-14} Productivity	Yes	Yes	Yes	Yes	Yes	Yes
Δ_{97-14} Net migration	Yes	Yes	Yes	Yes	Yes	Yes
Δ_{97-14} Capital flows	Yes	Yes	Yes	Yes	Yes	Yes
Δ_{97-14} CPI index	Yes	Yes	Yes	Yes	Yes	Yes
Education x Age	Yes	Yes	Yes	Yes	Yes	Yes
Occupation	Yes	Yes	Yes	Yes	Yes	Yes
Sector	Yes	Yes	Yes	Yes	Yes	Yes
Job Spell	No	No	No	No	No	No
Observations	436,595	436,595	916,288	916,288	1,412,932	1,412,932
Adj. R^2	0.575	0.457	0.596	0.423	0.570	0.400
Countries	9	9	9	9	9	9
Regions	20	20	20	20	20	20

Note: Dependent variable is the log (hourly) wages and dummy variable equal to 1 if the individual works in shift, during weekend or at night in 2014. RTR_{rc} is the change in regional tariffs between 1997 and 2014. LMI_c is the fall in the percentage of unionized workers between 1998 and 2014. Standard errors adjusted for clustering by NUTS regions and country are in parentheses. ***, **, * significantly different from 0 at the 1%, 5%, and 10% levels respectively.

Table D10. By Age

Age group Dep. Variable	(20-29)		(30-49)		(50-59)	
	Wages	Night-Weekend Shift Work	Wages	Night-Weekend Shift Work	Wages	Night-Weekend Shift Work
	(1)	(2)	(3)	(4)	(5)	(6)
RTR_{rc}	-0.016*** (0.002)	0.007** (0.002)	-0.014*** (0.002)	0.007*** (0.002)	-0.012*** (0.002)	0.008*** (0.002)
LMI_c	-1.851*** (0.256)	1.884*** (0.384)	-1.459*** (0.331)	1.818*** (0.316)	-1.330*** (0.357)	1.982*** (0.306)
$RTR_{rc} \times LMI_c$	-0.132*** (0.023)	0.104*** (0.034)	-0.111*** (0.031)	0.103*** (0.028)	-0.111*** (0.033)	0.113*** (0.030)
Large firm	0.234*** (0.022)	0.149*** (0.024)	0.267*** (0.019)	0.142*** (0.022)	0.234*** (0.016)	0.131*** (0.017)
Temporary	-0.097*** (0.009)	0.006 (0.012)	-0.135*** (0.018)	-0.001 (0.016)	-0.107*** (0.023)	-0.006 (0.018)
Women	-0.116*** (0.005)	-0.043*** (0.006)	-0.200*** (0.017)	-0.048*** (0.009)	-0.161*** (0.015)	-0.061*** (0.010)
Δ_{97-14} Productivity	Yes	Yes	Yes	Yes	Yes	Yes
Δ_{97-14} Net migration	Yes	Yes	Yes	Yes	Yes	Yes
Δ_{97-14} Capital flows	Yes	Yes	Yes	Yes	Yes	Yes
Δ_{97-14} CPI index	Yes	Yes	Yes	Yes	Yes	Yes
Education	Yes	Yes	Yes	Yes	Yes	Yes
Occupation	Yes	Yes	Yes	Yes	Yes	Yes
Sector	Yes	Yes	Yes	Yes	Yes	Yes
Job Spell	Yes	Yes	Yes	Yes	Yes	Yes
Observations	587,024	587,024	1,581,793	1,581,793	596,998	596,998
Adj. R^2	0.537	0.444	0.610	0.411	0.605	0.400
Countries	9	9	9	9	9	9
Regions	20	20	20	20	20	20

Note: Dependent variable is the log (hourly) wages and dummy variable equal to 1 if the individual works in shift, during weekend or at night in 2014. RTR_{rc} is the change in regional tariffs between 1997 and 2014. LMI_c is the fall in the percentage of unionized workers between 1998 and 2014. Standard errors adjusted for clustering by NUTS regions and country are in parentheses. ***, **, * significantly different from 0 at the 1%, 5%, and 10% levels respectively.

D2.4 Extensions regarding Firm Characteristics

Table D11. By Education

Education group	Low		Medium		High	
	Wages	Night–Weekend Shift Work	Wages	Night–Weekend Shift Work	Wages	Night–Weekend Shift Work
Dep. Variable	(1)	(2)	(3)	(4)	(5)	(6)
RTR_{rc}	-0.016*** (0.001)	0.007*** (0.002)	-0.014*** (0.002)	0.007*** (0.002)	-0.020*** (0.004)	0.005*** (0.001)
LMI_c	-2.549*** (0.151)	2.170*** (0.358)	-1.747*** (0.324)	2.023*** (0.354)	-1.819*** (0.447)	1.092*** (0.170)
$RTR_{rc} \times LMI_c$	-0.138*** (0.013)	0.101*** (0.030)	-0.112*** (0.029)	0.110*** (0.031)	-0.210*** (0.048)	0.074*** (0.017)
Large firm	0.167*** (0.018)	0.192*** (0.035)	0.253*** (0.018)	0.158*** (0.022)	0.290*** (0.021)	0.036*** (0.009)
Temporary	-0.046*** (0.013)	0.017 (0.024)	-0.102*** (0.013)	0.001 (0.016)	-0.209*** (0.032)	-0.011** (0.005)
Women	-0.122*** (0.009)	-0.037*** (0.009)	-0.174*** (0.017)	-0.062*** (0.008)	-0.174*** (0.006)	-0.038*** (0.006)
Δ_{97-14} Productivity	Yes	Yes	Yes	Yes	Yes	Yes
Δ_{97-14} Net migration	Yes	Yes	Yes	Yes	Yes	Yes
Δ_{97-14} Capital flows	Yes	Yes	Yes	Yes	Yes	Yes
Δ_{97-14} CPI index	Yes	Yes	Yes	Yes	Yes	Yes
Age	Yes	Yes	Yes	Yes	Yes	Yes
Occupation	Yes	Yes	Yes	Yes	Yes	Yes
Sector	Yes	Yes	Yes	Yes	Yes	Yes
Job Spell	Yes	Yes	Yes	Yes	Yes	Yes
Observations	209,449	209,449	2,122,390	2,122,390	433,976	433,976
Adj. R^2	0.546	0.437	0.554	0.409	0.437	0.211
Countries	9	9	9	9	9	9
Regions	20	20	20	20	20	20

Note: Dependent variable is the log (hourly) wages and dummy variable equal to 1 if the individual works in shift, during weekend or at night in 2014. RTR_{rc} is the change in regional tariffs between 1997 and 2014. LMI_c is the fall in the percentage of unionized workers between 1998 and 2014. A "High" education level corresponds to attending more than 4 years of tertiary education, a "Low" level is equivalent to attending up to lower secondary education and a "Medium" education level corresponds to attending secondary or tertiary education up to 4 years. Standard errors adjusted for clustering by NUTS regions and country are in parentheses. ***, **, * significantly different from 0 at the 1%, 5%, and 10% levels respectively.

Table D12. By Gender

Gender	Men		Women	
	Wages (1)	Night–Weekend–Shift Work (2)	Wages (3)	Night–Weekend–Shift Work (4)
RTR_{rc}	-0.011*** (0.002)	0.008*** (0.002)	-0.017*** (0.002)	0.006** (0.002)
LMI_c	-1.243*** (0.299)	1.936*** (0.329)	-1.971*** (0.341)	1.807*** (0.321)
$RTR_{rc} \times LMI_c$	-0.078*** (0.027)	0.116*** (0.030)	-0.171*** (0.032)	0.093*** (0.029)
Large firm	0.297*** (0.019)	0.151*** (0.022)	0.205*** (0.020)	0.124*** (0.020)
Temporary	-0.139*** (0.021)	-0.001 (0.015)	-0.103*** (0.013)	-0.001 (0.016)
Δ_{97-14} Productivity	Yes	Yes	Yes	Yes
Δ_{97-14} Net migration	Yes	Yes	Yes	Yes
Δ_{97-14} Capital flows	Yes	Yes	Yes	Yes
Δ_{97-14} CPI index	Yes	Yes	Yes	Yes
Education \times Age	Yes	Yes	Yes	Yes
Occupation	Yes	Yes	Yes	Yes
Sector	Yes	Yes	Yes	Yes
Job Spell	Yes	Yes	Yes	Yes
Observations	1,536,556	1,536,556	1,229,259	1,229,259
Adj. R^2	0.589	0.409	0.587	0.430
Countries	9	9	9	9
Regions	20	20	20	20

Note: Dependent variable is the log (hourly) wages and dummy variable equal to 1 if the individual works in shift, during weekend or at night in 2014. RTR_{rc} is the change in regional tariffs between 1997 and 2014. LMI_c is the fall in the percentage of unionized workers between 1998 and 2014. Standard errors adjusted for clustering by NUTS regions and country are in parentheses. ***, **, * significantly different from 0 at the 1%, 5%, and 10% levels respectively.

Table D13. By Type of Contract

Type of contract	Permanent		Temporary	
	Wages (1)	Night-Weekend-Shift Work (2)	Wages (3)	Night-Weekend-Shift Work (4)
RTR_{rc}	-0.014*** (0.002)	0.007*** (0.002)	-0.015*** (0.002)	0.007*** (0.002)
LMI_c	-1.613*** (0.322)	1.754*** (0.322)	-1.497*** (0.366)	2.077*** (0.315)
$RTR_{rc} \times LMI_c$	-0.115*** (0.030)	0.101*** (0.030)	-0.125*** (0.026)	0.110*** (0.023)
Large firm	0.269*** (0.020)	0.140*** (0.020)	0.176*** (0.013)	0.133*** (0.027)
Women	-0.186*** (0.018)	-0.053*** (0.009)	-0.129*** (0.009)	-0.039*** (0.005)
Δ_{97-14} Productivity	Yes	Yes	Yes	Yes
Δ_{97-14} Net migration	Yes	Yes	Yes	Yes
Δ_{97-14} Capital flows	Yes	Yes	Yes	Yes
Δ_{97-14} CPI index	Yes	Yes	Yes	Yes
Education x Age	Yes	Yes	Yes	Yes
Occupation	Yes	Yes	Yes	Yes
Sector	Yes	Yes	Yes	Yes
Job Spell	Yes	Yes	Yes	Yes
Observations	2,253,038	2,253,038	512,777	512,777
Adj. R^2	0.610	0.410	0.469	0.442
Countries	9	9	9	9
Regions	20	20	20	20

Note: Dependent variable is the log (hourly) wages and dummy variable equal to 1 if the individual works in shift, during weekend or at night in 2014. RTR_{rc} is the change in regional tariffs between 1997 and 2014. LMI_c is the fall in the percentage of unionized workers between 1998 and 2014. Standard errors adjusted for clustering by NUTS regions and country are in parentheses. ***, **, * significantly different from 0 at the 1%, 5%, and 10% levels respectively.

Table D14. By Occupation, using Interactions

Dep. Variable	Wages		Night–Weekend–Shift Work	
	(1)	(2)	(3)	(4)
$RTR_{rc} \times Occup\ H$	-0.004 (0.003)	-0.018*** (0.006)	0.001 (0.001)	0.011*** (0.002)
$RTR_{rc} \times Occup\ M$	-0.006*** (0.001)	-0.016*** (0.002)	-0.000 (0.000)	0.008*** (0.002)
$RTR_{rc} \times Occup\ L$	-0.006** (0.003)	-0.016*** (0.003)	-0.001* (0.001)	0.007*** (0.002)
$LMI_c \times Occup\ H$	-1.348 (1.372)	-1.057 (2.242)	0.917** (0.363)	1.296** (0.524)
$LMI_c \times Occup\ M$	-0.563 (0.528)	-1.903*** (0.361)	1.042*** (0.280)	2.137*** (0.314)
$LMI_c \times Occup\ L$	-1.215 (1.022)	-3.102** (1.355)	0.900*** (0.225)	2.054*** (0.409)
$RTR_{rc} \times LMI_c \times Occup\ H$		-0.232*** (0.074)		0.158*** (0.026)
$RTR_{rc} \times LMI_c \times Occup\ M$		-0.138*** (0.035)		0.116*** (0.028)
$RTR_{rc} \times LMI_c \times Occup\ L$		-0.112* (0.058)		0.114*** (0.031)
Large firm	0.238*** (0.017)	0.246*** (0.017)	0.153*** (0.019)	0.145*** (0.020)
Temporary	-0.169*** (0.018)	-0.157*** (0.018)	0.027 (0.021)	0.021 (0.022)
Women	-0.198*** (0.013)	-0.196*** (0.012)	-0.052*** (0.009)	-0.053*** (0.009)
Δ_{97-14} Productivity	Yes	Yes	Yes	Yes
Δ_{97-14} Net migration	Yes	Yes	Yes	Yes
Δ_{97-14} Capital flows	Yes	Yes	Yes	Yes
Δ_{97-14} CPI index	Yes	Yes	Yes	Yes
Education x Age	Yes	Yes	Yes	Yes
Occupation	No	No	No	No
Sector	Yes	Yes	Yes	Yes
Job Spell	Yes	Yes	Yes	Yes
Observations	2,765,815	2,765,815	2,765,815	2,765,815
Adj. R^2	0.517	0.524	0.371	0.375
Countries	9	9	9	9
Regions	20	20	20	20

Note: Dependent variable is the log (hourly) wages and dummy variable equal to 1 if the individual works in shift, during weekend or at night in 2014. RTR_{rc} is the change in the weighted regional tariffs between 1997 and 2014. LMI_c is the change in the percentage of unionized workers between 1998 and 2014. The different *Occup* variables are dummy equal to 1 for individual belonging to the occupational group. Standard errors adjusted for clustering by NUTS regions and country are in parentheses. ***, **, * significantly different from 0 at the 1%, 5%, and 10% levels respectively.

Table D15. Public versus Private companies

Company ownership	Private		Public	
	Wages (1)	Night–Weekend–Shift Work (2)	Wages (3)	Night–Weekend–Shift Work (4)
RTR_{rc}	-0.015*** (0.002)	0.007** (0.002)	-0.009*** (0.002)	0.011*** (0.001)
LMI_c	-1.554*** (0.333)	1.862*** (0.351)	-2.166*** (0.349)	1.830*** (0.205)
$RTR_{rc} \times LMI_c$	-0.136*** (0.031)	0.099*** (0.032)	-0.056* (0.029)	0.163*** (0.020)
Large firm	0.267*** (0.019)	0.142*** (0.024)	0.175*** (0.027)	0.052* (0.028)
Temporary	-0.116*** (0.015)	0.004 (0.016)	-0.116*** (0.016)	-0.020 (0.018)
Women	-0.175*** (0.014)	-0.048*** (0.009)	-0.132*** (0.010)	-0.086*** (0.017)
Δ_{97-14} Productivity	Yes	Yes	Yes	Yes
Δ_{97-14} Net migration	Yes	Yes	Yes	Yes
Δ_{97-14} Capital flows	Yes	Yes	Yes	Yes
Δ_{97-14} CPI index	Yes	Yes	Yes	Yes
Education x Age	Yes	Yes	Yes	Yes
Occupation	Yes	Yes	Yes	Yes
Sector	Yes	Yes	Yes	Yes
Job Spell	Yes	Yes	Yes	Yes
Observations	2,440,093	2,440,093	325,722	325,722
Adj. R^2	0.609	0.425	0.565	0.386
Countries	9	9	9	9
Regions	20	20	20	20

Note: Dependent variable is the log (hourly) wages and dummy variable equal to 1 if the individual works in shift, during weekend or at night in 2014. RTR_{rc} is the change in regional tariffs between 1997 and 2014. LMI_c is the fall in the percentage of unionized workers between 1998 and 2014. A company is considered publicly-owned if at least 50% of its capital is detained by public entities. Standard errors adjusted for clustering by NUTS regions and country are in parentheses. ***, **, * significantly different from 0 at the 1%, 5%, and 10% levels respectively.

Table D16. Manufacturing versus Services, using Interactions

Dep. Variable	Wages		Night–Weekend–Shift Work	
	(1)	(2)	(3)	(4)
$RTR_{rc} \times Manuf$	0.000 (0.000)	0.000 (0.000)	-0.001 (0.001)	-0.001*** (0.000)
$LMI_c \times Manuf$	0.056 (0.163)	0.042 (0.117)	-0.066 (0.218)	0.325*** (0.072)
$RTR_{rc} \times LMI_c \times Manuf$		-0.000 (0.005)		-0.021*** (0.003)
RTR_{rc}	-0.005*** (0.001)	-0.014*** (0.002)	-0.000 (0.000)	0.008*** (0.002)
LMI_c	-0.536 (0.403)	-1.533*** (0.314)	0.969*** (0.258)	1.732*** (0.309)
$RTR_{rc} \times LMI_c$		-0.116*** (0.029)		0.115*** (0.028)
Large firm	0.248*** (0.018)	0.254*** (0.018)	0.149*** (0.021)	0.144*** (0.021)
Temporary	-0.127*** (0.017)	-0.123*** (0.016)	0.003 (0.015)	0.000 (0.015)
Women	-0.175*** (0.013)	-0.175*** (0.013)	-0.050*** (0.008)	-0.050*** (0.008)
Δ_{97-14} Productivity	Yes	Yes	Yes	Yes
Δ_{97-14} Net migration	Yes	Yes	Yes	Yes
Δ_{97-14} Capital flows	Yes	Yes	Yes	Yes
Δ_{97-14} CPI index	Yes	Yes	Yes	Yes
Education x Age	Yes	Yes	Yes	Yes
Occupation	Yes	Yes	Yes	Yes
Sector	Yes	Yes	Yes	Yes
Job Spell	Yes	Yes	Yes	Yes
Observations	2,765,815	2,765,815	2,765,815	2,765,815
Adj. R^2	0.599	0.601	0.413	0.416
Countries	9	9	9	9
Regions	20	20	20	20

Note: Dependent variable is the log (hourly) wages and dummy variable equal to 1 if the individual works in shift, during weekend or at night in 2014. RTR_{rc} is the change in the weighted regional tariffs between 1997 and 2014. LMI_c is the change in the percentage of unionized workers between 1998 and 2014. The $Manuf$ variable is a dummy equal to 1 for workers in the mining and quarrying sector and the manufacturing sector, as defined in the NACE rev2 classification. Standard errors adjusted for clustering by NUTS regions and country are in parentheses. ***, **, * significantly different from 0 at the 1%, 5%, and 10% levels respectively.

Bibliography

- Ariu, Andrea (2019). *Migration, Better Products and Trade: Evidence From the Swiss-EU Agreement on the Free Movement of Persons*. Tech. rep. Mimeo, LMU University.
- Arpaia, Alfonso et al. (2016). "Labour mobility and labour market adjustment in the EU". In: *IZA Journal of Migration* 5.1, p. 21.
- Autor, David H., David Dorn, and Gordon H. Hanson (2013). "The Geography of Trade and Technology Shocks in the United States". In: *American Economic Review* 103.3, pp. 220–25. DOI: 10.1257/aer.103.3.220.
- Barba Navaretti, Giorgio, Giuseppe Bertola, Alessandro Sembenelli, et al. (2008). *Offshoring and immigrant employment: firm-level theory and evidence*. Tech. rep. CEPR Discussion Papers.
- Barone, Guglielmo et al. (2016). "Mr. Rossi, Mr. Hu and politics. The role of immigration in shaping natives' voting behavior". In: *Journal of Public Economics* 136, pp. 1–13. ISSN: 0047-2727. DOI: <https://doi.org/10.1016/j.jpubeco.2016.03.002>. URL: <http://www.sciencedirect.com/science/article/pii/S0047272716000414>.
- Barth, Erling, Alex Bryson, and Harald Dale-Olsen (2020). "Union Density Effects on Productivity and Wages". In: *The Economic Journal*.
- Basso, Gaetano, Francesco D'Amuri, and Giovanni Peri (2019). "Immigrants, labor market dynamics and adjustment to shocks in the Euro Area". In: *IMF Economic Review* 67.3, pp. 528–572.
- Bauer, Thomas K and Astrid Kunze (2004). "The demand for high-skilled workers and immigration policy". In.
- Bayoumi, Tamim (1994). "A formal model of optimum currency areas". In: *IMF Staff Papers* 41.4, pp. 537–554.
- Beine, Michel, Pauline Bourgeon, and Jean-Charles Bricongne (2019). "Aggregate fluctuations and international migration". In: *The Scandinavian Journal of Economics* 121.1, pp. 117–152.
- Beine, Michel, Frédéric Docquier, and Hillel Rapoport (2001). "Brain drain and economic growth: theory and evidence". In: *Journal of development economics* 64.1, pp. 275–289.
- Bertoli, Simone, Herbert Brücker, and Jesús Fernández-Huertas Moraga (2013). "The European crisis and migration to Germany: expectations and the diversion of migration flows". In.
- Beyer, Robert CM and Frank Smets (2015). "Labour market adjustments and migration in Europe and the United States: how different?" In: *Economic Policy* 30.84, pp. 643–682.
- Blanchard, Olivier and Augustin Landier (2002). "The perverse effects of partial labour market reform: fixed-term contracts in France". In: *The Economic Journal* 112.480, F214–F244.
- Blanchflower, David and Alex Bryson (Dec. 2002). *Changes over time in union relative wage effects in the UK and the US revisited*. NBER Working Papers 9395. National Bureau of Economic Research, Inc.
- Blanchflower, David G and Alex Bryson (2004). "What effect do unions have on wages now and would Freeman and Medoff be surprised?" In: *Journal of Labor Research* 25.3, pp. 383–414.

- Blau, Francine D and Lawrence M Kahn (1994). "Rising wage inequality and the US gender gap". In: *The American Economic Review* 84.2, pp. 23–28.
- Booth, Alison L., Marco Francesconi, and Jeff Frank (2002). "Temporary Jobs: Stepping Stones or Dead Ends?" In: *The Economic Journal* 112.480, F189–F213. ISSN: 00130133, 14680297.
- Borjas, George J (1999). "Immigration and welfare magnets". In: *Journal of labor economics* 17.4, pp. 607–637.
- (2003). "The labor demand curve is downward sloping: Reexamining the impact of immigration on the labor market". In: *The quarterly journal of economics* 118.4, pp. 1335–1374.
- Bourdieu, Pierre and Jean-Claude Passeron (2018). *La reproduction: éléments pour une théorie du système d'enseignement*. Minuit.
- Brainerd, Elizabeth (2000). "Women in Transition: Changes in Gender Wage Differentials in Eastern Europe and the Former Soviet Union". In: *ILR Review* 54.1, pp. 138–162. DOI: 10.1177/001979390005400108.
- Bronstein, Arturo S. (2003). *Labour law reform in the EU candidate countries : achievements and challenges*. ILO Working Papers 993617133402676. International Labour Organization.
- Burchardi, Konrad, Thomas Chaney, and Tarek A Hassan (2017). "Migrants, ancestors, and foreign investments". In.
- Caliendo, Lorenzo et al. (2017). *Goods and factor market integration: a quantitative assessment of the EU enlargement*. Tech. rep. National Bureau of Economic Research.
- Card, David (1996). "The Effect of Unions on the Structure of Wages: A Longitudinal Analysis". In: *Econometrica* 64.4, pp. 957–979.
- (2001a). "Immigrant inflows, native outflows, and the local labor market impacts of higher immigration". In: *Journal of Labor Economics* 19.1, pp. 22–64.
- (2001b). "The Effect of Unions on Wage Inequality in the U.S. Labor Market". In: *ILR Review* 54.2, pp. 296–315.
- Card, David, Thomas Lemieux, and W. Craig Riddell (2020). "Unions and wage inequality: The roles of gender, skill and public sector employment". In: *Canadian Journal of Economics/Revue canadienne d'économique* 53.1, pp. 140–173. DOI: 10.1111/caje.12432.
- Cazes, Sandrine (2002). "Do labour market institutions matter in transition economies? An analysis of labour market flexibility in the late nineties". In: *An Analysis of Labour Market Flexibility in the Late Nineties*.
- Chiswick, Barry R and Paul W Miller (2009). "The international transferability of immigrants' human capital". In: *Economics of Education Review* 28.2, pp. 162–169.
- Colantone, Italo, Rosario Crinò, and Laura Ogliari (2019). "Globalization and mental distress". In: *Journal of International Economics* 119.C, pp. 181–207. DOI: 10.1016/j.jinteco.2019.04.
- Colantone, Italo and Piero Stanig (2018). "The Trade Origins of Economic Nationalism: Import Competition and Voting Behavior in Western Europe". In: *American Journal of Political Science* 62.4, pp. 936–953. DOI: 10.1111/ajps.12358.
- Costa, Giovanni (Mar. 2003). "Shift work and occupational medicine: an overview". In: *Occupational Medicine* 53.2, pp. 83–88. ISSN: 0962-7480. DOI: 10.1093/occmed/kqg045.
- Cottini, Elena and Claudio Lucifora (2013). "Mental Health and Working Conditions in Europe". In: *ILR Review* 66.4, pp. 958–988.

- D'Amuri, Francesco, Gianmarco IP Ottaviano, and Giovanni Peri (2010). "The labor market impact of immigration in Western Germany in the 1990s". In: *European Economic Review* 54.4, pp. 550–570.
- D'Amuri, Francesco and Giovanni Peri (2014). "Immigration, jobs, and employment protection: evidence from Europe before and during the great recession". In: *Journal of the European Economic Association* 12.2, pp. 432–464.
- Dauth, Wolfgang, Sebastian Findeisen, and Jens Suedekum (2014). "The Rise Of The East And The Far East: German Labor Markets And Trade Integration". In: *Journal of the European Economic Association* 12.6, pp. 1643–1675.
- De Backer, Koen and Sébastien Miroudot (2014). "Mapping global value chains". In: .
- Decressin, Jörg and Antonio Fatas (1995). "Regional labor market dynamics in Europe". In: *European Economic Review* 39.9, pp. 1627–1655.
- Díaz-Francés, Eloísa and Francisco J Rubio (2013). "On the existence of a normal approximation to the distribution of the ratio of two independent normal random variables". In: *Statistical Papers* 54.2, pp. 309–323.
- DiNardo, John, Nicole M Fortin, and Thomas Lemieux (1996). "Labor Market Institutions and the Distribution of Wages, 1973-1992: A Semiparametric Approach". In: *Econometrica* 64.5, pp. 1001–1044.
- Dippel, Christian et al. (2020). "The Effect of Trade on Workers and Voters". In: *Economic Journal* conditionally accepted.
- Dix-Carneiro, Rafael and Brian K. Kovak (2017). "Trade Liberalization and Regional Dynamics". In: *American Economic Review* 107.10, pp. 2908–2946.
- (2019). "Margins of labor market adjustment to trade". In: *Journal of International Economics* 117, pp. 125–142. ISSN: 0022-1996. DOI: <https://doi.org/10.1016/j.jinteco.2019.01.005>.
- Docquier, Frédéric and Elisabetta Lodigiani (2010). "Skilled migration and business networks". In: *Open Economies Review* 21.4, pp. 565–588.
- Docquier, Frédéric and Hillel Rapoport (2012). "Globalization, brain drain, and development". In: *Journal of Economic Literature* 50.3, pp. 681–730.
- Donaldson, Dave (2018). "Railroads of the Raj: Estimating the Impact of Transportation Infrastructure". In: *American Economic Review* 108.4-5, pp. 899–934. DOI: 10.1257/aer.20101199. URL: <https://www.aeaweb.org/articles?id=10.1257/aer.20101199>.
- Donaldson, Dave and Richard Hornbeck (Feb. 2016). "Railroads and American Economic Growth: A "Market Access" Approach *". In: *The Quarterly Journal of Economics* 131.2, pp. 799–858. ISSN: 0033-5533. DOI: 10.1093/qje/qjw002. eprint: <https://academic.oup.com/qje/article-pdf/131/2/799/30636260/qjw002.pdf>. URL: <https://doi.org/10.1093/qje/qjw002>.
- Dustmann, Christian, Tommaso Frattini, and Ian P Preston (2013). "The effect of immigration along the distribution of wages". In: *Review of Economic Studies* 80.1, pp. 145–173.
- Dustmann, Christian, Uta Schönberg, and Jan Stuhler (2016). "The impact of immigration: Why do studies reach such different results?" In: *Journal of Economic Perspectives* 30.4, pp. 31–56.
- Edmonds, Eric V., Nina Pavcnik, and Petia Topalova (2010). "Trade Adjustment and Human Capital Investments: Evidence from Indian Tariff Reform". In: *American Economic Journal: Applied Economics* 2.4, pp. 42–75.
- Edo, Anthony et al. (2019). "Immigration and electoral support for the far-left and the far-right". In: *European Economic Review* 115, pp. 99–143. ISSN: 0014-2921. DOI: <https://doi.org/10.1016/j.euroecorev.2019.03>.

001. URL: <http://www.sciencedirect.com/science/article/pii/S0014292119300418>.
- Egger, Peter H, Katharina Erhardt, and Andrea Lassmann (2019). "Immigration and firms' integration in international production networks". In: *European Economic Review* 111, pp. 1–34.
- Fajgelbaum, Pablo D. et al. (2020). "The Return to Protectionism". In: *The Quarterly Journal of Economics*. Working Paper Series 135.1, pp. 1–55.
- Fally, Thibault (2015). "Structural gravity and fixed effects". In: *Journal of International Economics* 97.1, pp. 76–85.
- Fan, Haichao, Faqin Lin, and Shu Lin (2020). "The hidden cost of trade liberalization: Input tariff shocks and worker health in China". In: *Journal of International Economics*, p. 103349.
- Farhi, Emmanuel and Iván Werning (2014). *Labor mobility within currency unions*. Tech. rep. National Bureau of Economic Research.
- (2017). "Fiscal unions". In: *American Economic Review* 107.12, pp. 3788–3834.
- Felbermayr, Gabriel, Jasmin Katrin Gröschl, and Inga Heiland (2018). *Undoing Europe in a new quantitative trade model*. Tech. rep. Ifo working paper.
- Felbermayr, Gabriel J and Farid Toubal (2012). "Revisiting the trade-migration nexus: Evidence from new OECD data". In: *World Development* 40.5, pp. 928–937.
- Feld, Lars P and Steffen Osterloh (2013). *Is a fiscal capacity really necessary to complete EMU?* Tech. rep. Freiburger Diskussionspapiere zur Ordnungsökonomik.
- Fialová, Kamila and Ondřej Schneider (2009). "Labor Market Institutions and Their Effect on Labor Market Performance in the New EU Member Countries." In: *Eastern European Economics* 47.3, pp. 57–83. ISSN: 00128775.
- Freeman, Richard B. (1984). "Longitudinal Analyses of the Effects of Trade Unions". In: *Journal of Labor Economics* 2.1, pp. 1–26. ISSN: 0734306X, 15375307.
- Freeman, Richard B and James L Medoff (1981). "The Impact of the Percentage Organized on Union and Nonunion Wages". In: *The Review of Economics and Statistics* 63.4, pp. 561–572.
- Freeman, Richard B. and James L Medoff (1984). *What Do Unions Do*. New York: Basic Books.
- Gebel, Michael (2008). *Europe enlarged: A handbook of education, labour and welfare regimes in Central and Eastern Europe*. 1st ed. Bristol University Press.
- Gould, David M (1994). "Immigrant links to the home country: empirical implications for US bilateral trade flows". In: *The Review of Economics and Statistics*, pp. 302–316.
- Hagedorn, Jenn et al. (2016). "The role of labor unions in creating working conditions that promote public health". In: *American journal of public health* 106.6, pp. 989–995.
- Hagemeyer, Jan and Mahdi Ghodsi (2017). "Up or Down the Value Chain? A Comparative Analysis of the GVC Position of the Economies of the New EU Member States". In: *Central European Economic Journal* 1.ahead-of-print.
- Harmon, Nikolaj A (2018). "Immigration, ethnic diversity, and political outcomes: Evidence from Denmark". In: *The Scandinavian Journal of Economics* 120.4, pp. 1043–1074.
- Harrington, JM (1994). "Shift work and health—a critical review of the literature on working hours". In: *Annals of the Academy of Medicine, Singapore* 23.5, 699–705. ISSN: 0304-4602.
- Hatzigeorgiou, Andreas and Magnus Lodefalk (2016). "Migrants' influence on firm-level exports". In: *Journal of industry, competition and trade* 16.4, pp. 477–497.

- Head, Keith and John Ries (1998). "Immigration and trade creation: econometric evidence from Canada". In: *Canadian journal of economics*, pp. 47–62.
- Hertz, Tom et al. (2008). "The inheritance of educational inequality: International comparisons and fifty-year trends". In: *The BE Journal of Economic Analysis & Policy* 7.2.
- Holland, Dawn et al. (2011). "Labour mobility within the EU-The impact of enlargement and the functioning of the transitional arrangements". In: *National Institute of Economic and Social Research* 2978.
- Hummels, David, Jun Ishii, and Kei-Mu Yi (2001). "The nature and growth of vertical specialization in world trade". In: *Journal of international Economics* 54.1, pp. 75–96.
- in 't Veld, Jan (2019). "The economic benefits of the EU Single Market in goods and services". In: *Journal of Policy Modeling* 41.5, pp. 803–818. ISSN: 0161-8938. DOI: <https://doi.org/10.1016/j.jpolmod.2019.06.004>. URL: <http://www.sciencedirect.com/science/article/pii/S0161893819300882>.
- Jauer, Julia et al. (2019). "Migration as an adjustment mechanism in the crisis? A comparison of Europe and the United States 2006–2016". In: *Journal of Population Economics* 32.1, pp. 1–22.
- Javorcik, Beata S et al. (2011). "Migrant networks and foreign direct investment". In: *Journal of development economics* 94.2, pp. 231–241.
- Kahanec, Martin et al. (2013). "Labor mobility in an enlarged European Union". In: *International handbook on the economics of migration*, pp. 137–152.
- Katz, Eliakim and Hillel Rapoport (2005). "On human capital formation with exit options". In: *Journal of Population Economics* 18.2, pp. 267–274.
- Kersan-Škabić, Ines (2017). "Assessment of EU member states' positions in Global Value Chains." In: *Eastern Journal of European Studies* 8.2.
- Knepper, Matthew (2020). "From the Fringe to the Fore: Labor Unions and Employee Compensation". In: *Review of Economics and Statistics* 102.1, pp. 98–112.
- Kovak, Brian K. (2013). "Regional Effects of Trade Reform: What Is the Correct Measure of Liberalization?" In: *American Economic Review* 103.5, pp. 1960–76. DOI: 10.1257/aer.103.5.1960.
- Kugler, Maurice and Hillel Rapoport (2005). "Skilled emigration, business networks and foreign direct investment". In.
- Levhari, David and Yoram Weiss (1974). "The effect of risk on the investment in human capital". In: *The American Economic Review* 64.6, pp. 950–963.
- Malinowski, Beth, Meredith Minkler, and Laura Stock (2015). "Labor unions: a public health institution". In: *American journal of public health* 105.2, pp. 261–271.
- Marchal, Léa and Clément Nedoncelle (2019). "Immigrants, occupations and firm export performance". In: *Review of International Economics*.
- Marchand, Alain, Andrée Demers, and Pierre Durand (2005). "Do occupation and work conditions really matter? A longitudinal analysis of psychological distress experiences among Canadian workers". In: *Sociology of Health & Illness* 27.5, pp. 602–627. DOI: 10.1111/j.1467-9566.2005.00458.x. eprint: <https://onlinelibrary.wiley.com/doi/pdf/10.1111/j.1467-9566.2005.00458.x>.
- Mayer, Thierry, Vincent Vicard, and Soledad Zignago (2019). "The cost of non-Europe, revisited". In: *Economic Policy* 34.98, pp. 145–199.
- Michaels, Guy (2008). "The Effect of Trade on the Demand for Skill: Evidence from the Interstate Highway System". In: *The Review of Economics*

- and Statistics* 90.4, pp. 683–701. DOI: 10.1162/rest.90.4.683. URL: <https://doi.org/10.1162/rest.90.4.683>.
- Mitaritonna, Cristina, Gianluca Orefice, and Giovanni Peri (2017). “Immigrants and firms’ outcomes: Evidence from France”. In: *European Economic Review* 96, pp. 62–82.
- Mountford, Andrew (1997). “Can a brain drain be good for growth in the source economy?” In: *Journal of development economics* 53.2, pp. 287–303.
- Moussault, Erwan et al. (2017). *Intergenerational transfers, tax policies and public debt*. Tech. rep. THEMA (THéorie Economique, Modélisation et Applications), Université de ...
- Mundell, Robert A (1961). “A theory of optimum currency areas”. In: *The American economic review* 51.4, pp. 657–665.
- OECD (2017). *OECD Guidelines on Measuring the Quality of the Working Environment*. OECD Publishing.
- Olney, William W (2012). “Offshoring, immigration, and the native wage distribution”. In: *Canadian Journal of Economics/Revue canadienne d’économique* 45.3, pp. 830–856.
- (2013). “Immigration and firm expansion”. In: *Journal of regional science* 53.1, pp. 142–157.
- Ortega, Francesc and Giovanni Peri (2014). “Openness and income: The roles of trade and migration”. In: *Journal of International Economics* 92.2, pp. 231–251.
- Ottaviano, Gianmarco IP and Giovanni Peri (2006). “The economic value of cultural diversity: evidence from US cities”. In: *Journal of Economic geography* 6.1, pp. 9–44.
- (2012). “Rethinking the effect of immigration on wages”. In: *Journal of the European economic association* 10.1, pp. 152–197.
- Ottaviano, Gianmarco IP, Giovanni Peri, and Greg C Wright (2013). “Immigration, offshoring, and American jobs”. In: *American Economic Review* 103.5, pp. 1925–59.
- Otto, Alkis Henri and Max Friedrich Steinhardt (2014). “Immigration and election outcomes — Evidence from city districts in Hamburg”. In: *Regional Science and Urban Economics* 45, pp. 67–79. ISSN: 0166-0462. DOI: <https://doi.org/10.1016/j.regsciurbeco.2014.01.004>. URL: <http://www.sciencedirect.com/science/article/pii/S016604621400012X>.
- Peri, Giovanni (2016). “Immigrants, productivity, and labor markets”. In: *Journal of Economic Perspectives* 30.4, pp. 3–30.
- Perugini, Cristiano and Fabrizio Pompei (2017). “Temporary Jobs, Institutions, and Wage Inequality within Education Groups in Central-Eastern Europe”. In: *World Development* 92, pp. 40–59. ISSN: 0305-750X. DOI: <https://doi.org/10.1016/j.worlddev.2016.11.009>.
- Pikhart, Hynek et al. (2004). “Psychosocial factors at work and depression in three countries of Central and Eastern Europe”. In: *Social Science & Medicine* 58.8. Health inequalities and the psychosocial environment, pp. 1475–1482. ISSN: 0277-9536.
- Quast, Bastiaan and Victor Kummritz (2015). *decompr: Global value chain decomposition in r*. Tech. rep. The Graduate Institute of International and Development Studies.
- Ramaswami, VK (1968). “International factor movement and the national advantage”. In: *Economica* 35.139, pp. 309–310.
- Rauch, James E and Vitor Trindade (2002). “Ethnic Chinese networks in international trade”. In: *Review of Economics and Statistics* 84.1, pp. 116–130.

- Riboud, Michelle, Carolina Sanchez-Paramo, and Carlos Silva-Jauregui (2002). *Does Eurosclerosis Matter? Institutional Reform and Labor Market Performance in Central and Eastern Europe*. The World Bank.
- Richard, Freeman (1994). "What Direction for Labor Market Institutions in Eastern and Central Europe?" In: *Transition in Eastern Europe*. Ed. by O. Blanchard, K. Froot, and J. Sachs. Vol. 2. NBER. University of Chicago Press. Chap. 8.
- Richardson, J. David (1995). "Income Inequality and Trade: How to Think, What to Conclude". In: *Journal of Economic Perspectives* 9.3, pp. 33–55.
- Robone, Silvana, Andrew Jones, and Nigel Rice (2011). "Contractual conditions, working conditions and their impact on health and well-being". In: *The European Journal of Health Economics* 12.5, pp. 429–444. DOI: 10.1007/s10198-010-0256-0.
- Rogerson, Richard (2008). "Structural Transformation and the Deterioration of European Labor Market Outcomes". In: *Journal of Political Economy* 116.2, pp. 235–259. DOI: 10.1086/588029.
- Romalis, John (2007). "NAFTA's and CUSFTA's Impact on International Trade". In: *The Review of Economics and Statistics* 89.3, pp. 416–435.
- Stark, Oded, Christian Helmenstein, and Alexia Prskawetz (1997). "A brain gain with a brain drain". In: *Economics letters* 55.2, pp. 227–234.
- Stark, Oded and Yong Wang (2002). "Inducing human capital formation: migration as a substitute for subsidies". In: *Journal of Public Economics* 86.1, pp. 29–46.
- The European Commission (2006). *Enlargement, two years after: an economic evaluation*. Tech. rep. European Commission.
- Topalova, Petia (2007). "Trade Liberalization, Poverty and Inequality: Evidence from Indian Districts". In: *Globalization and Poverty*. NBER Chapters. National Bureau of Economic Research, Inc, pp. 291–336.
- (2010). "Factor Immobility and Regional Impacts of Trade Liberalization: Evidence on Poverty from India". In: *American Economic Journal: Applied Economics* 2.4, pp. 1–41.
- Wagner, Don, Keith Head, and John Ries (2002). "Immigration and the Trade of Provinces". In: *Scottish Journal of Political Economy* 49.5, pp. 507–525.
- Wang, Zhi, Shang-Jin Wei, and Kunfu Zhu (2013). *Quantifying international production sharing at the bilateral and sector levels*. Tech. rep. National Bureau of Economic Research.

Titre: Marchés du travail et migrations dans une économie européenne intégrée

Mots clés: Intégration européenne, marchés du travail, migration, macroéconomie internationale

Résumé: Cette thèse s'intéresse aux transformations apportées par l'intégration européenne à un large éventail d'enjeux de politique publique tels que l'éducation, les conditions de travail, les salaires ou les délocalisations. À cette fin, des méthodes théoriques et empiriques sont utilisées, comprenant entre autres l'analyse de larges bases de micro-données. Les cycles économiques et l'éducation sont deux éléments importants de la compréhension de la mobilité des travailleurs en Europe. Le premier chapitre propose ainsi un modèle à générations imbriquées à deux pays avec agents hétérogènes et fluctuations économiques pour réévaluer l'importance de la mobilité des travailleurs comme mécanisme d'ajustement dans une zone monétaire. Il montre que, avec des agents mobiles, des chocs asymétriques de court terme amènent à une augmentation générale du niveau de compétences des travailleurs. En effet, dans une économie en dépression, la possibilité de migrer constitue une option payante qui renforce les incitations à s'éduquer. Certaines hypothèses et résultats du modèle théorique sont confirmés empiriquement. Une simulation illustre certaines propriétés du modèle, tel que la

persistance des chocs conjoncturels et le compromis à faire entre l'augmentation du niveau de compétence et l'importance des flux migratoires. D'autres effets de la mobilité des travailleurs sont développés dans le deuxième chapitre. Bien que les élargissements de l'UE en 2004 et 2007 se soient traduits par une suppression instantanée des barrières commerciales, les marchés du travail ouest-européens n'ont été ouverts que graduellement aux travailleurs d'Europe de l'Est. Nous utilisons ce décalage pour montrer que la vague migratoire ayant suivi cette ouverture a réduit les délocalisations à l'Ouest. En effet, il est devenu plus aisé d'employer des travailleurs Est-Européens peu qualifiés. Le troisième chapitre se concentre sur les conséquences des élargissements européens sur les nouveaux pays membres. Nous utilisons une nouvelle base de données au niveau travailleurs portant sur 9 pays d'Europe Centrale et Orientale afin d'explorer les effets de la libéralisation commerciale ayant accompagné l'intégration sur les salaires et les conditions de travail. Nos résultats montrent une baisse des salaires et une détérioration des conditions de travail, qui sont amplifiées par l'érosion des institutions protectrices du marché du travail.

Title: Labour markets and migrations in an integrated European economy

Keywords: European integration, labour markets, migration, international macroeconomics

Abstract: This thesis delves into the transformations brought by European integration to a wide array of policy relevant issues, including education choices, working conditions, wages and offshoring. To that end both theory and empirical methods are used, involving diverse quantitative techniques and large micro-level datasets. Economic cycles and education both matter in the understanding of labour mobility in Europe. Hence, the first chapter proposes a two-country overlapping generation model with heterogeneous agents and fluctuations to reassess the value of labour mobility as an adjustment mechanism in a currency area. It shows that, if agents are mobile, short-term asymmetric shocks lead to a population-wide upgrade in skills. Indeed, in a depressed economy the possibility to migrate provides a skill-biased outside option for agents willing to pay a migration cost and reinforces incentives to educate. Then, an empirical approach is used to confirm some of the theoretical assumptions and results. Finally,

a simulation exercise illustrates some properties of the model, in particular the persistence of temporary shocks and the trade-off between the skill upgrade effect and the size of migration flows. Other effects of labour mobility are developed in the second chapter. While the 2004 and 2007 EU enlargements led to an instant trade liberalization, Western European labour markets only gradually opened to Eastern European workers. We use this gap to provide evidence that the migration wave that followed reduced offshoring as employing low-skill Eastern European workers became easier in Western Europe. The third chapter focuses on the consequences of EU enlargement on entrants. We use a large new worker-level dataset spanning across 9 Central and Eastern European countries to explore the effects of EU-induced trade liberalization on wages and working conditions. We find that this event reduced hourly wages and deteriorated working conditions. These effects are magnified by the erosion of protective labour market institutions.