Trade, FDI, and Equilibrium Unemployment: Theory and some Evidence

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Chapter 1

Introduction

The public opinion meets globalization with mixed feelings. On the one hand exports are often viewed as a beneficial source of economic growth and prosperity, but on the other hand the deepening of international relations is also often regarded as threat for domestic labor markets. Figure (1.1) summarizes a poll conducted for the Flash Eurobarometer, where people were asked about their personal opinion on globalization and its impact on domestic labor markets.

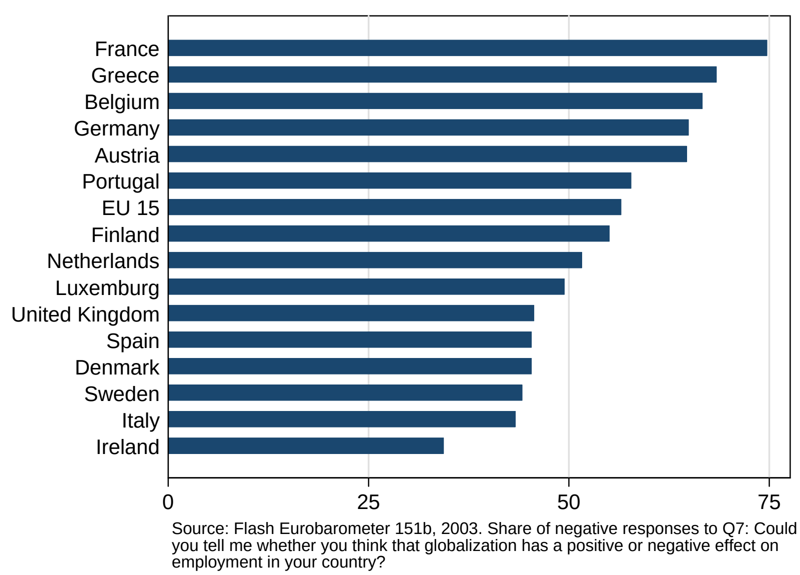

Figure 1.1: Is Globalization Bad for Employment?

In France, for instance, almost 75% of the participants expressed a negative view by answering the question whether globalization is bad for employment with "Yes". The result for the EU 15 countries is less extreme but still more than 50% of the participants conveyed concerns over globalization when it comes to employment-effects. Moreover, Frijters and Geishecker (2008) find that outsourcing to low-cost countries increases the fear of a potential job loss. Strikingly, they find that the magnitude of this fear is stronger for medium and high-skilled than for low skilled workers. They conclude that high skilled workers (compared to low skill workers) face the same risk of loosing their job but have more to loose in terms of firm and industry specific capital. High skilled workers therefore might be more concerned about a potential job loss than low skilled workers. The widespread believe that globalization may cause massive job losses motivates the studies presented in this thesis. In various ways, the studies combine theory and empirics in order to shed light on the relationship between trade liberalization, foreign direct investment and unemployment.

But how relevant is the topic unemployment in the public debate? It is certainly true that only a small fraction of a country's labor force is directly affected by unemployment. Nevertheless, the Eurobarameter identifies unemployment as one of the most important issues amongst topics as inflation, or health for instance. Shortly after the financial crisis in 2008 unemployment replaces inflation as most important issue. One potential explanation for this outcome is given by an emerging literature on the effects of unemployment on individuals' happiness. See for instance Di Tella, MacCulloch, and Oswald (2001) who show that individuals' well-being negatively depends on the overall rate of unemployment and inflation, even for those who are employed. The contributions of our research is to advance an understanding on different channels through which globalization in form of trade liberalization or foreign direct investment can affect a country's equilibrium rate of unemployment, which is closely related to a series of theoretical and empirical papers that also focus on the labor market effects of globalization. Brecher (1974) was amongst the first researchers who investigated the link between trade and labor markets in an open economy setup with minimum wages. Based on Brecher (1974), Davis (1998) asked how asymmetric labor market institutions affect equilibrium wages and unemployment in the transition from autarky to free trade in a two-country setup. He distinguishes between a European labor market with less flexible wages, and a more flexible American economy. Going from autarky to free trade simultaneously increases the rigid country's unemployment, and the flexible country's unskilled wage. More recently, a novel paper by Egger, Egger, and Markusen (2009) also investigates those spillover effects in a trade model with heterogeneous firms and minimum wages.

Davidson and Matusz (2004) and Davidson et al. (1988, 1999) analyze those effects by incorporating the Pissarides search and matching framework into international trade models such as the Heckscher Ohlin model. Building on their work, Moore and Ranjan (2005) came forward with a model that allows to study how globalization affects skill-specific unemployment in a Heckscher Ohlin framework. Larch and Lechthaler (2011) combine Moore and Ranjan (2005) and Bernard et al. (2007). They study how trade liberalization in a model with heterogeneous firms, high and low skill workers and search frictions. They find that high skill workers benefit most from trade liberalization, whereas low skill workers' skill specific unemployment rate slightly increases. However, the reduction of high skill unemployment dominates the increasing effect on low skill unemployment.

At the research frontier on trade and labor markets, a series of papers introduced labor market frictions from different provenances into the Melitz (2003) heterogeneous firm framework. Egger and Kreickemeier (2009) were amongst the first who relaxed the full employment condition in the Melitz model by introducing a fair wage constraint, which gives rise to unemployment and wage dispersion. They further advanced their model by additionally allowing for heterogeneous workers in a companion paper. Davis and Harrigan (2011) later focus on an efficiency wage approach and analyze the impact of globalization on good and bad jobs.

Another source of frictions are those related to search and matching. Mortensen and Pissarides (1994) highlighted the problem of costly search in the labor market and show how search frictions affect wages and equilibrium unemployment. The huge success of their theory is also due to its empirical relevance. Davis et al. (1998) showed that a closer look at firm level data reveals huge job turnover rates in the labor market, which is due to simultaneous job creation and destruction. Thus, the impact of search frictions and the efficiency in search and matching has a strong impact on the workers' performance in the labor markets. Analyzing the labor market effects of globalization by combining the two workhorse models in trade and labor is thus sensible and was done by Helpman and Itskhoki (2010), who introduced search frictions into the Melitz (2003) model to study the effects of trade liberalization on unemployment.

More recently, the interaction between worker and firm heterogeneity raised new insights in the sorting of firms and workers. Helpman et al. (2010 a,b) or Davidson et al. (2008) show that heterogeneous workers in a model with firm heterogeneity leads to assortative matching. Moreover, both papers provide an analysis on how globalization can affect the sorting of workers into firms. In Helpman et al. (2010 a,b) more productive firms are more efficient in screening their workers, which allows them to sort out the less efficient workers with low ability. Thus, more productive firms have more productive workers, where workers'productivity is measured as ability drawn from a distribution common to all workers. Davidson et al. (2008) distinguish between high and low technology firms and show that it is optimal for firms and workers to match assortatively. Mismatches are more likely to occur if the gap between low and high skill firms' profits is small. They show that trade increases the gap between both type of firms' profits, which affects assortative matching between firms and workers due to the low number of mismatches.

Davidson et al. (2010) also provide some empirical evidence for their theoretically derived results and show that assortative matching is stronger in industries more prone to globalization indicated by a higher degree of openness. However, they do not provide any evidence on the channel highlighted in their theory, where the causality goes from openness, to the dispersion of profits, to the sorting behavior of firms and workers.

Recently, Davidson and Matusz (2004) gave an overview over the existing trade and unemployment literature where they focus on the classical trade models with search frictions. Dutt, Mitra, and Ranjan (2009) compare a Ricardo and a Heckscher Ohlin model with search and matching between workers and firms under perfect competition. They distinguish between the input factors capital and labor and assume frictionless capital markets. They also test the predictions of both theories and find a negative relationship between trade and unemployment.

Another strand of literature focuses on outsourcing or offshoring and labor market outcomes. Mitra and Ranjan (2007) and Davidson et al. (2008) focus on the employment effects of outsourcing in trade models with search frictions. Mitra and Ranjan (2007) propose a two sector model with one input factor labor. In their model outsourcing decreases equilibrium unemployment. In Davidson et al. (2008) outsourcing forces some of the high skill workers in the North to search for jobs in the low skill sector. This stirs up job competition in the low skill sector and thus triggers a rise in unemployment. Kohler and Wrona (2010) find a non-monotonic relationship between offshoring and unemployment by identifying channels through which offshoring can affect labor demand at the intensive and extensive margin. The two opposing effects lead to an outcome where the sign of the effect hinges on the level of offshoring. This thesis contributes to this large and emerging literature as follows. In chapter 2, 3, and 4 we focus on the effects of trade liberalization on labor market outcomes, in particular unemployment. In chapter 5 and 6 of this thesis FDI thrust into our spotlight. Some predictions about how capital flows between countries affect labor markets are derived theoretically and tested in the last chapter using macroeconomic data provided from the OECD and the UNCDAT. The thesis is structured as follows.

Globalization and Labor Market Outcomes (Felbermayr, Prat, and Schmerer (2011a)).[1] This chapter is based on Felbermayr, Prat, and Schmerer (2011a) where we introduce search unemployment into Melitz's trade model. Firms' monopoly power on product markets leads to strategic wage bargaining. Solving for the symmetric equilibrium we show that the selection effect of trade influences labor market outcomes. Trade liberalization lowers unemployment and raises real wages as long as it improves average productivity. We show that this condition is likely to be met by a reduction in variable trade costs or by entry of new trading countries. Calibrating the model, we show that the long-run impact of trade openness on the rate of unemployment is negative and quantitatively significant.

Trade and Unemployment (Felbermayr, Prat, and Schmerer (2011b)).[2] Chapter 3 is based on Felbermayr, Prat, and Schmerer (2011b), which documents a robust empirical regularity: in the long-run, higher trade openness is causally associated with a lower structural rate of unemployment. We establish this fact using: (i) panel data from 20 OECD countries, and (ii) cross-sectional data on a larger set of countries. The time structure of the panel data allows to deal with endogeneity concerns, whereas cross-sectional data make it possible to instrument openness by its geographical component. In both setups, we carefully purge the data from business

[1] This Chapter is based on Felbermayr, Prat, and Schmerer (2011a), an article published in the *Journal of Economic Theory*. The concept for the paper was developed jointly, theoretical analysis and writing were shared equally, and the calibration exercise was carried out by the author of this thesis.

[2] This Chapter is based on Felbermayr, Prat, and Schmerer (2011b), an article published in the *European Economic Review*. The concept for the paper was developed jointly, writing was shared equally, and the empirical analysis was carried out by the author of this thesis.

cycle effects, include a host of institutional and geographical variables, and control for within-country trade. Our main finding is robust to various definitions of unemployment rates and openness measures. The preferred specification suggests that a 10 percent increase in total trade openness reduces unemployment by about one percentage point. Moreover, we show that openness affects unemployment mainly through its effect on TFP and that labor market institutions do not appear to condition the effect of openness.

FDI and Skill-Specific Unemployment. The model established in this chapter allows to study the interaction and cross-country-spillover effects between FDI and labor markets in a Feenstra and Hanson (1996) type of theoretical model with a continuum of industries and imperfect labor markets due to Pissarides (2000) type search frictions. I can show that FDI outflows increase skill-specific equilibrium unemployment in the FDI sending country whereas the receiving country benefits from FDI-inflows and expands production to industries formerly associated to the sending country. The analysis of unemployment in a continuum of industries framework facilitates the distinction between adjustments at the intensive and extensive margin of labor demand. Changes in labor market institutions also affect FDI-flows between countries and lead to spillover effects between the integrated countries' labor markets.

FDI and Unemployment: Theory and Empirics. Chapter 6 differs from Chapter 5 in making the assumption that only homogeneous labor is used for production. It is possible to replicate the same findings as derived in chapter 5 on the aggregate level which facilitates an empirical investigation of the relationship highlighted in the theory presented before. The focus in this chapter lies on the empirical evidence for the relationship highlighted in chapter 5 and 6. Panel data on unemployment rates for 20 OECD countries is used to show that net-FDI is robustly associated with lower aggregate and skill-specific unemployment rates. Finally, the empirical findings presented in this section suggest that improvements in labor market institutions tend to trigger *FDI-outflows*.

The conclusion in the last chapter summarizes the main findings. Moreover, it sketches an interesting array of future research.

Chapter 2

Globalization and Labor Market Outcomes[1]

2.1 Introduction

As discussed in the introduction, people agree that consumers benefit from trade but they are at the same time deeply concerned by its impact on job security. Fueled by numerous headlines about layoffs and outsourcing, many fear that globalization will worsen their prospects on the labor market.[2] To a certain extent, economic theory can rationalize this fear. Workers who lose their jobs due to trade liberalization have to go through a period of active search before finding new employment opportunities. During this transition period, job reallocations increase the amount of frictions in the labor market which mechanically pushes up the rate of unemployment. On the other hand, comparatively little is known about the long-run effect of trade liberalization on unemployment. This is largely because equilibrium theories of trade and labor

[1] This Chapter is based on an article published in the *Journal of Economic Theory.* For the article version, see Felbermayr, Prat, and Schmerer (2011a). The concept for the paper was developed jointly, theoretical analysis and writing were shared equally, and the calibration exercise was carried out by the author of this thesis.

[2] Scheve and Slaughter (2001) provide a detailed analysis of how American workers perceive globalization.

are still poorly integrated. In Felbermayr, Prat, and Schmerer (2011a), we attempt to bridge the two literatures by proposing a framework which combines the currently dominant approaches in each field. We integrate a version of Melitz's (2003) trade model with Pissarides' (2000) canonical model of equilibrium unemployment. Building on Hopenhayn (1992) and Krugman (1980), the Melitz-model shows how trade liberalization affects the productivity distribution of firms through selection of efficient firms into exporting and of inefficient firms into exit. That *selection effect* enjoys massive empirical support[3] and constitutes a tangible source of gains from trade that the earlier literature has paid little attention to. Our analysis suggests that it also matters for labor market outcomes. We find that, for reasonable parameter values, the cleansing effect of trade lowers search unemployment. As the cost of vacancy posting relative to the productivity of the average firm decreases, employers intensify their recruitment efforts. This raises the ratio of job vacancies to unemployed workers, which leads to lower unemployment and higher real wages.

Our framework modifies Melitz's and Pissarides' setups as follows. First, we neutralize the external scale effect that is inherent to the usual CES description of utility. This allows to concentrate on the selection effect that is novel to Melitz and avoids that the model features a negative correlation between country size and the equilibrium rate of unemployment, which would be at odds with empirical evidence. In the Appendix, we show that our results are robust to allowing for the existence of a scale effect.

We also need to adapt the search-matching framework, which builds on competitive product markets, so as to make it compatible with the assumption of monopolistic competition used in trade models of the Krugman (1980) tradition. Allowing for monopoly power on product markets implies that we have to abandon matches as our unit of analysis and consider instead multiple-worker firms. Given the existence of

[3] See, among others, the surveys by Helpman (2006) or Bernard et al. (2007).

search frictions, this introduces the complication of intra-firm bargaining. We focus on individual bargaining, where each worker is treated as the marginal worker and which is closest to competitive wage setting. However, in the Appendix we show that our main results continue to hold in a setting where management bargains with firm-level unions.

Although the model features firms with heterogeneous productivity, monopoly power on product markets, external economies of scale, and, due to search frictions, monopsony power on labor markets, we are able to characterize its equilibrium in closed-form. The aggregation procedure proposed by Melitz goes through with little modification because, regardless of the bargaining environment, firms with different productivity levels pay similar wages. We also obtain a useful *separability result* according to which the equilibrium *average* productivity of input producers is independent from labor market outcomes. As a result, the system of equilibrium conditions turns out to be recursive. One can follow the same steps as Melitz (2003) to compute the average productivity in the economy and then solve for the equilibrium in the labor market.

The labor market equilibrium can be derived as in the standard Pissarides model by interacting a job creation and a wage curve. Then, whether trade liberalization improves or worsens labor market outcomes depends solely on how it affects average productivity. Even though trade liberalization reallocates market shares toward efficient firms, exporters also incur transport costs that have to be deducted from the productivity gains. This is why trade liberalization does not necessarily enhance average productivity net of transport costs. We establish that both average productivity and employment always increase following a reduction in variable trade costs or an increase in the number of trade partners, as long as fixed foreign distribution costs are larger than domestic ones. Given that this requirement is satisfied by realistic calibrations of the model, such liberalization policies are likely to improve labor market outcomes. The gains of reducing fixed costs for foreign firms turn out to be more elusive because such a change benefits almost exclusively to new exporters.[4]

We conclude our analysis by a calibration exercise. Simulating various trade liberalization scenarios allows us to to sort out the ambiguities, in particular regarding the role of fixed foreign costs, and to assess the magnitude of the effects. The simulations predict that reducing variable trade costs, or increasing the number of trade partners, has a significantly positive impact on both wages and employment.

Related literature. We build on an earlier work (Felbermayr and Prat (2011)) where search unemployment is introduced into a closed economy version of Melitz (2003) with the aim to study product market regulation. The relation is straightforward, since trade liberalization can be understood as an alternative type of product market reform. In modeling bargaining regimes, we draw on Ebell and Haefke (2009), who analyze a closed-economy, *homogeneous* firms model of search and unemployment.

Our approach is closely related to the recent work of Egger and Kreickemeier (2009), who study the effect of trade liberalization in a model with *fair wages* and without search frictions. They find that trade increases the wage dispersion among identical workers and also leads to more unemployment. Davis and Harrigan (2011) find similar results for the degree of wage dispersion and unemployment, using an efficiency wages approach instead of fair wages. The model closest to ours is presented by Janiak (2006). His framework exhibits an equilibrium under the assumption that the elasticity of substitution is smaller than two. As explained below, this restriction explains why Janiak's model predicts that trade liberalization raises equilibrium un-

[4]Introducing external economies of scale drives a wedge between *average* and *aggregate* productivity. It complicates the analysis as we also have to take into account the positive relationship between input diversity and average productivity. This new effect gives rise to an additional equilibrium relation and restricts the parameter space where the model admits a unique equilibrium. Setting aside these technical results, we find that economies of scale do not modify the qualitative implications of the model. They actually reinforce the positive impact of trade liberalization by adding the variety-enhancing effect described in Krugman (1980) to the selection effect.

employment. In our model, equilibrium existence and uniqueness is guaranteed under less restrictive and more plausible conditions.

Mitra and Ranjan (2007) and Helpman and Itskhoki (2010) introduce search unemployment in two-sector models with heterogeneous firms. Their approaches differ from ours in terms of motivation and setup: Mitra and Ranjan discuss the role of off-shoring; Helpman and Itskhoki focus on how labor market distortions diffuse internationally through trade. When, as in our setup, countries are symmetric, the model of Helpman and Itskhoki features a negative trade-unemployment link: trade boosts average productivity in the differentiated goods sector, making employment there more attractive. This leads to a reallocation of labor from the distortion-free numéraire sector into the friction-ridden differentiated goods sector.[5] Helpman, Itskoki and Redding (2010 a,b), propose models with heterogeneous firms and search frictions to address the effect of trade liberalization on wage inequality. There is also an emerging empirical literature on the effects of trade liberalization on aggregate unemployment.

Structure of the chapter. The remainder of the chapter is organized as follows. Chapter 2.2 lays out the setup of the model. Chapter 2.3, solves for labor market equilibrium as a function of average productivity. In chapter 2.4, we show how firms' exit and entry decisions shape average productivity in an economy open to international trade. Chapter 2.5 studies the effects of three globalization scenarios: (*i*) a reduction in variable trade costs, (*ii*) an increase in the number of trade relations, (*iii*) a reduction in fixed exporting costs. Chapter 2.6 calibrates the model in order to quantify the magnitude of the effects. Chapter 2.7 concludes. Chapter 2.8 provides additional results and chapter 2.9 provides all proofs of the propositions, lemmata and corollaries.

[5]Davidson et al. (1999) propose a model with two-sided heterogeneity, where goods markets are perfectly competitive and firms endogenously choose technologies.

2.2 Setup of the Model

We consider an economy that is essentially similar to the one analyzed in Melitz (2003) but for the existence of search frictions in the labor market. As in Melitz, the world is modeled as a collection of symmetric countries which interact on product markets.[6] We deviate from existing treatments by neutralizing the external effect of input diversity on average productivity.

Final output producers. The setup of the production side of our model is akin to Egger and Kreickemeier (2009). The single final output good, Y, is produced under conditions of perfect competition and can be either consumed or used as an input in the production process. Good Y is assembled from a continuum of intermediate inputs, which may be produced domestically or imported, and which may command different equilibrium prices. Denoting the quantity of such an input $q(\omega)$, we posit the following production function

$$Y = \left[M^{\frac{\nu-1}{\sigma}} \int_{\omega\in\Omega} q(\omega)^{\frac{\sigma-1}{\sigma}} d\omega \right]^{\frac{\sigma}{\sigma-1}}, \ \sigma > 1, \ \nu \in [0,1], \tag{2.1}$$

where the measure of the set Ω is the mass M of available intermediate inputs, each produced by a monopolistically competitive firm. We refer to M as the degree of *input diversity* while σ denotes the elasticity of substitution between any two varieties of inputs.

To understand the role played by ν, suppose that all varieties are demanded in identical quantities. Substituting $q(\omega) = Q/M$, where Q is an aggregate index of input demand, yields $Y = M^{\frac{\nu}{\sigma-1}}Q$. If $\nu = 0$, then $Y = Q$ and the number of available varieties is irrelevant for total output. This is the case discussed by Blanchard and Giavazzi (2003) or Egger and Kreickemeier (2009).[7] If $\nu = 1$, the production function

[6] For brevity, we skip the special case of autarky. Due to symmetry, we do not use country indices.

[7] Our formulation of the aggregate production is formally similar to the utility function employed

takes the conventional Dixit-Stiglitz form, where an increased number of varieties raises total output.

In the following, we set $\nu = 0$. This avoids a counterfactual negative correlation between the unemployment rate in autarky and the labor supply. With trade and symmetric countries, this counterfactual implication is maintained on the world level.[8] We nonetheless allow for $\nu > 0$ in the Appendix to accommodate the dominant practice in the trade literature where gains from increased diversity are generally deemed important.

Setting $\nu = 0$, the price index dual to (2.1) is $P = \left[M^{-1} \int_{\omega \in \Omega} p(\omega)^{1-\sigma} d\omega\right]^{1/(1-\sigma)}$, where $p(\omega)$ is the price of input ω, inclusive of potential trade costs. We choose the final output good as the *numéraire*, i.e. $P = 1$. Then the demand of intermediate inputs ω reads

$$q(\omega) = \frac{Y}{M} p(\omega)^{-\sigma}. \tag{2.2}$$

Intermediate input producers. At the intermediate inputs level, there is a continuum of monopolistically competitive firms which produce each a unique variety. Labor is the unique factor of production. It is inelastically supplied by the household and enters firms' production functions linearly. Firms have different productivity levels $\varphi(\omega)$, so that output $q(\omega) = l(\omega)\varphi(\omega)$. In the following, we use φ to index intermediate input producers.

On the domestic and on each of the n symmetric export markets, input producers face fixed market access costs (e.g., distribution costs), f_D and f_X respectively.[9]

by Corsetti, Martin, and Pesenti (2007) who also stress the role of ν. Egger and Kreickemeier (2009) allow for $\nu \in [0, 1]$ in the Appendix of their paper. Benassy (1996) discusses how the welfare properties of the Krugman (1990) model depend on ν. In particular, if $\nu \neq 1$, the decentralized equilibrium may yield over- or under-supply of input variety. This discussion carries over to the Melitz (2003) model.

[8] With heterogeneous countries and costly trade, larger countries suffer less from trade costs, have a higher level of average productivity, and a lower rate of unemployment.

[9] Since capital markets are perfect and uncertainty is resolved before market access costs are paid, f_X and f_D can be thought as flow fixed costs or – appropriately discounted – as upfront investment. In the latter case, whenever applicable, we use upper-case letters.

Throughout the chapter, we assume that $\tau^{\sigma-1} f_X > f_D$. As explained below, this ensures that only a subset of firms export and that exporters are on average more efficient than non-exporting firms, a well-established stylized fact in the trade literature (see for example the survey by Bernard et al. (2003)).

International trade is subject to variable iceberg trade costs $\tau \geq 1$ so that, in order to deliver a unit of input to a foreign market, the firm has to manufacture τ units. If it decides to serve both the domestic and the foreign markets, a firm allocates its output so as to maximize its total revenues. Operating revenues from sales on a given foreign market are therefore equal to $p_X q_X / \tau$.[10] By symmetry, demands on the domestic and foreign markets are given by equation (2.2). Equating marginal revenues across markets yields $p_X(\varphi) = \tau p_D(\varphi)$ and $q_X(\varphi) = \tau^{1-\sigma} q_D(\varphi)$, where D and X denote the domestic and the export market. Hence, total revenues are given by

$$R(l;\varphi) \equiv \left[\frac{Y}{M} \left(1 + I(\varphi) n \tau^{1-\sigma} \right) \right]^{1/\sigma} (\varphi l)^{\frac{\sigma-1}{\sigma}} , \tag{2.3}$$

with $I(\varphi)$ being an indicator function that takes value one when a φ-firm exports and zero otherwise. Apart from the fact that their effective demand level is multiplied by $1 + n\tau^{1-\sigma}$, exporting firms have similar revenue functions than non-exporting firms.

In order to facilitate the aggregation procedure, we define the *average productivity* level $\widetilde{\varphi}$ such that $q_D(\widetilde{\varphi}) = Y/M$. Hence, domestic sales of the average firm are equal to average sales per firm, and the domestic price of its good $p_D(\widetilde{\varphi}) = P = 1$.

Search frictions. The labor market is imperfectly competitive due to the existence of search frictions. Whereas marginal recruitment costs are increasing at the aggregate level because of congestion externalities, they are exogenous from a firm's point of view. The aggregate matching function is homogeneous of degree one so that the vacancy-unemployment ratio θ uniquely determines the rate $m(\theta)$ at which firms fill

[10]Notice that p_X is the c.i.f. price in the foreign market.

their vacancies. That rate is a decreasing function of θ and satisfies the following standard properties: $lim_{\theta\to\infty}m(\theta) = 0$ and $lim_{\theta\to 0}m(\theta) = \infty$. Due to the linear homogeneity of the matching function, job seekers meet firms at the rate $\theta m(\theta)$ which is increasing in θ. The cost of posting vacancies is proportional to the parameter c, so that recruiting l workers entails spending $[c/m(\theta)]\, l$.[11] In other words, firms face an adjustment cost function that is linear in labor.

2.3 Bargaining, wages, and unemployment

This chapter characterizes the labor market outcomes for given average productivity when wages are bargained individually. It shows that wages are constant across firms and the vacancy-unemployment ratio is increasing in average productivity.

We devise our model in discrete time. All payments are made at the end of each period. Before the beginning of the next period, firms and workers are hit by idiosyncratic shocks: (i) with probability δ, intermediate producers are forced to leave the market; (ii) with probability χ, each job is destroyed because of match-specific shocks. We assume that these two shocks are independent so that $s = \delta + \chi - \delta\chi$ denotes the actual rate of job separation.

Unemployed workers earn a flow income $b\bar{w}$, where $b \in (0, 1)$, and which we index to the average wage rate in the economy, $\bar{w}$.[12] Alternatively, one could also index the value of non-market activity to average productivity $\tilde{\varphi}$ or to the final output good (whose price is normalized to unity). In the case where $\nu = 0$, the choice of indexation makes no important difference. On the other hand, when there are economies of scales ($\nu > 0$), indexation to the final output good leads to multiple equilibria, while the other normalizations ensure the existence of a unique equilibrium. For the sake of realism and in order to rule out multiple equilibria, we therefore choose the first option

[11] The implications of the linearity assumption are discussed below in footnote 17.

[12] We thank the associate editor and an anonymous referee for suggesting this specific indexation.

and denote the flow income of the unemployed as $b\bar{w}$.

2.3.1 Optimal vacancy posting

Individual wage bargaining involves the following sequence of actions: at each period, the intermediate input producer decides about the optimal number of vacancies v, taking the wage rate as given. The matching technology brings together the workers and the firm. Before production takes place, wages are bargained. Wage contracts are unenforceable: at any point in time, the firm may fire any employee and symmetrically any employee may quit. Solving the game by backward induction, we first characterize the firm's optimal vacancy setting behavior and then analyze the bargaining problem.

The market value of an intermediate producer solves

$$J\left(l;\varphi\right) = \max_{v} \frac{1}{1+r}\left\{R(l;\varphi) - w\left(l;\varphi\right)l - cv - f_D - I(\varphi)nf_X + (1-\delta)J\left(l';\varphi\right)\right\}, \tag{2.4}$$

$$s.t.\ (i)\ R(l;\varphi) = \left[\frac{Y}{M^{\nu-1}}\left(1 + I(\varphi)n\tau^{1-\sigma}\right)\right]^{1/\sigma}(\varphi l)^{\frac{\sigma-1}{\sigma}}\ ,$$

$$(ii)\ l' = (1-\chi)l + m\left(\theta\right)v\ ,$$

where l' is the level of employment next period, and the dependence of l, v and q on φ is understood. Constraint (i) is the revenue function (2.3) and (ii) gives the law of motion of employment at the firm level. The first order condition for vacancy posting reads

$$\frac{c}{m(\theta)} = (1-\delta)\frac{\partial J(l',\varphi)}{\partial l'}\ , \tag{2.5}$$

so that the firm sets the shadow value of labor equal to the expected marginal recruitment cost. Substituting the constraints into the objective function of the firm, differentiating with respect to l, and using the optimality condition (2.5) yields

$$\frac{\partial J(l,\varphi)}{\partial l} = \frac{1}{1+r}\left[\frac{\partial R(l;\varphi)}{\partial l} - w(l,\varphi) - \frac{\partial w(l,\varphi)}{\partial l}l + \frac{c}{m(\theta)}(1-\chi)\right]. \tag{2.6}$$

The firm acts as a monopsonist by taking into account the effect of additional employment on the wage of inframarginal employees. The first order condition (2.6) regulates the optimal vacancy posting behavior of the firm, and hence, through the law of motion of employment, the optimal level of output. This, in turn, pins down the price of the intermediate input good: replacing the first order condition (2.5) on the left-hand side of (2.6) yields an expression that implicitly determines the optimal pricing behavior of the firm

$$\frac{\partial R(l;\varphi)}{\partial l} = w(l,\varphi) + \frac{\partial w(l,\varphi)}{\partial l}l + \frac{c}{m\left(\theta\right)}\left(\frac{r+s}{1-\delta}\right). \tag{2.7}$$

This expression differs from the pricing rule considered by Melitz (2003) in that marginal costs are augmented by a monopsony effect $(\partial w(l,\varphi)/\partial l)l)$ and expected recruitment costs $c(r+s)/(m(\theta)(1-\delta))$.

2.3.2 Individual wage bargaining

The total surplus accruing from a successful match is split between the employee and the firm. The worker's surplus is equal to the difference between the value of being employed $E\left(l;\varphi\right)$ by a firm with productivity φ and workforce l and the value of being unemployed U. The firm's surplus is simply equal to the marginal increase in the firm's value $\partial J\left(l;\varphi\right)/\partial l$ because individual bargaining implies that each employee is treated as the *marginal* worker. Following Stole and Zwiebel (1996) we assume that the outcome of bargaining over the division of the total surplus from the match satisfies the following "surplus-splitting" rule

$$(1-\beta)\left[E(l;\varphi)-U\right]=\beta\frac{\partial J(l;\varphi)}{\partial l}\ , \tag{2.8}$$

where the parameter β measures the bargaining power of the worker and thus belongs to $[0,1)$.[13]

As explained by Stole and Zwiebel (1996), condition (2.8) can be micro-founded either by cooperative or non-cooperative game theory. In the non-cooperative case, condition (2.8) characterizes the unique subgame perfect equilibrium of an extensive form game where the firm and its employees play the bargaining game of Binmore et al. (1986) *within* each bargaining session. Accordingly, neither the firm nor any employee can improve their positions by renegotiating. In the cooperative case, condition (2.8) assigns to each party its Shapley value, that is the average, over all possible permutations, of each player contribution to possible coalitions ordered below him.[14] When β differs from 1/2, condition (2.8) generalizes the symmetric Shapley value to situations where players are not treated identically.

2.3.3 Labor market outcomes for given average productivity

Reinserting the shadow value of labor (2.6) in the bargaining solution (2.8) leads to an ordinary differential equation in the wage rate. Combining its solution with the endogenous outside option of workers, $rU(\theta)$, we obtain a first relation between the degree of labor market tightness and the wage rate. We call it the *Wage* (W) curve. It reflects how behavior of firms and workers interact in the presence of monopoly power on product markets, search costs, and individual wage bargaining. Reinserting the solution of the differential equation satisfied by wages in the demand function for

[13] The case of $\beta = 1$ leads to the break-down of the labor market as firms cannot finance the posting of vacancies.

[14] This interpretation is the one favored by Helpman and Itskhoki (2010).

intermediate goods (2.2) yields a second relation between labor market tightness and the wage rate. Since this curve represents the demand for labor as a function of the bargained wage, we will hereafter refer to it as the *Labor Demand (LD)* curve.[15]

Proposition 1. *Under individual bargaining and without external economies of scale* ($\nu = 0$)*, the labor market admits a unique equilibrium such that wages are constant across firms. The equilibrium wage,* w*, and vacancy-unemployment ratio,* θ*, simultaneously satisfy the following Wage and Labor Demand conditions:*

$$W\text{:} \quad w = B\frac{c}{1-\delta}\left[\frac{r+s}{m(\theta)} + \theta\right] \tag{2.9}$$

$$LD\text{:} \quad w = \left(\frac{\sigma-1}{\sigma-\beta}\right)\tilde{\varphi} - \frac{c}{m(\theta)}\left(\frac{r+s}{1-\delta}\right) \tag{2.10}$$

where $B \equiv \frac{\beta}{1-\beta}\frac{1}{1-b}$ *is a measure of the bargaining power of the worker.*

The Labor Demand and Wage curves are illustrated in Figure 2.1. Note that, due to our choice of numeraire, w is the *real* wage. The Wage curve implies that wages depend only on *average* productivity so that workers are paid similarly across firms with different productivity levels. This somewhat surprising result extends to a dynamic setting the proof of Stole and Zwiebel (1996) that firms exploit their monopsony power until employees are paid their outside option. The equalization of wages across heterogeneous firms can also be understood by looking at equation (2.5). Since we assume that expected search costs are the same across firms, the shadow values of employment are identical, too. In other words, firms with different productivity levels choose employment levels such that the additional value created by the marginal worker is the same. Taking this insight to the surplus splitting rule (2.8), it is obvious that, despite firms having different productivity levels, job rents are the same over all firms. It follows that the value of employment $E(l;\varphi)$ and,

[15]The term commonly used in the search-matching literature for this relationship is *Job Creation* curve.

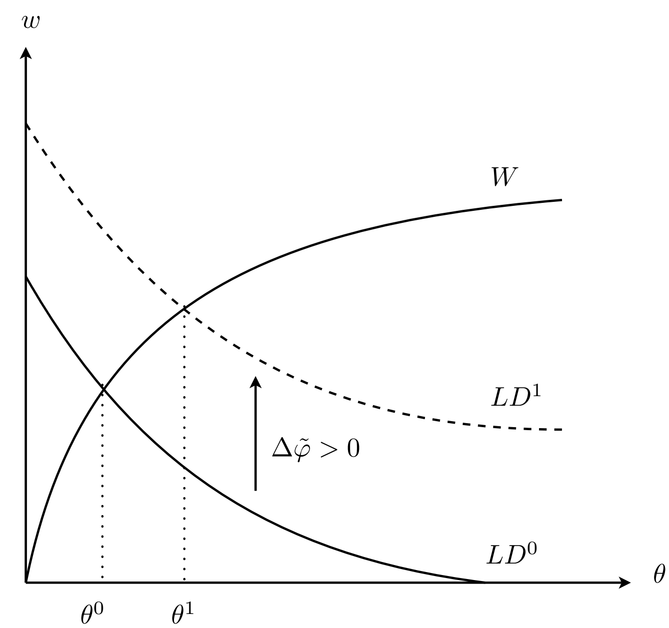

Figure 2.1: Effect of an increasing $\tilde{\varphi}$ in the Individual Bargaining regime.

hence, the wage rate cannot be different across firms.[16] The Wage curve is increasing in θ because the outside option is augmented by the recruitment costs that the firm has to pay in order to replace the worker. Quite intuitively, the workers' bargaining position is improving in the severity of labor market frictions.

The Labor Demand curve shows that θ is an increasing function of the wage rate because firms post more vacancies when wages are low. It also follows from (2.10) that the wage rate depends positively on the average firm's productivity $\tilde{\varphi}$, but any increase in $\tilde{\varphi}$ has a less than proportional effect on the wage rate due to the bargaining power of firms. The second right-hand-side term in (2.10) shows that higher expected search costs reduce the wage rate as they lead to a lower surplus out of a filled vacancy.

Figure 2.1 illustrates the effect of an increase in average productivity $\tilde{\varphi}$ on labor market tightness. The Labor Demand curve shifts upwards (from the solid to the dashed curve) because firms are on average more productive and search more intensively for workers. The flow value of non-market activity is simply set equal to an

[16] This is a fairly general result that does not rely on functional forms.

exogenous constant depending on the replacement rate and the equilibrium wage rate. Since the Wage curve is not affected by a change in $\tilde{\varphi}$, labor market tightness goes from θ^0 to θ^1 so that Corollary 2 follows immediately.

Corollary 2. *The vacancy-unemployment ratio θ is increasing in average productivity $\tilde{\varphi}$.*

The intuition for Corollary 2 is straightforward: as long as firms can appropriate some of the rents from a filled vacancy (i.e., if $\beta < 1$), the equilibrium wage increases less than proportionally with average productivity so that filled vacancies become more valuable. Firms intensify their recruitment effort until the increased congestion of the labor market brings back the value of posted vacancies down to zero.

It is instructive to consider two special cases. First, assume that the costs of vacancy posting c are indexed to the real wage. If that is the case, the Wage curve becomes vertical at some fixed level of θ. The reason is that the workers' outside option as well as their ability to extract rents does not change relative to the wage rate and hence bargaining settles at an unchanged employment level. Then, variations in $\tilde{\varphi}$ are entirely absorbed by variations in the wage while the rate of unemployment does not change. If c is at least partly indexed to the final output good, unemployment is still affected by $\tilde{\varphi}$. Second, assume that workers have no bargaining power, i.e., $\beta = 0$. Then, the Wage curve becomes horizontal at $w = 0$ and variations in $\tilde{\varphi}$ are entirely absorbed by changes in labor market tightness.

It may also be helpful to contrast the Wage and Labor Demand curves derived above with those obtained in more standard settings with homogeneous firms and perfect competition on product markets (as described in Chapter 1 of Pissarides (2000)). In this setup, average and all firm-level productivities coincide and are equal to the price of individual varieties of the final output good. The curves take the same slopes as in our model and the mechanisms that underly those curves are identical: the Wage curve is upward-sloping because a higher θ improves the outside option of workers, and the Labor Demand curve is downward-sloping because firms restrict the creation of vacancies when wages are higher.

In our model with heterogeneous firms, goods markets are more complex: the size of the surplus at the average firm depends on that firm's productivity level instead of an exogenous price. Even in the absence of technological progress, average productivity can change when employment shifts between firms with different productivity levels. Additionally, firm-level prices and the aggregate price index do not coincide; this allows relative prices (absent in the canonical model) to affect recruitment decisions. In spite of these important differences, the similarity between our Wage and Labor Demand curves and those derived in the canonical search-matching model is striking. The standard model therefore turns out to be quite robust to introducing firm-level productivity differences, product differentiation, and monopoly power on goods markets.

To sum up, we have shown that, if c is not fully proportional to wages and $\beta > 0$, the rate of unemployment falls and the real wage rises when average productivity $\tilde{\varphi}$ goes up. The next chapter explains how to endogenize $\tilde{\varphi}$.

2.4 Firm Entry and Exit

We model firm entry and exit in a similar fashion than Melitz (2003), which in turn draws on the seminal work by Hopenhayn (1992). We deliberately keep the analysis as brief as possible and refer the reader to Melitz' paper for further details. Our contribution is to show that the equilibrium level of average productivity $\tilde{\varphi}$ and labor market tightness θ are independent.

The entry process is in two stages. First, prospective entrants pay an entry cost F_E. Only after entering are they able to draw their productivity from a sampling distribution with c.d.f. $G(\varphi)$ and p.d.f. $g(\varphi)$. After the draw, productivities remain constant over time.[17] Given that firms' revenues are increasing in φ, there exists a threshold φ_D^* below which firms do not take up production. Similarly, firms with a productivity level between φ_D^* and φ_X^* will serve only their domestic market. The share of exporting firms is therefore equal to $\varrho \equiv [1 - G(\varphi_X^*)] / [1 - G(\varphi_D^*)]$. The average level of productivity of intermediate input producers is given by the following weighted sum

$$\tilde{\varphi} = \left\{ \frac{1}{1 + n\varrho} \left[\tilde{\varphi}_D^{\sigma-1} + n\varrho \left(\frac{\tilde{\varphi}_X}{\tau} \right)^{\sigma-1} \right] \right\}^{\frac{1}{\sigma-1}} , \tag{2.11}$$

where $\tilde{\varphi}_D$ and $\tilde{\varphi}_X$ are average productivity indices for the populations of firms that sell only domestically and that also sell abroad

$$\tilde{\varphi}(\varphi_D^*) = \left[\frac{\int_{\varphi_D^*}^{+\infty} \varphi^{\sigma-1} g(\varphi)\, d\varphi}{1 - G(\varphi_D^*)} \right]^{\frac{1}{\sigma-1}} \quad \text{and} \quad \tilde{\varphi}(\varphi_X^*) = \left[\frac{\int_{\varphi_X^*}^{+\infty} \varphi^{\sigma-1} g(\varphi)\, d\varphi}{1 - G(\varphi_X^*)} \right]^{\frac{1}{\sigma-1}} . \tag{2.12}$$

Because the adjustment cost function is linear in labor, firms reach their optimal size by the end of their first period of activity.[18] It is therefore profitable to start operating and exporting when

$$\frac{\Pi_i(\varphi)}{r+\delta} \equiv \left(\frac{1-\delta}{r+\delta} \right) \left[p_i(\varphi)\varphi l_i(\varphi) - w l_i(\varphi) - \frac{c}{m(\theta)} \chi l_i(\varphi) - f_i \right] - \frac{c}{m(\theta)} l_i(\varphi) - f_i \geq 0 , \tag{2.13}$$

where the subscript $i \in \{D; X\}$ indicates whether the variables relate to domestic or foreign markets operations, and Π_i denotes expected flow profits *net of recruitment costs.* Condition (2.13) accounts for the fact that firms pay market access and vacancy costs upfront but have to wait one period to recruit their workers. In this

[17] This stylized assumption is made mainly for tractability reasons. It is the key difference between Melitz's (2003) and Hopenhayn's (1992) models, as the latter also allows firms' productivities to vary over time.

[18] Gradual convergence can be restored either by considering that recruitment costs are convex in the number of posted vacancies, as in Bertola and Caballero (1994), or by assuming that firms can post only one vacancy, as in Acemoglu and Hawkins (2006). Since this greatly complicates the aggregation procedure, we adopt a more stylized specification where, as in Melitz (2003), firms jump to their optimal size. See Koeniger and Prat (2007) for a numerical analysis of a model with firm entry and convex adjustment costs.

period, they can be hit by a destruction shock, so that, with probability δ, they never start producing nor exporting. The cutoff productivities φ_i^* are such that the weak inequality in (2.13) binds.[19]

The proportionality of domestic and foreign prices implies that expected profits of the marginal and average firms satisfy the following relation

$$\frac{\Pi_i\left(\tilde{\varphi}_i\right)+f_i}{\Pi_i\left(\varphi_i^*\right)+f_i}=\frac{l_i\left(\tilde{\varphi}_i\right)}{l_i\left(\varphi_i^*\right)}=\left(\frac{\tilde{\varphi}_i}{\varphi_i^*}\right)^{\sigma-1} \quad , \text{ for } i\in\{D;X\} \ .$$

Hence, (2.13) is equivalent to the following *Zero Cutoff Profit* (ZCP) conditions

$$\Pi_i\left(\tilde{\varphi}_i\right)=(1+r)f_i\left[\left(\frac{\tilde{\varphi}_i}{\varphi_i^*}\right)^{\sigma-1}-1\right] \ , \text{ for } i\in\{D;X\} \ . \tag{2.14}$$

Combining both ZCP conditions, and exploiting the relationship between domestic and export cutoff allows us to establish a single aggregate ZCP condition which only depends on the domestic cutoff

$$\widetilde{\Pi}\equiv\Pi_D(\tilde{\varphi}_D)+n\varrho\Pi_X(\tilde{\varphi}_X)=(1+r)\left[f_Dk(\varphi_D^*)+n\varrho k(\varphi_X^*)\right] \ , \tag{2.15}$$

where $k(\varphi_D^*)=\left(\frac{\tilde{\varphi}_D(\varphi_D^*)}{\varphi_D^*}\right)^{\sigma-1}-1$, and $k(\varphi_X^*)=\left(\frac{\tilde{\varphi}_X(\varphi_X^*)}{\varphi_X^*}\right)^{\sigma-1}-1$, are both implicitly pinned down by φ_D^* through the relationship between domestic and export cutoffs, and where $\widetilde{\Pi}$ is average profits *net of adjustment costs*.[20]

The ZCP conditions characterize the optimal decision of a firm who knows its idiosyncratic productivity. Imposing *Free Entry* (FE) allows us to take into account the behavior of prospective entrants. Entry occurs until expected profits are equal to

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[19] To see that some firms serve solely their domestic market, notice that $R_X(\varphi)=p_X(\varphi)q_X(\varphi)/\tau=\tau^{1-\sigma}R_D(\varphi)$ and $l_X(\varphi)=\tau^{1-\sigma}l_D(\varphi)$. Replacing these expressions in (2.13) shows that a φ_D^*-firm does not find it profitable to incur the exporting costs when, as assumed in Chapter 2, $\tau^{\sigma-1}f_X>f_D$. When this partitioning does not hold, one cannot use equation (2.13) to determine whether or not a firm operates on the domestic market because it may be optimal to pay the fixed operating cost f_D in order to access the export markets.

[20] Although $\widetilde{\Pi}$ depends on both φ_D^* and φ_X^*, it identifies the two variables because $\varphi_X^*=\varphi_D^*\tau\left(f_X/f_D\right)^{\frac{1}{\sigma-1}}$. See the proof of Lemma 1 for a derivation of this equality.

the set up cost F_E, so that

$$\frac{F_E}{1-G(\varphi_D^*)} = \frac{\widetilde{\Pi}}{r+\delta} \ . \tag{2.16}$$

Free entry holds when this equality is satisfied because an entrant will start to operate with probability $1-G(\varphi_D^*)$ and then earn in each period an expected profit equal to $\widetilde{\Pi}$.

Apart from the deduction of recruitment and churning costs from revenues in the definition of expected profits, the aggregate ZCP and FE conditions are the same as in Melitz (2003). It follows that existence and uniqueness of the equilibrium in the product market are ensured. More precisely, the aggregate ZCP decreases in φ_D^* when average profits tend to be higher as the firm that breaks even at φ_D^* becomes more productive.[21] Conversely, the FE condition is upward-sloping: following an increase in φ_D^*, a larger fraction of started firms will fail to draw sufficiently high productivity levels. This drives up the expected cost of successful entry so that FE requires higher expected profits.

The two equilibrium conditions (2.15) and (2.16) are independent of the wage rate and vacancy-unemployment ratio θ. Thus, as stated in the following Lemma, the entry and export thresholds depend solely on the product market parameters $\{F_E, f_D, f_X, n, \tau, \sigma, r, \delta\}$ and the properties of the c.d.f. $G(\varphi)$.

Lemma 1. ***(Separability)*** *The equilibrium average productivity of intermediate producers, $\tilde{\varphi}$, does not depend on the vacancy-unemployment ratio θ.*

In other words, labor market conditions do not influence the selection of firms into failed ones, domestic sellers, and exporters. Separability holds because adjustment costs are *linear* in labor so that recruitment and churning expenses can be bundled with wages and treated as variable costs. Given that the endogenous variable, $\widetilde{\Pi}$, is defined net of variable costs, the intensity of search frictions is immaterial to the

[21] Melitz (2003) shows that the ZCP is non-increasing in φ_D^*. It can well be horizontal, however, for example when firm productivities are sampled from a Pareto distribution.

analysis. In equilibrium, revenues will adjust so as to compensate changes in labor market tightness through opposite variations in the optimal sizes and number of firms.[22] The neutrality of expenses that are proportional to the size of the labor force is already apparent in Melitz's model since it is solved using the wages rate as numeraire.[23] Lemma 1 shows that this feature continues to hold when variable costs include linear search costs on top of wages.

The *separability property* stated in Lemma 1 allows to solve for equilibrium in a recursive way. Average productivity and cutoff productivities can be determined as in Melitz (2003) by considering solely product market parameters. Taking these values as given, we can then solve for the equilibrium in the labor market. Note, however, that we would still need to determine input diversity M in order to derive average productivity Φ if we would allow for the more sophisticated scenario with external economies of scale. This is why external economies of scale lead to the introduction of an additional equilibrium condition.

2.5 Unemployment and Trade Liberalization

This chapter discusses three globalization scenarios: (*i*) a reduction of variable trade costs, (*ii*) an increase in the number of trade relations and (*iii*) a drop in the fixed foreign distribution costs f_X. The first and the third scenario capture technological (transportation costs) and political (tariffs, technical barriers to trade) changes, while the second addresses the emergence of new countries into the global trading system. We describe the interaction of trade liberalization and unemployment in two steps. First, we consider the case where trade affects aggregate outcomes through the selection effect only ($\nu = 0$). This isolates the novel mechanism introduced by Melitz

[22] See equation (2.46) in the Appendix.

[23] A related neutrality result can also be found in Bernard, Redding and Schott (2007). They assume that output, fixed and entry costs require using skilled and unskilled labor with common intensity. They show that factor rewards cancel out from the FE and ZCP conditions because average firm profitability and entry costs are each proportional to factor costs.

(2003) and characterizes a particularly tractable special case. In the Appendix we analyze the more intricate case where trade also affects outcomes through an external scale effect, as in Krugman (1980) and in much of the subsequent literature.

2.5.1 The equilibrium rate of unemployment and the mass of firms

The steady-state rate of unemployment is linked to the degree of labor market tightness θ and the importance of labor market churning, as captured by s, via the standard Beveridge curve

$$u(\theta) = \frac{s}{s + \theta m(\theta)}. \tag{2.17}$$

This condition ensures that the flows in and out of the unemployment pool are equal. As in standard search-matching models, the rate of unemployment is a decreasing function of the vacancy-unemployment ratio. Since we have shown in Corollary 1 that θ is increasing in the level of average productivity, it is sufficient to know how trade affects $\tilde{\varphi}$ in order to characterize its impact on employment.

The equilibrium mass of firms is obtained reinserting the equilibrium labor market tightness and the equilibrium levels of average productivity, as determined in chapters 2.3.3 and 2.4, in the labor market clearing condition. Note that under our assumptions we have determined both θ and $\tilde{\varphi}_D$ without knowing the equilibrium mass of firms. Hence,

$$M_D \left[l_D(\tilde{\varphi}_D) + n\varrho l_X(\tilde{\varphi}_X) \right] = \left[1 - u(\theta) \right] L\,, \tag{2.18}$$

where L is the size of the labor force and M_D is the mass of domestic producers in each country. Due to imports from foreign firms, input diversity M (i.e., the number of available varieties) is higher and equal to $M = M_D(1 + n\varrho)$.

As shown in the Appendix, the mass of firms is increasing in the level of employment. Although this may seem obvious, it turns out that, in the general case where

$\nu \geq 0$, the relationship is actually ambiguous. This is because M has two opposite effects: (i) at the aggregate level, a larger number of firms naturally increases the number of employees; (ii) at the firm level, economies of scale imply that more input diversity raises revenues per worker so that firms have to be smaller for the ZCP condition to be satisfied. When $\sigma > \nu + 1$, which is an empirically plausible restriction, effect (i) dominates and the equilibrium mass of firms increases in employment.[24]

2.5.2 The effect of trade liberalization on labor market outcomes

To ascertain the effect of trade on labor market outcomes, it is sufficient to see how it affects average productivity, $\tilde{\varphi}$. As in Melitz (2003), trade liberalization moves the ZCP but does not affect the FE condition. Trade affects the distribution of productivities across intermediate input producers by reallocating labor towards exporters, which are situated at the upper tail of the productivity distribution, and away from purely domestic firms, both at the extensive and at the intensive margin. Nevertheless, the effect of trade liberalization on average productivity is ambiguous because $\tilde{\varphi}$ factors in the output loss in export transit. Figure 2.2 illustrates a situation where the ZCP shifts right so that average productivity actually increases.

Part (i) of the following proposition gives a sufficient condition under which some liberalization scenarios always lead to an increase in aggregate employment. Part (ii) derives necessary and sufficient conditions for the case where the productivity distribution $G(\varphi)$ belongs to the Pareto family of distributions, as usually done in the literature on heterogeneous firms.[25]

[24]When $\sigma < \nu + 1$, so that firms enjoy strong market power and external economies of scale are significant, M is decreasing in aggregate employment because the effect at the firm level dominates. This is the case studied by Janiak (2006). Such a parameter restriction is, however, in contradiction with empirical studies which typically yield estimates for σ above 2 and for ν in the interval $(0, 1)$. Hence, we restrict our attention to cases where $\sigma > \nu + 1$. Egger and Kreickemeier (2009) also impose a similar restriction in order to ensure that their equilibrium is stable.

[25]See Egger and Kreickemeier (2009); Bernard, Redding, Schott (2007); Helpman, Melitz, Yeaple

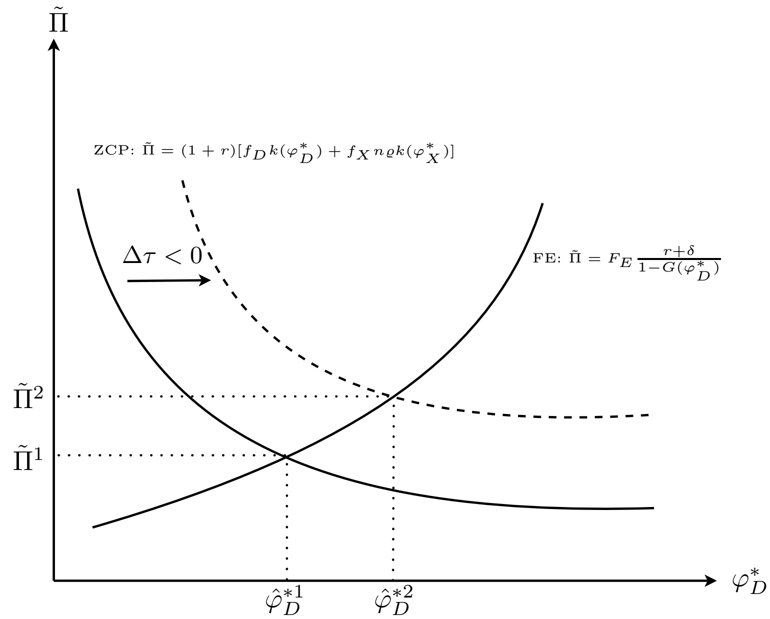

Figure 2.2: The effect of lower variable trade costs when $f_X \geq f_D$.

Proposition 3. *(i) If $f_X \geq f_D$, a reduction of variable trade costs τ or an increase in the number of trading partners n lead to a fall in the equilibrium rate of unemployment and a rise in the real wage, regardless of whether wages are bargained individually or collectively. A fall in fixed foreign distribution costs has an ambiguous effect on labor market outcomes.*
(ii) Let firms draw their productivities from a Pareto distribution with dispersion parameter γ such that $\gamma > \sigma - 1$. Then, regardless of the wage bargaining regime, the equilibrium rate of unemployment falls and the real wage rises
(a) due to a reduction in τ or an increase in n if and only if $\frac{\sigma-1}{\gamma}\left(1 + n\tau^{-\gamma}(f_D/f_X)^{\frac{\gamma}{\sigma-1}}\right) \geq \frac{f_D}{f_X} - 1$,
(b) and due to a reduction in f_X if and only if $\frac{\gamma^2}{(\sigma-1)^2} \geq \frac{f_X}{f_X - f_D}\left[1 + n\tau^{-\gamma}\left(\frac{f_D}{f_X}\right)^{\frac{\gamma}{\sigma-1}}\right]$.

The new insight in Melitz (2003) is that trade liberalization reallocates market shares towards efficient firms. Exporters, however, also incur iceberg transport costs

(2004).

which have to be deducted from the productivity gains at the factory gate. Whether or not trade liberalization enhances average productivity depends on which of these two adjustments prevails.[26] When $f_X > f_D$, revenues generated on each foreign market have to exceed domestic revenues. In other words, the higher efficiency of exporting firms offsets both transport costs and the difference between f_X and f_D. This is why the selection effect always dominates the losses in export transit. On the other hand, when $f_X < f_D$, some of the transport costs are compensated by lower fixed costs in foreign markets. Then the productivity gains at the factory gate due to trade liberalization are not necessarily higher than the increase in export losses.

A reduction in fixed costs of export f_X triggers similar adjustments than a decrease in τ: it raises the domestic threshold φ_D^* and lowers the export threshold φ_X^*. Yet, it reallocates market shares in a different way. Whereas a decrease in τ raises the combined market shares of firms that already exported prior to liberalization, a decrease in f_X mostly benefits new exporters which are, on average, less productive than existing ones. Hence, the overall effect on average productivity is ambiguous and depends on whether the new exporters are on average more productive than the economy-wide average before the fall in f_X.

The region where the relationship between trade openness and average productivity is negative depends on the other parameters of the model. It can be characterized when parametric assumptions are imposed on the sampling distribution $G(\varphi)$, as shown in part (ii) of Proposition 2 for cases where the sampling distribution is Pareto. Note that the effect of f_X is non-linear, since the stated parameter restrictions depends on $f_X - f_D$. If that difference is negative, a reduction in fixed market access costs always lowers unemployment.

In chapter 2.6 we calibrate the model towards U.S. data. This allows us to assess

[26] Melitz (2003) briefly alludes to the ambiguity of the relationship between trade liberalization and $\tilde{\varphi}$ (see footnote 26, page 1713). He also introduces a measure of productivity at the factory gate and shows that it is always lower in autarky.

whether or not the conditions required for a beneficial impact of trade liberalization on labor market outcomes are likely to be met in reality.

2.6 Numerical Illustration

Although our theoretical model can be fully characterized analytically, the effect of trade liberalization on labor market outcomes is potentially ambiguous, a beneficial effect requiring specific restrictions on exogenous parameters. Calibrating the model illustrates that those restrictions are likely to hold in reality. We simulate the labor market effects of different trade liberalization scenarios to shed light on the quantitative importance of the trade-unemployment nexus. Our numerical exercise is merely illustrative since we model a world of perfectly symmetric countries. Also note that we focus on the long-run and neglect adjustment dynamics in the two key variables of the model, θ and $\tilde{\varphi}$.

Our calibration follows standard practice, as versions of the Melitz (2003) and of the Pissarides search-matching model have been frequently calibrated in the literature. Regarding the product market, we follow Bernard, Redding, and Schott (2007); calibration of the labor market side is close to Shimer (2005).[27]

2.6.1 Calibration

In the following, we describe the calibration of our model. Table 2.1 summarizes all parameter values and statistics are for monthly values.

Sampling distribution and aggregate production function. As Bernard *et al.* (2003), Ghironi and Melitz (2005) or Helpman, Melitz, Yeaple (2004), we assume that firm productivities are distributed according to a Pareto distribution. Setting the scale parameter of that distribution to unity, the probability density is $g(\varphi) =$

[27] See Felbermayr and Prat (2011) for a related calibration exercise for the case of a closed economy.

$\gamma\varphi^{-(1+\gamma)}$. The shape parameter γ governs the rate of decay of the distribution. We need to impose $\gamma > \sigma - 1$ to ensure that the variance of the sales distribution is finite. As Bernard, Redding, and Schott (2007), we set $\gamma = 3.4$ and choose $\sigma = 3.8$.

Variable and fixed costs of trade and entry. We normalize the number of potential workers and set $L = 1$.[28] We choose variable trade costs τ equal to 1.3 as Ghironi and Melitz (2003). Given the Pareto distribution, the share of firms that export is given by

$$\varrho = \tau^{-\gamma} \left(\frac{f_D}{f_X} \right)^{\frac{\gamma}{\sigma-1}} .$$

That number is put at about 21% by Bernard *et al.* (2007). Together with $\tau = 1.3$, this pins down the ratio f_X/f_D at about 1.7. Setting the number of trading partners $n = 2$, we obtain an overall degree of openness (export sales over total sales) of about 19%. Finally, we calibrate $F_E = 39.57$ and $f_D = 1.77$ such that the equilibrium labor market tightness produced by our model is 0.5 (Hall (2005)) and the average firm size is equal to 21.9 (Axtell (2001)).[29]

Separation shocks. Job separations occur either because a firm exit the market or because the match itself is destroyed. Bartelsman *et al.* (2004) estimates are centered around a monthly hazard rate of exiting the market $\delta = 0.97\%$. Match-specific shocks account for the job separations that are left unexplained by firm-specific shocks. Shimer (2005) estimates the monthly job separation rate to be on average equal to $s = 0.034$. It follows that the monthly Poisson arrival rate of match-specific shocks $\chi = \frac{s-\delta}{1-\delta} \approx 0.024$.

[28] Without external economies of scale, the size of the labor force is meaningless for the labor market outcomes. L only affects the mass of active firms in the economy and leaves unemployment, average firm size, and wages unchanged.

[29] The relation between F_E and f_D is of the same order of magnitude than in Ghironi and Melitz (2003).

Parameters for the matching function and cost of vacancy-posting. We postulate a Cobb-Douglas matching function $m(\theta) = m_0\theta^{-\alpha}$, whose elasticity α is set equal to 0.5 following Petrongolo and Pissarides (2001). The assumption of constant returns to matching implies that θ is equal to the job finding rate $m(\theta)\theta$ over the job filling rate $m(\theta)$. Shimer (2005) estimates the monthly job finding rate in the U.S. to be around 0.45, whereas Hall (2005) finds an average labor market tightness θ of around 0.5. It follows that the monthly job filling rate $m(\theta)$ is equal to $0.45/0.5 \approx 0.9$, so that $m_0 \approx 0.64$. We target the flow income of unemployment to be 40% of the equilibrium real wage and set b equal to 0.4. Firms' vacancy posting costs are fixed to 1.1 times the monthly wage (Ebell and Haefke (2009)). We calibrate those costs at 4.73, which appears large compared to flow fixed costs.

Bargaining power. The results of Abowd and Allain (1996) suggest that, in the case of individual bargaining, workers' bargaining power is close to $\beta = 0.5$.

2.6.2 The labor market effects of trade liberalization

The calibrated parameters summarized in Table 2.1 show that the sufficient condition, $f_X/f_D > 1$, for lower variable trade costs to reduce unemployment is very likely to be met. Foreign relative to domestic distribution costs need to be large for the model to be consistent with the low export participation rates of firms. Moreover, the sufficient and necessary condition for foreign market access costs is met in the neighborhood of the calibrated value of f_X.[30] Hence, from Table 2.1 it is possible to conclude that all three trade liberalization scenarios lead to lower equilibrium unemployment and higher real wages.

By simulating the model, we can go beyond these findings. First, while the theo-

[30] Moreover, the values of ν, σ, and α provided by the empirical literature suggest that the existence and uniqueness requirement of Lemma 2 is fairly weak.

Table 2.1: *Calibration-Parameter Values*

Parameter	*Interpretation*	*Value*	*Source*
	<u>*External parameter estimates*</u>		
β	Bargaining power, individual bargaining	0.5	Abowd and Allain (1996)
α	Elasticity of matching function	0.5	Petrongolo and Pissarides (2001)
s	Monthly job destruction	3.4%	Shimer (2005)
r	Monthly discount rate	0.33%	4% annual interest rate
δ	Monthly rate of firm exit	0.97%	Bartelsmann *et al.* (2004)
σ	Elasticity of substitution	3.8	Bernard et al. (2007)
γ	Decay of productivity distribution	3.4	Bernard et al. (2007)
τ	Iceberg trade costs	1.3	Ghironi & Melitz (2005)
	<u>*Parameters matched to moments in the data*</u>		
b	Value of non-market activity	0.4	40% replacement rate
m_0	Scale of matching function	0.64	Monthly job finding rate=0.45
c	Cost of posting a vacancy	4.73	1.1 times monthly wage (Ebell and Haefke (2009)
F_E	Entry costs	39.57	$\theta \approx 0.5$ (Hall, (2005))
f_D	Domestic flow fixed costs	1.77	Average firm size = 21.9 (Axtell (2001))
f_X	Fixed foreign market access costs	3.01	$\varrho = 0.21$ (Bernard *et al.* (2007))
	<u>*Normalized Parameters*</u>		
L	Labor endowment per country	1	
P	Aggregate price level	1	
$n+1$	Number of countries	3	

Note: All parameter values and statistics are for monthly time periods and are calibrated towards the U.S. economy.

retical analysis is *local*, our numerical exercise allows for a global analysis; this is particularly relevant for fixed costs of accessing foreign markets as they have non-linear effects. Second, by means of simulation we can quantify the unemployment-reducing effect of trade liberalization.

Figure 2.3 illustrates the three liberalization scenarios: The top diagram studies variations in variable trade costs (τ), the middle diagram analyzes changes in the number of countries to which any country may export to (n), and the bottom diagram shows the effects of changing fixed costs of foreign market access. All pictures have the real wage on the right ordinate and the unemployment rate (in percent) on the left ordinate.[31] The baseline calibration at $\tau = 1.3, n = 2, f_X = 3.01$ leads to an unemployment rate of 7% and a wage rate of 4.3.

The first row of Figure 2.3 illustrates that lower variable trade costs τ can have a sizable effect on labor market outcomes. In the case of individual bargaining, moving τ from 1.6 to 1 lowers the unemployment rate by 1 percentage point from 7.4% to 6.4% and increases the wage rate from 3.9 to 5.2.[32]

The second row in Figure 2.3 relates to variation in the number of export markets. In the baseline case we have $n = 2$. Now, consider an increase of n to, say, 4: the wage rate goes up to about 4.9 while the unemployment rate falls to 6.6%.

Finally, consider a change in the fixed foreign market entry costs f_X. A marginal reduction of f_X at the baseline parameterization ($f_X = 3.01$) leads to an increase in the unemployment rate and to a decrease in the real wage. Remember that the impact of f_X depends on the new exporters' average productivity relative to the economy-wide average. In our baseline calibration, the latter dominates the former. However, if f_X is large enough, only firms at the absolute top export. Then, a marginal reduction

[31] Obviously, the intersection of both curves has no particular meaning.

[32] The discussed reduction of τ from 1.6 to 1 describes the entirely unrealistic transition from costly trade to a situation where no trade-costs whatsoever exist. Since higher τ lowers the effective labor productivity, reducing τ by 60% has a massive effect on average productivity. With n growing towards infinity, the share of imported inputs converges towards 1 and a reduction in τ is equivalent to an increase in the marginal productivity of labor.

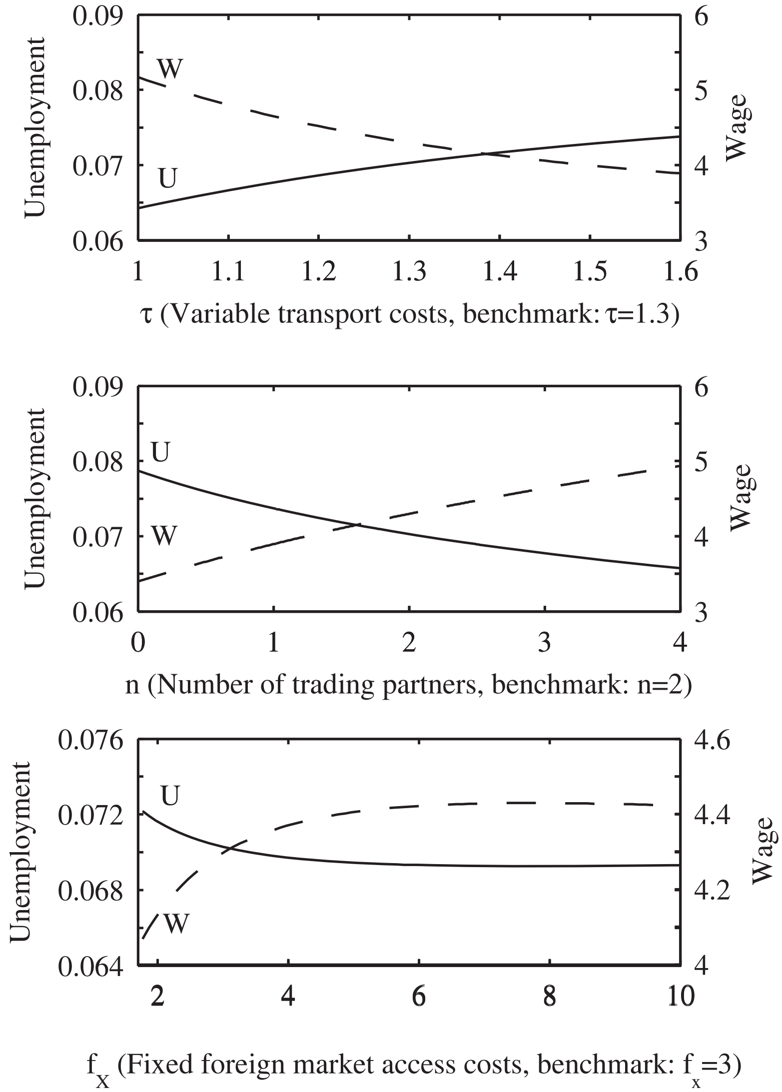

Figure 2.3: Simulation results

of f_X involves very efficient firms, whose average productivity exceeds the economy-wide average. In the simulation, the threshold value of f_X is at about 8. Interestingly, the gradient of both the wage and the unemployment schedules is extremely low at that value.

2.7 Conclusion

Bringing together two important established but hitherto unrelated models in the trade and labor literatures - the Melitz (2003) model of trade with heterogeneous firms, and the Pissarides (2000) search and matching approach to unemployment - we develop conditions under which the selection effect of trade improves labor market outcomes. The proposed framework is surprisingly tractable, in spite of the existence of heterogeneous firms, various types of trade costs, monopoly power on product markets, and monopsony power due to search frictions on the labor market. The equilibrium is recursive since labor market conditions do not affect *average* productivity (the converse, of course, is not true). Introducing external economies of scale drives a wedge between average and aggregate productivity. Then, *aggregate* productivity does depend on labor market outcomes.

We show that the labor market implications of trade liberalization are largely shaped by its impact on average productivity. This latter relation, however, depends on parameter constellations. To sort out the ambiguities, we calibrate the model towards U.S. data. We find that different trade liberalization scenarios all improve labor market outcomes, regardless of the bargaining environment. Moreover, the reduction in the unemployment rate is numerically non-trivial, in particular when wages are bargained individually and external economies of scale are important.

Compared to existing models that combine search unemployment and heterogeneous firms, our treatment features forward-looking firms, micro-founds the wage determination, and allows one to derive the main results without any assumptions on the distribution of firm productivities. External economies of scale are shown to be important for the model's properties. Existence and uniqueness do not require strong assumptions on parameters, and the model is straight-forwardly calibrated. There are, however, two obvious and interesting extensions which we have to relegate to future research.

First, our approach focuses on long-run equilibria. This precludes the analysis of potentially interesting short-run adjustments, which result from the fact that producers adjust only sluggishly to a changed environment. Most empirical studies on the interaction between trade liberalization and labor turnover capture short to medium-run correlations, so that our model has little to say about their results. Moreover, any sensible welfare analysis requires to weigh potential losses along the transition path against the positive long-run effects.

Second, our conclusions are limited to the impact of multilateral trade liberalization amongst symmetric countries. Hence, we cannot say much about the recent surge in bilateral trade treaties or, even more importantly, about the effect on employment of trade liberalization with emerging countries such as China or India. We therefore believe that the most promising direction for further research would be to extend the model to cases where countries differ with respect to sizes, productivity levels and institutions. This will probably be a rather demanding project since addressing country asymmetries has proved difficult in the literature, in particular if one is not willing to narrow the analysis to two countries or to allow for a numéraire sector whose output is costlessly tradable.

2.8 Additional results

2.8.1 Collective bargaining

In a firm covered by collective bargaining, workers form a firm-wide coalition, that is, a trade union. When bargaining fails and workers go on strike, the firm loses not only the value associated to the marginal worker, as with individual bargaining, but its entire labor force. We opt for an *efficient bargaining* setup so that the firm and the union bargain about both wages and employment. This ensures that we are considering equilibria lying on the Pareto frontier.[33]

Negotiations between the union and the firm take place in the first period.[34] The union's objective is the expected sum of its members' rents

$$\mathbf{U}(l,w) \equiv (1-\delta)l\left[\frac{w-rU}{r+\delta}\right] ,$$

while the firm seeks to maximize its expected variable profits

$$\mathbf{F}(l,w;\varphi) \equiv \left(\frac{1-\delta}{r+\delta}\right)\left[R\left(l;\varphi\right)-wl(\varphi)-\frac{c}{m\left(\theta\right)}\chi l(\varphi)\right]-\frac{c}{m(\theta)}l \, .$$

The negotiation specifies both employment and wages. The solution lies on the contract curve which connects the points where the firm iso-profit curves are tangent to the union indifference curves. The actual agreement is pinned down by the union's bargaining power β. Proposition 2 shows that the labor market equilibrium can be characterized in a similar fashion than in the Individual Bargaining regime.

Proposition 4. *When wages are collectively bargained, the labor market admits an*

[33] Our main results also hold in a *right to manage* setup where unions negotiate only about wages and firms have full freedom to set the level of employment. Barth and Zweimüller (1995) study different wage bargaining scenarios when firms are heterogeneous with respect to their productivity.

[34] One could instead consider that the firm and the union bargain on the steady-state profits, so that $\mathbf{F}(l,w;\varphi) = \left(\frac{1-\delta}{r+\delta}\right)\left[R\left(l;\varphi\right)-wl(\varphi)-\frac{c}{m(\theta)}\chi l(\varphi)\right]$. This obviously generates a hold-up problem where the union does not take into account the initial recruitment costs. Then employment is lower and wages higher but the main insights are not fundamentally modified.

equilibrium if and only if $b < (\sigma-1)/\sigma$. The equilibrium is unique and such that wages are constant across firms. The equilibrium wage, w, and vacancy-unemployment ratio, θ, simultaneously satisfy the following Wage and Labor Demand conditions:

$$W: \quad w = \frac{\beta}{\sigma(1-b)}\left(\frac{\theta m(\theta)}{r+s}\right)\tilde{\varphi} + \frac{\beta}{\sigma(1-b)}\tilde{\varphi} \tag{2.19}$$

$$LD: \quad w = \left(1 - \frac{1-\beta}{\sigma}\right)\tilde{\varphi} - \frac{c}{m(\theta)}\left(\frac{r+s}{1-\delta}\right) \tag{2.20}$$

Proof of Proposition 4. The contract curve is given by the points where the firm iso-profit curves are tangent to the union's indifference curves, so that

$$\frac{\partial \mathbf{F}(l,w;\varphi)/\partial l}{\partial \mathbf{F}(l,w;\varphi)/\partial w} = \frac{\partial \mathbf{U}(l,w;\varphi)/\partial l}{\partial \mathbf{U}(l,w;\varphi)/\partial w} \Rightarrow \frac{\partial R(l;\varphi)}{\partial l} = rU + \left(\frac{r+s}{1-\delta}\right)\frac{c}{m(\theta)}\,. \tag{2.21}$$

The actual contract solves the following Nash-bargaining problem [35]

$$\max_{w,l} \Omega(w,l;\varphi) \equiv \mathbf{U}(l,w;\varphi)^{\beta}\mathbf{F}(l,w;\varphi)^{1-\beta}\,. \tag{2.22}$$

The union and the firm split the forward looking surplus.[36] The first order condition with respect to the wage rate is

$$w(\varphi,l) = (1-\beta)\,rU + \beta\left[\frac{R(l;\varphi)}{l} - \left(\frac{r+s}{1-\delta}\right)\frac{c}{m(\theta)}\right] = rU + \left(\frac{\beta}{\sigma}\right)\frac{R(l;\varphi)}{l}, \tag{2.23}$$

where the second equality is obtained substituting the Pareto optimality condition (2.21) and using the identity $\partial R(l;\varphi)/\partial l = \left(\frac{\sigma-1}{\sigma}\right)R(l;\varphi)/l$. Equation (2.23) is the Wage curve under collective bargaining. The Labor Demand curve is given by the first order condition

[35] The setup cost is sunk and so cannot be recovered by the firm in case of disagreement with the union. Thus it does not enter the firm's outside option. If one assume, as in Melitz (2003), that operating costs are paid in each period, the strategic form of the Nash-bargaining problem still holds as long as the firm cannot default on his payment following a breakdown in the wage negotiation. Notice, however, that when fixed costs are included in the firm's threat point, the solution to (2.22) does not lie on the contract curve and so violates the axiom of Pareto optimality. Hence, our formulation can also be justified on axiomatic ground.

[36] Considering instead that disagreement delays production does not fundamentally affect our result.

of problem (2.22) with respect to the employment level

$$w(\varphi, l) = \left(1 - \frac{1-\beta}{\sigma}\right) \frac{R(l;\varphi)}{l} - \left(\frac{r+s}{1-\delta}\right) \frac{c}{m(\theta)} \,. \tag{2.24}$$

Both conditions indicate that wages are identical across firms since, as explained in the proof of Proposition 1, $R(l;\varphi)/l = p_D(\varphi)\varphi = p_D(\tilde{\varphi})\tilde{\varphi} = \tilde{\varphi}$. The employees' outside option therefore reads

$$rU(\theta) = b\bar{w} + \theta m(\theta) \left(\frac{w - rU}{r+s}\right) = bw + \theta m(\theta) \left(\frac{\beta}{\sigma(r+s)}\right) \tilde{\varphi} \,, \tag{2.25}$$

where the last equality follows from (2.23). Combining the three equations above, yields the expressions in Proposition 3. The existence and uniqueness requirements follow from the same reasoning than in the proof of Proposition 1.

For the same reasons than before, the Wage curve is increasing in θ while the Labor Demand curve is decreasing. The bargained wage is equal to the opportunity cost of employment rU plus a share β of the remaining profits per worker. Due to the existence of rent-sharing, and in contrast to individual bargaining, the slope of the Wage curve is increasing in aggregate productivity. Yet, as with individual bargaining, the wage rate is the same across firms with different levels of productivity.

The most significant difference with the individual bargaining regime is that now average productivity $\tilde{\varphi}$ also raises the slope of the Wage curve. Yet, as stated in Corollary 5, this additional effect on the Wage curve is again unambiguously dominated by the shift of the Labor Demand curve.

Corollary 5. *When wages are collectively bargained, the vacancy-unemployment ratio θ is increasing in aggregate productivity $\tilde{\varphi}$.*

Proof of Corollary 5 . The proof is established in a similar fashion as Corollary 2. Combining the Labor Demand and Wage curves in Proposition 4 leads to the following equilibrium requirement

$$\Psi\left(\theta;\tilde{\varphi}\right)\equiv\tilde{\varphi}\left(\frac{\beta}{\sigma(1-b)}\left(\frac{\theta m(\theta)+r+s}{r+s}\right)+\frac{-\sigma+1-\beta}{\sigma}\right)+\left(\frac{r+s}{1-\delta}\right)\frac{c}{m\left(\theta\right)}=0\ .$$

Differentiating $\Psi\left(\theta;\tilde{\varphi}\right)$ with respect to $\tilde{\varphi}$ and θ yields

$$\frac{\partial\theta}{\partial\tilde{\varphi}}=-\frac{\partial\Psi\left(\theta;\tilde{\varphi}\right)/\partial\tilde{\varphi}}{\partial\Psi\left(\theta;\tilde{\varphi}\right)/\partial\theta}>0\ .$$

The inequality sign follows from

$$\frac{\partial\Psi\left(\theta;\tilde{\varphi}\right)}{\partial\tilde{\varphi}}=\frac{\beta}{\sigma(1-b)}\frac{\theta m(\theta)+r+s}{r+s}+\frac{-\sigma+1-\beta}{\sigma}=-\frac{1}{\tilde{\varphi}}\left[\left(\frac{r+s}{1-\delta}\right)\frac{c}{m\left(\theta\right)}\right]<0\ , \quad (2.26)$$

$$\frac{\partial\Psi\left(\theta;\tilde{\varphi}\right)}{\partial\theta}=\frac{\tilde{\varphi}\beta\left[\theta m'(\theta)+m(\theta)\right]}{\sigma(1-b)(r+s)}-\left(\frac{r+s}{1-\delta}\right)\frac{cm'(\theta)}{m(\theta)^2}>0\ . \quad (2.27)$$

The last equality follows from $\Psi(\theta;\tilde{\varphi})=0$ and the sign of the inequality holds true due to the homogeneity of degree one of the matching function. Finally, the LMC is given by

$$LMC_C:M(\theta)=(1+n\varrho)\left(1-u(\theta)\right)L\left(\frac{1-\beta}{\sigma}\right)\left(\frac{1-\delta}{1+r}\right)\left(\frac{\tilde{\varphi}}{\left(\frac{r+\delta}{1+r}\right)\frac{F_E}{1-G(\varphi_D^*)}+f_D+n\varrho f_X}\right). \quad (2.28)$$

2.8.2 Equilibrium with external economies of scale

Under external economies of scale $p_D\left(\varphi\right)\varphi=p_D\left(\tilde{\varphi}\right)\tilde{\varphi}=M^{\frac{\nu}{\sigma-1}}\tilde{\varphi}$ implies that the Wage and the Labor Demand curve also depend on the mass of firms. Thus, labor market tightness, real wages and input diversity are determined jointly when there are external economies of scale ($\nu>0$). Their equilibrium values follow from the Labor Demand, Wage Curve and Labor Market Clearing conditions, as defined in chapters 2.3 and 2.5.1. To clarify the analysis, we combine the Labor Demand and Wage Curve into one equation that we label *Equilibrium Tightness Condition* (ETC). As the LMC, the ETC defines a mapping between input diversity M and labor market tightness θ. We can then combine the LMC and the ETC for each bargaining environment to pin down the equilibrium values of M and θ. Index I denotes individual and C collective bargaining, respectively. Using (2.9) and (2.10) for individual, (2.19) and (2.20) for collective bargaining, we obtain

$$ETC_I : M_I(\theta_I) = \left[\frac{\frac{c}{(1-\beta)(1-b)(1-\delta)} \left(\frac{(1-b(1-\beta))(r+s)}{m(\theta_I)} + \beta\theta_I \right)}{\tilde{\varphi}\left(\frac{\sigma-1}{\sigma-\beta}\right)} \right]^{\frac{\sigma-1}{\nu}} \tag{2.29}$$

$$ETC_C : M_C(\theta_C) = \left[\frac{\left(\frac{r+s}{1-\delta}\right) \frac{c}{m(\theta_C)}}{\tilde{\varphi}\left(\frac{\sigma-1}{\sigma} - \frac{\beta}{\sigma(1-b)} \frac{\theta_C m(\theta_C)}{r+s} - \frac{\beta b}{(1-b)\sigma}\right)} \right]^{\frac{\sigma-1}{\nu}} . \tag{2.30}$$

The ETCs are upward-sloping in each bargaining regime because more input diversity raises efficiency and thus compensates the increase in recruitment costs as θ goes up. The LMC curves also need some adjustment since they depend on the economies of scale parameter ν.

$$LMC_I : M_I(\theta_I) = \left[(1+n\varrho)\,(1-u(\theta_I))\, L \left(\frac{1-\beta}{\sigma-\beta}\right) \left(\frac{1-\delta}{1+r}\right) \left(\frac{\tilde{\varphi}}{\left(\frac{r+\delta}{1+r}\right) \frac{F_E}{1-G(\varphi_D^*)} + f_D + n\varrho f_X} \right) \right]^{\frac{\sigma-1}{\sigma-1-\nu}} . \tag{2.31}$$

For collective bargaining, the LMC is given by

$$LMC_C : M_C(\theta_C) = \left[(1+n\varrho)\,(1-u(\theta_C))\, L \left(\frac{1-\beta}{\sigma}\right) \left(\frac{1-\delta}{1+r}\right) \left(\frac{\tilde{\varphi}}{\left(\frac{r+\delta}{1+r}\right) \frac{F_E}{1-G(\varphi_D^*)} + f_D + n\varrho f_X} \right) \right]^{\frac{\sigma-1}{\sigma-1-\nu}} . \tag{2.32}$$

Given that the LMC conditions are also increasing, equilibrium existence and uniqueness are not anymore ensured but can be established imposing empirically reasonable restrictions.[37]

Lemma 2. *When $\nu \geq 0$, equilibrium tightness and input diversity are pinned down by the system $\{(2.31), (2.29)\}$ for the case of individual bargaining and by $\{(2.32), (2.30)\}$ for the case of collective bargaining. Assume that the aggregate matching function is Cobb-Douglas, so that $m(\theta) = m_0\theta^{-\alpha}$, with $m_0 > 0$ and $\alpha \in (0,1)$. In case of individual bargaining, a sufficient condition for existence and uniqueness of an equilibrium with $u \in (0,1)$ is $\nu/(\sigma-1) < \alpha$. For the collective bargaining scenario, a sufficient condition is $\nu/(\sigma-1) < min\ [\alpha, \frac{1}{2}]$.*

Proof of Lemma 2

[37] As explained in subchapter 2.5.1, when $\sigma < \nu + 1$, the LMCs conditions are decreasing in θ. Hence, there always exists a unique equilibrium when this parameter restriction is satisfied. Yet, we do not focus on this case because it is neither theoretically realistic nor empirically relevant.

Individual Bargaining. It is easily seen that, when $\sigma + (1-\nu) > 2$, both (2.29) and (2.31) converge to zero as θ_I goes to zero. When θ_I goes to infinity, (2.29) diverges to infinity whereas (2.31) converges to

$$\overline{M} \equiv \left[L(1+n\varrho)\left(\frac{1-\beta}{\sigma-\beta}\right)\left(\frac{1-\delta}{1+r}\right)\left(\frac{\tilde{\varphi}_I}{\left(\frac{r+\delta}{1+r}\right)\frac{F_E}{1-G(\varphi_D^*)} + f_D + n\varrho f_X}\right)\right]^{\frac{1-\sigma}{1-\sigma+\nu}} < \infty \, .$$

Hence, the existence of an equilibrium is established if the derivative of (2.29) at $\theta_I = 0$ is inferior to that of (2.31). Since

$$\left.\frac{\partial M_I}{\partial \theta_I}\right|_{ETC_I} = \frac{\sigma-1}{\nu} K_1 \left(\frac{(1-b(1-\beta))(r+s) + \beta\theta_I m(\theta_I)}{m(\theta_I)}\right)^{\frac{\sigma-1}{\nu}-1}\left(\frac{\alpha(1-b(1-\beta))(r+s)+\beta\theta_I m(\theta_I)}{\theta_I m(\theta_I)}\right) \, ,$$

with $K_1 \equiv \left[c\left((1-\beta)(1-b)(1-\delta)\tilde{\varphi}\left(\frac{\sigma-1}{\sigma-\beta}\right)\right)^{-1}\right]^{\frac{\sigma-1}{\nu}}$, the derivative of (2.31) w.r.t. θ_I converges to zero as θ_I goes to zero if and only if: $\lim_{\theta_I \to 0} \theta_I m(\theta_I)^{\frac{\sigma-1}{\nu}} = \infty$. With the Cobb-Douglas specification, this requirement is fulfilled when $\alpha > \frac{\nu}{\sigma-1}$. Consider now the derivative of (2.31) w.r.t. θ_I

$$\left.\frac{\partial M_I}{\partial \theta_I}\right|_{LMC_I} = \frac{\sigma-1}{\sigma-1-\nu} K_2 \left(\frac{\theta_I m(\theta_I)}{s+\theta_I m(\theta_I)}\right)^{\frac{1-\sigma}{1-\sigma+\nu}-1}\left(\frac{(1-\alpha)m(\theta_I)s}{(s+\theta_I m(\theta_I))^2}\right) \, ,$$

where

$$K_2 \equiv \left[L(1+n\varrho)\left(\frac{1-\beta}{\sigma-\beta}\right)\left(\frac{1-\delta}{1+r}\right)\left(\frac{\tilde{\varphi}}{\left(\frac{r+\delta}{1+r}\right)\frac{F_E}{1-G(\varphi_D^*)} + f_D + n\varrho f_X}\right)\right]^{\frac{1-\sigma}{1-\sigma+\nu}} \, .$$

Hence it diverges to infinity as θ goes to zero if and only if: $\lim_{\theta \to 0} \theta^{\frac{1-\sigma}{1-\sigma+\nu}-1} m(\theta)^{\frac{1-\sigma}{1-\sigma+\nu}} = \infty$. With the Cobb-Douglas specification, this requirement is fulfilled when $\alpha > \frac{\nu}{\sigma-1}$. Hence, equilibrium existence is established.

The uniqueness of the equilibrium follows from the fact that (2.29) is convex while (2.31) is concave in θ_I. Since

$$\left.\frac{\partial^2 M_I}{\partial \theta_I^2}\right|_{ETC_I} = K_1 \left(\frac{\sigma-1}{\nu}\right)[Z_1 - Z_2] \, ,$$

where

$$Z_1 = \left(\frac{\sigma-1}{\nu}-1\right)\left(H(r+s)m_0^{-1}\theta_I^{\alpha}+\beta\theta_I\right)^{\frac{\sigma-1}{\nu}-2}\left(\alpha H(r+s)m_0^{-1}\theta_I^{\alpha-1}+\beta\right)^2, \qquad (2.33)$$

$$Z_2 = (1-\alpha)\left(H(r+s)m_0^{-1}\theta_I^{\alpha}+\beta\theta_I\right)^{\frac{\sigma-1}{\nu}-1}\alpha H(r+s)m_0^{-1}\theta_I^{\alpha-2} \qquad (2.34)$$

and $H = (1-b(1-\beta))$. The second derivative of (2.29) is positive when

$$Z_1 > Z_2 \Leftrightarrow \left(\frac{\sigma-1}{\nu}-1\right)\left(\alpha H(r+s)m_0^{-1}\theta_I^{\alpha-1}+\beta\right)^2 > (1-\alpha)\left(H(r+s)m_0^{-1}\theta^{\alpha}+\beta\theta_I\right)\alpha H(r+s)m_0^{-1}\theta_I^{\alpha-2}\,.$$

But the term on the left-hand side of the inequality can be lower-bounded as follows

$$\begin{aligned}\left(\frac{\sigma-1}{\nu}-1\right)\left(\alpha H(r+s)m_0^{-1}\theta_I^{\alpha-1}+\beta\right)^2 &> \left(\frac{\sigma-1}{\nu}-1\right)\alpha^2\left(H(r+s)m_0^{-1}\theta_I^{\alpha-1}+\beta\right)^2\\ &> \left(\frac{\sigma-1}{\nu}-1\right)\alpha H\left((r+s)m_0^{-1}\theta_I^{\alpha}+\beta\theta_I\right)\alpha H(r+s)m_0^{-1}\theta_I^{\alpha-2}\,.\end{aligned}$$

Thus (2.29) is convex when $\left(\frac{\sigma-1}{\nu}-1\right)\alpha > 1-\alpha \Leftrightarrow \alpha > \frac{\nu}{\sigma-1}$. Similarly differentiating twice (2.31) w.r.t. θ_I yields

$$\left.\frac{\partial^2 M_I}{\partial\theta_I^2}\right|_{LMC_I} = \frac{K_2\frac{(1-\sigma)(1-\alpha)}{1-\sigma+\nu}s}{\left(s+m_0\theta_I^{1-\alpha}\right)^{2\left(\frac{1-\sigma}{1-\sigma+\nu}+1\right)}}\left[Z_3 - Z_4\right]\ ,$$

where

$$Z_3 = \left(\frac{(1-\sigma)(1-\alpha)}{1-\sigma+\nu}-1\right)m_0^{\frac{1-\sigma}{1-\sigma+\nu}}\theta_I^{\frac{(1-\sigma)(1-\alpha)}{1-\sigma+\nu}-2}\left(s+m_0\theta_I^{1-\alpha}\right)^{\frac{1-\sigma}{1-\sigma+\nu}+1}, \qquad (2.35)$$

$$Z_4 = \left(\frac{1-\sigma}{1-\sigma+\nu}+1\right)(1-\alpha)m_0^{\frac{1-\sigma}{1-\sigma+\nu}+1}\theta_I^{\frac{(1-\sigma)(1-\alpha)}{1-\sigma+\nu}-\alpha-1}\left(s+m_0\theta_I^{1-\alpha}\right)^{\frac{1-\sigma}{1-\sigma+\nu}}, \qquad (2.36)$$

which is negative when $\frac{(1-\sigma)(1-\alpha)}{1-\sigma+\nu} < 1 \Leftrightarrow \alpha > \frac{\nu}{\sigma-1}$.

Collective Bargaining. The ETC_C is well defined (i.e., the equilibrium mass of firms is real-valued) only if

$$\frac{\sigma-1}{\sigma} - \frac{\beta b}{\sigma(1-b)} > \frac{\beta}{\sigma(1-b)}\frac{\theta_C m(\theta_C)}{r+s} \qquad (2.37)$$

Hence, there exists a unique $\Upsilon > 1$ for which

$$\frac{\sigma-1}{\sigma} - \frac{\beta b}{\sigma(1-b)} = \Upsilon \frac{\beta}{\sigma(1-b)} \frac{\theta_C m(\theta_C)}{r+s}. \tag{2.38}$$

Using (2.38), a sufficient condition for the strict convexity of ETC_C can be stated.

It is easily seen that (2.31) and (2.29) converge to zero as θ goes to zero. When θ goes to the upper bound $\bar{\theta}_C$, (2.30) diverges to infinity whereas (2.32) converges to some $\bar{M}_C < \infty$. Under collective bargaining the first derivative of the ETC_C with respect to θ_C is

$$\left.\frac{\partial M_C}{\partial \theta_C}\right|_{ETC_C} = \frac{\sigma-1}{\nu} \frac{\left[\left(\frac{r+s}{1-\delta}\right)\frac{c}{m_0}\right]^{\frac{\sigma-1}{\nu}}(Z_5+Z_6)}{\tilde{\varphi}^{\frac{\sigma-1}{\nu}}\left(\frac{\sigma-1}{\sigma} - \frac{\beta b}{\sigma(1-b)} - \frac{\beta}{\sigma(1-b)}\frac{m_0\theta_C^{1-\alpha}}{r+s}\right)^{\frac{\sigma-1}{\nu}+1}}$$

where

$$\begin{aligned} Z_5 &= \left\{\alpha\left[\left(\frac{\sigma-1}{\sigma} - \frac{\beta b}{\sigma(1-b)}\right)\theta_C^{\alpha\frac{\sigma-1}{\nu}-1} - \frac{\beta}{\sigma(1-b)}\frac{m_0}{r+s}\theta_C^{\alpha\left(\frac{\sigma-1}{\nu}-1\right)}\right]\right\}, \\ Z_6 &= \left\{(1-\alpha)\frac{\beta}{\sigma(1-b)}\frac{m_0}{r+s}\theta_C^{\alpha\left(\frac{\sigma-1}{\nu}-1\right)}\right\}, \end{aligned}$$

which converges to zero when θ goes to zero if $\alpha > \frac{\nu}{\sigma-1}$. The slope of LMC_C in θ_C depends on the same conditions than LMC_I. The LMC_C is strictly concave (the proof is identical to the case of individual bargaining). The strict convexity of ETC_C requires

$$\left.\frac{\partial^2 M_C}{\partial \theta_C^2}\right|_{ETC_C} = \frac{\sigma-1}{\nu}\frac{1}{\tilde{\varphi}^{\frac{\sigma-1}{\nu}}} \frac{\left[\left(\frac{1+r}{1-\delta}\right)\frac{c}{m_0}\right]^{\frac{\sigma-1}{\nu}}\{(Z_5'+Z_6')Z_7 - (Z_5+Z_6)Z_7'\}}{Z_7^2} > 0 \tag{2.39}$$

where $Z_7 = \left(\frac{\sigma-1}{\sigma} - \frac{\beta b}{\sigma(1-b)} - \frac{\beta}{\sigma(1-b)}\frac{m_0\theta_C^{1-\alpha}}{r+s}\right)^{\frac{\sigma-1}{\nu}+1}$ and

$$\begin{aligned} Z_5' &= \left\{\alpha\left[\left(\alpha\frac{\sigma-1}{\nu}-1\right)\left(\frac{\sigma-1}{\sigma} - \frac{\beta b}{\sigma(1-b)}\right)\theta_C^{\alpha\frac{\sigma-1}{\nu}-2} - \left(\alpha\left(\frac{\sigma-1}{\nu}-1\right)\right)\frac{\beta}{\sigma(1-b)}\frac{m_0}{r+s}\theta_C^{\alpha\left(\frac{\sigma-1}{\nu}-1\right)-1}\right]\right. \\ Z_6' &= \left\{(1-\alpha)\,\alpha\left(\frac{\sigma-1}{\nu}-1\right)\frac{\beta}{\sigma(1-b)}\frac{m_0}{r+s}\theta_C^{\alpha\left(\frac{\sigma-1}{\nu}-1\right)-1}\right\}, \\ Z_7' &= -(1-\alpha)\left(\frac{\sigma-1}{\nu}+1\right)\left(\frac{\sigma-1}{\sigma} - \frac{\beta b}{\sigma(1-b)} - \frac{\beta}{\sigma(1-b)}\frac{m_0\theta_C^{1-\alpha}}{r+s}\right)^{\frac{\sigma-1}{\nu}}\left(\frac{\beta}{\sigma(1-b)}\frac{m_0\theta_C^{-\alpha}}{r+s}\right). \end{aligned}$$

The second derivative is positive when $Z_5' + Z_6'$ is positive which holds true if

$$\alpha\left(\alpha\frac{\sigma-1}{\nu}-1\right)\left(\frac{\sigma-1}{\sigma}-\frac{b\beta}{\sigma(1-b)}\right)\theta_C^{\alpha\frac{\sigma-1}{\nu}-1}+(1-2\alpha)\left(\alpha\left(\frac{\sigma-1}{\nu}-1\right)\right)\frac{\beta}{\sigma(1-b)}\frac{m_0}{r+s}\theta_C^{\alpha\left(\frac{\sigma-1}{\nu}-1\right)}>0$$

while $\alpha > \frac{\nu}{\sigma-1}$ and $\sigma > 2$. This condition can be lower bounded using (2.38). Thus we know that the second derivative is positive as long as the following condition holds

$$\alpha\left(\alpha\frac{\sigma-1}{\nu}-1\right)\Upsilon+(1-2\alpha)\left(\alpha\left(\frac{\sigma-1}{\nu}-1\right)\right)>0 \tag{2.40}$$

Let $\Upsilon \to 1$, then $(\sigma-1)/\nu > 2$ secures that the the second derivative is positive. Hence, the equilibrium is unique if $\frac{\nu}{\sigma-1} < min\ [\alpha, \frac{1}{2}]$.

To see this, assume that Υ is very close to unity. For $\Upsilon = 1$ and $\alpha = 1$ (2.40) would hold as an equality which is the most extreme scenario. For all $\Upsilon > 1$ (required condition for (2.38) to hold) (2.40) is satisfied. For $\alpha < 1$ the requirement $(\sigma-1)/\nu > 2$ is sufficient for the strong inequality. It is also easy to show that the inequality holds for all $0 < \alpha \leq 1/2$ as long as $\alpha > \frac{\nu}{\sigma-1}$.[38]

Figure 2.4 shows the equilibrium conditions when wages are bargained at the individual level. Under the parameter restrictions presented in Lemma 2, both the ETC and the LMC start at the origin. The ETC is strictly convex while the LMC is strictly concave over the relevant parameter ranges. The LMC converges to some upper bound on input diversity $\bar{M}$ while the ETC diverges. The collective bargaining case looks almost identical.[39] Hence, the existence of a unique equilibrium (point E) is guaranteed. As $\nu \to 0$, the ETC locus converges towards a vertical line, whose position is pinned down by average productivity $\tilde{\varphi}$ and labor market variables.[40]

The parameter restriction stated in Lemma 2 requires that the strength of the external scale effect is sufficiently low when compared to the elasticity of the matching function α.

[38]The last inequality also makes sure that $\alpha = 0$ is ruled out.

[39]The only difference is that the ETC_C locus asymptotes toward some tightness $\bar{\theta} > 0$ implicitly determined by $\frac{\beta}{\sigma(1-b)}\frac{\bar{\theta}m(\bar{\theta})}{r+s} = \frac{\sigma-1}{\sigma} - \frac{\beta b}{\sigma(1-b)} > 0$.

[40]When the flow-value of non market activity is not indexed to aggregate productivity but instead equal to an exogenous constant, the ETC locus has a positive intercept on the vertical axis. As can easily be seen from Figure 2.4, this implies that the model admits at least two equilibria or none. This explains why we have assumed from the outset that non market activity yields revenues proportional to Φ. Janiak (2006) considers instead that they are purely exogenous and so, in order to circumvent the multiplicity issue, focuses on cases where $\sigma < \nu + 1$. This is also why he finds a positive relationship between variable trade costs and employment.

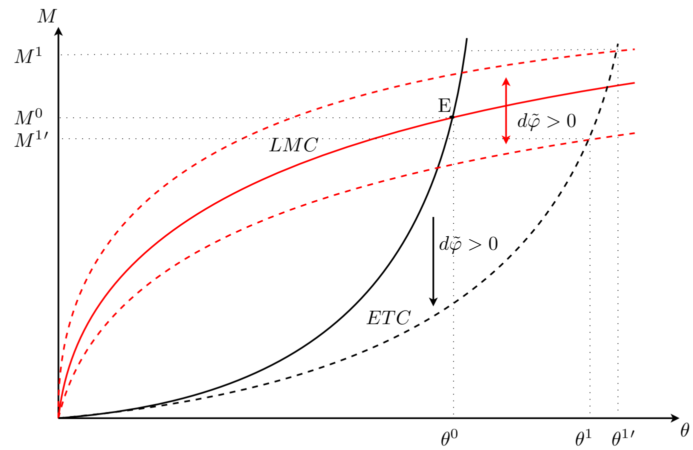

Figure 2.4: Determination of input diversity and labor market tightness in general equilibrium with $\nu > 0$.

Empirically, sectoral estimates of ν and α cluster around 0.5,[41] hence σ would need to be above 2. This requirement does not seem implausible empirically.

Only if $\nu > 0$ do changes in labor market parameters affect *aggregate* productivity Φ. Average productivity of input producers, however, remains unchanged, as Lemma 1 still applies. Hence, labor market institutions matter for aggregate productivity only through their effect on input diversity. Inspection of the equilibrium conditions reveals that higher levels of b or c rotate the ETC loci upwards, while they do not affect the LMC curves. In both bargaining regimes, those changes lower labor market tightness, real wages, and increase unemployment. In contrast, an improvement in the matching efficiency m_0 affects the ETC and the LMC curves. The LMC loci rotate upwards, while the ETC curves move in opposite direction: equilibrium tightness unambiguously increases, leading to higher real wages and lower unemployment.

To sum up, labor market parameters have a qualitatively similar impact on unemployment than in the standard Pissarides (2000) model with homogeneous firms and perfect competition on product markets. Notice also that economies of scale generate a negative relationship between the external size of the economy, L, and the rate of unemployment. Given that such a correlation is not substantiated by the data, the model suggests that the marginal scale effect has to be small, either because of a low value of ν or a very high degree of input diversity.

[41] See Ardelean (2007) for estimates of the external scale effect and Petrongolo and Pissarides (2001) for estimates of the matching function parameters.

Trade liberalization and unemployment with external economies of scale

We are now able to characterize the effect of trade liberalization on labor market outcomes when the production function exhibits external economies of scale. This is done in the next proposition, which – as Proposition 3 – falls in two parts. Part (i) provides a sufficient condition for some trade liberalization scenarios to improve labor market outcomes.[42] Part (ii) assumes that the productivity distribution is Pareto and provides necessary and sufficient conditions.

Proposition 6. *Assume that there are external economies of scale ($\nu > 0$) and that the existence and uniqueness condition in Lemma 2 is satisfied.*
(i) If $f_X \geq f_D$ a reduction of variable trade costs τ or an increase in the number of trading partners n lead to a fall in the equilibrium rate of unemployment and a rise in the real wage, regardless of whether wages are bargained individually or collectively. A fall in fixed foreign distribution costs has an ambiguous effect on labor market outcomes.
(ii) Let firms draw their productivities from a Pareto distribution. Then, regardless of the wage bargaining regime, the equilibrium rate of unemployment falls and the real wage rises
(a) due to a reduction in τ or an increase in n if and only if $\frac{\sigma-1}{(1-\nu)\gamma}\left(1+n\tau^{-\gamma}(f_D/f_X)^{\frac{\gamma}{\sigma-1}}\right) \geq \frac{f_D}{f_X}-1$,
(b) due to a reduction in f_X if and only if $\frac{\gamma^2(1-\nu)}{(\sigma-1)((\sigma-1)-\nu\gamma)} \geq \frac{f_X}{f_X-f_D}\left[1+n\tau^{-\gamma}\left(\frac{f_D}{f_X}\right)^{\frac{\gamma}{\sigma-1}}\right]$.

Proof of Proposition 6(i) Interacting equations (2.29) and (2.31), and the proof in Lemma 2 that (2.29) intersects (2.31) from below, it can be seen that

$$sign\left\{\frac{\partial\theta}{\partial n}\right\} = sign\left\{\frac{\partial\left[\tilde{\varphi}^{\frac{(\sigma-1)^2}{(\sigma-1-\nu)\nu}}(1+n\varrho)^{\frac{1-\sigma}{1-\sigma+\nu}}\left[\left(\frac{r+\delta}{1+r}\right)\frac{F_E/f_D}{1-G(\varphi_D^*)}+1+n\varrho(f_X/f_D)\right]^{\frac{\sigma-1}{1-\sigma+\nu}}\right]}{\partial n}\right\}.$$

According to the definition of $\tilde{\varphi}$ in (2.47), the term on the right-hand side reads

$$\tilde{\varphi}^{\frac{(\sigma-1)^2}{(\sigma-1-\nu)\nu}}\left[\frac{1+n\varrho}{\left(\frac{r+\delta}{1+r}\right)\frac{F_E/f_D}{1-G(\varphi_D^*)}+1+n\varrho(f_X/f_D)}\right]^{\frac{1-\sigma}{1-\sigma+\nu}} = \varphi_D^{*\ \lambda 1}\left[\frac{\left(\frac{r+\delta}{1+r}\right)\frac{F_E/f_D}{1-G(\varphi_D^*)}+1+n\varrho(f_X/f_D)}{1+n\varrho}\right]^{\lambda 2}, \tag{2.41}$$

[42] Baldwin and Forslid (2006) provide conditions for different globalization scenarios to improve average productivity in a Melitz model with $\nu = 1$ and φ following the Pareto distribution.

where

$$\lambda_1 = \frac{(\sigma-1)^2}{\nu(\sigma-1-\nu)} > 0 \text{ and } \lambda_2 = \frac{(1-\nu)(\sigma-1)}{\nu(\sigma-1-\nu)} > 0 \; .$$

We know from Melitz (2003) that φ_D^* is increasing in n. Hence, the number of trading partners unambiguously raises the vacancy-unemployment ratio when $f_x > f_D$. As before, a similar prediction can be derived for τ noticing that $\partial\varrho/\partial\tau < 0$, whereas the effect of f_X is *a priori* ambiguous.

Proof of Proposition 6(ii) When firms draw their productivities from a Pareto distribution, we can use (2.49) to substitute φ_D^* in condition (2.41). Since ϱ can be replaced by $\tau^{-\gamma}(f_D/f_X)^{\frac{\gamma}{\sigma-1}}$, we obtain

$$sign\left\{\frac{\partial\theta}{\partial n}\right\} = sign\left\{\frac{\partial\left[\left(1+n\tau^{-\gamma}(f_D/f_X)^{\frac{\gamma}{\sigma-1}}\right)^{-\lambda 2}\left(1+n\tau^{-\gamma}(f_D/f_X)^{\frac{\gamma-\sigma+1}{\sigma-1}}\right)^{\lambda 2+\lambda 1/\gamma}\right]}{\partial n}\right\} .$$

Differentiating this expression with respect to n shows that

$$\frac{\partial\theta}{\partial n} \geq 0 \Leftrightarrow \left(\frac{\sigma-1}{\gamma\,(1-\nu)}\right)\left(1+n\tau^{-\gamma}(f_D/f_X)^{\frac{\gamma}{\sigma-1}}\right) \geq \frac{f_D}{f_X} - 1 \; .$$

Obviously, this condition is always satisfied when $(1-\nu)=0$, as in Melitz (2003). A similar result follows for τ. An increase in foreign beachhead costs leads to a decreasing average productivity if the following requirement is fulfilled

$$\frac{\partial\theta}{\partial f_X} \leq 0 \Leftrightarrow \frac{\gamma^2(1-\nu)}{(\sigma-1)\left((\sigma-1)-\nu\gamma\right)} \geq \frac{f_X}{f_X-f_D}\left[1+n\tau^{-\gamma}\left(\frac{f_D}{f_X}\right)^{\frac{\gamma}{\sigma-1}}\right]$$

Proposition 6 generalizes Proposition 3 to cases with external economies of scale, as long as the additional parameter restriction ensuring existence and uniqueness of the equilibrium is satisfied. As discussed before, the requirements in Proposition 6 are largely satisfied by empirically reasonable parameter values. Accordingly, our theoretical analysis leads us to the conclusion that trade openness is likely to have a beneficial impact on labor market outcomes.

Figure 4 illustrates our findings: when $\tilde{\varphi}$ goes up, the ETC locus rotates downwards;

the effect on the LMC curve, however, depends on parameters. Nevertheless, even when the LMC locus rotates down, the net effect on θ is positive in both wage bargaining scenarios. The effect on input diversity, in contrast, remains ambiguous.

Part (ii) of Proposition 6 derives sufficient and necessary conditions under the Pareto assumption. Inspection of condition (a) shows that the higher external economies of scale are, the more likely it is that labor market outcomes are improved by a reduction in export tariffs or an increase in the number of trading partners. Accordingly, when economies of scale are maximal ($\nu = 1$), as in Melitz (2003), condition (a) is always satisfied. The influence of ν is rather intuitive: trade raises not only productivity at the factory gate but also input diversity and this second effect is obviously more beneficial when economies of scales are strong.

2.9 Proofs

Proof of Proposition 1. To solve the surplus-splitting rule (2.8), notice that the optimality condition (2.5) does not vary with the level of the control variable v. Hence, the optimal firm size remains constant through time, so that $l = l'$. This condition and the envelope theorem enable us to rewrite (2.6) as

$$\frac{\partial J\left(l,\varphi\right)}{\partial l} = \left(\frac{1}{r+s}\right)\left[\frac{\partial R(l;\varphi)}{\partial l} - w\left(l,\varphi\right) - \frac{\partial w\left(l,\varphi\right)}{\partial l}l\right] .$$

Reinserting this expression together with $E\left(\varphi\right) - U = \left(w\left(l,\varphi\right) - rU\right)/(r+s)$ into (2.8) yields

$$\begin{aligned} w\left(l,\varphi\right) &= \beta\frac{\partial R(l;\varphi)}{\partial l} + (1-\beta)rU - \beta\frac{\partial w\left(l,\varphi\right)}{\partial l}l \qquad (2.42)\\ &= \beta\left(\frac{\sigma-1}{\sigma}\right)\left[\frac{Y}{M^{(1-\nu)}}\left(1+I(\varphi)n\tau^{1-\sigma}\right)\right]^{1/\sigma}\varphi^{\frac{\sigma-1}{\sigma}}l^{-\frac{1}{\sigma}} + (1-\beta)rU - \beta\frac{\partial w\left(l,\varphi\right)}{\partial l}l\ . \end{aligned}$$

Equation (2.42) is a linear differential equation in l. One can verify by direct substitution[43] that

$$w\left(l,\varphi\right) = (1-\beta)rU + \beta\left(\frac{\sigma}{\sigma-\beta}\right)\frac{\partial R(l;\varphi)}{\partial l} \qquad (2.43)$$

[43] See Bertola and Garibaldi (1994) or Ebell and Haefke (2009) for a detailed solution of a similar ODE by the method of variation of parameters.

solves (2.42). Equation (2.43) is the counterpart of the Wage curve in the standard search-matching model. The Labor Demand curve is derived reinserting the demand function (2.2) into (2.43) and differentiating the resulting equation with respect to l

$$\frac{\partial w\left(l,\varphi\right)}{\partial l}l=-\frac{1}{\sigma}\left[\beta\left(\frac{\sigma}{\sigma-\beta}\right)\frac{\partial R(l;\varphi)}{\partial l}\right]\ .$$

This expression allows us to substitute $\left(\partial w\left(l,\varphi\right)/\partial l\right)l$ in (2.7) to obtain

$$w\left(l,\varphi\right)=\left(\frac{\sigma}{\sigma-\beta}\right)\frac{\partial R(l;\varphi)}{\partial l}-\left(\frac{r+s}{1-\delta}\right)\frac{c}{m\left(\theta\right)}\ . \tag{2.44}$$

Finally, we express the Wage Curve as a function of θ by reinserting (2.43) into (2.44)

$$w\left(l,\varphi\right)=rU+\left(\frac{\beta}{1-\beta}\right)\left(\frac{r+s}{1-\delta}\right)\frac{c}{m(\theta)}\ . \tag{2.45}$$

It follows that wages are identical across firms. Thus the workers' outside option reads

$$rU(\theta)=b\bar{w}+\theta m(\theta)\left(\frac{w-rU}{r+s}\right)=bw+\frac{\beta}{1-\beta}\left(\frac{c\theta}{1-\delta}\right)\ ,$$

where (2.45) is used to drop the dependence of w on l and φ. The Wage curve in Proposition 1 follows after reinserting the expression of U into (2.45). To simplify the Labor Demand curve, consider first a firm that does not export, so that $I(\varphi)=0$. In this case, it is easily seen that the iso-elastic demand (2.2) implies $\partial R(l;\varphi)/\partial l=p_D(l;\varphi)\varphi\left(\sigma-1\right)/\sigma$. This equality also holds true for exporting firms because they are facing the same domestic demand than non-exporting firms and that marginal revenues are equalized across markets. To see this formally, notice that

$$\begin{aligned}\frac{\partial R(l;\varphi)}{\partial l}&=\left(\frac{\sigma-1}{\sigma}\right)\left[\frac{Y}{M^{(1-\nu)}}\left(1+n\tau^{1-\sigma}\right)\right]^{1/\sigma}\varphi q(l;\varphi)^{-\frac{1}{\sigma}}\\&=\left(\frac{\sigma-1}{\sigma}\right)\left(\frac{Y}{M^{(1-\nu)}}\right)^{1/\sigma}q_D(l;\varphi)^{-\frac{1}{\sigma}}\varphi=\left(\frac{\sigma-1}{\sigma}\right)p_D(l;\varphi)\varphi\ ,\ \text{when } I(\varphi)=1.\end{aligned}$$

The second equality holds true because output is optimally allocated across markets when $q_X=q_D\tau^{1-\sigma}$. Equation (2.44) therefore implies that $p_D\left(\varphi\right)\varphi=p_D\left(\tilde{\varphi}\right)\tilde{\varphi}=\tilde{\varphi}$, where the last equality follows from the definition of $\tilde{\varphi}$. These simplifications lead to the Job Creation condition reported in Proposition 1.

The uniqueness of the equilibrium is ensured since the Wage curve is increasing in θ and the Labor Demand curve decreasing. Existence follows from the same reason since the intercept of the Wage curve is smaller than that of the Labor Demand curve, which yields the condition stated in Proposition 1.

Proof of Corollary 2. Combining the Labor Demand and Wage curves in Proposition 1 leads to the following equilibrium requirement

$$\Psi\left(\theta;\tilde{\varphi}\right) \equiv \tilde{\varphi}\left(-\frac{\sigma-1}{\sigma-\beta}\right)+\frac{c}{(1-\beta)(1-b)}\left(\frac{(1-b(1-\beta))(r+s)}{m(\theta)(1-\delta)}+\frac{\beta\theta}{1-\delta}\right)=0\ .$$

Differentiating $\Psi\left(\theta;\Phi\right)$ with respect to $\tilde{\varphi}$ and θ yields

$$\frac{\partial\theta}{\partial\tilde{\varphi}}=-\frac{\partial\Psi\left(\theta;\tilde{\varphi}\right)/\partial\tilde{\varphi}}{\partial\Psi\left(\theta;\tilde{\varphi}\right)/\partial\theta}=-\frac{-\frac{\sigma-1}{\sigma-\beta}}{\frac{c}{(1-\beta)(1-b)}\left(-\frac{(1-b(1-\beta))(r+s)}{1-\delta}\frac{m'(\theta)}{m(\theta)^2}+\frac{\beta}{1-\delta}\right)}>0\ .$$

Proof of Lemma 1. The Lemma follows from the two equilibrium conditions (2.15) and (2.16). Yet, we still have to establish that the relationship between φ_D^* and φ_X^* does not depend on θ. From the definition of the cutoff productivity in equation (2.13) we know that

$$\pi_X\left(\varphi_X^*\right)+f_X-\left(\frac{r+\delta}{1-\delta}\right)\frac{c}{m\left(\theta\right)}l_X\left(\varphi_X^*\right)=\tau^{1-\sigma}\left[\pi_D\left(\varphi_X^*\right)+f_D-\left(\frac{r+\delta}{1-\delta}\right)\frac{c}{m\left(\theta\right)}l_D\left(\varphi_X^*\right)\right]=\left(\frac{r+\delta}{1-\delta}\right)f_X\ .$$

But we also know that employment levels are log-linear functions of φ, so that

$$\begin{aligned}\pi_D\left(\varphi_X^*\right)+f_D-\left(\frac{r+\delta}{1-\delta}\right)\frac{c}{m\left(\theta\right)}l_D\left(\varphi_X^*\right) &= \left(\frac{\varphi_X^*}{\varphi_D^*}\right)^{\sigma-1}\left[\pi_D\left(\varphi_D^*\right)+f_D-\left(\frac{r+\delta}{1-\delta}\right)\frac{c}{m\left(\theta\right)}l_D\left(\varphi_D^*\right)\right]\\ &= \left(\frac{\varphi_X^*}{\varphi_D^*}\right)^{\sigma-1}\left(\frac{r+\delta}{1-\delta}\right)f_D\ ,\end{aligned}$$

where the last equality follows from the definition of φ_D^*. Combining the two relations above, yields the same relationship than in Melitz (2003): $\varphi_X^*=\tau\varphi_D^*\left(f_X/f_D\right)^{\frac{1}{\sigma-1}}$. This equation allows us to use (2.16) to pin down φ_D^*. We can then use (2.12) to express $\tilde{\varphi}_k$ as a function of φ_k^*, for $k\in\{D,X\}$.

Equilibrium mass of firms. We use the labor market clearing condition to derive the equilibrium mass of firms when wages are bargained at the individual level. The average levels of employment follow from the requirement that the profits of φ_D^*-firms be zero

$$l_i(\varphi_i^*)\left[(\tilde{\varphi}-w)\frac{1-\delta}{r+\delta}-\frac{c}{m(\theta)}\frac{r+s}{r+\delta}\right]=f_i\left(\frac{1+r}{r+\delta}\right)\text{ , for } i\in\{D,X\}, \tag{2.46}$$

and the log-linear relation between firm sizes: $l_i(\tilde{\varphi})=(\tilde{\varphi}_i/\varphi_i^*)^{\sigma-1}\,l_i(\varphi_i^*)$, for $i\in\{D;X\}$. Reinserting the Labor Demand curve yields

$$l_i(\tilde{\varphi}_i)=\left(\frac{\tilde{\varphi}_i}{\varphi_i^*}\right)^{\sigma-1}\left(\frac{1+r}{1-\delta}\right)\left(\frac{\sigma-\beta}{1-\beta}\right)\frac{f_i}{\tilde{\varphi}}\text{ , for } i\in\{D,X\}\ .$$

Accordingly, equation (2.18) is equivalent to

$$M_D=L\left(\frac{\theta m(\theta)}{s+\theta m(\theta)}\right)\left(\frac{1-\beta}{\sigma-\beta}\right)\left(\frac{1-\delta}{1+r}\right)\left[\left(\frac{\tilde{\varphi}_D}{\varphi_D^*}\right)^{\sigma-1}\left(\frac{f_D}{\tilde{\varphi}}\right)+n\varrho\left(\frac{\tilde{\varphi}_X}{\varphi_X^*}\right)^{\sigma-1}\left(\frac{f_X}{\tilde{\varphi}}\right)\right]^{-1},$$

Using the Free Entry condition (2.16), we can rearrange this expression as follows

$$M_D=\tilde{\varphi}L\left(\frac{\theta m(\theta)}{s+\theta m(\theta)}\right)\left(\frac{1-\beta}{\sigma-\beta}\right)\left(\frac{1-\delta}{1+r}\right)\left[\left(\frac{r+\delta}{1+r}\right)\frac{F_E}{1-G(\varphi_D^*)}+f_D+n\varrho f_X\right]^{-1}\ .$$

In order to get the final solution for the number of available varieties, one has to take $M_I=(1+n\varrho)M_D$ into consideration, so that

$$\begin{aligned}M&=(1+n\varrho)\tilde{\varphi}L\left(\frac{\theta m(\theta)}{s+\theta m(\theta)}\right)\left(\frac{1-\beta}{\sigma-\beta}\right)\left(\frac{1-\delta}{1+r}\right)\left[\left(\frac{r+\delta}{1+r}\right)\frac{F_E}{1-G(\varphi_D^*)}+f_D+n\varrho f_X\right]^{-1}\\&=(1+n\varrho)L\left(\frac{\theta m(\theta)}{s+\theta m(\theta)}\right)\left(\frac{1-\beta}{\sigma-\beta}\right)\left(\frac{1-\delta}{1+r}\right)\left(\frac{\tilde{\varphi}}{\left(\frac{r+\delta}{1+r}\right)\frac{F_E}{1-G(\varphi_D^*)}+f_D+n\varrho f_X}\right)\ .\end{aligned}$$

Proof of Proposition 3(i). The definition of $\tilde{\varphi}$ in equation (2.11) and the equilibrium condition (2.16) imply that

$$\tilde{\varphi}=\varphi_D^*\left\{\frac{1}{1+n\varrho}\left[\left(\frac{\tilde{\varphi}_D}{\varphi_D^*}\right)^{\sigma-1}+n\varrho\frac{f_X}{f_D}\left(\frac{\tilde{\varphi}_X}{\varphi_X^*}\right)^{\sigma-1}\right]\right\}^{\frac{1}{\sigma-1}}=\varphi_D^*\left[\frac{\frac{F_E/f_D}{1-G(\varphi_D^*)}\left(\frac{1+r}{r+\delta}\right)+1+n\varrho\frac{f_X}{f_D}}{1+n\varrho}\right]^{\frac{1}{\sigma-1}}. \tag{2.47}$$

As explained in Melitz, trade liberalization always raises φ_D^* as it shifts up the Zero Cutoff Profit condition but leaves the Free Entry condition unchanged. Hence $\partial\left(\frac{1+n\varrho\frac{f_X}{f_D}}{1+n\varrho}\right)/\partial n\geq$

$0 \Rightarrow \partial\tilde{\varphi}/\partial n \geq 0$, which obviously holds true when $f_X \geq f_D$. A similar result can be derived for τ noticing that $\partial\varrho/\partial\tau < 0$. On the other hand, f_X has two opposite effects: it reduces the share of exporting firms ϱ and it increases the ratio $\{f_X/f_D\}$. Thus, even when $f_X > f_D$, the effect of f_X is *a priori* ambiguous. The effect of trade liberalization on unemployment stated in Proposition 3(i) immediately follows from Corollaries 2 and 5. Given that the Wage curve is increasing in θ, it also follows that real wages are increasing in n and τ.

Proof of Proposition 3(ii). Because there does not exist a general closed-form solution for φ_D^*, we have to impose a particular functional form on $g(\varphi)$ in order to derive necessary conditions which are functions of the exogenous parameters. We follow the common practice in the literature by considering that $g(\varphi)$ is Pareto, so that $g(\varphi) = \frac{\gamma}{\varphi}\left(\frac{\bar{\varphi}}{\varphi}\right)^{\gamma}$. Since the absolute value of φ is meaningless in our model, we can normalize $\bar{\varphi}$ to one without loss of generality. Then it holds true that

$$\tilde{\varphi}_D = \left(\frac{\gamma}{1-\sigma+\gamma}\right)^{\frac{1}{\sigma-1}} \varphi_D^* \quad \text{and} \quad \tilde{\varphi}_X = \left(\frac{\gamma}{1-\sigma+\gamma}\right)^{\frac{1}{\sigma-1}} \varphi_X^* \,,$$

and $\tilde{\varphi}$ can be decomposed as follows

$$\tilde{\varphi} = \left[\frac{1}{1+n\varrho}\left(\tilde{\varphi}_D^{\sigma-1} + n\varrho\tau^{1-\sigma}\tilde{\varphi}_X^{\sigma-1}\right)\right]^{\frac{1}{\sigma-1}} = \left(\frac{\gamma}{1-\sigma+\gamma}\right)^{\frac{1}{\sigma-1}} \varphi_D^* \left[\frac{1+n\varrho\left(\frac{f_X}{f_D}\right)}{1+n\varrho}\right]^{\frac{1}{\sigma-1}} . \tag{2.48}$$

We can now use the equilibrium condition (2.16) to express φ_D^* as a function of the parameters

$$\begin{aligned}\varphi_D^* &= \left[\left(\frac{1}{F_E}\right)\left(\frac{1+r}{r+\delta}\right)\left\{f_D\left[\left(\frac{\tilde{\varphi}_D}{\varphi_D^*}\right)^{\sigma-1} - 1\right] + n\varrho f_X\left[\left(\frac{\tilde{\varphi}_X}{\varphi_X^*}\right)^{\sigma-1} - 1\right]\right\}\right]^{\frac{1}{\gamma}} \\ &= \left[\left(\frac{f_D}{F_E}\right)\left(\frac{1+r}{r+\delta}\right)\left(\frac{\gamma}{1-\sigma+\gamma} - 1\right)\left(1+n\varrho\left(\frac{f_X}{f_D}\right)\right)\right]^{\frac{1}{\gamma}} .\end{aligned} \tag{2.49}$$

Reinserting this expression into (2.48) and using the fact that $\varrho = \tau^{-\gamma}(f_D/f_X)^{\frac{\gamma}{\sigma-1}}$, we finally obtain

$$\tilde{\varphi} = K_0\left(1+n\tau^{-\gamma}(f_D/f_X)^{\frac{\gamma-\sigma+1}{\sigma-1}}\right)^{\frac{1}{\sigma-1}+\frac{1}{\gamma}}\left(1+n\tau^{-\gamma}(f_D/f_X)^{\frac{\gamma}{\sigma-1}}\right)^{-\frac{1}{\sigma-1}} , \tag{2.50}$$

where

$$K_0 \equiv \left(\frac{\gamma}{1-\sigma+\gamma}\right)^{\frac{1}{\sigma-1}} \left[\left(\frac{f_D}{F_E}\right)\left(\frac{1+r}{r+\delta}\right)\left(\frac{\sigma-1}{1-\sigma+\gamma}\right)\right]^{\frac{1}{\gamma}} .$$

Differentiating this expression with respect to n shows that

$$\frac{\partial\tilde{\varphi}}{\partial n} \geq 0 \Leftrightarrow \frac{\sigma-1}{\gamma}\left(1+n\tau^{-\gamma}(f_D/f_X)^{\frac{\gamma}{\sigma-1}}\right) \geq \frac{f_D}{f_X} - 1 .$$

Since $f_X\tau^{\sigma-1} > f_D$, it is easily seen that: $\frac{\sigma-1}{\gamma}(1+n) \leq \frac{f_D}{f_X} - 1 \Rightarrow \partial\tilde{\varphi}/\partial n < 0$. This establishes that the necessary condition above can be violated. The effects of τ is easily derived following similar steps. Regarding the comparative static with respect to f_X, we have

$$\frac{\partial\tilde{\varphi}}{\partial f_X} \leq 0 \Leftrightarrow \left(\frac{\gamma}{\sigma-1}\right)^2 \geq \frac{f_X}{f_X-f_D}\left[1+n\tau^{-\gamma}\left(\frac{f_X}{f_D}\right)^{-\frac{\gamma}{\sigma-1}}\right] .$$

Clearly, that inequality can hold only if $f_X > f_D$. The impact on employment and real wages is obtained from the same reasoning than in the proof of Proposition 3 (i).

Chapter 3

Trade and Unemployment: Empirics[1]

3.1 Introduction

Building on the theory presented in Chapter 2 we use macroeconomic data from the OECD to test the main predictions in this chapter. Again, the question we ask is: *Does exposure to international trade create or destroy jobs?* In the short run, trade liberalization increases job turnover as workers are reallocated from shrinking to expanding sectors.[2] Empirical evidence suggests that those adjustments temporarily raise frictional unemployment at the aggregate level, as documented by Trefler (2004) for the case of NAFTA. On the other hand, the long run effect of trade liberalization on the equilibrium rate of unemployment is less clear.[3]

A burgeoning literature introduces labor market imperfections into workhorse models of international trade. Most papers conclude that trade openness matters for the equilibrium rate of unemployment; however, the sign of the relationship differs across papers. Blanchard (2006) talks about an "*overabundance of theories*" of wage setting and unemployment. In-

[1]This Chapter is based on Felbermayr, Prat, and Schmerer (2011b). The article is published in the *European Economic Review.* The concept for the paper was developed jointly, writing was shared equally, and the empirical analysis was carried out by the author of this thesis.

[2]See Bernard, Redding and Schott (2007) for recent evidence.

[3]Paul Krugman (1993) famously argues that "*... the level of employment is a macroeconomic issue, depending in the short run on aggregate demand and depending in the long run on the natural rate of unemployment, with microeconomic policies like tariffs having little net effect.*" However, theoretical considerations, as well as empirical evidence suggest that at least *some* microeconomic policies–such as product market regulation–do affect the structural rate of unemployment; see Blanchard and Giavazzi (2003) for the theoretical argument and Bassanini and Duval (2006, 2009) for a survey of the empirics.

teracted with different explanations for international trade (comparative advantage versus product differentiation models), the number of possible theoretical frameworks is large and already discussed in the introduction.

The state of the theoretical literature therefore suggests turning towards an empirical assessment. As stated by Davidson and Matusz (2004), whether trade affects the level of equilibrium unemployment is "*primarily an empirical issue* ". Yet, "*there is very little empirical work on the aggregate employment effects of trade policies* ". We attempt to shed some light on this question. Rather than testing a specific theoretical model, it presents some robust facts about the relationship between the rate of unemployment and openness in cross-sections of countries. There are two important challenges on the way. First, published data on unemployment rates are notoriously unreliable, with *measurement bias* systematically related to determinants of unemployment. Moreover, "good data "on labor market regulation is available only for a few countries. Second, the incentive for politicians to erect trade barriers as a response to unemployment shocks, may introduce a negative *spurious correlation* between unemployment and openness. If the timing of trade liberalization and labor market reform coincide, domestic demand shocks will concurrently reduce unemployment and increase imports.

We tackle the data quality problem by focusing on two different samples. We start with a high-quality data set of 20 rich OECD countries, provided by Bassanini and Duval (2006, 2009). Great efforts have been made at the OECD to construct unemployment rates and indicators of various labor market institutions with meaningful time and cross-sectional variance. In a second step, we use a lower-quality cross-section of countries, for which we average yearly unemployment rates from various data sets such as provided by the World Bank, the International Labor Organization, the International Monetary Fund, or the CIA and draw on labor market variables provided by Botero et al. (2004). To achieve unbiased estimates, we do our best to purge the data from business cycle effects and we use a comprehensive set of variables to control for labor market institutions. To address simultaneity bias in the OECD panel, we use various GMM-based techniques and exploit the time dimension of the data to construct instruments. In the cross-section, we use the geographical component of trade openness as an instrument.

Across different econometric models, different specifications, and different data sources, we are able to flesh out an important and robust result: the structural rate of unemployment is a non-increasing function of openness to trade. In the largest share of our regressions, higher trade openness actually decreases unemployment. In some exercises, it is irrelevant but never turns out to be positively correlated with unemployment. We find the following additional results. (i) There is no evidence that the effect of openness on unemployment is biased upwards due to endogeneity. Quite to the contrary, we find that OLS yields a negative bias, which signals that attenuation bias due to non-systematic measurement error in the openness measure (which biases results to zero) dwarves the endogeneity bias. (ii) It is important to adjust the openness measures for differences in the relative prices of non-traded goods, as suggested by Alcalá and Ciccone (2004) in the context of cross-country growth regressions. In particular, the unadjusted openness measure tends to exaggerate the effect of openness on unemployment.[4] (iii)It appears that the reduction in aggregate unemployment is primarily due to lower unemployment of high-skilled workers.

Related literature. Apart from the theoretical literature discussed above, our exercise is closely related to two important strands of empirical research. First, labor economists have long estimated cross-country unemployment regressions, usually based on panel data for a restricted sample of rich OECD countries. Following Blanchard and Wolfers' (2000) seminal paper, the literature is mainly concerned with the explanatory power of labor market institutions and macroeconomic shocks. Nickell et al. (2005) provide a recent example of this approach, whereas Bassanini and Duval (2006) present a comprehensive survey. The terms "international trade", "openness" or "globalization" do not appear in their comprehensive 130 pages study. Hence, it appears to us that the role of international trade in cross-country regressions has not yet been thoroughly addressed.[5] To connect our results with previous research, we closely follow the received methodology since we use similar data, econometric techniques and specifications. To the best of our knowledge, our work is the first to systematically assess the role of trade openness for unemployment within the context

[4]Note that this issue is of much less concern in our panel analysis, where we can effectively control for the time-invariant component of cross-country variation in relative prices.

[5]Scarpetta (1996) uses an index measuring the pervasiveness of trade restrictions to proxy the intensity of competition. One also should add that many papers interact terms-of-trade shocks with labor market variables. However, they do not use the level of openness as an independent covariate. Boulhol (2008) interacts trade openness with labor market institutions, but does not address the endogeneity problem.

of standard cross-country unemployment regressions for OECD countries.[6] Surprisingly enough, the influence of trade turns out to be much more robust than that of many labor market institutions.

We also incorporate insights from the large empirical literature about the effect of trade openness on per capita income. Frankel and Romer (1999) have proposed an instrumentation strategy based on geography which is, as a matter of fact, applicable only in cross-sections. The consensus is that the positive effect of openness on per capita income is not robust to seemingly unrelated geographical controls, such as the distance to equator.[7] Their paper has triggered a debate on the relative importance of trade, institutions, and the common underlying exogenous driver, geography. Prolonging this line of investigation, a recent paper by Dutt et al. (2009) test specific implications of the Davidson and Matusz (1999) model using cross-country regressions and a geography-based instrument. Although their sample, data sources and methodology are different, their results are qualitatively in line with ours. Interestingly, our own IV estimates, much inspired by the approach of Alcalá and Cicone (2004), suggest a negative relationship between openness and unemployment that is robust to inclusion of variables such as distance to equator or general institutional controls.

Structure of the chapter. In chapter 3.2 we provide a brief first glance at the data. We identify two key concerns about data quality and endogeneity bias. This motivates chapter 3.3, where we sketch the empirical strategy for our different data sets. Chapter 3.4 contains our core results on the trade-unemployment relation. We provide evidence for a high-quality OECD panel with relatively narrow country coverage, a larger cross-section of countries, and a short-panel with a greater number of countries. We contrast import and export openness, and compare the real measure proposed by Alcalá and Ciccone (2004) to the traditional one used, e.g., in Frankel and Romer (1999). Chapter 3.5 presents additional results on the channels through which openness affects labor markets and on interactions between labor market institutions, the capital-labor ratio, and trade. It also discusses a large number of robustness checks with the details relegated to a supplement paper. Finally, chapter 3.6 concludes.

[6] The report of the European Economic Advisory Group at CESifo (2008) also includes some cross-country regressions of unemployment rates on openness, but does not attempt to sort out correlation from causality.

[7] See, for example, Rodriguez and Rodrik, 2000.

3.2 A descriptive look at the data

As a first step, this Chapter discusses the data that we use in our empirical exercise: unemployment rates and different measures of openness to international trade. It also provides a first heuristic look at the unemployment-openness relationship. A detailed discussion of the data is contained in the last chapter.

3.2.1 Data sources and variables

Unemployment rates

International institutions such as the OECD, the World Bank or the International Labor Organization (ILO) provide harmonized aggregate unemployment rates that are calculated following the same conventions. Across different international institutions, these rules can differ. For example, the rates published by the OECD or the World Bank rely on national administrative sources, while the ILO data is based on labour market surveys. The former strategy presupposes the cooperation of national statistical agencies; the latter is probably better suited to developing countries. Country coverage is always an issue: While the World Bank has 185 members, in the year 2000 it reports unemployment rates only for 93 of them. The ILO data exhibits an even lower degree of country coverage (86 countries). Skill-specific unemployment rates are from the World Bank (WDI data base), but time and country coverage is fairly poor.

In all cases the accuracy of the published rates depends on the quality of the data delivered by the institutions' member states. Data quality is only a minor issue for the 20 rich OECD countries, but appears to be highly problematic for the rest of the world.[8] The correlation between unemployment rates from these different data sets is strikingly low within the group of low-income, low-openness countries, which suggests that data quality systematically depends on country characteristics. Such non-random measurement error in our dependent variable (the rate of unemployment) will tend to bias the absolute value of the estimated effect of openness upwards.

[8] In its statistical factbook, the CIA publishes yearly estimates of unemployment rates for a larger sample of countries (as of 2000, there is data for 160 countries). The CIA makes use of all publicly available information plus the insider information of its employees. How exactly the CIA experts obtain these estimates is not made explicit. In the non-OECD sample, average CIA estimates are substantially larger than the information provided by official sources; in the OECD sample there is no such gap.

Unfortunately, there is very little that one can do about data quality problems except running as many robustness checks as possible or working with the small panel of OECD countries for which data quality is satisfactory.[9] Hence, in a first step, we focus on 20 high-quality OECD countries, for which systematic measurement bias in the rate of unemployment is unlikely (but where the analysis may suffer from non-random sample selection). This choice strongly limits the cross-sectional scope of our analysis and makes it necessary to use panel data and rely on time-variance for estimation. In addition, we perform purely cross-sectional regressions with larger country samples and also experiment with a short panel for this larger sample. To verify the robustness of our results, we use different data sources for the dependent variable (unemployment rate). Finally, we also report regression results where we use skill-specific unemployment rates.

Openness measures

The summary measure of trade openness nearly always used in empirical work is *nominal* imports plus exports relative to nominal GDP, usually referred to as (trade) openness and denoted by T. For recent examples see Coe and Helpman (1995), Frankel and Romer's (1999), Ades and Glaeser (1999), Alesina, Spolaore and Wacziarg (2000), Dinopoulos and Thompson (2000) or Alcalá and Ciccone (2004). The openness measure has the advantage that it reflects the actual exposure of an economy to international trade and is easily measurable. Trade policy itself is often hard to observe, in particular because of the declining importance of tariffs or quotas and the increasing use of informal trade barriers. Also, membership in regional trade agreements or the WTO does not necessarily provide information about the actual openness of an economy, see Rose (2005).

Alcalá and Ciccone (2004) argue that the Balassa-Samuelson effect distorts nominal price openness measures since countries with low labor productivity and hence a high price of traded relative to non-traded goods have artificially high degrees of openness. They propose to use *real* openness defined as imports plus exports in exchange rate US$ relative to GDP in purchasing-power-parity US$ (PPP GDP). This eliminates cross-country differences in the relative price of non-traded services from the summary measure of trade. They show how the real openness measure can be computed using data provided in the Penn World Tables (PWT). The measure of real openness may be particularly relevant to the extent

[9] More details on countries included is provided in the Appendix.

that the effect of trade openness on aggregate unemployment works through total factor productivity. We use real total trade openness constructed according to Alcalá and Ciccone (2004) as our benchmark measure. Even if accounting for the Balassa-Samuelson effect is not a big issue for countries in our OECD sample, the problem becomes more severe in our large cross sectional regressions. Comparing real and current price openness measures reveals that the effect is smaller for real openness but coefficients are more stable across different models and setups.[10]

As with unemployment rates, the openness measures may be noisy proxies for the actual degree of exposure to international trade. It is less obvious, however, that measurement error should be *systematically* related to any determinant of the unemployment rate. Random measurement error would bias estimated towards zero, making it harder for us to find significant effects.

Labor market institutions

The OECD has collected data on a wide array of institutional variables that can be expected to affect the equilibrium rate of unemployment. Bassanini and Duval (2006, 2009) discuss the data in detail. These measures include the degree of union density or of union coverage, the extent of employment protection legislation or of active labor market policies, effective average tax rates on wages, the average replacement rate of unemployment insurance, the degree of corporatism and many more. The data also includes a measure of product market regulation which reflects entry barriers. These variables are available for 20 rich OECD countries, and for most of them we have time series ranging from 1980 - 2003.

The data for the wider cross-section of countries is more problematic. By far the most careful data collection has been undertaken by Botero et al. (2004). They provide a data set containing data on various aspects of labor market regulations for 85 countries. Observations range from 1990 - 2000 and were averaged over the whole period. In our study we focus on measures related to the generosity of unemployment benefits, the extent of employment protection (EPL) and the importance of minimum wages. Additionally to those labor market regulations Botero et al. also collected data on the size of the informal economy. Reported

[10] In our robustness checks, we also work with *constant* price openness measures which fix *all* prices at some base year. Moreover, data provided by the World Bank allows to focus on merchandize trade only. This allows to see whether trade in services has a different effect on unemployment compared to trade in goods.

unemployment rates and the degree of openness may both be systematically related to the size of the shadow economy so that omitting this variable could easily bias the effect of trade. This is a particularly important issue in the large cross-section, where we cannot control for unobserved heterogeneity and where we have a large number of developing countries.

The Botero et al. data does not contain a time dimension. Therefore, when running panel regressions for the large country sample, we need to rely on data from the Fraser *Freedom of the world* data base, where we have variables on unemployment benefits, labor market institutions and product market regulations. The former variable is an index that collects information on many dimensions of labor market institutions; the latter quantifies the extent of price controls.[11] Observations for 116 countries are available in five year intervals beginning in 1975 and ranging until 2005.

3.2.2 A first glance at the openness-unemployment nexus

Time variance in the OECD sample.

The solid line in Figure 3.1 plots the *unweighted* average unemployment rate of 20 rich OECD countries (see the Appendix for a list of countries). Starting from a low level at about 2 percentage points in 1970, the unemployment rate increased over time to reach a peak of 10 percent in the mid-nineties, but fell back to about 6 percent in 2003. Measured on the right vertical axis of Figure 3.1, the unweighted average share of trade in total GDP (measured as real openness) also displays a clear upward trend: it increased from about 25 percent in 1970 to about 40 percent in the early years of the new millennium. Because of this common time trend, average unemployment rates and real openness measures appear to be positively correlated.

So far, the empirical labor market literature has usually not accounted for any measure of trade openness. Nickell et al. (2005) show that the evolution of labor market institutions has substantial explanatory power for unemployment rates. In particular, tax rates and replacement rates perform well; other institutional variables do not yield robust results. This is not entirely surprising since the theoretical predictions relating to employment protection legislation or union coverage are usually ambiguous. Costain and Reiter (2008) use

[11] In the original Fraser data higher values indicate more freedom and thus less regulation. To avoid confusion when comparing with the OECD or the Botero et al. data we rescale the Fraser variables by the factor -1.

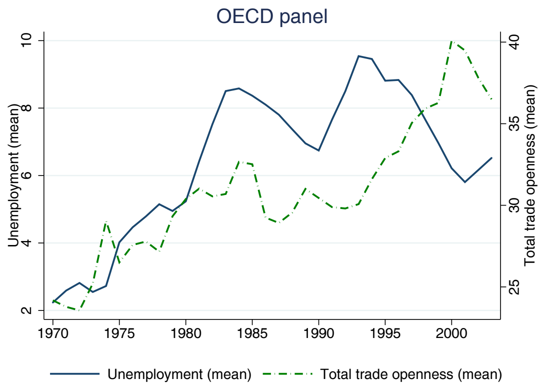

Figure 3.1: Unemployment and openness

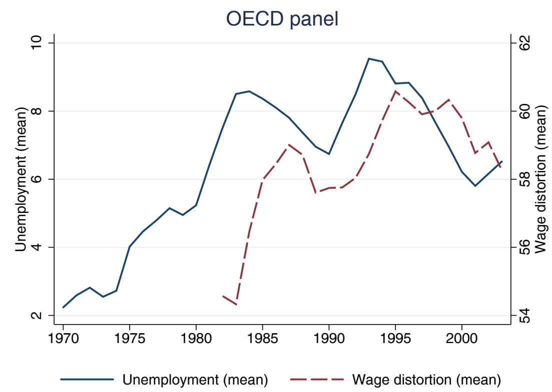

Figure 3.2: Unemployment and wage distortion

a theoretical model to argue that tax and replacement rates should have similar qualitative and quantitative effects in a search and matching model of unemployment. They propose to add them. The obtained index consists of the sum of the average wage tax burden and social benefits foregone when a worker switches from unemployment into a job. It therefore measures the *total* fiscal burden imposed on the worker (see also Saez (2002) or Immervoll et al. (2007)) and is sometimes referred to as the participation tax. Figure 3.2 shows that the average wedge and average unemployment are also positively correlated over time. Hence, the *prima facie* evidence suggests that it is important to control for both variables in any meaningful cross-country unemployment regression that draws on time variance.[12]

Figures 3.1 and 3.2 present sample averages over time and fully disregard heterogeneity across countries. In a next step we correlate *first-differences* of the real openness measure against *first-differences* in the unemployment rate. Differencing should eliminate country-specific effects unrelated to openness that may drive the correlation in Figure 3.1. Figure 3.3 shows the scatter plot and fits a univariate linear regression. The slope of the line is estimated at -0.04 with a t-value of 5.69. This preliminary evidence points towards a negative effect of trade openness on the rate of unemployment. A one-standard deviation increase (about 10 percentage points) of openness is associated to a decrease in the rate of unemployment of about 0.4 percentage points. Interestingly, our more elaborate multivariate instrumental variable analysis below suggests results of very similar magnitude.

[12] In the picture, the unemployment rate leads the measure of wage distortion over time. Costain and Reiter (2008) discuss the endogeneity issues suggested by this fact but conclude that they are unlikely to pose any serious problems.

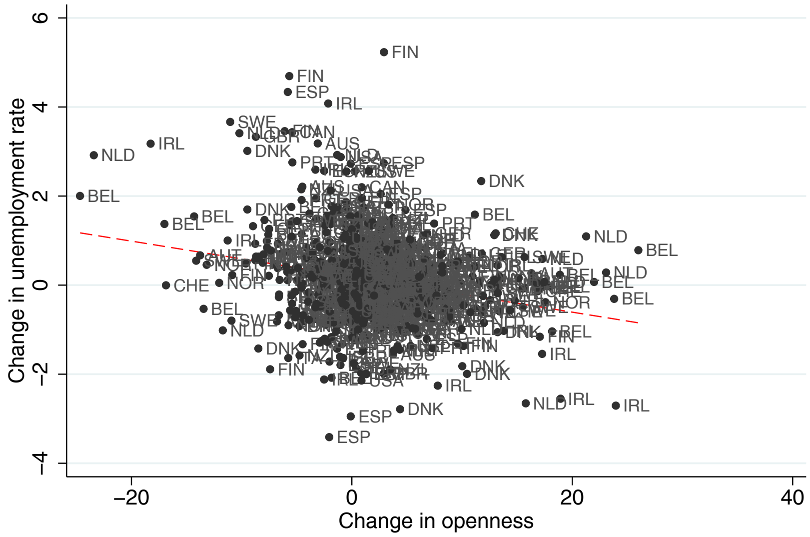

Figure 3.3: Unemployment and trade openness: first differences of 5-year averages (OECD sample)

Cross-sectional variance in the large sample

Figure 3.4 sets the average *level* of unemployment (WDI estimates) against the average *level* of openness (real current price) for the largest cross-section of countries, for which we have data. Averages are based on the period from 1990-2006, but there may be substantial spans of missing values within that period.

The linear regression line fitted to the scatter plot has a slope of about -0.044 with a t-value of 2.20.[13] Hence, also in the large cross-section of countries, the unconditional regression of openness on the rate of unemployment yields a negative correlation. Because the variance of the openness measure is much larger in the large cross-section than in the narrow OECD sample, the point estimate implies that a one-standard deviation increase of openness is associated to a decrease in the rate of unemployment by about 1 percentage point.

3.2.3 Implications and challenges

The above figures are suggestive. However, there are several reasons why the correlations in figures 3.3 and 3.4 may be spurious. First, while we have used yearly data, there may be business cycle effects: any positive shock on domestic spending is likely to increase domestic

[13]The finding of a negative slope is robust to the exclusion of HKG (Hong Kong) and SGP (Singapore); statistical fit is improved by taking logs of both variables.

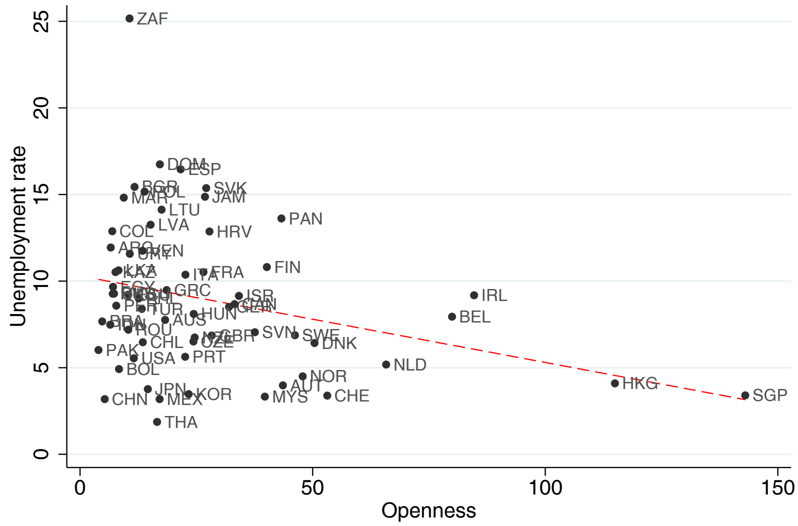

Figure 3.4: Unemployment and trade openness: averaged levels (large cross-section)

as well as import demand, and thus to lower unemployment and increase openness. Second, in periods of reform, countries may simultaneously liberalize their product and labor markets, leading to a simultaneous increase in openness and employment. Third, politicians may react to shocks in the unemployment rate by imposing protectionist measures. More precisely, they may resort to policy measures that discourage imports and encourage exports; since the overt use of tariffs, quotas, or subsidies is strongly restricted by international agreements, governments may use non-tariff measures which are difficult to control for directly. In the case that import-restricting policies dominate, the rise in unemployment would be associated with a reduction in openness.

We deal with the first problem, the *business-cycle effect*, in the following way: In the OECD sample, we take 5-year averages to smooth out business cycle variation. Moreover, in all regressions we include a measure of the output gap, based on HP filtering methods, and provided by Bassanini and Duval (2006). In the larger cross-section, we take averages over the entire available period (1990-2006) and also include the output gap.

The second issue relates to an *omitted variables bias*. In the OECD sample, we can draw on high-quality data provided by Bassanini and Duval (2009). For the wider sample, we use the variables provided by Botero et al. (2004). See the Appendix for a detailed description of all our data.

The third and most interesting problem is a classical *simultaneity* problem. We can only address it by instrumenting the openness measures. In the case of the OECD panel, we can exploit the time-variance of the data and use lagged differences and levels as instruments. In the case of the wider cross-section, we draw on the instrument proposed by Frankel and Romer (1999) and used, i.a., by Alcalá and Ciccone (2004). This empirical approach in the cross-section has been criticized in the literature; see Rodriguez and Rodrik (2000) or Kraay (2010). The main two issues relate to unresolved omitted variable bias and the validity of the exclusion restriction. We add the variables that have been found in the literature to undo the significance of the growth-openness nexus (e.g., latitude). However, the panel approach is clearly preferable from an econometric point of view.

3.3 Empirical strategy

We have to adapt our econometric strategy to the nature of the available data. For the OECD sample, where we can draw on meaningful time-variance, we build on the rich tradition of empirical labor market studies surveyed in Bassanini and Duval (2006) and use panel methods. For the wider sample, we use the cross-sectional approach which has been widely employed in the growth-openness literature. While time-variance in the larger cross-section is somewhat problematic, we still check our results by running panel regressions as well.

3.3.1 OECD sample: GMM panel regressions

We extend Nickell et al. (2005) and estimate variants of a dynamic model

$$u_{i,t} = \sum_{s=1}^{S} \rho_s u_{i,t-s} + \beta \cdot T_{i,t} + \lambda \cdot \mathbf{LMI}_{i,t} + \pi \cdot \mathbf{PMR}_{i,t} + \chi \cdot \ln POP_{i,t} + \gamma \cdot GAP_{i,t} + \nu_i + \nu_t + \varepsilon_{i,t}, \quad (3.1)$$

where S is the number of lags of the endogenous variables. All variables are five-year averages. The vectors $\mathbf{LMI}_{i,t}$ and $\mathbf{PMR}_{i,t}$ collect variables measuring labor market institutions and product market regulation, respectively. $POP_{i,t}$ refers to population, $GAP_{i,t}$ is the output gap,[14] ν_i is a vector of country-specific effects, ν_t denotes time effects, and $\varepsilon_{i,t}$ is an error term. We are primarily interested in the estimate of β and expect that the effects of LMI and PMR conform with the evidence surveyed in Bassanini and Duval (2009). This

[14]For the OECD output gap is measured as derivation of actual output from potential output (Basanini and Duval (2006). For the large cross section we use a proxy constructed as difference between actual GDP and trend GDP. The latter is obtained by HP-filtering the data, where the smoothing parameter is set to 400.

evidence is mixed: Baker et al. (2004) show that those panel data estimations lack robustness and that clear results on the role of most labor market institutions hardly exist. There is, however, an emerging consensus that replacement rates and the tax wedge have a robust and theoretically sensible effect; see Costain and Reiter (2008).

The (preferred) equation estimated by Nickell et al. (2005) is similar to (3.1), but does not include openness or a measure of the country's market size (such as population). They use generalized least squares techniques on this equation and are not particularly worried by the potential endogeneity of labor or product market institutions. Many of the specifications surveyed in Bassanini and Duval (2009) constrain $\rho_s = 0$ and estimate static fixed effects models. Some papers use the log of $u_{i,t}$ as the dependent variable (Nickell, 1997; Costain and Reiter, 2008), but there does not seem any consensus as to which specification is preferred. In our baseline specifications, we use $u_{i,t}$ in levels, but provide robustness checks for the logarithmic case.

We address the potential endogeneity of openness and of the lagged dependent variable by instrumenting with the respective lagged values.[15] In the first-differenced general method of moments (diff-GMM) approach by Arellano and Bond (1991), all variables are differenced and endogenous variables are instrumented by their lags (in differences). The more general approach proposed by Blundell and Bond (1998) adds level equations to the differenced ones. This leads to a system of two different sets of moment conditions (differences and levels). Blundell and Bond use Monte Carlo simulations to show that the sys-GMM approach is more efficient since a larger number of moment conditions is available. All techniques discussed above allow to control for potential endogeneity, even when there is no obvious instrument waiting on the wing. Nevertheless those GMM approaches must be treated cautiously since small degrees of model specification error may induce large effects on results and lagged variables might be weak instruments. There are however, a number of tests that can be used to check whether the conditions of the approach are fulfilled. For both GMM methods, two requirements must hold: *i*) the instruments must be uncorrelated with the error term and *ii*) the instruments must be correlated with the instrumented variables. Both types of GMM are valid if we find evidence in favor of first order, but against second order auto correlation in the residuals.[16]

[15] Additionally, we treat the wage distortion index (sum of average replacement rate and tax wedge) as endogenous.

[16] We have also experimented with the Anderson and Hsiao approach where lagged variables are

3.3.2 Large cross-section of countries: 2SLS regressions

To extend the analysis beyond the 20 rich OECD countries, we focus on a pure cross-section of countries. This approach is strongly related to cross-country income regressions (Frankel and Romer, 1999; Alcalá and Ciccone, 2004), with the most important difference being the change in the dependent variable.

We estimate the following second stage regression

$$u_i = \alpha + \beta \cdot T_i + \lambda \cdot \mathbf{LMI_i} + \pi \cdot \mathbf{PMR}_i + \delta \cdot \mathbf{GEO}_i + \iota \cdot \mathbf{INST}_i + \chi \cdot \ln POP_{i,t} + \gamma \cdot GAP_i + \varepsilon_i, \quad (3.2)$$

which includes the same type of controls than (3.1). Given that we have no reliable time-variance available to control for unobserved country-specific fixed effects, we have to add geographical variables to control for the size of the home-market and hence the importance of *within-country trade* as compared to international trade. Frankel and Romer (1999) and much of the following literature use the log of population and the log of land area of country i.[17] Regressions also contain a continuous measure of landlockedness as an additional strictly exogenous control. We proxy for the overall quality of institutions by including distance to the equator and continent dummies.

We follow Frankel and Romer (1999) and instrument T_i by its (exogenous) geographical component; however, our strategy is somewhat more general. It consists in using bilateral trade data (for the year of 2000) and regress total trade (exports plus imports) between country i and j, normalized by country $i's$ GDP, on geographical determinants of trade in an equation of the type

$$T_{ij} = \exp\left[\varphi \mathbf{X}_{ij}\right] \cdot \upsilon_{ij}. \quad (3.3)$$

The vector $\mathbf{X}$ contains the *log* of bilateral distance between i and j, the *log* of population of i and j as of year 1960, the *log* of land area of i and j, and a continuous measure of landlockedness. It also contains interactions of all those terms with an adjacency dummy. All of the elements in $\mathbf{X}$ are exogenous while υ_{ij} is an error term.

The standard procedure is to take logs of (3.3) and estimates the vector φ using OLS. Since $T_{ij} = 0$ for many country pairs, we follow Santos and Tenreyro (2006) and estimate

used as instruments when estimating two stage least square IV regressions. Results are available on request.

[17]While standard in the related literature and crucial for the interpretation of the results, Dutt et al. (2009) do not include these controls.

(3.3) using Poisson pseudo maximum-likelihood. Predicting $\hat{T}_{ij}$ and summing over j, we have a measure of the trade share $\hat{T}_i$ that is by construction orthogonal to unemployment and hence a valid instrument.[18] The Poisson approach leads to a stronger instrument since we do not have to omit the information contained in the zero trade observations and need not resort to out-of-sample predictions to construct the instrument.[19]

3.3.3 Large sample: Panel regressions

In the setup described in chapter 3.3.2, we have averaged yearly available unemployment data for a large set of countries into a cross-section. This seems appropriate to deal with business cycle effects and should also help to reduce (non-systematic) measurement error in both the dependent and the independent variables. It is also possible to generate averages over shorter periods of time (five years), stack data from different periods, and use panel methods. The drawback of this approach is that unemployment data are available only for a very small sample for a long time horizon so that we end up with a strongly unbalanced panel. Nonetheless, applying panel methods still allows us to check the overall robustness of our results in 3.3.2 to country-specific unobservable effects.

We use the same econometric specification than the one used on OECD data, i.e. equation (3.1). Since we need time-variant information about labor and product market regulation, we cannot use the Botero et al. (2004) data, but have to work with variables provided by the Fraser Institute (see the Appendix for details on data).

3.4 The effect of openness on unemployment

In the following chapter, we present benchmark results for our different samples, empirical strategies and IV strategies. The overall picture is fairly robust and surprisingly clear-cut: regardless of the precise econometric model used, independent from the exact source of data or the definition of the employed openness measure or the nature of controls, we find that higher openness does not increase unemployment. Quite to the contrary, openness *strictly*

[18]Note that validity of the instrument does not require that the coefficients associated to $\mathbf{X}$ are *consistently* estimated parameters of a gravity equation. Rather, equation (3.3) is a constructed exogenous measure of multilateral resistance.

[19]Noguer and Siscart (2005) show that out-of-sample predictions has important adverse implications for the strength of the instrument.

lowers the equilibrium rate of unemployment in most regressions.

3.4.1 Benchmark results

OECD sample: panel regressions

Table 3.1 presents panel regressions for 20 rich OECD countries. The dependent variable is the rate of unemployment in the total working age population (age 15-64). All variables are five-year averages ranging from 1980 - 2003.[20] Robust standard errors are reported. A list of countries used in these regressions is provided in the Appendix.

Columns (1) and (2) show standard regressions as carried out by Bassanini and Duval (2009). The first treats country-effects as fixed, the second treats them as random, everything else is equal. We let a Hausman test decide which of the two specifications is preferred. In all cases presented in Table 3.1 the test recommends the random effects (RE) specification over the fixed effects (FE) model.

The regressions reveal a well-known pattern: only a few labor market controls are statistically significant, and often the sign pattern seems to be counter-intuitive. The stringency of firing restrictions as reflected by our employment protection legislation (EPL) index is negatively associated to the rate of unemployment. Hence, firing restrictions seem to discourage job destruction more than job creation even though the effect is not statistically distinguishable from zero. Similarly, we do not find any robust role for the degree of union density. The degree of wage distortion (the sum of the replacement rate and the average tax rate on wages) is positively related to the equilibrium unemployment rate. Statistically significant at the 1% level, an increase in the wedge by 10 percentage points increases the rate of unemployment by about 1.1 percentage point. Countries with a highly corporatist bargaining culture have an unemployment rate that is by about 2.6 percentage points lower than countries without this tradition. These findings are in line with the literature,[21] and the emerging consensus that the degree of wage distortion is the most important institutional variable in panel regressions.[22] We also add a variable that has received much interest

[20] We have also run regressions on yearly data. Results are similar and statistical significance is usually higher. However we prefer to work with averages to better account for business cycle variations.

[21] As can be seen from the survey by Bassanini and Duval (2009) or the critical discussion in Baker et al. (2002).

[22] See Costain and Reiter (2008).

in the last years as a determinant of unemployment, namely the degree of product market regulation (PMR).[23] The effect of PMR on unemployment is positive, but not significant and therefore meaningless.[24]

Although we average our data over five-year intervals to mitigate business cycle concerns, the output gap is strongly significant and has the expected negative sign. This shows that taking averages alone is not sufficient to purge out the business cycle. Also note that country-specific effects are important for the overall explanatory power of the model. A model that explains unemployment only by country-effects yields an R^2 statistic of about 63%; adding year dummies improves the share of left-hand-side variance explained to 75%. In the random effects model shown in column (2), the exact variance decomposition shows that the within component is much larger than the between component.

Columns (3) and (4) include the *real openness* measure proposed by Alcalá and Ciccone (2004) into the fixed- and the random effects models, respectively. Again, the Hausman test recommends the more efficient RE model. Inclusion of the openness measure increases the explanatory power (within R^2) of the regression by about 5 percentage points. Focusing on the RE specification and comparing the models with and without the openness measures, we find that the coefficients on the labor market variables change only very slightly so that omitted variable bias from not incorporating openness seems unimportant. This suggests that labor market regulation does not systematically correlate with the degree of openness. Also the output gap does not seem to covary with openness. The effect of openness on the rate of unemployed is estimated to be 0.076. Hence, a 10 percentage point increase lowers the equilibrium rate of unemployment by about 0.76 percentage points.

Given that column (4) reports our preferred estimate, it is worthwhile to note that it implies a rather moderate contribution of trade liberalization for unemployment. Amongst larger countries, such as the US, Japan, or the EU en bloc, pre-crisis openness was at about 30%, 34% and 29%, on average 13% higher than before world war II. The increase in openness was therefore responsible for a decrease in the average unemployment rate of about 1.2 percentage points. Given the standard deviation of unemployment rates in our sample (about 4 percentage points), this seems a sizable effect. Yet, it is clear that other determinants of unemployment rates (such as institutions) play a more important role.

[23] See Felbermayr and Prat (2011) for theory and evidence on the role of PMR.

[24] Regressions with the logarithm of GDP instead population yield very similar results but raise more serious concerns about regressor endogeneity.

Table 3.1: Benchmark regressions: OECD panel

Dependent variable: Total unemployment (16-64 years old)
Openness measure: Real openness (Alcala & Ciccone, 2004)

	(1) FE	(2) RE	(3) FE	(4) RE	(5) FGLS	(6) Diff-GMM	(7) Sys-GMM
Total trade openness			−0.128***	−0.076***	−0.112***	−0.230***	−0.052***
			(0.035)	(0.021)	(0.021)	(0.062)	(0.019)
Lag dep. var.					0.305***	0.220	0.725***
					(0.047)	(0.174)	(0.089)
Wage distortion (index)	0.114**	0.111***	0.065	0.103***	0.073***	0.016	0.085*
	(0.044)	(0.027)	(0.044)	(0.026)	(0.018)	(0.114)	(0.049)
EPL (index)	−0.444	−1.027	−0.380	−0.969	−0.589	−0.112	−1.188**
	(1.329)	(0.662)	(1.378)	(0.652)	(0.377)	(1.161)	(0.580)
Union density (index)	0.038	0.007	0.025	0.009	0.025*	−0.010	−0.053*
	(0.041)	(0.029)	(0.043)	(0.029)	(0.014)	(0.039)	(0.029)
High corporatism (dummy)	−3.668***	−2.542***	−2.325*	−1.805**	−2.574***	−1.181	−1.572
	(0.822)	(0.735)	(1.203)	(0.744)	(0.467)	(1.399)	(0.981)
PMR (index)	0.745	0.769	0.963	0.835*	0.820***	0.700	0.893*
	(0.553)	(0.478)	(0.591)	(0.462)	(0.230)	(0.669)	(0.476)
Population (ln)	−17.578***	0.739	−19.689**	0.141	−13.402***	−20.200***	−0.610
	(6.007)	(0.540)	(6.994)	(0.605)	(3.391)	(6.832)	(0.704)
Output gap	−0.606***	−0.636***	−0.624***	−0.626***	−0.589***	−0.872***	−0.842***
	(0.082)	(0.114)	(0.089)	(0.114)	(0.047)	(0.168)	(0.125)
Observations	100	100	100	100	100	80	100
R^2 (within)	0.602	0.569	0.648	0.608			
R^2 (between)	0.012	0.353	0.018	0.282			
R^2 (overall)	0.004	0.411	0.008	0.369			
Hausman	0.599		0.188				
Hansen test (OID)						0.407	0.999
AR(1)						0.025	0.017
AR(2)						0.314	0.219

Robust standard errors in parentheses, * significant at 10%, ** significant at 5%, *** significant at 1%. Number of observation N=100 (20 countries observed for 4 5-year periods and 1 4-year period; averages taken; 1980-2003). Hausman test p-values reported (Fixed effects estimator always consistent; random effects estimator efficient under Ho). All models control for unobserved country and period effects. FGLS allows for heteroscedastic errors and country specific first order serial correlation. First lag of dependent variable used for Feasible Least Square and Generalized Methods of Moments regressions. Diff- and Sys-GMM estimators are valid if i) OID test does not reject the H0 (H0: overidentifying restrictions are valid) and ii) if test on AR(1) is positive and negative on AR(2) (H0: no autocorrelation). Openness, output gap and wage distortion treated as endogenous in the GMM regressions. Maximum number of lags used as instruments equals one (21 instruments for diff-GMM, and 36 instruments for sys-GMM). Constant estimated but not reported.

The remaining models presented in Table 3.1 are dynamic models. Column (5) uses the feasible generalized least square methodology proposed by Nickel et al. (2005) to estimate an autoregressive model.[25] The lagged rate of unemployment has an estimated coefficient of about 0.3, signaling that–over our five-year periods–unemployment rates are only mildly persistent. Again, the effect of openness is precisely estimated and negative. The short-run effect together with the autoregressive coefficient implies that a ten percentage point increase in openness lowers the equilibrium rate of unemployment by roughly 1.1 percentage points in the short-run, and by about 1.6 percentage points[26] in the long-run.[27]

So far we have not dealt with the potential endogeneity of openness. Models (6) and (7) use lagged realizations or lagged differences of openness as instruments. In the first case, GMM estimation is applied to a differenced version of equation (3.1). In the second case, moment conditions from an additional level equation are used to increase efficiency. In both cases, we find that openness reduces unemployment. In the diff-GMM model (6), the short- and the long-run effects coincide. A ten percentage points increase of openness suggests a reduction in average unemployment rate by about 2.3 points, which seems implausibly large. In the more general sys-GMM model (7), the short-run effect is smaller: a 10 percentage points increase in openness decreases unemployment by about 0.5 percentage points. The long run effect, however, is again comparable: a 10 percent openness increase leads to lower unemployment by 1.9 points,[28] which is comparable to the FGLS results. GMM methods are vulnerable to misspecification problems and applicable only under certain conditions. For both models, the OID tests for overidentification yield high p-values so that validity of the instruments cannot be rejected.[29] Furthermore, the AR(1) and AR(2) statistics suggest that the model is not misspecified.

Comparing (long-run) estimates across different columns of Table 3.1, we find that the point estimates of the openness coefficient are typically larger under the IV strategy. This is consistent with several explanations. First, the non-IV estimates may be biased down (in absolute value) due to endogeneity bias. This would happen if governments respond to adverse unemployment shocks by promoting exports since then total openness, which reflects

[25] Their approach includes country effects into the regressions.

[26] $0.112/(1-0.305)$.

[27] Long-run coefficients are found at the fixed-point of the difference equation.

[28] $0.052/(1-0.725)$.

[29] Note that the tests remain stochastic (p-values < 1) and consequently meaningful.

imports as well, would also go up. Second, the fact that non-IV estimates are biased towards zero may arise when our openness indicator is a noisy proxy of the true relevant degree of openness. Since instrumentation also remedies measurement error, this may explain the observed sign of the bias.

Table 3.2: Benchmark regressions: large cross-section

Dependent variable: Total unemployment (WDI)
Openness measure: Real openness (Alcala & Ciccone, 2004)

	(1) OLS	(2) IV	(3) OLS	(4) IV	(5) OLS	(6) IV	(7) OLS	(8) IV	(9) OLS	(10) IV
Total trade openness	−0.047***	−0.036	−0.093***	−0.102*	−0.087***	−0.099	−0.079***	−0.097**	−0.081***	−0.099**
	(0.011)	(0.025)	(0.019)	(0.055)	(0.023)	(0.066)	(0.022)	(0.04)	(0.028)	(0.048)
Unemployment benefits (index)									1.644	1.659
									(1.638)	(1.405)
EPL (index)									5.330*	5.515**
									(2.830)	(2.553)
Minimum wage (index)									−0.013	−0.413
									(1.546)	(1.608)
Unofficial economy (index)					0.021	0.013	0.016	0.003	0.014	0.006
					(0.041)	(0.057)	(0.041)	(0.046)	(0.037)	(0.039)
Population (ln)			−1.010**	−1.005**	−0.947**	−0.965**	−0.848	−0.916*	−0.610	−0.622
			(0.443)	(0.418)	(0.435)	(0.427)	(0.556)	(0.510)	(0.546)	(0.480)
Land lockedness (index)			−0.778	−0.908	−0.873	−0.974	−1.795	−1.952	−1.991	−2.046
			(1.429)	(1.483)	(1.399)	(1.359)	(1.423)	(1.311)	(1.454)	(1.296)
Latitude			0.018	0.023	0.117	0.086	−0.002	−0.033	−0.058	−0.054
			(0.372)	(0.357)	(0.355)	(0.406)	(0.419)	(0.421)	(0.485)	(0.440)
Area (ln)			−0.355	−0.440	−0.357	−0.445	−0.412	−0.520	−0.743	−0.887*
			(0.358)	(0.523)	(0.362)	(0.505)	(0.451)	(0.444)	(0.466)	(0.507)
Output gap (ln)	−60.837	−63.129	−62.04	−63.33	−61.74	−63.18	−61.86	−64.76	−70.71	−73.70*
	(53.028)	(50.635)	(51.81)	(50.61)	(53.41)	(51.39)	(50.22)	(45.82)	(44.19)	(38.96)
Continent dummies							x	x	x	x
Observations	62	62	62	62	62	62	62	62	62	62
R^2 (adjusted)	0.085	0.08	0.162	0.160	0.150	0.147	0.316	0.311	0.330	0.325
F (1st stage)		27.527		20.456		20.442		31.364		20.649
Partial R^2		0.538		0.269		0.238		0.408		0.392

Robust standard errors in parentheses, * significant at 10%, ** significant at 5%, *** significant at 1%. All variables averaged over the period 1990 - 2006 in order to net out business cycle effects. World development indicators total unemployment rate used as dependent variable and current price real total trade openness captures trade liberalization. Openness instrumented with an improved Frankel & Romer (1999) instrument.

Large sample: cross sections

Next, in Table 3.2, we study the effect of *real openness* in a cross-section of 62 countries. Unemployment rates are taken from the World Development Indicators data base provided by the World Bank. We average all variables over the window 1990-2006, so that business cycle effects are unlikely to contaminate the results. We nevertheless control for the output gap. We deal with endogeneity as described in chapter 3.3.2 by using an improved Frankel and Romer (1999) - type instrumentation strategy.

Column (1) is the most parsimonious model. It uses no additional controls (except the output gap whose inclusion is inconsequential). The OLS regression produces a coefficient of 0.047, estimated with high precision, and implying that a 10 percentage points increase in openness lowers unemployment by about half a percentage point. When openness is instrumented, the point estimate is close to zero and statistical significance is lost. Hence, it appears that, in this very parsimonious model, OLS strongly overestimates the absolute size of the openness effect.

Column (3) and (4) are virtually identical to Table IV in Alcalá and Ciccone (2004) or to Table 3 in Frankel and Romer (1999), with the key differences being the different dependent variable and a slightly more general construction of the instrument. These papers stress the importance of including variables that control for the size of the domestic market (logarithm of population, the logarithm of land area, and a continuous measure of landlockedness). This is crucial since a country's degree of openness is negatively correlated to its own economic size. As suggested by theoretical arguments based on economic geography models, omitting the domestic market size control biases the openness coefficient away from zero if domestic market size is positively correlated to the unemployment rate, and biases it towards zero if it is negatively correlated.[30] The regressions also include a rough proxy for institutional quality–the logarithm of distance to the equator (latitude). The IV estimate is now significant at the 1 percent level. It follows that the failure to produce a significant IV coefficient in column (2) is not due to endogeneity bias, but rather to omitted variable bias.

Models (5) and (6) add a variable provided by Botero et al. (2004), namely the size of the unofficial economy as a share of officially reported GDP. It is plausible to assume that more open economies have smaller unofficial sectors, since exporting or importing requires

[30] Assuming for simplicity that all covariates other than openness and domestic market size are uncorrelated, the bias is $\beta_{size} \times cov\left(open, size\right)/var(open)$.

formal clearing at the borders. It may also be the case that officially reported unemployment rates are inversely proportional to the size of the shadow economy. Indeed, in our data the discrepancy between estimates by the CIA and official data correlates with the size of the unofficial economy. Hence, it seems meaningful to control for the extent of the shadow economy. Compared to the results presented in columns (3) and (4), we find that this additional variable leaves the OLS estimates broadly unchanged but undoes the statistical significance of openness in the instrumental variable regressions. The size and sign of the estimates hardly moves. This is, however, not a robust result. For example, taking out latitude restores significance. More importantly, even with latitude included, we obtain fairly precise and roughly comparable estimates for both the OLS and the IV regressions when the model is augmented by continent dummies. The latter may help to further control for unobserved heterogeneity across countries.

Finally, models (9) and (10) are the most comprehensive in that they include a list of labor market covariates provided by Botero et al. (2004). In particular, we use a measure related to the strictness of employment protection legislation (EPL), an index related to unemployment benefits, a variable indicating the existence of minimum wages and a variable measuring non-wage costs of labor (i.e., taxes). With the exception of EPL, none of those additional controls turns out significant.

Summarizing, we find that across most multivariate cross-sectional regressions, the effect of a 10 percentage points increase in openness lowers unemployment by about 1 percentage point (columns (8) and (10)). As with the high-quality OECD data, and presumably for the same reasons, there is no robust evidence that OLS overestimates the size of the true effect. In particular, in the more complete specification, it is hard to see any difference between IV and OLS results.

Large sample: panel regressions

Table 3.3 runs panel regression of five-year averages on a larger set of countries. We employ the same econometric specifications and use similar controls as in chapter 3.4.1. In particular, we control for the output gap in all specifications. This is important as taking five-year averages does not seem to entirely purge business cycle effects. We control for market size changes by including the logarithm of population. The institutional labor market controls are from the Fraser Institute and measure overall hiring and firing restrictions and the replacement rate.[31] We also use a measure of product market regulation from the same data source. We do not have time-variant information about tax rates. Geographical variables and time-invariant institutional features are accounted for by country effects.

The results confirm the existence of a negative relation between *real openness* and the rate of unemployment. More specifically, columns (1) and (2) show the fixed (FE) and the random effects (RE) model. The Hausman test (p-value of 0.291) prefers random effects. This choice has important quantitative implications in the present setup since the openness coefficient is more than twice as large in the FE model than in the RE specification. The latter indicates that an increase of openness by 10 percentage points lowers unemployment by about 0.78 percentage points. It is striking how close this latter effect comes to our cross-sectional results presented above.

The dynamic models (3) to (5) are problematic because the panel is strongly unbalanced and the number of observations over time is very small for some countries. Interestingly, in all dynamic models, the evidence for persistence in (five-year-averaged) unemployment rates is fairly low and much smaller than in the case of the OECD sample where country coverage is more homogenous and the panel is longer. The FGLS model signals a short-run openness coefficient close to the one obtained under FE in column (1); the long-run effect is almost identical. Diff-GMM produces similar results. The Sys-GMM model is more efficient, and can make use of more observations. The OID test and the other test statistics are fine, so that we take the Sys-GMM results as the most credible. Here, an increase in openness by 10 percentage points reduces equilibrium unemployment by about 0.55 percentage points in the short-run and by 0.8 points in the long run. Notice the quantitative similarity of these coefficients with those obtained for the smaller OECD sample discussed in chapter 3.4.1.

3.5 Additional results and robustness checks

In this chapter we investigate whether openness affects skill-classes differently and discuss the sensitivity of our main results with respect to alternative openness measures, unemployment data and additional controls.

[31] The benchmark data from Botero et al. (2004) has no time dimension.

Table 3.3: Benchmark regressions: large panel

Dependent variable: Total unemployment (WDI)
Openness measure: Real openness (Alcala & Ciccone, 2004)

	(1) FE	(2) RE	(3) FGLS	(4) Diff-GMM	(5) Sys-GMM
Total trade openness	-0.223^{***}	-0.078^{***}	-0.217^{***}	-0.639^{**}	-0.055^{*}
	(0.063)	(0.020)	(0.023)	(0.288)	(0.031)
Lag. dep. var.			0.106^{**}	-0.410	0.313
			(0.047)	(0.367)	(0.204)
Pop (ln)	-5.337	-0.584^{*}	5.202^{**}	-3.934	-0.663
	(6.987)	(0.306)	(2.119)	(4.093)	(0.870)
LMR (index)	0.638^{*}	0.448^{*}	0.546^{***}	-0.091	1.112^{**}
	(0.372)	(0.248)	(0.101)	(1.104)	(0.544)
Unemployment benefits (index)	0.076	0.128	0.210^{***}	0.407	0.0001
	(0.160)	(0.141)	(0.043)	(0.285)	(0.163)
PMR (index)	-0.227^{*}	-0.126	-0.253^{***}	-0.419^{**}	-0.194
	(0.133)	(0.127)	(0.054)	(0.213)	(0.158)
Output gap (%)	-15.88^{***}	-19.43^{***}	-21.84^{***}	-43.58^{*}	-15.87
	(5.658)	(5.736)	(3.259)	(24.48)	(14.50)
Observations	186	186	164	93	164
R^2 (within)	0.291	0.243			
R^2 (overall)	0.04	0.132			
R^2 (between)	0.063	0.116			
Hausman	0.291				
Hansen (OID)				0.485	0.439
AR(1)				0.598	0.023
AR(2)				0.294	0.645

Robust Standard errors in parentheses, * significant at 10%, ** significant at 5%, *** significant at 1%. All variables averaged over 5 year periods between 1971 - 2005 in order to net out business cycle effects. Number of observations N=186 (77 countries, 5-year periods; data averaged). Panel is strongly unbalanced due to missing observations (186 five year averages available). Dependent variable is World Development Indicators total unemployment rate. Data on labor and product market regulation from Fraser institute. All models control for unobserved country- and period effects. FGLS allows for heteroscedastic errors. First lag of dependent variable used for Feasible Least Square and Generalized Methods of Moments regressions. Diff- and Sys-GMM estimators are valid if i) Sargan test does not reject the H0 (H0: overidentifying restrictions are valid) and ii) if test on AR(1) is positive and negative on AR(2) (H0: no autocorrelation). Openness, output gap and LMR treated as endogenous in the GMM regressions. Maximum number of lags used as instruments equals one (16 instruments for diff-GMM and 28 instruments for sys-GMM). Constant estimated but not reported.

Table 3.4: Openness and skill-specific unemployment

Dependent variable: Skill-specific unemployment
Openness measure: Real openness (Alcala & Ciccone, 2004)

	Skill-specific unemployment				Skill-specific unemployment HO			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	OLS	OLS	IV	IV	OLS	OLS	IV	IV
DEPENDENT VARIABLES ⇒	u (low)	u (high)	u (low)	u (high)	u (low)	u (high)	u (low)	u (high)
Total trade openness *(T)*	−0.015	-0.062^{**}	−0.038	-0.065^{*}	−0.028	-0.089^{*}	−0.099	-0.201^{***}
	(0.039)	(0.027)	(0.041)	(0.037)	(0.053)	(0.050)	(0.061)	(0.070)
Endowment share (L_{low}/L_{high})					0.219	−0.133	0.044	−0.343
					(0.386)	(0.402)	(0.301)	(0.350)
Interaction $(T \times L_{low}/L_{high})$					0.015	−0.002	0.034^{**}	0.050^{**}
					(0.014)	(0.018)	(0.015)	(0.02)

Each row represents one regression. Openness coefficients, endowment share coefficients, and interaction coefficients reported only. Robust standard errors in parentheses, * significant at 10 %, ** significant at 5 %, *** significant at 1 %. We use skill-specific unemployment rates as dependent variable. Data for skill-specific unemployment is available for the period 1994 - 2003 (WDI). We average the data over the whole period to construct a cross section. In row 1 - 4 we regress openness on high and low skill unemployment, in row 5 - 8 we additionally include the interaction between openness and the low to high skill endowment share. We use Barro & Lee data to construct the endowment shares.

Openness and skill-specific unemployment. It is natural to investigate the effects of openness on a more disaggregated level by substituting aggregate with skill-specific unemployment. This allows us to assess whether all skill groups equally benefit from globalization, or whether the beneficial overall effect obscures potential job losses for certain groups of workers. We use data from the World Bank's WDI data set which allows to calculate skill-specific unemployment rates. Unfortunately the data coverage is poor, and observations exist at best from 1994 onwards. Hence, we average the data over time and focus on the cross section. Table 3.4 reports the results for the key coefficients (full results are in the Appendix). The first four columns refer to standard regressions; columns (5) to (8) include interaction terms with endowment shares. Over all skill classes, openness has a negative effect on the unemployment rate. However, the effect is statistically significant only for high-skilled workers. This pattern suggests that the result found for aggregate unemployment is robust over skill-classes, but the high-skilled labor market segment plays by far the most important role in the aggregate trade-unemployment relationship.

Columns (5) to (8) additionally include the endowment ratio and its interaction with openness. We term this set of regression Heckscher-Ohlin (HO) regressions, because in the HO framework, the effect of trade liberalization on skill-specific unemployment rates depends on the relative endowments. Moore and Ranjan (2005) show that lower trade costs reduce the high-skilled unemployment rate in skill abundant countries and increases it elsewhere, while the low-skilled unemployment rate behaves in the opposite way. For low-skilled workers, we find inconclusive results. on the other hand, when looking at the high-skilled segment, the IV regressions show that unemployment falls by less if the country is richly endowed with low-skilled workers, as predicted by HO explanations.[32]

Alternative openness measures. Table 3.5 presents summary results on alternative openness measures. Each cell reports point estimate and standard error associated to openness; see the companion paper for full results. Coefficients pertaining to the dynamic Sys-GMM model refer to the fixed-point of the difference equation. In a first step, we stick with the real openness measure of Alcalá and Ciccone (2004), but use export and import openness rather than the canonical gross measure. In all specifications reported in lines **i** and **ii**, we find negative coefficients, except for the system GMM estimator, these are also statically different from zero.

In the main body of this paper, we use the *real openness* measure of Alcalá and Ciccone (2004). This is our preferred indicator, because the effect of openness may affect the tradeable sector differently than the non-tradeable sector. Nonetheless, the growth-openness literature uses an uncorrected measure that we call *current price openness*.[33] Lines **iii**, **iv**, and **v** of Table 3.5 report results for current price openness. We also try the constant price openness measure reported in the Penn World Tables (line **vi**) and an indicator that draws only on merchandise trade (i.e, excluding services; line **vii**). Across all these specifications, we do not find a single positive coefficient. Coefficient estimates are often algebraically bigger than in our benchmark results, so that the choice of the openness measure does have an influence on the quantitative interpretation of results. Some of the coefficients from the large panel are insignificant statistically, but for reasons detailed above we do not want to over emphasize these findings. Hence, we confirm our general conclusion that openness certainly does not increase unemployment in the long-run.

[32] The result implies that there is some threshold value of the endowment share for which the negative effect of openness turns positive. The endowment ratio ranges from 0.18 to 10.47 with an average of 3.16. Computing the threshold for which the marginal effect of openness turns from negative to positive yields 4.00, which is between the minimum and the maximum. For countries with low to high skill endowment ratio greater than 4 openness is positively associated with high-skill unemployment.

[33] See chapter 3.2.1 for a more detailed discussion of different openness measures.

Table 3.5: Robustness checks

Dependent variable: Total unemployment (OECD and WDI)	OECD panel		Large cross section		Large panel	
Openness measure ⇓	(1) FE/RE	(2) Sys-GMM	(3) OLS	(4) IV	(5) FE/RE	(6) Sys-GMM
Real import and export openness						
i: Import	−0.196***	−0.168**	−0.084***	−0.107**	−0.081***	−0.077
	(0.038)	(0.072)	(0.030)	(0.052)	(0.021)	(0.058)
ii: Export	−0.050***	−0.213***	−0.077***	−0.093**	−0.178***	−0.086**
	(0.019)	(0.065)	(0.026)	(0.045)	(0.064)	(0.039)
Current price openness						
iii: Total trade	−0.057**	−0.214**	−0.026	−0.123*	−0.032**	−0.061
	(0.027)	(0.105)	(0.017)	(0.066)	(0.014)	(0.039)
iv: Import	−0.081***	−0.257**	−0.023	−0.140*	−0.029**	−0.041
	(0.031)	(0.115)	(0.019)	(0.077)	(0.014)	(0.049)
v: Export	−0.036	−0.160*	−0.028*	−0.110*	−0.032**	−0.079**
	(0.024)	(0.091)	(0.016)	(0.057)	(0.013)	(0.037)
Constant price total trade openness						
vi: Total trade	−0.075***	−0.171**	−0.027	−0.130*	−0.042***	−0.039
	(0.021)	(0.073)	(0.018)	(0.072)	(0.015)	(0.037)
Merchandize trade openness						
vii: Total trade	−0.035	−0.154*	−0.013	−0.073*	−0.029**	−0.07*
	(0.032)	(0.082)	(0.010)	(0.040)	(0.014)	(0.04)
Log total unemployment and real total trade openness						
viii: Total trade	−0.006*	−0.018***	−0.009**	−0.009*	−0.009***	−0.008
	(0.003)	(0.005)	(0.003)	(0.005)	(0.003)	(0.008)
Unemployment rate	Sys-GMM Prime	Sys-GMM Youth	IV CIA	IV IFS	Sys-GMM ILO	Sys-GMM IFS
ix: Total trade	−0.196**	−0.112	−0.166**	−0.083*	−0.103*	−0.091*
	(0.083)	(0.190)	(0.067)	(0.045)	(0.054)	(0.047)

In row i - ix, each cell represents one regression. Openness coefficients reported only. Robust standard errors in parentheses, *significant at 10%, ** significant at 5%, *** significant at 1%. All variables averaged over 5-year periods between 1980 - 2003 (OECD panel), 1971 - 2005 (large panel) and over the whole period 1990 - 2006 (large cross section) to net out business cycles. Long-run effects reported for sys-GMM regressions. Total unemployment rate (OECD and WDI) used as dependent variable in row i - viii. Real import export openness measures used in row i and ii, Current price openness measures used in row iii - v, constant price openness in row vi, merchandize in row vii. In row viii we use the respective ln unemployment variable. In row ix we use prime age, youth, CIA, IFS, and ILO data instead of total unemployment. An improved Frankel & Romer (1999) instrument used for the IV regressions. FE/RE: fixed or random effects model selected according to Hausman test (RE is preferred for all regressions). For further details see Tables 1,2, and 3.

Log unemployment. There is no apparent consensus in the labor market literature as to whether unemployment regressions have to be run with the dependent variable in logs or in levels. Almost all equations discussed in Bassanini and Duval (2009) are in levels whereas the recent paper by Costain and Reiter (2008) uses logs. In the present setup, results are largely independent of this choice, as can be seen from line **viii** of Table 3.5, where we keep estimation strategies and samples identical to those used in the upper part but use the log of unemployment as the dependent variable. While significance of the openness coefficient may be lost in some cases, there is no evidence–not in a single regression–that openness increases unemployment in the long run.

Alternative unemployment measures and data sources. Our benchmark regressions use total unemployment rates provided by the OECD, and in the larger samples, data reported by the World Bank in their World Indicator Data base. There are substantial concerns about data quality, in particular in samples that include developing countries. Moreover, even OECD countries have very different approaches to dealing with employment issues for workers at the start or the end of their professional careers. We deal with this problem by running our regressions using alternative unemployment measures.

For the OECD we substitute the total unemployment rate by prime age and youth unemployment but use the Alcalá and Ciccone real openness measure. The first two columns in line **ix** of 3.5 show sys-GMM estimates. For prime age unemployment, openness has a stronger effect than for youth unemployment and is not statistically significant in the latter case. This is not overly surprising because youth unemployment is probably much more strongly related to institutional features of labor markets rather than to the extent of trade openness.

The remaining columns in line **ix** of Table 3.5 report results for the larger cross-section and then for the larger panel, but use unemployment data from alternative data sources. Most importantly, data from the CIA leads to a much stronger effect of openness on the structural rate of unemployment. This is a robust finding, for which we present more evidence in the supplement paper. The other data sources also yield negative coefficients that are of similar size to those obtained with our preferred data base, the WDI.

TFP and trade openness. Next, we present evidence consistent with the view that the effect of openness on unemployment works via TFP. Our results are tentative, because the construction of a TFP measure from observable data requires critical assumptions so that the measure is very imperfect. [34] Also, TFP is likely not exogenous. For these reasons, we do not want to overemphasize our results but rather view them as a first piece of evidence.

Column (1) in Table 3.6 shows that countries with higher TFP have lower unemployment rates. Note that the relationship cannot be driven by business cycle variation since we work with averages over 5-years, and have included year dummies as well as a measure of the output gap into the regressions. The effect is fairly strong in the OECD panel: a one percent increase in TFP lowers the equilibrium rate of unemployment by about 0.3 percentage points. Going from the sample mean of TFP to the highest realization, the decrease in unemployment is about 6 percentage points. The other cells in the first and second panel show that the relationship continues to hold when using more elaborate regression methods. If anything, controlling for endogeneity biases strengthens the size of the correlation. The third and last panel reports results for the large cross-section where TFP is important, too. Then a one percent increase in TFP lowers unemployment by about 0.04 percentage points. Due to greater variance of TFP measures in the large cross-section, moving from the sample mean to the highest realization of TFP yields an unemployment reduction of about 2.8 percentage points.

These findings are not necessarily contradictory with the concurrent increases in productivity and unemployment observed in Europe over the post-war period because the structure of the regressions is such that TFP levels are not relevant *per se*.[35] Identification relies on time variation and demeaned cross-country variance so that lower unemployment will arise for two reasons. First, countries that had higher TFP *growth* should exhibit lower unemployment, as extensively documented by Pissarides and Vallanti (2004). Second, countries with higher TFP than the cross country average are also likely to have smaller unemployment rates, as implied by the theoretical model in Felbermayr, Prat and Schmerer (2011a).

[34] We construct our measure of TFP by following the procedure in Benhabib and Spiegel (2005). We apply the perpetual inventory method to back out estimates for capital and then compute TFP as the Solow residual. We use the original estimates published in Benhabib and Spiegel (2005) for the large cross-section.

[35] We thank an anonymous referee for raising this point.

Table 3.6: Channels of interaction

Dependent variable: total Unemployment (OECD and WDI), or "channel variables"
Channel variable: TFP
Openness measure: Real openness (Alcala & Ciccone, 2004)

	(1)	(2)	(3)	(1)	(2)	(3)
I Dep. var. ⇒	u	log TFP	u	u	log TFP	u
	OECD panel			**OECD panel**		
	FE/RE	FE/RE	FE/RE	FGLS	FGLS	FGLS
log TFP	-0.312^{***} (0.080)		-0.295^{***} (0.095)	-0.491^{***} (0.079)		-0.364^{***} (0.087)
Total trade openness *(real)*		0.264^{**} (0.119)	-0.014 (0.030)		0.390^{***} (0.07)	-0.066^{**} (0.031)
	OECD panel			**OECD panel**		
	Diff-GMM	Diff-GMM	Diff-GMM	Sys-GMM	Sys-GMM	Sys-GMM
log TFP	-0.789^{*} (0.479)		-0.670 (0.521)	-0.477^{*} (0.284)		-0.516^{*} (0.289)
Total trade openness *(real)*		0.635^{*} (0.341)	0.002 (0.141)		2.476^{**} (0.976)	-0.017 (0.082)
	Large cross section			**Large cross section**		
	OLS	OLS	OLS	IV	IV	IV
log TFP	-4.231^{**} (1.783)		-2.949 (2.376)	-4.231^{***} (1.471)		-2.244 (3.599)
Total trade openness *(real)*		0.008^{***} (0.001)	-0.027 (0.034)		0.008^{***} (0.002)	-0.042 (0.067)

Each column in each cell represents one regression. Openness and channel variable coefficients reported only. As channel variables we use Total Factor Productivity. In (1) we regress the channel variable on unemployment, in (2) we regress the channel variable on openness, and in (3) we regress openness and the channel variable on unemployment. Robust standard errors in brackets, * significant at 10%, ** significant at 5% and *** significant at 1%. For the OECD panel we run benchmark type fixed and random effects regressions in the upper left panel (Hausman test indicates that RE is efficient in (1) and (3)) and FGLS regressions in the upper right panel. Openness, output gap and wage distortion treated as endogenous when preforming diff- and sys-GMM in the middle left and right panel (OECD). For the large cross section we run benchmark type OLS and IV regressions. An improved Frankel & Romer (1999) instrument used as instrument for the IV regressions.

Column (2) in the table shows that openness and TFP are positively related. We treat openness as endogenous using the same empirical strategy than in the benchmark regressions. The results are broadly in line with Alcalá and Ciccone, who use a somewhat different definition of TFP for the year of 1985 in their cross-sectional analysis. Doubling real openness from the sample mean (about 35 for the OECD panel and 30 in the large cross section) leads to an increase in TFP by about 10 percent in the FE/RE effects benchmark OECD regressions and by about 24 percent in the large cross-section for both OLS and IV. The additional FGLS and GMM regressions in the upper right and middle panel reveal the same significant relationship and thus support the benchmark results.

Let us now turn our attention to our main interest, that is the interaction between TFP and trade openness. The third columns of each cell use both real openness and the log of TFP in the same unemployment regressions. Interestingly enough, adding TFP leads to drastic losses in statistical significance for trade openness. Among all specifications, only the FGLS regression in the OECD sample yields a statistically significant negative coefficient for our preferred measure of openness, a finding that stands in sharp contrast to the robustness exhibited in previous regressions. However, out of the five non significant coefficients, four are negative.

These results suggest that that the impact of openness mostly goes through TFP. This is an intriguing implication because it echoes recent theoretical research on the interactions between trade, firm selection and unemployment. In search-theoretic explanations of equilibrium unemployment, firms with higher productivity find it more attractive to post vacancies; see Epifania and Gancia (2005) or Felbermayr, Prat and Schmerer (2011a). In the latter work, more openness forces inefficient firms to quit and allows more productive ones to expand. The average firm's productivity increases, its revenue per match relative to the costs of vacancy creation goes up, and so do its incentives to create jobs. Hence, increased openness leads to lower equilibrium unemployment in the long-run through higher productivity. Establishing the existence of causal links from trade to TFP and then from TFP to unemployment would obviously require more detailed data on industry structure with potentially exogenous episodes of trade liberalization. Our findings can nonetheless be interpreted as encouraging piece of evidence for further research in that direction.

3.6 Conclusion

This paper establishes an empirical regularity: trade openness does not increase structural unemployment in the long run. Quite to the contrary, in most of our regressions, we find overwhelming evidence for a beneficial effect. This finding is robust to the choice of sample, estimation strategy, and does not hinge on our particular choice of openness measure or the definition of the unemployment rate.

Our analysis draws on two long-standing research traditions: panel unemployment regressions for OECD countries, recently summarized by Nickel et al. (2005), and cross-sectional analysis of the effect of trade liberalization pioneered by Frankel and Romer (1999). In all cases, we average our data and use information on the output gap in order to control for business cycle effects. We include a large host of institutional variables and of geographical controls related to the importance of domestic as compared to international trade. Whenever possible, we include country and year effects. We deal with the possible endogeneity of openness either by exploiting the time dimension of the data or by using the geography-based instrumentation strategy developed by Frankel and Romer (1999). All of our different approaches have advantages and drawbacks. However, the picture across all models is fairly stable and robust: There is no evidence for an unemployment-increasing effect of openness.

Our results are therefore in line with theoretical work that points towards a negative effect of trade liberalization on the structural rate of unemployment. Models of this type are presented in Dutt et al. (2009) or in Felbermayr, Prat, and Schmerer (2011a). The recent work by Helpman, Itshoki, and Redding (2011 a,b) is also compatible with the evidence.

Finally, it is worth noting that the present paper has a focus on long-run effects. We pay special attention to netting out business cycle disturbances. In this sense, our work is complementary to a growing number of empirical papers on the short-run implications of trade liberalization for labor markets.

3.7 Data description and summary statistics

3.7.1 Unemployment rates

Table 3.7: Unemployment rates according to different sources

Year	Sample	Unemployment rate (average) WDI	ILO	CIA	ratio CIA / ILO Avg.	Median
1990	Full (N=48)	7.74	7.79	9.69	1.29	1.16
	OECD 20	6.90	6.88	7.02	1.07	1.00
	RoW	8.16	8.24	11.03	1.40	1.18
1995	Full (N=68)	8.69	9.00	9.64	1.16	1.10
	OECD 20	8.74	8.75	10.39	1.22	1.17
	RoW	8.68	9.10	9.34	1.13	1.08
2000	Full (N=77)	9.06	9.43	10.88	1.39	1.02
	OECD 20	6.15	6.13	6.73	1.09	1.03
	RoW	10.09	10.59	12.34	1.50	1.02
2005	Full (N=69)	8.94	8.94	9.89	1.15	1.07
	OECD 20	6.39	6.34	6.63	1.04	1.03
	RoW	9.98	9.99	11.23	1.20	1.08

Data sources: CIA (Central Intelligence Agency); ILO (International Labor Organization), WDI (World Development Indicators, World Bank).
OECD20 sample includes the 20 OECD countries used in Bassanini & Duval (2009) and in our panel regressions.

Countries included: Albania^{C}, Argentina^{BCD}, Australia^{ABCD}, Austria^{ABCD}, Belgium^{ABCD}, Bolivia^{BCD}, Brazil^{BCD}, Bulgaria^{BCD}, Canada^{ABCD}, Chile^{BC}, China^{BC}, Colombia^{BC}, Costa Rica^{C}, Croatia^{BCD}, Czech Republic^{BCD}, Denmark^{ABCD}, Dominican Rep.^{BC}, Ecuador^{BC}, Egypt^{BC}, El Salvador^{C}, Estonia^{C}, Finland^{ABCD}, France^{ABCD}, Georgia^{CD}, Germany^{ABCD}, Greece^{BCD}, Guatemala^{C}, Honduras^{C}, Hong Kong^{BCD}, Hungary^{BCD}, Iceland^{C}, Indonesia^{BCD}, Ireland^{ABCD}, Israel^{BCD}, Italy^{ABCD}, Jamaica^{BC}, Japan^{ABCD}, Jordan^{CD}, Kazakstan^{BD}, Korea^{BCD}, Kuwait^{C}, Kyrgyz Republic^{D}, Latvia^{BCD}, Lithuania^{BCD}, Malaysia^{BC}, Mauritius^{C}, Mexico^{BCD}, Moldova^{C}, Morocco^{BCD}, Netherlands^{ABCD}, New Zealand^{ABCD}, Nicaragua^{C}, Norway^{ABCD}, Pakistan^{BCD}, Panama^{BCD}, Paraguay^{C}, Peru^{BC}, Philippines^{BCD}, Poland^{BCD}, Portugal^{ABCD}, Romania^{BCD}, Russian Federation^{BCD}, Singapore^{BCD}, Slovak Republic^{BCD}, Slovenia^{BCD}, South Africa^{BCD}, Spain^{ABCD}, Sri Lanka^{BC}, Sweden^{ABCD}, Syria^{C}, Switzerland^{ABCD}, Thailand^{BC}, Tunisia^{C}, Turkey^{BCD}, Ukraine^{BCD}, United Kingdom^{ABCD}, United States^{ABCD}, Uruguay^{BCD}, Venezuela^{BC}.

A: included in the OECD sample, B included in the large cross section, C: included in the large panel, D included in the skill specific unemployment regressions, large cross section.

3.7.2 OECD sample

Unemployment rates For our OECD benchmark regressions we use total unemployment, measuring the percentage share of unemployed workers in total labor force (15 - 66 years old individuals). Data taken from Basanini and Duval. Original Source: OECD, Database on Labour Force Statistics; OECD, Annual Labour Force Statistics.

Openness measures Total trade openness is defined as imports plus exports divided by two times GDP in current prices. Real openness measures are constructed as respective current price openness measure times price level (taken from the Penn World Table 6.2) in order to account for the Balassa Samuelson effect by using real purchasing power GDP as denominator. Merchandise openness excludes services. The variable is taken from the WDI data base. Constant price total trade openness comes from the Penn World Table 6.2.

Wage distortion Wage distortion lumps replacement rate and tax wedge together. Both variables affect unemployment through the same channel, namely wages. Therefore lumping both variables together further reduces the number of instruments when estimating GMM regressions.

Replacement rate Average unemployment benefits taken from the Basanini and Duval data set. Original source: OECD Benefits and Wages Database. According to Basanini and Duval data is available for odd years only, so that they had to fill the gaps by linear interpolation.

Tax wedge This variable measures taxation on wages by computing the difference between wages paid by employers and wages earned by employees. The variable on tax wedge is constructed using the OECD taxing wages data. Some observations were adjusted by B&D in order to fill the gaps in the data, thus providing a complete sample for the period 1982 - 2003.

Union density Union density measures the percentage share of workers associated to unions. According to B&D the data was taken from the OECD Employment Outlook 2004 and inter / extrapolated in order to maximize the sample.

High corporatism Dummy variable that takes the value one if wage bargaining is highly centralized. Source: Basanini and Duval.

Table 3.8: Summary statistics

OECD panel			Large cross section			Large panel		
Variable	Mean	Std. Dev.	**Variable**	Mean	Std. Dev.	**Variable**	Mean	Std. Dev.
Unemployment (total)	7.532	3.890	Unemployment (WDI)	8.964	4.343	Unemployment (WDI)	8.343	4.372
Unemployment (prime)	6.631	3.323	Unemployment (CIA)	11.269	7.812	Unemployment (ILO)	8.378	4.290
Unemployment (youth)	15.122	8.029	Unemployment (IFS)	8.591	3.961	Unemployment (IFS)	8.225	4.041
Total trade(real)	34.466	18.598	Total trade(real)	26.679	25.947	Total trade(real)	27.092	22.315
Import (real)	33.533	17.193	Import (real)	26.332	24.526	Import (real)	26.809	21.049
Export (real)	35.398	20.162	Export (real)	27.026	27.466	Export (real)	27.375	23.749
Total trade(cur. P.)	32.879	16.036	Total trade(cur. P.)	41.508	31.111	Total trade(cur. P.)	38.387	24.607
Import (cur. P.)	32.206	15.142	Import (cur. P.)	41.345	29.742	Import (cur. P.)	38.612	24.027
Export (cur. P.)	33.552	17.157	Export (cur. P.)	41.671	32.698	Export (cur. P.)	38.162	25.723
Total trade (con. P.)	30.390	16.527	Total trade (con. P.)	39.924	28.231	Total trade (con. P.)	38.317	25.589
Total trade (merch.)	26.938	14.142	Total trade (merch.)	65.009	48.742	Total trade (merch.)	30.899	21.281
Wage distortion	58.142	17.825	EPL	0.487	0.187	LMR	−5.235	1.347
Replacement rate	29.430	12.572	Unemployment benefits	0.599	0.344	Unemployment benefits	−4.740	2.134
Tax wedge	28.712	8.928	Minimum wage	0.758	0.432	PMR	−5.833	2.261
Union density	40.263	20.768						
High corporatism	0.554	0.486						
EPL	2.086	1.092						
PMR	3.848	1.293						
Population	16.689	1.255	Population	9.863	1.377	Population	9.788	1.463
Output gap	−0.819	1.736	Output gap	−0.004	0.011	Output gap	0.000	0.033
			Land lockedness	0.486	0.348	Land lockedness	0.457	0.338
			Area	12.517	2.011	Area	12.475	1.892
			Latitude	3.314	0.997	Latitude	3.409	0.860
			Unofficial economy	28.619	13.851			
			F & R trade share	37.189	19.265			
TFP	266.838	6.902	TFP	1.199	0.432			
Skill specific unemployment rates								
			Low skill unemployment	11.379	6.499			
			High skill unemployment	6.842	5.868			
			Low/High skill endowment ratio	3.159	2.521			

EPL Measures the stringency of employment protection legislation, taken from Basanini and Duval. Original source: OECD, Employment Outlook 2004.

PMR Measures the regulation on product markets and competition, taken from Basanini and Duval. Original source: Conway et al. (2006).

Output gap Output gap measures the difference between actual and potential GDP as percentage of potential output. As source B&D cite the OECD Economic outlook and IMF International finance statistics.

3.7.3 Large global cross country sample

Unemployment rate We use three different sources for total unemployment: The World Developing Indicators mainly provide official estimates on unemployment and are used as benchmark. Average unemployment rates constructed with less than 10 observations dropped. For additional robustness checks we include unemployment rates taken from the CIA factbook and IFS data base.

For our skill specific unemployment regressions we use data from the World Developing Indicators. We have percentage information on the fraction of total unemployment with primary, secondary, and tertiary skilled labor force. In order to derive specific skill-group unemployment rates, we construct skill specific total unemployment rates, multiply them with a measure on the total labor force in order to drive the number of skill specific unemployed workers, and divide by the number of workers belonging to the respective skill group (available in the WDI data base).

Openness measures See OECD sample data description for further details.

Frankel and Romer instrument (F&R) Our improved Frankel and Romer instrument bilateral trade data was used to regress total trade (exports plus imports) between country i and j, normalized by country $i's$ GDP, on geographical determinants of trade. The standard procedure is to take logs and estimate using OLS. Since $T_{ij} = 0$ for many country pairs, we follow Santos and Tenreyro (2006) and estimate (3.3) using Poisson pseudo maximum-likelihood. Predicting $\hat{T}_{ij}$ and summing over j, we have a measure of the trade share $\hat{T}_i$ that is by construction orthogonal to unemployment and hence a valid instrument.

EPL Employment laws index measuring the protection of labor and employment (EPL). The index variable includes: 1) Alternative employment contracts, 2) cost of increasing hours worked, 3) cost of firing workers and 4) dismissal procedures. Source: Botero et al. (2004).

Unemployment benefits Unemployment benefits is an index variable taken from Botero et al. (2004), including: 1) time of employment needed to qualify for unemployment benefits, 2) percentage of workers monthly income, paid to finance unemployment benefits, 3) waiting time on unemployment benefits, 4) percentage of income covered by unemployment benefits in case of a one year unemployment spell.

Minimum wage Dummy variable which takes the value one if there are binding minimum wages in the respective economy, taken from Botero et al. (2004).

Latitude Measures the distance between a country's capital and the equator. Data taken from the CIA factbook.

Area We control for the size of the economy in terms of its log area.

Land lockedness Land lockedness is constructed as index, measuring the length of neighboring borders relative to total length of borders.

Population We use Penn World Table 6.2 data on the size of population and take logs.

Unofficial economy This variable measures the size of the shadow economy, taken from Botero et al. (2004).

Output gap We construct output gap as difference between ln GDP and ln trend GDP, where the latter one is constructed by HP filtering the GDP data with smoothing factor 400. GDP is constructed as real GDP per capita (chain) times population taken from the Penn World Table 6.2.

3.7.4 Large panel

Unemployment (u) See large cross section for further details. We also use unemployment rates from the ILO Laborsta database for robustness checks.

Openness measures See OECD data description for further details.

Labor market regulations (LMR) An index variable capturing labor market regulations. This index contains information on minimum wages, mandated hiring costs, unemployment benefits and other variables. Notice that higher index values indicate more freedom and thus lower labor market regulations. Higher values indicate more freedom in terms of less regulation. Between 1975 and 2000 data was estimated in 5-year intervals. From 2000 till 2006 yearly data is available. Source: Fraser Freedom of the World data set, 2008. Recoded by multiplying with -1.

Unemployment benefits Higher values indicate more freedom in terms of less regulation. Source: Fraser Freedom of the World Data set, 2008. Recoded by multiplying with -1.

Product market regulations (PMR) Taken from the Fraser freedom of the world database. We use price control as proxy for product market regulations. Higher values indicate more freedom in terms of less regulation. Source: Fraser Freedom of the World data set, 2008. Recoded by multiplying with -1.

Output gap See large cross section data description for more details.

Population See large cross section data description for more details.

Chapter 4

Trade and Unemployment revisited

4.1 Detailed regression tables

In this companion chapter we present all results discussed in chapter 3 of this thesis at full length by reporting detailed regression output tables together with the main test statistics for all tables in the main chapter. In the description provided below we always refer to the related tables in Felbermayr, Prat, and Schmerer (2011b), which is the paper that contains the study presented in chapter 3, by using the label FPS (2011b). Table 1 in FPS (2011b) is therefore identical to the Table 4.1 in the underlying thesis.

In the second part of the companion chapter some additional robustness checks not included in FPS (2011b) are provided.

4.1.1 Details on Table 3.4 to 3.6 in the main chapter.

Table 3.4 in the main chapter. Our skill-specific unemployment regression strategy is to distinguish between standard regressions in line with our large cross section, and regressions where we additionally include the low to high skill endowment share as well as the interaction between openness and low to high skill endowment share.

The skill-specific unemployment results indicate that the negative and highly significant coefficient found for aggregate unemployment regressions are mainly driven by the reduction in high skill unemployment rate. In both models, OLS and IV, we find negative and highly significant coefficients when regressing openness on high skill specific unemployment rates. Conversely, the data remains silent when using low skill unemployment rates as dependent variable.[1] Both first stage F

[1] We also experimented with various tariff measures, where we find that tariffs have an decreasing effect on tertiary unemployment only. What we can say for certain is, that the effect on the aggregate

and partial R-square statistics fulfill the requirements for valid instruments.[2]

Table 3.5 in the main chapter. In Table 5 (FPS (2011b)) we extend the OECD panel benchmark regressions by separate import and export openness measures. In the main chapter we report FE/RE and sys-GMM regression openness-coefficients for the OECD panel, OLS and IV openness-coefficients for the large cross section, as well as FE/RE and sys-GMM openness-coefficients for the large panel regressions. In the companion chapter we present tables containing information on regressions for all openness measures available. The first regression thus replicates the benchmark regressions by including real total trade openness. The rest of the tables contain details on Table 5 in FPS (2011b) where we report openness coefficients for regressions that include real import openness, real export openness, current price total openness, current price import openness, current price export openness, constant price total openness, and merchandize openness.

Table 4.1 in this subchapter reports the detailed regression output tables for fixed and random effects regression, whereas Table 4.2 reports the respective Sys-GMM regression results. For both fixed and random effects regressions we select the preferred openness coefficient according to the Hausman test. Hausman p-values are reported in the last line of Table 4.1. Random effects regressions are preferred if we cannot reject the H0. For the OECD sample random effects is always preferred over the within estimator.

Table 4.2 presents details on OECD sys-GMM regressions in FPS (2011b). Long run effects are constructed by solving the regression equation for long run unemployment (dependent variable). The Hansen test of overidentification for the sys-GMM lies between 0.1 and 1.0. Although this is still in range, the p-value is alarmingly high. We thus might have overidentification due to too many instruments. However, this shortcoming disappears once we use the consistent diff-GMM regressions, where we have a Hansen test p-value close to 0.5. Diff-GMM generates less instruments due to a lower number of moment conditions. The results are in line with those from sys-GMM. The requirement for the test on autocorrelation supports both types of GMM regressions by indicating second order serial correlation.

In Table 4.3 we present detailed regression tables for the corresponding large cross sectional OLS and IV regressions. Again, we only extend the benchmark regressions by controlling for different openness measures without changing the dependent variable or other control variables used as benchmark. As test statistic we report first stage F-statistic which have the power to identify weak instrument problems. As a rule of thumb, a F-statistic lower than 10 indicates that instruments

level is mainly driven by a reduction in more skilled workers, whereas less skilled workers remain unaffected.

[2] For regressions (3) and (4) we find that the first stage F-statistic is 39.963 and the partial R-squared is 0.484. For (7) and (8) we find Shea's partial R-squares equal to 0.598 for openness and 0.441 for the interaction between openness and the endowment share.

are weak. The F-statistic for our real openness measures are around 20. For current price openness measures the F-statistic is around 10. However, current price import openness and constant price total openness yields F-statistics around 8 which is too low. Partial R-square statistics are always more than 0.13 and thus sufficiently high. Again, we get much better results for our real openness measures where we have partial R-square statistics around 0.4.

In Table 4.4 and 4.5 we report details on FE/RE and sys-GMM large panel regressions. The Hausman test almost always prefers the random effects estimator over the within estimator. For sys-GMM we find Hansen test p-values around $0.2 - 0.4$, which is much lower than for the OECD sample before. However, some of the openness measures are not significant anymore.[3] The test on auto correlation also satisfies the requirements.

Row vi in Table 5, FPS (2011b), also provides results for regressions where we use log unemployment rates. Detailed output tables for the respective log unemployment regressions are reported in Table 4.7 - 4.11. As additional robustness checks we study the role of the unemployment measures in FPS (2011b) by extending our benchmark regressions with various unemployment rates. The detailed results are reported in Table 4.12 - 4.16 where only the first column is related to Table 5 FPS (2011b). Additional robustness checks including other openness measures are also reported in Table 4.12 - 4.16. The results of those additional robustness checks are not included in FPS (2011b). For the OECD panel we use prime age and youth unemployment from the OECD, CIA and IFS data for the large cross section, and ILO and IFS data for the large panel.[4] We solely focus on sys-GMM regressions. Diff-GMM regressions are included in the last part of this supplement as further robustness checks. Necessary test statistics are all included for the respective regression Tables. All regressions are valid as far as the usual test statistics are concerned.

Table 3.6 in the main chapter. Table 4.17 and 4.18 present details on the channel regressions summarized in Table 6, FPS (2011b). As channel variable we focus on log TFP. As a first step we regress log TFP on unemployment. Second, we regress log TFP on openness, and in a last step we regress openness and log TFP on unemployment. For the OECD panel we run benchmark-type fixed and random effects regressions (Hausman test indicates that RE is preferred in (1) and (3)) and FGLS regressions. Openness, output gap and wage distortion treated as endogenous when preforming diff-GMM in the middle left panel (OECD). For sys-GMM we do not treat output gap as endogenous in order to reduce the number of instruments. For the large cross section we run benchmark-type OLS and IV regressions where we instrument openness with an improved Frankel and Romer instrument.

[3]In particular import openness and constant price openness.

[4]We do not have enough observations for the CIA measure to construct a panel variable and thus use ILO unemployment rates instead.

Table 4.1: OECD panel: FE / RE regressions (Table 3.1 and Table 3.5, column (1))

	Table 1		Robustness checks													
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)
	FE	RE	FE	RE	FE	RE	FE	RE	FE	RE	FE	RE	FE	RE	FE	RE
Opennes measure	Total trade (real)		Import (real)		Export (real)		Total trade (cur. p.)		Import (cur. p.)		Export (cur. p.)		Total trade (con. p.)		Total trade (merch.)	
Openness	-0.128***	**-0.076*****	**-0.196*****	-0.110***	-0.074**	**-0.050*****	-0.102*	**-0.057****	-0.164**	**-0.081*****	-0.053	**-0.036**	-0.121***	**-0.075*****	-0.091	**-0.035**
	(0.035)	**(0.021)**	**(0.038)**	(0.025)	(0.033)	**(0.019)**	(0.054)	**(0.027)**	(0.063)	**(0.031)**	(0.047)	**(0.024)**	(0.033)	**(0.021)**	(0.058)	**(0.032)**
Wage distortion	0.065	0.103***	0.052	0.103***	0.081*	0.104***	0.092**	0.110***	0.086**	0.111***	0.100**	0.110***	0.076*	0.105***	0.109**	0.114***
	(0.044)	(0.026)	(0.041)	(0.026)	(0.044)	(0.026)	(0.041)	(0.027)	(0.040)	(0.028)	(0.041)	(0.027)	(0.041)	(0.027)	(0.040)	(0.028)
EPL	-0.380	-0.969	-0.459	-0.974	-0.364	-0.976	-0.541	-0.992	-0.674	-0.989	-0.470	-1.000	-0.483	-0.925	-0.509	-1.015
	(1.378)	(0.652)	(1.263)	(0.646)	(1.410)	(0.658)	(1.393)	(0.670)	(1.337)	(0.673)	(1.396)	(0.669)	(1.425)	(0.665)	(1.364)	(0.676)
Union density	0.025	0.009	0.018	0.008	0.031	0.009	0.035	0.009	0.038	0.010	0.035	0.008	0.023	0.005	0.044	0.010
	(0.043)	(0.029)	(0.038)	(0.028)	(0.044)	(0.029)	(0.040)	(0.030)	(0.037)	(0.030)	(0.042)	(0.030)	(0.042)	(0.029)	(0.038)	(0.030)
High corporatism	-2.325*	-1.805**	-2.077*	-1.715**	-2.718**	-1.957***	-2.999**	-2.306***	-2.943***	-2.366***	-3.207***	-2.326***	-2.554**	-2.018***	-3.441***	-2.482***
	(1.203)	(0.744)	(1.101)	(0.726)	(1.203)	(0.757)	(1.082)	(0.711)	(0.960)	(0.696)	(1.098)	(0.728)	(1.110)	(0.733)	(0.769)	(0.722)
PMR	0.963	0.835*	1.038*	0.843*	0.886	0.820*	0.764	0.793*	0.740	0.792*	0.766	0.786*	0.638	0.680	0.648	0.742
	(0.591)	(0.462)	(0.568)	(0.445)	(0.582)	(0.471)	(0.588)	(0.467)	(0.592)	(0.458)	(0.575)	(0.472)	(0.572)	(0.455)	(0.550)	(0.469)
Population	-19.689**	0.141	-20.323**	-0.073	-18.980***	0.327	-14.762*	0.348	-12.529	0.222	-16.283**	0.479	-16.688**	0.193	-15.677**	0.583
	(6.994)	(0.605)	(7.129)	(0.625)	(6.604)	(0.592)	(7.795)	(0.598)	(8.222)	(0.608)	(7.184)	(0.590)	(7.249)	(0.615)	(6.496)	(0.549)
Output gap	-0.624***	-0.626***	-0.588***	-0.600***	-0.633***	-0.640***	-0.603***	-0.625***	-0.568***	-0.607***	-0.615***	-0.635***	-0.596***	-0.613***	-0.596***	-0.629***
	(0.089)	(0.114)	(0.085)	(0.112)	(0.094)	(0.115)	(0.091)	(0.116)	(0.088)	(0.117)	(0.093)	(0.116)	(0.092)	(0.115)	(0.086)	(0.117)
Observations	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
R2 (within)	0.648	0.608	0.682	0.634	0.625	0.590	0.622	0.591	0.641	0.607	0.610	0.581	0.645	0.611	0.613	0.578
R2 (overall)	0.007	0.369	0.008	0.323	0.006	0.397	0.005	0.364	0.005	0.331	0.005	0.387	0.007	0.337	0.005	0.382
R2 (between)	0.018	0.282	0.021	0.212	0.016	0.329	0.016	0.281	0.018	0.231	0.014	0.317	0.019	0.236	0.014	0.311
Hausman	0.188		n.a.		0.564		0.528		0.271		0.667		0.173		0.563	

Table 4.2: OECD panel: Sys-GMM regressions (Table 3.1 and Table 3.5, column (2))

	Table 1	Robustness checks						
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Sys-GMM	Sys-GMM	Sys-GMM	Sys-GMM	Sys-GMM	Sys-GMM	Sys-GMM	Sys-GMM
Opennes measure	Total trade (real)	Import (real)	Export (real)	Total trade (cur. p.)	Import (cur. p.)	Export (cur. p.)	Total trade (con. p)	Total trade (merch.)
Openness	-0.052***	-0.049**	-0.055***	-0.073**	-0.085**	-0.051*	-0.056**	-0.058*
	(0.019)	(0.021)	(0.017)	(0.036)	(0.038)	(0.029)	(0.024)	(0.031)
Lagged dep. Var.	0.725***	0.710***	0.742***	0.660***	0.670***	0.682***	0.674***	0.624***
	(0.089)	(0.086)	(0.092)	(0.077)	(0.067)	(0.083)	(0.075)	(0.080)
Openness (long run)	**-0.189*** **	**-0.169** **	**-0.213*** **	**-0.215** **	**-0.258** **	**-0.16* **	**-0.172** **	**-0.154* **
	(0.069)	**(0.072)**	**(0.066)**	**(0.106)**	**(0.115)**	**(0.091)**	**(0.074)**	**(0.079)**
Wage distortion	0.085*	0.095*	0.074*	0.105*	0.127**	0.081*	0.107*	0.135**
	(0.049)	(0.054)	(0.044)	(0.057)	(0.064)	(0.047)	(0.055)	(0.065)
EPL	-1.188**	-1.017	-1.192**	-0.996	-1.359*	-0.649	-0.697	-0.616
	(0.580)	(0.656)	(0.523)	(0.686)	(0.793)	(0.581)	(0.779)	(0.792)
Union density	-0.053*	-0.058**	-0.049	-0.030	-0.049	-0.029	-0.053**	-0.030
	(0.029)	(0.028)	(0.031)	(0.027)	(0.034)	(0.026)	(0.027)	(0.024)
High corporatism	-1.572	-1.408	-1.568*	-2.212**	-2.014**	-2.296**	-1.713*	-1.594*
	(0.981)	(0.974)	(0.950)	(0.894)	(0.854)	(0.957)	(0.941)	(0.931)
PMR	0.893*	0.799*	0.859*	0.922**	1.065**	0.681	0.613	0.678
	(0.476)	(0.460)	(0.491)	(0.463)	(0.529)	(0.448)	(0.506)	(0.447)
Population	-0.610	-0.650	-0.659	0.186	-0.261	0.230	-0.290	0.336
	(0.704)	(0.644)	(0.795)	(0.611)	(0.691)	(0.642)	(0.508)	(0.494)
Output gap	-0.842***	-0.886***	-0.802***	-0.691***	-0.650***	-0.791***	-0.787***	-0.778***
	(0.125)	(0.123)	(0.135)	(0.134)	(0.135)	(0.126)	(0.109)	(0.118)
Observations	100	100	100	100	100	100	100	100
AR(1)	0.017	0.021	0.015	0.022	0.038	0.017	0.025	0.025
AR(2)	0.220	0.126	0.369	0.599	0.501	0.485	0.300	0.311
OID-test	0.999	0.994	0.991	0.999	0.997	0.995	0.993	0.990

Table 4.3: Large cross section: OLS/IV regressions, WDI unemployment (Table 3.2 and Table 3.5, columns (3)-(4))

	Table 2		Robustness checks													
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)
	OLS	IV	OLS	IV	OLS	IV	OLS	IV	OLS	IV	OLS	IV	OLS	IV	OLS	IV
	Total trade (real)		Import (real)		Export (real)		Total trade (cur. p.)		Import (cur. p.)		Export (cur. p.)		Total trade (con. p.)		Total trade (merch.)	
Openness	**-0.081*** **	**-0.099** **	**-0.084*** **	**-0.107** **	**-0.077*** **	**-0.093** **	**-0.026**	**-0.123* **	**-0.023**	**-0.140* **	**-0.028* **	**-0.110* **	**-0.027**	**-0.130* **	**-0.013**	**-0.073* **
	(0.028)	**(0.048)**	**(0.030)**	**(0.052)**	**(0.026)**	**(0.045)**	**(0.017)**	**(0.066)**	**(0.019)**	**(0.077)**	**(0.016)**	**(0.057)**	**(0.018)**	**(0.072)**	**(0.010)**	**(0.040)**
Unemployment benefits	1.644	1.659	1.633	1.647	1.654	1.669	1.476	1.090	1.461	0.845	1.504	1.283	1.523	1.313	1.386	0.522
	(1.638)	(1.405)	(1.644)	(1.408)	(1.636)	(1.404)	(1.780)	(1.628)	(1.795)	(1.691)	(1.767)	(1.593)	(1.770)	(1.619)	(1.792)	(1.720)
EPL	5.330*	5.515**	5.179*	5.358**	5.456*	5.652**	4.826	6.058**	4.696	5.723*	4.959	6.321**	4.606	5.009*	4.604	5.073*
	(2.830)	(2.553)	(2.811)	(2.511)	(2.854)	(2.598)	(3.079)	(3.016)	(3.089)	(3.031)	(3.073)	(3.032)	(3.028)	(2.919)	(3.082)	(2.937)
Minimum Wage	-0.013	-0.413	0.150	-0.280	-0.134	-0.528	1.435	0.116	1.566	0.424	1.304	-0.125	1.493	0.390	1.516	0.313
	(1.546)	(1.608)	(1.545)	(1.573)	(1.542)	(1.640)	(1.481)	(1.650)	(1.464)	(1.614)	(1.490)	(1.690)	(1.454)	(1.598)	(1.458)	(1.674)
Population	-0.610	-0.622	-0.578	-0.585	-0.638	-0.655	-0.599	-0.773	-0.585	-0.759	-0.611	-0.785	-0.636	-0.953	-0.550	-0.543
	(0.546)	(0.480)	(0.555)	(0.491)	(0.538)	(0.472)	(0.572)	(0.602)	(0.577)	(0.638)	(0.568)	(0.576)	(0.571)	(0.631)	(0.569)	(0.606)
Land lockedness	-1.991	-2.046	-1.992	-2.058	-1.986	-2.036	-1.663	-1.363	-1.685	-1.386	-1.643	-1.345	-1.739	-1.726	-1.475	-0.281
	(1.454)	(1.296)	(1.464)	(1.311)	(1.445)	(1.286)	(1.468)	(1.697)	(1.467)	(1.771)	(1.467)	(1.642)	(1.480)	(1.678)	(1.454)	(1.983)
Latitude	-0.058	-0.054	-0.035	-0.024	-0.079	-0.080	-0.216	-0.741	-0.184	-0.738	-0.245	-0.744	-0.258	-0.941	-0.178	-0.628
	(0.485)	(0.440)	(0.482)	(0.437)	(0.487)	(0.443)	(0.492)	(0.858)	(0.480)	(0.889)	(0.502)	(0.835)	(0.496)	(0.893)	(0.471)	(0.741)
Area	-0.743	-0.887*	-0.779	-0.958*	-0.701	-0.825*	-0.355	-1.317	-0.326	-1.508	-0.368	-1.167	-0.293	-1.023	-0.306	-1.232
	(0.466)	(0.507)	(0.482)	(0.540)	(0.452)	(0.481)	(0.480)	(0.821)	(0.491)	(0.945)	(0.469)	(0.731)	(0.450)	(0.719)	(0.474)	(0.796)
Unofficial economy	0.014	0.006	0.016	0.007	0.013	0.005	0.048	0.036	0.050	0.041	0.047	0.032	0.051	0.047	0.045	0.013
	(0.037)	(0.039)	(0.037)	(0.039)	(0.037)	(0.039)	(0.038)	(0.041)	(0.038)	(0.042)	(0.037)	(0.040)	(0.037)	(0.041)	(0.038)	(0.046)
Output gap	-70.710	-73.702*	-69.672	-72.941*	-71.448	-74.365*	-67.314	-105.147**	-65.828	-110.434**	-68.291	-100.987**	-64.250	-90.599*	-65.086	-100.026*
	(44.191)	(38.960)	(44.337)	(39.003)	(44.078)	(38.938)	(49.138)	(52.138)	(49.572)	(55.109)	(48.706)	(50.031)	(48.522)	(49.519)	(49.005)	(52.074)
Observations	62	62	62	62	62	62	62	62	62	62	62	62	62	62	62	62
R-squared	0.483	0.480	0.479	0.475	0.486	0.483	0.426	0.260	0.422	0.211	0.430	0.293	0.426	0.260	0.423	0.261
R2 (adjusted)	0.330	0.325	0.324	0.318	0.333	0.329	0.255	0.039	0.250	-0.023	0.260	0.082	0.255	0.039	0.251	0.041
F-stat (1st stage)		20.649		20.192		20.642		9.571		7.923		11.002		8.756		8.939
Partial R-squared		0.392		0.392		0.387		0.152		0.135		0.165		0.152		0.167

Table 4.4: Large panel: FE/RE regressions, WDI unemployment (Table 3.3 and Table 3.5, column (5))

	Table 3		Robustness checks													
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)
	FE	RE	FE	RE	FE	RE	FE	RE	FE	RE	FE	RE	FE	RE	FE	RE
	Total trade (real)		Import (real)		Export (real)		Total trade (cur. p.)		Import (cur. p.)		Export (cur. p.)		Total trade (con. p.)		Total trade (merch.)	
Openness	-0.223***	**-0.078*****	-0.232***	**-0.082*****	**-0.178*****	-0.071***	-0.073	**-0.032****	-0.090	**-0.029****	-0.052	**-0.032****	-0.099	**-0.042*****	-0.010	**-0.030****
	(0.064)	**(0.020)**	(0.075)	**(0.021)**	**(0.065)**	(0.018)	(0.062)	**(0.014)**	(0.062)	**(0.015)**	(0.055)	**(0.013)**	(0.064)	**(0.016)**	(0.037)	**(0.014)**
Population	-5.337	-0.584*	-6.196	-0.613**	-3.137	-0.541*	1.699	-0.409	0.129	-0.408	2.908	-0.388	-2.730	-0.456	3.395	-0.318
	(6.987)	(0.306)	(7.125)	(0.312)	(7.016)	(0.300)	(6.797)	(0.314)	(6.892)	(0.324)	(6.785)	(0.305)	(6.902)	(0.312)	(6.667)	(0.304)
LMR	0.638*	0.448*	0.617*	0.439*	0.603	0.459*	0.427	0.489*	0.453	0.495*	0.398	0.487*	0.400	0.421	0.338	0.479*
	(0.372)	(0.248)	(0.369)	(0.249)	(0.379)	(0.248)	(0.457)	(0.262)	(0.459)	(0.263)	(0.464)	(0.261)	(0.427)	(0.266)	(0.521)	(0.265)
Unemployment benefits	0.077	0.128	0.100	0.136	0.071	0.121	0.136	0.127	0.134	0.128	0.139	0.124	0.136	0.145	0.152	0.138
	(0.160)	(0.141)	(0.157)	(0.141)	(0.164)	(0.143)	(0.190)	(0.154)	(0.190)	(0.154)	(0.191)	(0.154)	(0.180)	(0.152)	(0.204)	(0.157)
PMR	-0.227*	-0.126	-0.229*	-0.124	-0.214	-0.125	-0.167	-0.056	-0.179	-0.058	-0.158	-0.055	-0.220	-0.061	-0.163	-0.063
	(0.133)	(0.127)	(0.131)	(0.127)	(0.135)	(0.127)	(0.131)	(0.126)	(0.132)	(0.125)	(0.130)	(0.126)	(0.133)	(0.125)	(0.124)	(0.125)
Output gap	-15.877***	-19.428***	-14.899***	-18.949***	-17.361***	-19.910***	-20.254***	-20.887***	-19.538***	-20.458***	-20.645**	-21.322***	-18.357***	-20.027***	-20.275**	-21.229***
	(5.658)	(5.736)	(5.552)	(5.719)	(5.878)	(5.787)	(7.582)	(6.234)	(7.290)	(6.226)	(7.924)	(6.265)	(6.315)	(5.967)	(8.059)	(6.353)
Observations	186	186	186	186	186	186	186	186	186	186	186	186	186	186	186	186
R2 (within)	0.291	0.243	0.294	0.245	0.269	0.234	0.195	0.179	0.203	0.179	0.187	0.176	0.225	0.200	0.172	0.161
R2 (overall)	0.04	0.132	0.03	0.128	0.07	0.136	0.0	0.089	0.03	0.081	0.000	0.097	0.02	0.092	0.0	0.096
R2 (between)	0.063	0.116	0.050	0.108	0.090	0.123	0.003	0.069	0.013	0.057	0.000	0.081	0.039	0.077	0.001	0.085
Hausman	0.292		0.264		0.001		0.657		0.999		0.936		0.807		0.833	

Table 4.5: Large panel: Sys-GMM regressions, WDI unemployment(Table 3.3 and Table 3.5, column (6))

	Table 3	Robustness checks						
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Sys-GMM	Sys-GMM	Sys-GMM	Sys-GMM	Sys-GMM	Sys-GMM	Sys-GMM	Sys-GMM
	Total trade (real)	Import (real)	Export (real)	Total trade (cur. p.)	Import (cur. p.)	Export (cur. p.)	Total trade (con. p.)	Total trade (merch.)
Openness	-0.056*	-0.048	-0.062**	-0.046	-0.029	-0.062**	-0.028	-0.053*
	(0.031)	(0.036)	(0.028)	(0.030)	(0.035)	(0.029)	(0.027)	(0.030)
Lag dep. Var.	0.313	0.378**	0.277	0.240	0.285	0.211	0.275	0.245
	(0.204)	(0.187)	(0.223)	(0.226)	(0.235)	(0.225)	(0.255)	(0.238)
Openness (long-run)	**-0.082***	**-0.077**	**-0.086****	**-0.061**	**-0.041**	**-0.079****	**-0.039**	**-0.07***
	(0.045)	**(0.058)**	**(0.039)**	**(0.039)**	**(0.049)**	**(0.037)**	**(0.037)**	**(0.04)**
LMR	1.112**	1.077**	1.030*	0.517	0.568	0.479	0.884	0.602
	(0.544)	(0.480)	(0.608)	(0.655)	(0.626)	(0.692)	(0.652)	(0.680)
Population	-0.663	-0.658	-0.712	-0.514	-0.416	-0.547	-0.661	-0.588
	(0.870)	(0.844)	(0.874)	(0.590)	(0.613)	(0.633)	(0.884)	(0.629)
Unemployment benefits	0.000	0.001	0.005	0.074	0.078	0.068	0.026	0.058
	(0.163)	(0.158)	(0.167)	(0.184)	(0.181)	(0.189)	(0.178)	(0.193)
PMR	-0.194	-0.145	-0.213	0.080	0.057	0.087	-0.031	0.070
	(0.158)	(0.148)	(0.180)	(0.144)	(0.159)	(0.137)	(0.135)	(0.138)
Output gap	-15.871	-9.937	-22.773	-23.478	-19.343	-26.631*	-16.472	-25.074
	(14.500)	(14.968)	(14.956)	(16.123)	(17.167)	(15.925)	(16.908)	(16.549)
Observations	164	164	164	164	164	164	164	164
AR(1)	0.023	0.009	0.049	0.309	0.177	0.418	0.112	0.341
AR(2)	0.645	0.718	0.589	0.951	0.900	0.987	0.700	0.990
OID-test	0.440	0.460	0.385	0.233	0.231	0.300	0.377	0.175

Table 4.6: Large cross section: skill specific OLS/IV regressions, (Table 3.4)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	OLS	OLS	IV	IV	OLS	OLS	IV	IV
DEPENDENT VARIABLES	u (low)	u (high)	u (low)	u (high)	u (low)	u (high)	u (low)	u (high)
Total trade openness (T)	-0.0149	-0.0621**	-0.0381	-0.0653*	-0.0282	-0.0888*	-0.0986	-0.201***
	(0.0390)	(0.0268)	(0.0405)	(0.0367)	(0.0533)	(0.0504)	(0.0613)	(0.0703)
Endowment share (L)					0.219	-0.133	0.0441	-0.343
					(0.386)	(0.402)	(0.301)	(0.350)
Interaction (T x L)					0.0148	-0.00188	0.0338**	0.0502**
					(0.0141)	(0.0175)	(0.0151)	(0.0198)
Unemployment benefits	6.054**	-4.910	6.156***	-4.896	8.041***	-1.762	8.041***	-1.981
	(2.601)	(4.069)	(2.284)	(3.520)	(2.707)	(4.683)	(2.051)	(3.549)
EPL	0.431	9.745*	0.211	9.715**	3.670	10.07	4.835	14.88***
	(5.902)	(5.142)	(5.144)	(4.377)	(4.925)	(6.525)	(4.010)	(5.656)
Output gap	-49.88	-83.78	-52.08	-84.09	-167.8**	-128.5	-159.9***	-87.53
	(136.6)	(70.52)	(120.5)	(62.21)	(76.04)	(111.2)	(57.85)	(84.66)
Popultation	-0.564	-0.531	-0.577	-0.532	-0.0659	-0.928	-0.262	-1.541*
	(1.004)	(0.932)	(0.870)	(0.805)	(0.938)	(1.132)	(0.724)	(0.916)
Landlockedness	3.559	-4.420**	3.108	-4.481**	1.651	-1.850	1.072	-3.049
	(2.226)	(1.891)	(1.965)	(1.823)	(2.310)	(2.261)	(1.921)	(2.132)
Latitude	-0.973	1.133	-1.162	1.107	1.936	-0.895	3.526	4.976
	(1.634)	(1.779)	(1.475)	(1.538)	(2.564)	(3.448)	(2.408)	(3.129)
Area	0.161	-0.686	-0.0442	-0.714	0.111	-0.604	0.0101	-0.121
	(1.067)	(0.908)	(0.985)	(0.880)	(0.625)	(0.916)	(0.693)	(1.030)
Continent dummies	x	x	x	x	x	x	x	x
Observations	53	53	53	53	39	39	39	39
R-squared	0.425	0.574	0.422	0.573	0.727	0.526	0.701	0.357

Table 4.7: OECD panel: FE / RE regressions, ln unemployment (Table 3.5, column (1))

	Table 5		Additional robustness checks													
	(1) FE	(2) RE	(3) FE	(4) RE	(5) FE	(6) RE	(7) FE	(8) RE	(9) FE	(10) RE	(11) FE	(12) RE	(13) FE	(14) RE	(15) FE	(16) RE
	Total trade (real)		Import (real)		Export (real)		Total trade (cur. p.)		Import (cur. p.)		Export (cur. p.)		Total trade (con. p.)		Total trade (merch.)	
Openness	-0.008	**-0.006***	-0.016	-0.009***	-0.003	-0.003	-0.014*	-0.007*	-0.022**	-0.010**	-0.007	-0.005	-0.014*	-0.008**	-0.016*	-0.006
	(0.009)	**(0.003)**	(0.009)	(0.003)	(0.008)	(0.003)	(0.008)	(0.004)	(0.008)	(0.004)	(0.007)	(0.004)	(0.007)	(0.003)	(0.009)	(0.005)
Wage distortion	0.014	0.017***	0.012	0.017***	0.016	0.017***	0.014	0.017***	0.013	0.018***	0.015	0.017***	0.013	0.017***	0.016*	0.018***
	(0.011)	(0.005)	(0.011)	(0.005)	(0.011)	(0.005)	(0.009)	(0.005)	(0.009)	(0.005)	(0.009)	(0.005)	(0.010)	(0.005)	(0.008)	(0.005)
EPL	-0.152	-0.220**	-0.158	-0.220**	-0.153	-0.220**	-0.169	-0.219**	-0.187	-0.219**	-0.160	-0.220**	-0.161	-0.213**	-0.168	-0.221**
	(0.219)	(0.094)	(0.211)	(0.094)	(0.221)	(0.094)	(0.224)	(0.096)	(0.217)	(0.097)	(0.225)	(0.095)	(0.225)	(0.095)	(0.220)	(0.096)
Union density	0.003	0.003	0.002	0.003	0.004	0.003	0.004	0.003	0.004	0.003	0.004	0.003	0.002	0.003	0.005	0.003
	(0.006)	(0.005)	(0.006)	(0.005)	(0.007)	(0.005)	(0.006)	(0.005)	(0.006)	(0.005)	(0.006)	(0.005)	(0.006)	(0.005)	(0.006)	(0.005)
High corporatism	-0.447*	-0.374***	-0.404*	-0.359***	-0.494**	-0.392***	-0.441**	-0.397***	-0.435**	-0.404***	-0.468**	-0.398***	-0.404*	-0.374***	-0.493***	-0.416***
	(0.220)	(0.143)	(0.204)	(0.137)	(0.217)	(0.148)	(0.185)	(0.130)	(0.160)	(0.127)	(0.193)	(0.134)	(0.206)	(0.137)	(0.149)	(0.129)
PMR	0.304**	0.275***	0.314**	0.278***	0.296**	0.272***	0.293*	0.274***	0.290*	0.275***	0.293*	0.272***	0.278*	0.262***	0.274*	0.266***
	(0.143)	(0.094)	(0.145)	(0.093)	(0.139)	(0.094)	(0.146)	(0.093)	(0.145)	(0.092)	(0.145)	(0.094)	(0.148)	(0.093)	(0.139)	(0.092)
Population	-2.353	0.130	-2.441*	0.109	-2.276	0.149	-1.837	0.124	-1.545	0.109	-2.040	0.139	-2.117	0.118	-1.894	0.146
	(1.367)	(0.115)	(1.390)	(0.114)	(1.331)	(0.115)	(1.614)	(0.110)	(1.626)	(0.109)	(1.529)	(0.111)	(1.527)	(0.117)	(1.427)	(0.105)
Output gap	-0.101***	-0.101***	-0.099***	-0.098***	-0.101***	-0.102***	-0.100***	-0.100***	-0.095***	-0.098***	-0.102***	-0.101***	-0.099***	-0.099***	-0.099***	-0.100***
	(0.014)	(0.016)	(0.013)	(0.016)	(0.014)	(0.016)	(0.013)	(0.016)	(0.013)	(0.016)	(0.014)	(0.016)	(0.013)	(0.016)	(0.013)	(0.016)
Observations	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
R2 (between)	0.018	0.495	0.022	0.477	0.016	0.495	0.017	0.435	0.018	0.400	0.016	0.460	0.022	0.424	0.017	0.439
R2 (overall)	0.006	0.518	0.007	0.508	0.005	0.518	0.004	0.481	0.003	0.460	0.004	0.496	0.007	0.474	0.004	0.483
R2 (within)	0.608	0.589	0.621	0.599	0.602	0.584	0.615	0.598	0.628	0.607	0.607	0.591	0.623	0.602	0.613	0.593
Hausman	0.987		0.960		0.990		0.994		0.949		0.984		0.913		0.987	

Table 4.8: OECD panel: Sys-GMM regressions, ln unemployment (Table 3.5, column (2))

	Robustness checks	Further robustness checks						
	(1) Sys-GMM	(2) Sys-GMM	(3) Sys-GMM	(4) Sys-GMM	(5) Sys-GMM	(6) Sys-GMM	(7) Sys-GMM	(8) Sys-GMM
	Totatl trade (real)	Import (real)	Export (real)	Total trade (cur. p.)	Import (cur. p.)	Export (cur. p.)	Total trade (con. p.)	Total trade (merch.)
Openness	-0.007***	-0.006**	-0.008***	-0.009***	-0.008***	-0.008***	-0.007***	-0.007**
	(0.002)	(0.003)	(0.002)	(0.003)	(0.003)	(0.003)	(0.002)	(0.003)
Lag dep. Var.	0.619***	0.595***	0.648***	0.627***	0.632***	0.633***	0.664***	0.635***
	(0.088)	(0.073)	(0.099)	(0.082)	(0.078)	(0.085)	(0.078)	(0.080)
Openness (long-run)	**-0.018*** **	-0.015**	-0.023***	-0.024***	-0.022***	-0.022***	-0.021***	-0.019**
	(0.005)	(0.007)	(0.006)	(0.008)	(0.008)	(0.008)	(0.006)	(0.008)
Wage distortion	0.009**	0.010**	0.008	0.012**	0.011**	0.010**	0.010**	0.014***
	(0.005)	(0.005)	(0.005)	(0.005)	(0.005)	(0.005)	(0.005)	(0.005)
EPL	-0.213***	-0.185**	-0.210**	-0.164**	-0.191**	-0.139*	-0.138	-0.113
	(0.076)	(0.077)	(0.086)	(0.082)	(0.084)	(0.081)	(0.088)	(0.086)
Union density	-0.003	-0.004	-0.003	-0.001	-0.003	-0.001	-0.004	-0.001
	(0.004)	(0.004)	(0.004)	(0.003)	(0.003)	(0.003)	(0.003)	(0.002)
High corporatism	-0.128	-0.104	-0.114	-0.189	-0.162	-0.197*	-0.106	-0.104
	(0.147)	(0.138)	(0.143)	(0.123)	(0.125)	(0.118)	(0.129)	(0.128)
PMR	0.198***	0.171**	0.193**	0.186***	0.191***	0.168***	0.143**	0.148**
	(0.068)	(0.067)	(0.075)	(0.065)	(0.070)	(0.062)	(0.073)	(0.066)
Population	-0.020	-0.018	-0.029	0.050	0.016	0.048	-0.005	0.071
	(0.075)	(0.064)	(0.086)	(0.052)	(0.057)	(0.057)	(0.056)	(0.052)
Output gap	-0.110***	-0.122***	-0.104***	-0.094***	-0.099***	-0.101***	-0.105***	-0.105***
	(0.015)	(0.015)	(0.014)	(0.014)	(0.016)	(0.014)	(0.014)	(0.012)
Observations	100	100	100	100	100	100	100	100
AR(1)	0.0030	0.0063	0.002	0.0022	0.0029	0.0031	0.002	0.003
AR(2)	0.0639	0.022	0.1530	0.2396	0.1409	0.2786	0.1349	0.1002
OID-test	1.000	0.998	1.000	1.000	1.000	1.000	1.000	0.999

Table 4.9: Large cross section: OLS/IV regressions, ln WDI unemployment (Table 3.5, columns (3)-(4))

	Robustness checks		Further robustness checks													
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)
	OLS	IV	OLS	IV	OLS	IV	OLS	IV	OLS	IV	OLS	IV	OLS	IV	OLS	IV
	Total trade (real)		Import (real)		Export (real)		Total trade (cur. p.)		Import (cur. p.)		Export (cur. p.)		Total trade (con. p.)		Total trade (merch.)	
Openness	**-0.009****	**-0.009***	-0.009**	-0.010*	-0.008**	-0.009*	-0.004	-0.011	-0.003	-0.013	-0.004*	-0.010*	-0.004	-0.012	-0.002	-0.007
	(0.003)	**(0.005)**	(0.004)	(0.006)	(0.003)	(0.005)	(0.002)	(0.007)	(0.002)	(0.008)	(0.002)	(0.006)	(0.002)	(0.008)	(0.001)	(0.004)
Unemployment benefits	0.245	0.245	0.244	0.244	0.246	0.246	0.223	0.193	0.221	0.170	0.228	0.211	0.230	0.213	0.209	0.141
	(0.211)	(0.183)	(0.212)	(0.183)	(0.211)	(0.183)	(0.218)	(0.196)	(0.218)	(0.202)	(0.217)	(0.193)	(0.217)	(0.194)	(0.217)	(0.207)
EPL	0.612	0.617*	0.595	0.602*	0.627*	0.629*	0.569	0.667*	0.552	0.636*	0.586	0.691*	0.537	0.570*	0.538	0.576*
	(0.366)	(0.324)	(0.363)	(0.320)	(0.369)	(0.328)	(0.380)	(0.350)	(0.381)	(0.349)	(0.380)	(0.353)	(0.377)	(0.345)	(0.380)	(0.341)
Minimum Wage	0.113	0.104	0.132	0.116	0.098	0.093	0.257	0.153	0.274*	0.181	0.240	0.130	0.267*	0.178	0.267*	0.171
	(0.160)	(0.159)	(0.160)	(0.156)	(0.159)	(0.163)	(0.156)	(0.161)	(0.155)	(0.158)	(0.156)	(0.165)	(0.154)	(0.155)	(0.156)	(0.163)
Population	-0.097	-0.097	-0.094	-0.094	-0.100	-0.100	-0.097	-0.111	-0.096	-0.110	-0.099	-0.112	-0.102	-0.128*	-0.091	-0.090
	(0.076)	(0.066)	(0.077)	(0.067)	(0.075)	(0.066)	(0.079)	(0.074)	(0.080)	(0.076)	(0.078)	(0.071)	(0.079)	(0.077)	(0.078)	(0.073)
Land lockedness	-0.325*	-0.327**	-0.325*	-0.328**	-0.325*	-0.326**	-0.287	-0.264	-0.290	-0.266	-0.285	-0.262	-0.298	-0.297	-0.259	-0.164
	(0.187)	(0.163)	(0.189)	(0.165)	(0.186)	(0.162)	(0.188)	(0.190)	(0.188)	(0.196)	(0.187)	(0.185)	(0.189)	(0.190)	(0.189)	(0.214)
Latitude	-0.015	-0.015	-0.012	-0.012	-0.017	-0.017	-0.036	-0.078	-0.032	-0.078	-0.040	-0.078	-0.041	-0.096	-0.032	-0.067
	(0.054)	(0.047)	(0.054)	(0.047)	(0.054)	(0.047)	(0.056)	(0.084)	(0.055)	(0.086)	(0.057)	(0.082)	(0.057)	(0.090)	(0.054)	(0.073)
Area	-0.058	-0.061	-0.061	-0.068	-0.054	-0.056	-0.025	-0.101	-0.022	-0.119	-0.026	-0.087	-0.015	-0.074	-0.019	-0.093
	(0.059)	(0.060)	(0.060)	(0.063)	(0.058)	(0.057)	(0.059)	(0.087)	(0.060)	(0.099)	(0.058)	(0.078)	(0.055)	(0.077)	(0.059)	(0.084)
Unofficial economy	0.002	0.002	0.002	0.002	0.002	0.002	0.006	0.005	0.006	0.005	0.005	0.004	0.006	0.006	0.005	0.003
	(0.005)	(0.005)	(0.005)	(0.005)	(0.005)	(0.005)	(0.005)	(0.005)	(0.005)	(0.005)	(0.005)	(0.005)	(0.005)	(0.005)	(0.005)	(0.005)
Output gap	-9.804	-9.871*	-9.677	-9.801*	-9.898	-9.932*	-9.772	-12.770**	-9.609	-13.257**	-9.872	-12.386**	-9.298	-11.429*	-9.508	-12.297**
	(5.997)	(5.246)	(6.013)	(5.257)	(5.983)	(5.238)	(6.351)	(6.199)	(6.391)	(6.456)	(6.313)	(6.019)	(6.309)	(6.011)	(6.397)	(6.160)
Observations	62	62	62	62	62	62	62	62	62	62	62	62	62	62	62	62
R-squared	0.500	0.500	0.495	0.495	0.503	0.503	0.460	0.387	0.455	0.356	0.464	0.407	0.459	0.382	0.456	0.384
R2 (adjusted)	0.351	0.351	0.345	0.344	0.355	0.355	0.299	0.204	0.293	0.164	0.305	0.231	0.297	0.198	0.294	0.200
F-stat (1st stage)	20.649		20.192		20.642		9.571		7.923		11.002		8.756		8.939	
Partial R-squared	0.392		0.392		0.387		0.152		0.135		0.165		0.152		0.167	

Table 4.10: Large panel: FE/RE regressions, ln WDI unemployment (Table 3.5, column (5))

	Table 5		Additional robustness checks													
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)
	FE	RE	FE	RE	FE	RE	FE	RE	FE	RE	FE	RE	FE	RE	FE	RE
	Total trade (real)		Import (real)		Export (real)		Total trade (cur. p.)		Import (cur. p.)		Export (cur. p.)		Total trade (con. p.)		Total trade (merch.)	
Openness	-0.027***	**-0.009*** **	-0.030***	-0.010***	-0.020***	-0.008***	-0.007	-0.003	-0.010	-0.003	-0.004	-0.003*	-0.011	-0.004**	-0.001	-0.003
	(0.006)	**(0.003)**	(0.007)	(0.003)	(0.007)	(0.002)	(0.008)	(0.002)	(0.008)	(0.002)	(0.007)	(0.002)	(0.008)	(0.002)	(0.006)	(0.002)
Population	-1.171	-0.068	-1.367	-0.072	-0.840	-0.062	-0.251	-0.042	-0.454	-0.040	-0.128	-0.041	-0.808	-0.049	-0.090	-0.034
	(0.938)	(0.046)	(0.946)	(0.047)	(0.957)	(0.044)	(0.965)	(0.048)	(0.997)	(0.051)	(0.943)	(0.046)	(0.989)	(0.048)	(0.947)	(0.046)
LMR	0.085*	0.059*	0.085*	0.057*	0.078	0.060*	0.056	0.065**	0.061	0.066**	0.052	0.065**	0.055	0.057*	0.048	0.064*
	(0.046)	(0.031)	(0.045)	(0.031)	(0.047)	(0.031)	(0.056)	(0.033)	(0.055)	(0.033)	(0.056)	(0.032)	(0.050)	(0.033)	(0.060)	(0.033)
Unemployment benefits	0.023	0.033**	0.025	0.034**	0.023	0.033**	0.030	0.033**	0.030	0.033**	0.031	0.033**	0.030	0.035**	0.032	0.034**
	(0.017)	(0.014)	(0.016)	(0.014)	(0.018)	(0.015)	(0.020)	(0.016)	(0.020)	(0.016)	(0.021)	(0.016)	(0.019)	(0.016)	(0.021)	(0.016)
PMR	-0.039**	-0.024	-0.040**	-0.024	-0.037**	-0.024	-0.031*	-0.016	-0.033**	-0.016	-0.031*	-0.016	-0.038**	-0.017	-0.031**	-0.017
	(0.017)	(0.015)	(0.016)	(0.015)	(0.017)	(0.015)	(0.016)	(0.015)	(0.016)	(0.015)	(0.016)	(0.015)	(0.017)	(0.015)	(0.015)	(0.015)
Output gap	-2.384***	-2.738***	-2.215***	-2.675***	-2.590***	-2.798***	-2.914***	-2.903***	-2.839***	-2.861***	-2.938***	-2.949***	-2.699***	-2.815***	-2.909***	-2.941***
	(0.691)	(0.691)	(0.662)	(0.683)	(0.731)	(0.703)	(0.909)	(0.760)	(0.873)	(0.759)	(0.947)	(0.764)	(0.768)	(0.728)	(0.949)	(0.771)
Observations	186	186	186	186	186	186	186	186	186	186	186	186	186	186	186	186
R2 (within)	0.341	0.291	0.362	0.301	0.308	0.278	0.243	0.231	0.254	0.233	0.236	0.228	0.275	0.249	0.231	0.221
R2 (between)	0.032	0.135	0.026	0.122	0.039	0.146	0.034	0.097	0.017	0.085	0.056	0.112	0.015	0.097	0.037	0.114
R2 (overall)	0.021	0.167	0.016	0.159	0.027	0.175	0.040	0.133	0.018	0.124	0.073	0.142	0.011	0.133	0.062	0.139
Hausman	0.279		0.101		0.603		0.935		0.575		0.986		0.816		0.947	

Table 4.11: Large panel: Sys-GMM regressions, ln WDI unemployment (Table 3.5, column (6))

	Robustness checks	Further robustness checks						
	(1) Sys-GMM	(2) Sys-GMM	(3) Sys-GMM	(4) Sys-GMM	(5) Sys-GMM	(6) Sys-GMM	(7) Sys-GMM	(8) Sys-GMM
	Totatl trade (real)	Import (real)	Export (real)	Total trade (cur. p.)	Import (cur. p.)	Export (cur. p.)	Total trade (con. p.)	Total trade (merch.)
Openness	-0.006	-0.005	-0.007*	-0.006	-0.003	-0.009**	-0.004	-0.007
	(0.004)	(0.005)	(0.004)	(0.005)	(0.005)	(0.004)	(0.004)	(0.004)
Lag dep. Var.	0.293*	0.360**	0.263	0.236	0.273*	0.226	0.296*	0.237
	(0.153)	(0.144)	(0.162)	(0.170)	(0.165)	(0.175)	(0.175)	(0.179)
Openness (long-run)	**-0.008**	-0.008	-0.009*	-0.008	-0.004	-0.012**	-0.006	-0.009
	(0.006)	(0.008)	(0.005)	(0.007)	(0.007)	(0.005)	(0.006)	(0.005)
LMR	0.154**	0.152**	0.148**	0.119	0.134	0.100	0.129	0.119
	(0.066)	(0.060)	(0.070)	(0.088)	(0.089)	(0.085)	(0.084)	(0.085)
Population	-0.043	-0.044	-0.057	-0.065	-0.052	-0.065	-0.020	-0.078
	(0.117)	(0.111)	(0.115)	(0.095)	(0.100)	(0.093)	(0.111)	(0.097)
Unemployment benefits	0.012	0.013	0.011	0.016	0.016	0.016	0.014	0.017
	(0.020)	(0.020)	(0.021)	(0.023)	(0.023)	(0.024)	(0.024)	(0.025)
PMR	-0.032	-0.026	-0.035	-0.007	-0.012	-0.002	-0.015	-0.007
	(0.025)	(0.023)	(0.028)	(0.022)	(0.023)	(0.021)	(0.021)	(0.021)
Output gap	-2.411	-1.450	-3.502*	-3.024	-2.430	-3.483*	-1.844	-3.414
	(2.012)	(2.032)	(1.974)	(2.072)	(2.216)	(2.014)	(1.973)	(2.113)
Observations	164	164	164	164	164	164	164	164
AR(1)	0.005	0.002	0.009	0.111	0.031	0.215	0.013	0.146
AR(2)	0.990	0.978	0.921	0.996	0.971	0.987	0.973	0.953
OID-test	0.208	0.216	0.221	0.140	0.144	0.155	0.208	0.118

Table 4.12: OECD panel: Sys-GMM regressions, prime age unemployment (Table 3.5, column (1), lower panel)

	Robustness checks	**Further robustness checks**						
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Sys-GMM	Sys-GMM	Sys-GMM	Sys-GMM	Sys-GMM	Sys-GMM	Sys-GMM	Sys-GMM
Opennes measure	Total trade (real)	Import (real)	Export (real)	Total trade (cur. P.	Import (cur. P.)	Export (cur. P.)	Total trade (con. P.)	Total trade (merch.)
Opennes	-0.054**	-0.049**	-0.056**	-0.062**	-0.075**	-0.046*	-0.059**	-0.050*
	(0.023)	(0.022)	(0.022)	(0.030)	(0.034)	(0.027)	(0.028)	(0.028)
Lagged dep. Var.	0.725***	0.722***	0.718***	0.586***	0.641***	0.591***	0.631***	0.566***
	(0.081)	(0.084)	(0.088)	(0.090)	(0.071)	(0.113)	(0.082)	(0.109)
Openness (long-run)	**-0.196****	-0.176**	-0.199**	-0.15**	-0.209**	-0.112*	-0.16**	-0.115*
	(0.084)	(0.079)	(0.078)	(0.072)	(0.095)	(0.066)	(0.076)	(0.065)
Wage distortion	0.061	0.074*	0.047	0.090*	0.092*	0.080*	0.103*	0.106*
	(0.041)	(0.044)	(0.036)	(0.050)	(0.054)	(0.045)	(0.055)	(0.055)
High Corporatism	-1.138	-1.151	-1.005	-1.783*	-1.421	-2.033*	-1.377	-1.502
	(1.048)	(1.035)	(0.989)	(1.067)	(1.079)	(1.118)	(1.159)	(1.107)
Union density	-0.024	-0.026	-0.021	-0.015	-0.038	-0.006	-0.040*	-0.004
	(0.017)	(0.019)	(0.018)	(0.020)	(0.024)	(0.022)	(0.023)	(0.020)
EPL	-0.875	-0.720	-0.866*	-0.854	-0.976	-0.632	-0.859	-0.538
	(0.592)	(0.585)	(0.508)	(0.685)	(0.704)	(0.631)	(0.805)	(0.688)
PMR	0.919*	0.839	0.871	1.015*	0.938	0.898*	0.848	0.840*
	(0.545)	(0.522)	(0.541)	(0.532)	(0.580)	(0.484)	(0.593)	(0.485)
Population	-0.234	-0.187	-0.309	0.228	-0.222	0.407	-0.227	0.574
	(0.549)	(0.436)	(0.617)	(0.461)	(0.557)	(0.483)	(0.429)	(0.432)
Output gap	-0.511***	-0.554***	-0.484***	-0.477***	-0.480***	-0.506***	-0.503***	-0.508***
	(0.181)	(0.169)	(0.173)	(0.172)	(0.163)	(0.168)	(0.171)	(0.161)
Observations	75	75	75	75	75	75	75	75
AR(1)	0.066	0.085	0.056	0.070	0.077	0.071	0.096	0.129
AR(2)	0.902	0.913	0.778	0.963	0.944	0.939	0.933	0.959
OID-test	0.989	0.988	0.986	0.977	0.997	0.992	0.970	0.992

Table 4.13: OECD panel: Sys-GMM regressions, youth unemployment (Table 3.5, column (1), lower part)

	Robustness checks	Further robustness checks						
	(25) sys-GMM	(26) sys-GMM	(27) sys-GMM	(28) sys-GMM	(29) sys-GMM	(30) sys-GMM	(31) sys-GMM	(32) sys-GMM
Opennes measure	Total trade (real)	Import (real)	Export (real)	Total trade (cur. P.)	Import (cur. P.)	Export (cur. P.)	Total trade (con. P.)	Total trade (merch.)
Openness	-0.032	-0.036	-0.041	-0.067	-0.090	-0.041	-0.032	-0.050
	(0.054)	(0.054)	(0.049)	(0.055)	(0.055)	(0.053)	(0.055)	(0.062)
Lagged dep. Var.	0.716***	0.718***	0.699***	0.637***	0.636***	0.667***	0.711***	0.656***
	(0.089)	(0.081)	(0.088)	(0.091)	(0.081)	(0.095)	(0.058)	(0.093)
Openness (long-run)	**-0.113**	-0.128	-0.136	-0.185	-0.247	-0.123	-0.111	-0.145
	(0.190)	(0.191)	(0.163)	(0.152)	(0.151)	(0.159)	(0.190)	(0.180)
Wage distortion	-0.106*	-0.078	-0.114**	-0.094*	-0.056	-0.108**	-0.058	-0.096
	(0.055)	(0.048)	(0.057)	(0.049)	(0.048)	(0.049)	(0.063)	(0.065)
High corporatism	-0.312	-0.452	-0.190	-0.616	-0.402	-0.906	-0.267	-0.018
	(1.966)	(1.671)	(1.998)	(1.830)	(1.438)	(1.971)	(1.661)	(1.678)
Union density	0.023	0.011	0.030	0.051	0.026	0.047	0.002	0.067
	(0.027)	(0.025)	(0.031)	(0.042)	(0.041)	(0.043)	(0.031)	(0.042)
EPL	0.681	0.579	0.607	1.205	0.625	1.449	0.926	1.073
	(0.846)	(0.760)	(0.901)	(1.036)	(0.957)	(1.036)	(0.904)	(0.883)
PMR	0.612	0.617	0.643	0.478	0.800	0.200	0.434	0.492
	(0.758)	(0.839)	(0.756)	(0.946)	(0.962)	(0.920)	(0.793)	(0.794)
Population	0.039	-0.068	-0.063	0.605	0.081	0.641	-0.222	0.995
	(0.723)	(0.663)	(0.790)	(0.964)	(1.000)	(0.935)	(0.606)	(0.989)
Output gap	-1.479***	-1.463***	-1.405***	-1.400***	-1.314***	-1.453***	-1.459***	-1.349***
	(0.277)	(0.255)	(0.260)	(0.318)	(0.302)	(0.312)	(0.284)	(0.347)
Observations	75	75	75	75	75	75	75	75
AR(1)	0.031	0.025	0.020	0.030	0.012	0.036	0.016	0.038
AR(2)	0.883	0.855	0.953	0.930	0.883	1.000	0.880	0.868
OID-test	0.786	0.847	0.876	0.906	0.989	0.970	0.909	0.965

Table 4.14: Large cross section: OLS/IV regressions, CIA unemployment (Table 3.5, column (3), lower part)

	Robustness checks		Further robustness checks													
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)
	OLS	IV	OLS	IV	OLS	IV	OLS	IV	OLS	IV	OLS	IV	OLS	IV	OLS	IV
	Total trade (real)		Import (real)		Export (real)		Total trade (cur. p.)		Import (cur. p.)		Export (cur. p.)		Total trade (con. p.)		Total trade (merch.)	
Openness	-0.129***	**-0.166****	-0.134***	-0.183**	-0.122***	-0.153**	-0.088***	-0.184**	-0.085***	-0.217**	-0.086***	-0.159**	-0.038	-0.230*	-0.050***	-0.105**
	(0.041)	**(0.067)**	(0.045)	(0.075)	(0.038)	(0.061)	(0.028)	(0.075)	(0.031)	(0.094)	(0.024)	(0.063)	(0.048)	(0.119)	(0.019)	(0.044)
Unemployment benefits	-3.999	-3.688*	-4.188*	-3.854*	-3.856	-3.549*	-4.912*	-4.720**	-5.324**	-5.686**	-4.510*	-4.010*	-5.182*	-5.646**	-5.322**	-5.574**
	(2.391)	(2.054)	(2.414)	(2.050)	(2.381)	(2.064)	(2.526)	(2.214)	(2.581)	(2.305)	(2.492)	(2.208)	(2.673)	(2.636)	(2.549)	(2.216)
EPL	5.395	5.316	5.430	5.340	5.371	5.295	5.807	5.951	5.930	6.326	5.675	5.675	5.703	5.852	5.288	4.871
	(4.738)	(4.211)	(4.729)	(4.219)	(4.748)	(4.213)	(4.463)	(4.007)	(4.516)	(4.157)	(4.430)	(3.939)	(4.560)	(4.258)	(4.445)	(3.928)
Minimum Wage	-3.532	-4.207	-3.297	-4.085	-3.684	-4.308	-2.616	-4.178	-2.260	-3.944	-2.879	-4.350	-1.519	-3.271	-2.351	-3.630
	(2.803)	(2.764)	(2.804)	(2.750)	(2.797)	(2.778)	(2.692)	(2.792)	(2.701)	(2.771)	(2.679)	(2.818)	(2.788)	(2.757)	(2.689)	(2.757)
Population	-0.145	-0.128	-0.132	-0.105	-0.159	-0.147	-0.087	0.041	-0.136	-0.029	-0.045	0.093	-0.327	-0.935	0.007	0.237
	(0.764)	(0.695)	(0.777)	(0.718)	(0.753)	(0.680)	(0.793)	(0.842)	(0.808)	(0.912)	(0.779)	(0.801)	(0.780)	(1.157)	(0.794)	(0.863)
Land lockedness	1.413	1.132	1.569	1.261	1.298	1.024	1.876	1.312	2.085	1.599	1.701	1.101	2.288	1.729	2.580	2.776
	(2.316)	(2.177)	(2.328)	(2.208)	(2.302)	(2.159)	(2.308)	(2.429)	(2.323)	(2.555)	(2.291)	(2.356)	(2.286)	(2.826)	(2.406)	(2.476)
Latitude	0.999	0.938	1.082	1.033*	0.930	0.859	0.576	-0.112	0.708	-0.073	0.486	-0.140	0.995	-0.102	0.705	0.154
	(0.688)	(0.601)	(0.706)	(0.601)	(0.678)	(0.604)	(0.678)	(0.968)	(0.684)	(1.009)	(0.687)	(0.943)	(0.979)	(1.071)	(0.716)	(0.820)
Area	-1.555**	-1.852***	-1.613**	-2.020**	-1.473**	-1.712***	-1.415**	-2.389**	-1.398*	-2.766**	-1.372**	-2.111**	-0.822	-2.370*	-1.294*	-2.138**
	(0.656)	(0.716)	(0.684)	(0.788)	(0.628)	(0.662)	(0.662)	(0.969)	(0.703)	(1.185)	(0.621)	(0.832)	(0.632)	(1.250)	(0.642)	(0.895)
Unofficial economy	0.034	0.023	0.035	0.020	0.035	0.025	0.069	0.061	0.068	0.055	0.071	0.066	0.073	0.055	0.055	0.031
	(0.077)	(0.069)	(0.077)	(0.069)	(0.077)	(0.068)	(0.082)	(0.079)	(0.082)	(0.082)	(0.082)	(0.077)	(0.080)	(0.082)	(0.081)	(0.076)
Output gap	-106.726	-110.535*	-109.014	-114.801*	-104.276	-106.980*	-120.771	-150.352**	-124.649	-172.985**	-115.060	-133.711**	-104.347	-159.442*	-112.180	-132.523*
	(73.967)	(64.775)	(73.965)	(65.025)	(74.111)	(64.787)	(77.167)	(71.465)	(78.786)	(78.346)	(76.076)	(68.146)	(77.261)	(84.022)	(77.081)	(69.565)
Observations	60	60	60	60	60	60	60	60	60	60	60	60	60	60	60	60
R-squared	0.617	0.612	0.610	0.602	0.621	0.617	0.600	0.547	0.588	0.507	0.608	0.568	0.562	0.356	0.557	0.547
R2 (adjusted)	0.497	0.491	0.488	0.478	0.504	0.498	0.475	0.406	0.460	0.354	0.486	0.434	0.426	0.155	0.419	.
F-stat (1st stage)		21.955		20.742		22.431		11.305		9.122		12.976		6.761		11.318
Partial R-squared		0.381		0.378		0.375		0.200		0.178		0.210		0.132		0.237

Table 4.15: Large cross section: OLS/IV regressions, IFS unemployment (Table 3.5, column (4), lower part)

	Robustness checks		Further robustness checks													
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)
	OLS	IV	OLS	IV	OLS	IV	OLS	IV	OLS	IV	OLS	IV	OLS	IV	OLS	IV
	Total trade (real)		Import (real)		Export (real)		Total trade (cur. p.)		Import (cur. p.)		Export (cur. p.)		Total trade (con. p.)		Total trade (merch.)	
Openness	-0.054**	**-0.083***	-0.057**	-0.089*	-0.051**	-0.077*	-0.024	-0.103*	-0.024	-0.120*	-0.024	-0.090*	-0.026	-0.107*	-0.015	-0.059*
	(0.026)	**(0.045)**	(0.027)	(0.049)	(0.024)	(0.042)	(0.016)	(0.059)	(0.018)	(0.072)	(0.014)	(0.051)	(0.016)	(0.063)	(0.009)	(0.034)
Unemployment benefits	2.075	1.872	2.078	1.857	2.077	1.885	2.170	1.214	2.173	1.003	2.177	1.373	2.195	1.354	2.086	1.024
	(1.766)	(1.539)	(1.765)	(1.542)	(1.767)	(1.537)	(1.816)	(1.857)	(1.817)	(1.954)	(1.814)	(1.797)	(1.807)	(1.852)	(1.774)	(1.813)
EPL	2.092	2.619	1.999	2.526	2.161	2.699	1.621	3.371	1.529	3.321	1.693	3.409	1.531	2.933	1.426	2.378
	(2.946)	(2.701)	(2.921)	(2.664)	(2.968)	(2.738)	(2.927)	(3.067)	(2.918)	(3.091)	(2.936)	(3.063)	(2.905)	(2.970)	(2.844)	(2.720)
Minimum Wage	-0.074	-0.680	0.026	-0.585	-0.146	-0.763	0.768	-0.264	0.858	-0.053	0.690	-0.423	0.806	-0.069	0.798	-0.006
	(1.427)	(1.576)	(1.422)	(1.545)	(1.427)	(1.605)	(1.368)	(1.549)	(1.360)	(1.519)	(1.371)	(1.581)	(1.352)	(1.481)	(1.357)	(1.500)
Population	-0.406	-0.393	-0.385	-0.359	-0.425	-0.422	-0.442	-0.478	-0.438	-0.470	-0.444	-0.483	-0.466	-0.578	-0.407	-0.338
	(0.537)	(0.481)	(0.541)	(0.490)	(0.533)	(0.474)	(0.537)	(0.556)	(0.539)	(0.587)	(0.536)	(0.536)	(0.534)	(0.559)	(0.531)	(0.548)
Land lockedness	-0.961	-1.149	-0.948	-1.147	-0.968	-1.151	-0.608	-0.621	-0.595	-0.558	-0.621	-0.668	-0.676	-0.905	-0.379	0.262
	(1.364)	(1.213)	(1.374)	(1.226)	(1.355)	(1.204)	(1.385)	(1.460)	(1.389)	(1.537)	(1.381)	(1.408)	(1.397)	(1.452)	(1.376)	(1.612)
Latitude	-0.198	-0.183	-0.183	-0.158	-0.212	-0.205	-0.351	-0.766	-0.330	-0.758	-0.367	-0.771	-0.368	-0.824	-0.347	-0.693
	(0.484)	(0.451)	(0.482)	(0.449)	(0.485)	(0.453)	(0.493)	(0.804)	(0.487)	(0.837)	(0.497)	(0.782)	(0.492)	(0.764)	(0.475)	(0.690)
Area	-0.505	-0.757	-0.529	-0.821	-0.475	-0.701	-0.286	-1.145	-0.286	-1.353	-0.276	-0.989	-0.252	-0.975	-0.275	-0.985
	(0.493)	(0.531)	(0.507)	(0.562)	(0.481)	(0.506)	(0.476)	(0.805)	(0.487)	(0.944)	(0.466)	(0.711)	(0.454)	(0.745)	(0.447)	(0.711)
Unofficial economy	0.033	0.016	0.034	0.016	0.032	0.015	0.058	0.037	0.060	0.041	0.057	0.034	0.060	0.047	0.053	0.021
	(0.041)	(0.042)	(0.041)	(0.042)	(0.041)	(0.042)	(0.038)	(0.043)	(0.038)	(0.044)	(0.038)	(0.043)	(0.037)	(0.042)	(0.037)	(0.045)
Output gap	-64.642	-73.327*	-63.717	-72.756*	-65.223	-73.820*	-60.728	-102.325*	-59.959	-108.404*	-61.019	-97.752*	-59.833	-97.157*	-59.172	-90.590*
	(46.810)	(42.655)	(46.781)	(42.642)	(46.796)	(42.678)	(48.209)	(57.601)	(48.333)	(61.539)	(48.020)	(54.916)	(48.495)	(57.400)	(46.959)	(52.752)
Observations	61	61	61	61	61	61	61	61	61	61	61	61	61	61	61	61
R-squared	0.481	0.471	0.479	0.468	0.483	0.473	0.457	0.324	0.455	0.286	0.459	0.346	0.457	0.337	0.458	0.351
R2 (adjusted)	0.323	0.31	0.320	0.306	0.325	0.313	0.292	0.118	0.290	0.0685	0.295	0.147	0.292	0.135	0.294	0.154
F-stat (1st stage)		18.690		17.839		19.106		9.473		7.426		11.296		9.194		8.949
Partial R-squared		0.395		0.392		0.392		0.146		0.126		0.160		0.159		0.168

Table 4.16: Large panel: Sys-GMM regressions, ILO/IFS unemployment (Table 3.5, columns (5)-(6), lower part)

	ILO unemployment								IFS unemployment							
	Robustness checks	Further robustness checks							Robustness checks	Further robustness checks						
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Sys-GMM	Sys-GMM	Sys-GMM	Sys-GMM	Sys-GMM	Sys-GMM	Sys-GMM	Sys-GMM	Sys-GMM	Sys-GMM	Sys-GMM	Sys-GMM	Sys-GMM	Sys-GMM	Sys-GMM	Sys-GMM
	Totatl trade (real)	Import (real)	Export (real)	Total trade (cur. p.)	Import (cur. p.)	Export (cur. p.)	Total trade (con. p.)	Total trade (merch.)	Totatl trade (real)	Import (real)	Export (real)	Total trade (cur. p.)	Import (cur. p.)	Export (cur. p.)	Total trade (con. p.)	Total trade (merch.)
Openness	-0.079*	-0.076*	-0.076**	-0.049*	-0.041	-0.054*	-0.041	-0.048	-0.072*	-0.065*	-0.077**	-0.060*	-0.047	-0.070**	-0.047	-0.062*
	(0.041)	(0.045)	(0.036)	(0.030)	(0.032)	(0.029)	(0.027)	(0.030)	(0.037)	(0.039)	(0.035)	(0.034)	(0.035)	(0.034)	(0.034)	(0.034)
Lag dep. Var.	0.236	0.272	0.239	0.341*	0.392*	0.286	0.286	0.339	0.213	0.227	0.217	0.255	0.285	0.212	0.217	0.256
	(0.206)	(0.2)	(0.218)	(0.207)	(0.238)	(0.203)	(0.280)	(0.228)	(0.208)	(0.206)	(0.207)	(0.206)	(0.225)	(0.205)	(0.259)	(0.238)
Openness (long-run)	**-0.103***	-0.104*	-0.1**	-0.074*	-0.067	-0.076*	-0.057	-0.073	**-0.091***	-0.084*	-0.098**	-0.081*	-0.066	-0.089**	-0.06	-0.083*
	(0.054)	(0.062)	(0.047)	(0.046)	(0.053)	(0.041)	(0.038)	(0.045)	**(0.047)**	(0.05)	(0.045)	(0.046)	(0.049)	(0.043)	(0.043)	(0.046)
LMR	1.002*	0.908*	0.965*	0.408	0.394	0.470	0.665	0.553	0.896*	0.947*	0.744	0.505	0.530	0.513	0.664	0.601
	(0.539)	(0.546)	(0.541)	(0.583)	(0.592)	(0.611)	(0.675)	(0.540)	(0.520)	(0.489)	(0.544)	(0.584)	(0.564)	(0.606)	(0.613)	(0.580)
Population	-1.229	-1.193	-1.133	-0.600	-0.399	-0.719	-0.634	-0.660	-0.872	-0.854	-0.910	-0.881*	-0.755	-0.916	-0.867	-0.899
	(1.156)	(1.054)	(1.145)	(0.760)	(0.756)	(0.803)	(1.126)	(0.935)	(0.998)	(0.964)	(0.996)	(0.528)	(0.559)	(0.594)	(1.001)	(0.554)
Unemployment benefits	0.061	0.073	0.057	0.044	0.034	0.051	0.058	0.026	0.028	0.036	0.046	0.045	0.039	0.055	0.043	0.045
	(0.179)	(0.177)	(0.180)	(0.175)	(0.170)	(0.183)	(0.161)	(0.182)	(0.181)	(0.182)	(0.182)	(0.178)	(0.177)	(0.182)	(0.188)	(0.192)
PMR	-0.203	-0.15	-0.218	0.106	0.113	0.075	0.015	0.084	-0.270*	-0.228	-0.284	0.065	0.070	0.038	-0.033	0.029
	(0.173)	(0.167)	(0.191)	(0.144)	(0.154)	(0.141)	(0.137)	(0.138)	(0.164)	(0.158)	(0.173)	(0.132)	(0.138)	(0.132)	(0.129)	(0.139)
Output gap	-26.376*	-23.567*	-28.432*	-22.996	-20.589	-24.840*	-20.697	-24.369*	-30.481**	-26.262*	-34.064**	-31.103**	-29.300*	-32.594**	-27.347*	-31.753**
	(13.94)	(13.851)	(14.740)	(15.126)	(16.815)	(14.394)	(18.378)	(14.806)	(13.577)	(13.723)	(13.720)	(14.169)	(15.818)	(13.525)	(15.567)	(15.336)
Observations	148	148	148	148	148	148	148	148	155	155	155	155	155	155	155	155
AR(1)	0.328	0.286	0.341	0.788	0.548	0.924	0.654	0.845	0.131	0.126	0.129	0.440	0.385	0.524	0.358	0.474
AR(2)	0.493	0.495	0.525	0.845	0.826	0.829	0.662	0.883	0.523	0.564	0.522	0.931	0.989	0.870	0.721	0.807
OID-test	0.756	0.685	0.740	0.162	0.165	0.204	0.395	0.103	0.340	0.378	0.298	0.155	0.134	0.211	0.318	0.092

Table 4.17: OECD panel: TFP channel regressions (Table 3.6, upper and middle panel)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)
	FE	RE	FE	RE	FE	RE	FGLS	FGLS	FGLS	diff-GMM	diff-GMM	diff-GMM	sys-GMM	sys-GMM	sys-GMM
Dep. Var.	u	u	TFP	TFP	u	u	u	TFP	u	u	TFP	u	u	TFP	u
Total trade openness			**0.264****	0.229***	-0.064	**-0.014**		0.167***	-0.046**		0.205*	0.002		0.104**	-0.006
			(0.119)	(0.062)	(0.057)	**(0.030)**		(0.030)	(0.022)		(0.110)	(0.183)		(0.041)	(0.029)
TFP	-0.306***	**-0.312*****			-0.231*	**-0.295*****	-0.329***		-0.251***	-0.946*		-0.872	-0.208*		-0.182*
	(0.084)	**(0.080)**			(0.113)	**(0.095)**	(0.053)		(0.060)	(0.574)		(0.678)	(0.124)		(0.102)
Lad. Dep. Var.							0.330***	0.572***	0.311***	-0.199	0.677***	-0.302	0.564***	0.958***	0.647***
							(0.062)	(0.063)	(0.062)	(0.352)	(0.189)	(0.324)	(0.087)	(0.097)	(0.095)
Long run openness								**0.390*****	**-0.067****		**0.635***	**0.002**		**2.476****	**-0.017**
								(0.07)	**(0.032)**		**(0.341)**	**(0.141)**		**(0.976)**	**(0.082)**
Long run TFP							**-0.491*****		**-0.364*****	**-0.789***		**-0.670**	**-0.477***		**-0.516***
							(0.079)		**(0.087)**	**(0.479)**		**(0.521)**	**(0.284)**		**(0.289)**
Wage distortion	0.067	0.082***	-0.078	-0.077**	0.056	0.081***	0.020	-0.042***	0.022	0.156	0.000	0.227	0.113	-0.037	0.115**
	(0.043)	(0.026)	(0.049)	(0.036)	(0.042)	(0.027)	(0.022)	(0.013)	(0.022)	(0.304)	(0.034)	(0.258)	(0.069)	(0.028)	(0.056)
High corporatism	-2.311**	-1.779**	0.305	-0.123	-1.871	-1.643**	-2.008***	-0.377	-1.995***	-2.344	-0.606	-2.490	-2.513***	0.070	-3.658**
	(1.069)	(0.740)	(1.186)	(1.003)	(1.168)	(0.770)	(0.463)	(0.418)	(0.471)	(3.099)	(0.669)	(3.168)	(0.954)	(1.866)	(1.523)
EPL	-0.195	-1.189**	0.409	-0.263	-0.189	-1.167*	-0.585	0.587***	-0.612	-0.162	0.002	0.131	-1.344*	-0.767	-1.983***
	(1.302)	(0.601)	(0.994)	(0.786)	(1.360)	(0.615)	(0.425)	(0.214)	(0.448)	(1.920)	(0.681)	(1.899)	(0.765)	(0.574)	(0.697)
Union density	0.042	0.005	-0.078	-0.033	0.043	0.006	-0.030	0.020	-0.020	0.068	0.026	0.105	-0.033	0.035	-0.041
	(0.050)	(0.031)	(0.053)	(0.036)	(0.050)	(0.031)	(0.029)	(0.022)	(0.029)	(0.151)	(0.020)	(0.141)	(0.030)	(0.027)	(0.034)
PMR	0.971*	0.742*	-0.053	-0.381	1.046*	0.757*	0.709***	0.194	0.708***	0.888	0.036	0.950	0.689	0.074	0.731
	(0.551)	(0.447)	(0.642)	(0.532)	(0.560)	(0.459)	(0.247)	(0.182)	(0.247)	(0.690)	(0.449)	(0.760)	(0.461)	(0.475)	(0.627)
Population	-20.208**	0.940*	2.052	2.309*	-20.995**	0.807	-14.228***	0.176	-15.121***	-18.388	-3.712	-21.853	-0.050	1.062	0.088
	(7.189)	(0.543)	(11.306)	(1.218)	(7.296)	(0.659)	(3.834)	(2.990)	(3.882)	(16.813)	(8.336)	(16.312)	(0.880)	(1.031)	(0.883)
Output gap	-0.397***	-0.417***	0.591***	0.646***	-0.448***	-0.426***	-0.431***	0.671***	-0.472***	0.489	0.713***	0.475	-0.508**	0.742***	-0.590***
	(0.105)	(0.126)	(0.099)	(0.119)	(0.118)	(0.129)	(0.068)	(0.050)	(0.071)	(0.644)	(0.048)	(0.744)	(0.200)	(0.054)	(0.144)
Observations	95	95	95	95	95	95	95	95	95	76	76	76	95	95	95
R2 (within)	0.664	0.625	0.928	0.923	0.672	0.628									
R2 (between)	0.008	0.576	0.037	0.165	0.010	0.561									
R2 (overall)	0.002	0.571	0.414	0.540	0.003	0.558									
Hausman	0.633		0.002		0.539										
AR(1)										0.440	0.538	0.492	0.064	0.103	0.047
AR(2)										0.379	0.139	0.677	0.631	0.065	0.563
OID-test										0.342	0.2294	0.685	0.939	0.903	0.869

Table 4.18: Large cross section: TFP channel regressions (Table 3.6, lower panel)

	(1)	(2)	(3)	(4)	(5)	(6)
	OLS	OLS	OLS	IV	IV	IV
Dep. var.	u	TFP	u	u	TFP	u
Total trade openness		**0.008*****	**-0.027**		**0.008*****	**-0.042**
		(0.001)	**(0.034)**		**(0.002)**	**(0.067)**
TFP	**-4.231****		**-2.949**	**-4.231*****		**-2.244**
	(1.783)		**(2.376)**	**(1.471)**		**(3.599)**
Unemployment benefits	3.768*	0.492***	3.106	3.768**	0.491***	2.742
	(2.122)	(0.113)	(2.259)	(1.751)	(0.092)	(2.423)
EPL	2.821	-0.103	3.078	2.821	-0.101	3.219
	(3.346)	(0.194)	(3.454)	(2.761)	(0.161)	(2.881)
Minimum wage	1.166	-0.114*	0.968	1.166	-0.119**	0.860
	(1.453)	(0.063)	(1.464)	(1.199)	(0.053)	(1.142)
Population	-0.193	0.029	-0.244	-0.193	0.029	-0.271
	(0.720)	(0.037)	(0.696)	(0.594)	(0.030)	(0.565)
Latitude	0.195	0.083***	0.084	0.195	0.082***	0.022
	(0.537)	(0.027)	(0.556)	(0.443)	(0.022)	(0.568)
Land lockedness	-3.895***	-0.132	-3.668***	-3.895***	-0.132*	-3.543***
	(1.281)	(0.099)	(1.311)	(1.057)	(0.079)	(1.246)
Area	-0.294	0.055*	-0.507	-0.294	0.052*	-0.623
	(0.442)	(0.028)	(0.548)	(0.365)	(0.030)	(0.612)
Unofficial economy	0.003	-0.008**	0.003	0.003	-0.008***	0.003
	(0.050)	(0.003)	(0.049)	(0.041)	(0.002)	(0.039)
Output gap	-17.025	5.416	-26.537	-17.025	5.374*	-31.768
	(43.527)	(3.604)	(45.351)	(35.916)	(3.060)	(40.996)
Observations	47	47	47	47	47	47
R2 (adjusted)	0.503	0.812	0.495	0.503	0.812	0.492
1st stage F-stat.					16.496	10.871
Partial R-squared					0.381	0.279

4.2 Further robustness checks

Tables in this subchapter are neither included in the main chapter 3 of this thesis, nor in FPS (2011b). We show further robustness checks for the OECD panel, cross section, and large panel. For the OECD and the large panel we report diff-GMM and FGLS regression results. All regressions show the same pattern as our main regression results. For aggregate unemployment we always find negative and coefficients and most of them are significant. For the OECD we also show prime age and youth unemployment regression results for fixed effects and random effects regression models. For the large cross section we use different sources for total unemployment, not shown in the main chapter (ILO, ln CIA, ln ILO, ln IFS). More precisely, we use data on unemployment from the ILO LABORSTAT data base, CIA factbook and IFS data base and rerun our benchmark fixed effects / random effects regressions and diff/sys GMM regressions.

Table 4.19 - 4.20 So far, we neglected FGLS and diff-GMM regressions. We present FGLS and diff-GMM regression results in Table 4.19 - 4.20. However, the results are in line with other regressions in FPS (2011b) and thus confirm our finding.

Table 4.21 - 4.22 We use OECD prime age unemployment rates for Table 4.21 and OECD youth unemployment rates in Table 4.22 and compare fixed effects and random effects regressions. The Hausman test reported in the last line always prefers random effects. Excluding workers on both margins by constructing prime age unemployment rates does not change the overall picture. Almost all openness measures reveal a negative and highly significant coefficients for both, random effects and fixed effects.

In Table 4.22 we use youth unemployment rates and focus on workers between 15 and 24 years old. Random and fixed effects regressions have the same significant signs and therefore further reinforce our findings.

Table 4.23 - 4.26 We present some cross sectional regressions not discussed in the main paper, namely ILO unemployment regressions, ln CIA, ln ILO, and ln IFS unemployment regressions. For the large cross section, using ILO unemployment implies that the significant effect of openness gets lost once we run IV regressions. Nevertheless, OLS still confirms our results so far and at least we do not find any positive openness coefficient for IV. CIA and IFS unemployment data works good, so we find negative and highly significant results, also further validating our benchmark results. Using CIA data, we also find that the magnitude of the effect is much stronger. This is due to the fact that the dispersion of unemployment is much higher for CIA than for WDI, ILO or IFS data. Especially less developed countries exhibit higher rates of unemployment, which boosts the magnitude of the effect.

Table 4.19: OECD panel: FGLS/diff-GMM regressions

	(1) FGLS	(2) FGLS	(3) FGLS	(4) FGLS	(5) FGLS	(6) FGLS	(7) FGLS	(8) FGLS	(1) diff-GMM	(2) diff-GMM	(3) diff-GMM	(4) diff-GMM	(5) diff-GMM	(6) diff-GMM	(7) diff-GMM	(8) diff-GMM
Opennes measure	Total trade (real)	Import (real)	Export (real)	Total trade (cur. p.)	Import (cur. p.)	Export (cur. p.)	Total trade (con. p)	Total trade (merch.)	Total trade (real)	Import (real)	Export (real)	Total trade (cur. p.)	Import (cur. p.)	Export (cur. p.)	Total trade (con. p)	Total trade (merch.)
Openness	-0.112***	-0.145***	-0.060***	-0.118***	-0.141***	-0.072***	-0.108***	-0.085**	-0.230***	-0.320***	-0.134***	-0.258***	-0.358***	-0.153***	-0.196***	-0.128
	(0.021)	(0.0187)	(0.019)	(0.027)	(0.023)	(0.023)	(0.019)	(0.033)	(0.062)	(0.081)	(0.051)	(0.086)	(0.129)	(0.059)	(0.054)	(0.102)
Lag dep. Var	0.305***	0.272***	0.324***	0.358***	0.355***	0.356***	0.305***	0.346***	0.220	0.134	0.275	0.152	0.034	0.233	0.166	0.266
	(0.047)	(0.0442)	(0.047)	(0.046)	(0.044)	(0.046)	(0.046)	(0.046)	(0.174)	(0.161)	(0.184)	(0.165)	(0.170)	(0.163)	(0.151)	(0.192)
Openness (long run)	-0.161	-0.199	-0.089	-0.184	-0.219	-0.112	-0.155	-0.130	-0.295	-0.370	-0.185	-0.304	-0.371	-0.199	-0.235	-0.174
	(0.030)	(0.026)	(0.028)	(0.042)	(0.036)	(0.036)	(0.027)	(0.050)	(0.079)	(0.094)	(0.070)	(0.101)	(0.134)	(0.077)	(0.065)	(0.139)
Wage distortion	0.073***	0.0588***	0.086***	0.081***	0.069***	0.088***	0.083***	0.087***	0.016	0.005	0.097	0.148	0.219	0.152	0.099	0.199
	(0.018)	(0.0173)	(0.018)	(0.015)	(0.014)	(0.015)	(0.016)	(0.015)	(0.114)	(0.108)	(0.121)	(0.147)	(0.167)	(0.128)	(0.121)	(0.138)
EPL	-0.589	-0.646*	-0.524	-0.787**	-0.951***	-0.673*	-0.450	-0.683**	-0.112	-0.217	0.137	0.206	0.293	0.281	-0.026	0.281
	(0.377)	(0.348)	(0.381)	(0.377)	(0.346)	(0.365)	(0.367)	(0.337)	(1.161)	(1.140)	(1.235)	(1.453)	(1.567)	(1.400)	(1.285)	(1.413)
Union density	0.025*	0.00986	0.024*	0.031**	0.023**	0.026*	0.019	0.032**	-0.010	-0.017	0.003	0.018	0.038	0.010	-0.008	0.016
	(0.014)	(0.0134)	(0.014)	(0.013)	(0.012)	(0.014)	(0.013)	(0.014)	(0.039)	(0.038)	(0.037)	(0.048)	(0.064)	(0.041)	(0.035)	(0.037)
High corporatism	-2.574***	-2.177***	-2.777***	-2.460***	-2.239***	-2.536***	-2.569***	-2.636***	-1.181	-0.902	-2.144	-2.450	-2.866	-2.707	-2.105	-3.506**
	(0.467)	(0.475)	(0.436)	(0.375)	(0.357)	(0.370)	(0.386)	(0.355)	(1.399)	(1.219)	(1.633)	(1.849)	(1.994)	(1.690)	(1.733)	(1.704)
PMR	0.820***	0.893***	0.707***	0.436**	0.465**	0.456**	0.306	0.327	0.700	0.769	0.577	0.191	0.033	0.295	0.184	0.220
	(0.230)	(0.222)	(0.216)	(0.212)	(0.186)	(0.201)	(0.200)	(0.203)	(0.669)	(0.644)	(0.665)	(0.595)	(0.538)	(0.653)	(0.584)	(0.693)
Population	-13.402***	-13.61***	-12.960***	-6.988**	-5.803*	-8.055**	-10.673***	-8.029**	-20.200***	-20.217***	-19.890***	-14.821**	-11.856	-17.148**	-17.989***	-18.481**
	(3.391)	(3.498)	(3.361)	(3.331)	(3.417)	(3.137)	(3.281)	(3.214)	(6.832)	(6.779)	(6.463)	(7.243)	(8.065)	(7.084)	(6.560)	(7.250)
Output gap	-0.589***	-0.592***	-0.606***	-0.574***	-0.572***	-0.598***	-0.591***	-0.592***	-0.872***	-0.810***	-0.864***	-0.671***	-0.520**	-0.761***	-0.691***	-0.788***
	(0.047)	(0.0389)	(0.051)	(0.050)	(0.043)	(0.051)	(0.045)	(0.049)	(0.168)	(0.154)	(0.188)	(0.205)	(0.219)	(0.199)	(0.154)	(0.201)
Observations	100	100	100	100	100	100	100	100	80	80	80	80	80	80	80	80
AR(1)									0.025	0.043	0.014	0.047	0.174	0.028	0.032	0.045
AR(2)									0.314	0.178	0.159	0.615	0.342	0.455	0.280	0.084
OID-test									0.407	0.547	0.490	0.638	0.604	0.388	0.504	0.503

Table 4.20: Large panel: FGLS/diff-GMM regressions

	(1) FGLS	(2) FGLS	(3) FGLS	(4) FGLS	(5) FGLS	(6) FGLS	(7) FGLS	(8) FGLS	(1) diff-GMM	(2) diff-GMM	(3) diff-GMM	(4) diff-GMM	(5) diff-GMM	(6) diff-GMM	(7) diff-GMM	(8) diff-GMM
Opennes measure	Total trade (real)	Import (real)	Export (real)	Total trade (cur. p.)	Import (cur. p.)	Export (cur. p.)	Total trade (con. p)	Total trade (merch.)	Total trade (real)	Import (real)	Export (real)	Total trade (cur. p.)	Import (cur. p.)	Export (cur. p.)	Total trade (con. p)	Total trade (merch.)
Openness	-0.217***	-0.248***	-0.139***	-0.091***	-0.118***	-0.069***	-0.154***	-0.046***	-0.639**	-0.602***	-0.548**	-0.374**	-0.409***	-0.272	-0.481**	-0.300*
	(0.0232)	(0.0259)	(0.0195)	(0.0179)	(0.0221)	(0.0130)	(0.0169)	(0.0173)	(0.288)	(0.204)	(0.272)	(0.184)	(0.159)	(0.185)	(0.208)	(0.174)
Lag dep. Var.	0.106**	0.0641	0.172***	0.207***	0.156***	0.208***	0.103**	0.187***	-0.410	-0.221	-0.462	-0.521	-0.426	-0.458	-0.815	-0.235
	(0.0474)	(0.0449)	(0.0462)	(0.0484)	(0.0485)	(0.0481)	(0.0432)	(0.0508)	(0.367)	(0.320)	(0.444)	(0.449)	(0.331)	(0.498)	(0.533)	(0.360)
Population	5.202**	4.167*	7.981***	9.749***	8.264***	11.33***	4.074**	8.914***	-3.934	-6.119	-2.362	-17.099*	-19.604**	-12.555	-14.899*	-12.388
	(2.119)	(2.460)	(1.738)	(2.886)	(2.894)	(2.690)	(1.887)	(2.667)	(4.093)	(3.970)	(4.644)	(9.592)	(8.806)	(8.857)	(7.967)	(7.541)
LMR	0.546***	0.583***	0.426***	0.365***	0.425***	0.339***	0.384***	0.354***	-0.092	0.689	-0.606	0.767	1.318	0.266	-0.361	0.255
	(0.101)	(0.111)	(0.0861)	(0.122)	(0.125)	(0.114)	(0.0937)	(0.119)	(1.104)	(0.943)	(1.272)	(1.463)	(1.334)	(1.410)	(1.651)	(1.039)
Unemployment benefits	0.210***	0.220***	0.176***	0.160***	0.185***	0.186***	0.184***	0.164***	0.407	0.261	0.468	0.219	0.127	0.264	0.621	0.280
	(0.0438)	(0.0450)	(0.0373)	(0.0549)	(0.0568)	(0.0457)	(0.0393)	(0.0478)	(0.285)	(0.225)	(0.333)	(0.324)	(0.296)	(0.338)	(0.408)	(0.306)
PMR	-0.253***	-0.286***	-0.226***	-0.262***	-0.291***	-0.218***	-0.267***	-0.316***	-0.419**	-0.411*	-0.393*	-0.344	-0.389	-0.285	-0.518*	-0.363
	(0.0549)	(0.0590)	(0.0486)	(0.0646)	(0.0643)	(0.0601)	(0.0487)	(0.0603)	(0.213)	(0.222)	(0.214)	(0.240)	(0.253)	(0.205)	(0.305)	(0.237)
Output gap	-21.84***	-18.64***	-24.43***	-29.44***	-28.96***	-28.67***	-22.45***	-26.19***	-43.581*	-27.761	-57.925**	-62.160***	-48.437***	-67.043**	-55.597**	-57.921***
	(3.259)	(3.304)	(3.238)	(3.178)	(3.082)	(2.984)	(2.366)	(3.306)	(24.478)	(21.532)	(27.646)	(22.863)	(16.771)	(27.510)	(22.929)	(19.241)
Observations	164	164	164	164	164	164	164	164	93	93	93	93	93	93	93	93
AR(1)									0.599	0.698	0.464	0.706	0.977	0.533	0.574	0.614
AR(2)									0.295	0.231	0.360	0.170	0.161	0.217	0.138	0.277
Hansen									0.485	0.242	0.595	0.322	0.408	0.128	0.838	0.322

Table 4.21: OECD panel: FE / RE regressions, prime unemployment

	FE	RE	FE	RE	FE	RE	FE	RE	FE	RE	FE	RE	FE	RE	FE	RE
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)
Opennes measure	Total trade (real)		Import (real)		Export (real)		Total trade (cur. p.)		Import (cur. p.)		Export (cur. p.)		Total trade (con. p.)		Total trade (merch.)	
Opennes	-0.132***	-0.086***	-0.190***	-0.117***	-0.083**	-0.060***	-0.106**	-0.069***	-0.153**	-0.086***	-0.065	-0.050**	-0.117***	-0.081***	-0.095	-0.044
	(0.033)	(0.019)	(0.036)	(0.023)	(0.031)	(0.017)	(0.047)	(0.024)	(0.057)	(0.028)	(0.041)	(0.021)	(0.032)	(0.018)	(0.057)	(0.030)
Wage distortion	0.098**	0.125***	0.088**	0.125***	0.112***	0.125***	0.129***	0.134***	0.127***	0.136***	0.135***	0.133***	0.114***	0.128***	0.148***	0.139***
	(0.038)	(0.024)	(0.034)	(0.023)	(0.039)	(0.024)	(0.035)	(0.025)	(0.035)	(0.026)	(0.036)	(0.025)	(0.036)	(0.024)	(0.036)	(0.027)
High Corporatism	-1.862*	-1.310*	-1.695*	-1.282*	-2.198*	-1.428**	-2.585**	-1.891***	-2.610***	-2.003***	-2.715**	-1.863***	-2.191**	-1.581**	-3.030***	-2.096***
	(1.021)	(0.672)	(0.904)	(0.662)	(1.062)	(0.684)	(0.924)	(0.640)	(0.833)	(0.646)	(0.960)	(0.651)	(0.952)	(0.653)	(0.764)	(0.677)
Union density	0.037	0.013	0.029	0.013	0.043	0.013	0.047	0.012	0.047	0.013	0.047	0.011	0.036	0.008	0.058	0.014
	(0.042)	(0.026)	(0.038)	(0.026)	(0.042)	(0.027)	(0.040)	(0.027)	(0.039)	(0.028)	(0.041)	(0.027)	(0.041)	(0.027)	(0.037)	(0.028)
EPL	-0.683	-1.372**	-0.788	-1.379**	-0.646	-1.379**	-0.851	-1.413**	-0.985	-1.416**	-0.771	-1.418**	-0.761	-1.349**	-0.818	-1.442**
	(1.267)	(0.571)	(1.156)	(0.568)	(1.309)	(0.575)	(1.285)	(0.586)	(1.240)	(0.592)	(1.296)	(0.583)	(1.304)	(0.578)	(1.269)	(0.595)
PMR	1.012*	0.911**	1.026*	0.910**	0.991*	0.906**	0.928	0.929**	0.889	0.927**	0.945	0.922**	0.802	0.799*	0.803	0.858*
	(0.556)	(0.440)	(0.538)	(0.424)	(0.552)	(0.449)	(0.561)	(0.445)	(0.566)	(0.436)	(0.550)	(0.452)	(0.564)	(0.434)	(0.552)	(0.446)
Population	-18.853***	0.134	-18.710***	-0.051	-18.609***	0.311	-13.776*	0.359	-11.518	0.284	-15.430**	0.463	-16.552**	0.240	-14.690**	0.626
	(6.294)	(0.570)	(5.858)	(0.589)	(6.243)	(0.558)	(6.955)	(0.560)	(7.060)	(0.568)	(6.631)	(0.551)	(6.429)	(0.568)	(6.118)	(0.519)
Output gap	-0.467***	-0.491***	-0.436***	-0.465***	-0.478***	-0.506***	-0.451***	-0.494***	-0.424***	-0.477***	-0.463***	-0.505***	-0.438***	-0.477***	-0.442***	-0.498***
	(0.079)	(0.104)	(0.078)	(0.102)	(0.082)	(0.106)	(0.080)	(0.108)	(0.079)	(0.108)	(0.082)	(0.107)	(0.080)	(0.106)	(0.076)	(0.108)
Observations	95	95	95	95	95	95	95	95	95	95	95	95	95	95	95	95
R2 (within)	0.686	0.643	0.715	0.669	0.662	0.622	0.655	0.622	0.668	0.635	0.643	0.610	0.679	0.641	0.641	0.602
R2 (between)	0.00976	0.156	0.0117	0.103	0.00793	0.207	0.00742	0.166	0.00877	0.134	0.00628	0.202	0.00961	0.131	0.00637	0.210
R2 (overall)	0	0.275	0.	0.230	0	0.310	4	0.273	2	0.246	3	0.299	0	0.253	3	0.298
Hausman	0.011		0.596		0.297		0.283		0.141		0.402		0.034		0.331	

Table 4.22: OECD panel: FE / RE regressions, youth unemployment

	(1) FE	(2) RE	(3) FE	(4) RE	(5) FE	(6) RE	(7) FE	(8) RE	(9) FE	(10) RE	(11) FE	(12) RE	(13) FE	(14) RE	(15) FE	(16) RE
Opennes measure	Total trade (real)		Import (real)		Export (real)		Total trade (cur. p.)		Import (cur. p.)		Export (cur. p.)		Total trade (con. p.)		Total trade (merch.)	
Openness	-0.187***	-0.124***	-0.323***	-0.206***	-0.090	-0.065*	-0.171**	-0.112**	-0.317***	-0.189***	-0.072	-0.054	-0.178***	-0.118***	-0.176**	-0.089
	(0.062)	(0.042)	(0.077)	(0.056)	(0.053)	(0.035)	(0.081)	(0.048)	(0.101)	(0.063)	(0.069)	(0.040)	(0.057)	(0.041)	(0.074)	(0.062)
Wage distortion	0.059	0.126**	0.026	0.118**	0.092	0.135***	0.098	0.142***	0.083	0.140***	0.116	0.146***	0.077	0.133***	0.127*	0.155***
	(0.085)	(0.050)	(0.082)	(0.050)	(0.083)	(0.050)	(0.078)	(0.050)	(0.077)	(0.052)	(0.077)	(0.050)	(0.079)	(0.049)	(0.070)	(0.050)
High corporatism	-3.371	-3.196**	-2.679	-2.816*	-4.189*	-3.656**	-4.252*	-3.998***	-3.981*	-4.063***	-4.749**	-4.139***	-3.717	-3.557**	-4.911***	-4.342***
	(2.344)	(1.614)	(2.224)	(1.546)	(2.313)	(1.648)	(2.200)	(1.452)	(2.024)	(1.363)	(2.172)	(1.512)	(2.186)	(1.550)	(1.658)	(1.417)
Unin density	0.054	0.039	0.037	0.036	0.064	0.040	0.067	0.041	0.066	0.043	0.069	0.040	0.051	0.034	0.087	0.046
	(0.111)	(0.066)	(0.104)	(0.064)	(0.110)	(0.067)	(0.104)	(0.067)	(0.094)	(0.065)	(0.106)	(0.068)	(0.110)	(0.067)	(0.097)	(0.067)
EPL	0.072	-0.181	-0.093	-0.180	0.096	-0.219	-0.190	-0.235	-0.522	-0.227	-0.041	-0.266	-0.041	-0.161	-0.156	-0.281
	(2.851)	(1.314)	(2.677)	(1.290)	(2.875)	(1.325)	(2.876)	(1.334)	(2.754)	(1.330)	(2.872)	(1.336)	(2.896)	(1.330)	(2.817)	(1.345)
PMR	0.684	0.713	0.730	0.713	0.635	0.699	0.565	0.738	0.483	0.743	0.585	0.711	0.373	0.540	0.332	0.617
	(1.176)	(0.904)	(1.126)	(0.861)	(1.167)	(0.924)	(1.184)	(0.916)	(1.188)	(0.889)	(1.157)	(0.930)	(1.123)	(0.895)	(1.077)	(0.910)
Population	-21.831*	0.515	-22.060*	-0.093	-21.041*	0.983	-13.973	0.788	-7.702	0.346	-17.533	1.170	-18.508	0.671	-14.856	1.169
	(10.991)	(1.196)	(11.462)	(1.233)	(10.479)	(1.174)	(13.392)	(1.203)	(14.311)	(1.231)	(12.316)	(1.181)	(11.765)	(1.214)	(10.676)	(1.140)
Output gap	-1.316***	-1.321***	-1.268***	-1.277***	-1.322***	-1.338***	-1.294***	-1.318***	-1.237***	-1.278***	-1.306***	-1.333***	-1.273***	-1.298***	-1.276***	-1.319***
	(0.151)	(0.198)	(0.149)	(0.192)	(0.151)	(0.200)	(0.160)	(0.201)	(0.160)	(0.199)	(0.155)	(0.201)	(0.164)	(0.201)	(0.159)	(0.202)
Observations	95	95	95	95	95	95	95	95	95	95	95	95	95	95	95	95
R-squared (within)	0.632	0.612	0.668	0.643	0.612	0.595	0.620	0.605	0.648	0.630	0.606	0.592	0.632	0.614	0.613	0.597
R-squared (overall)	0.0183	0.316	0.0207	0.229	0.0159	0.358	0.0126	0.298	0.00618	0.221	0.0131	0.342	0.0198	0.274	0.0124	0.304
R-squared (between)	0.	0.335	0.	0.279	0.	0.360	0.	0.322	0	0.269	0.	0.350	0.	0.304	0.	0.325
Hausman	0.713		0.355		0.909		0.872		0.637		0.932		0.790		0.853	

Table 4.23: Large cross section: OLS/IV regressions, ILO unemployment

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)
	OLS	IV	OLS	IV	OLS	IV	OLS	IV	OLS	IV	OLS	IV	OLS	IV	OLS	IV
	Total trade (real)		Import (real)		Export (real)		Total trade (cur. p.)		Import (cur. p.)		Export (cur. p.)		Total trade (con. p.)		Total trade (merch.)	
Openness	-0.063***	-0.060	-0.066***	-0.065	-0.060***	-0.056	-0.025*	-0.072	-0.022	-0.083	-0.027**	-0.064	-0.028*	-0.076	-0.016*	-0.041
	(0.021)	(0.037)	(0.023)	(0.040)	(0.020)	(0.035)	(0.015)	(0.048)	(0.016)	(0.057)	(0.013)	(0.041)	(0.015)	(0.051)	(0.009)	(0.027)
Unemployment benefits	1.476	1.473	1.482	1.481	1.470	1.467	1.249	0.913	1.257	0.773	1.257	1.020	1.295	1.070	1.117	0.606
	(1.614)	(1.395)	(1.622)	(1.396)	(1.610)	(1.395)	(1.749)	(1.505)	(1.772)	(1.552)	(1.733)	(1.477)	(1.731)	(1.490)	(1.737)	(1.565)
EPL	4.466	4.459*	4.369	4.368*	4.553	4.537*	4.398	4.532*	4.354	4.433*	4.444	4.607*	4.162	3.887	4.233	4.079
	(2.768)	(2.399)	(2.770)	(2.390)	(2.774)	(2.411)	(2.994)	(2.567)	(3.019)	(2.596)	(2.975)	(2.555)	(2.982)	(2.588)	(3.020)	(2.619)
Minimum Wage	1.067	1.132	1.179	1.198	0.983	1.075	1.999*	1.511	2.083*	1.581	1.924*	1.458	2.052*	1.703*	2.069**	1.755*
	(0.956)	(0.919)	(0.975)	(0.910)	(0.939)	(0.929)	(1.031)	(0.934)	(1.043)	(0.962)	(1.016)	(0.916)	(1.023)	(0.900)	(1.021)	(0.902)
Population	-0.101	-0.098	-0.069	-0.069	-0.129	-0.123	-0.079	-0.153	-0.061	-0.125	-0.096	-0.175	-0.120	-0.257	-0.039	-0.040
	(0.578)	(0.498)	(0.586)	(0.504)	(0.572)	(0.494)	(0.611)	(0.538)	(0.618)	(0.556)	(0.606)	(0.526)	(0.610)	(0.549)	(0.606)	(0.536)
Land lockedness	-1.892	-1.874*	-1.888	-1.882*	-1.890	-1.866*	-1.545	-1.519	-1.542	-1.496	-1.549	-1.536	-1.635	-1.764	-1.294	-0.857
	(1.299)	(1.121)	(1.311)	(1.130)	(1.290)	(1.113)	(1.326)	(1.252)	(1.331)	(1.302)	(1.319)	(1.216)	(1.350)	(1.270)	(1.299)	(1.352)
Latitude	-0.026	-0.022	-0.003	-0.002	-0.046	-0.039	-0.123	-0.447	-0.076	-0.433	-0.163	-0.458	-0.178	-0.561	-0.102	-0.353
	(0.439)	(0.382)	(0.434)	(0.378)	(0.443)	(0.386)	(0.453)	(0.675)	(0.435)	(0.687)	(0.470)	(0.665)	(0.465)	(0.706)	(0.438)	(0.574)
Area	-0.864**	-0.839**	-0.897**	-0.888**	-0.827**	-0.797**	-0.645	-1.095*	-0.623	-1.241*	-0.647	-0.983*	-0.597	-0.922*	-0.626	-0.991*
	(0.402)	(0.402)	(0.415)	(0.427)	(0.390)	(0.382)	(0.437)	(0.590)	(0.452)	(0.695)	(0.423)	(0.518)	(0.413)	(0.515)	(0.434)	(0.536)
Unofficial economy	0.030	0.032	0.033	0.033	0.029	0.031	0.064*	0.053*	0.067*	0.060*	0.060	0.048	0.066*	0.060*	0.057	0.037
	(0.036)	(0.038)	(0.036)	(0.038)	(0.036)	(0.039)	(0.037)	(0.032)	(0.038)	(0.031)	(0.036)	(0.033)	(0.036)	(0.031)	(0.038)	(0.038)
Output gap	-73.911	-73.673*	-73.344	-73.277	-74.364	-74.016*	-78.075	-94.076*	-77.382	-99.613*	-78.045	-89.831*	-74.891	-83.914*	-78.006	-91.965*
	(51.488)	(44.690)	(51.699)	(44.788)	(51.331)	(44.611)	(55.125)	(52.124)	(55.718)	(54.971)	(54.608)	(50.246)	(54.847)	(50.147)	(55.703)	(52.415)
Observations	58	58	58	58	58	58	58	58	58	58	58	58	58	58	58	58
R-squared	0.462	0.462	0.456	0.456	0.465	0.465	0.410	0.348	0.404	0.315	0.417	0.371	0.413	0.356	0.393	0.233
R2 (adjusted)	0.286	0.286	0.280	0.279	0.291	0.291	0.218	0.136	0.210	0.0914	0.227	0.166	0.222	0.146	0.196	-0.0167
F-stat (1st stage)		20.335		19.624		20.544		10.340		8.330		12.095		9.719		9.622
Partial R-squared		0.374		0.375		0.369		0.158		0.142		0.170		0.160		0.182

Table 4.24: Large cross section: OLS/IV regressions, ln ILO unemployment

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)
	OLS	IV	OLS	IV	OLS	IV	OLS	IV	OLS	IV	OLS	IV	OLS	IV	OLS	IV
	Total trade (real)		Import (real)		Export (real)		Total trade (cur. p.)		Import (cur. p.)		Export (cur. p.)		Total trade (con. p.)		Total trade (merch.)	
Openness	-0.008**	-0.007	-0.008**	-0.007	-0.007**	-0.006	-0.004*	-0.008	-0.003	-0.010	-0.004**	-0.007	-0.004*	-0.009	-0.002	-0.005
	(0.003)	(0.005)	(0.003)	(0.005)	(0.003)	(0.005)	(0.002)	(0.006)	(0.002)	(0.007)	(0.002)	(0.005)	(0.002)	(0.007)	(0.001)	(0.004)
Unemployment benefits	0.276	0.275	0.276	0.276	0.275	0.274	0.243	0.211	0.243	0.195	0.245	0.223	0.251	0.229	0.224	0.175
	(0.231)	(0.200)	(0.232)	(0.200)	(0.230)	(0.200)	(0.237)	(0.210)	(0.238)	(0.216)	(0.235)	(0.206)	(0.236)	(0.208)	(0.233)	(0.217)
EPL	0.544	0.542*	0.532	0.532*	0.555	0.551*	0.538	0.551*	0.531	0.539	0.544	0.559*	0.504	0.477	0.513	0.499
	(0.368)	(0.318)	(0.368)	(0.318)	(0.369)	(0.319)	(0.386)	(0.332)	(0.389)	(0.335)	(0.385)	(0.330)	(0.388)	(0.340)	(0.388)	(0.336)
Minimum Wage	0.156	0.173	0.171	0.180	0.144	0.166	0.263*	0.216*	0.275*	0.224*	0.253*	0.210*	0.273**	0.238**	0.274**	0.244**
	(0.134)	(0.132)	(0.135)	(0.131)	(0.132)	(0.134)	(0.136)	(0.127)	(0.138)	(0.129)	(0.134)	(0.126)	(0.135)	(0.121)	(0.135)	(0.121)
Population	-0.017	-0.016	-0.013	-0.013	-0.021	-0.019	-0.015	-0.023	-0.013	-0.019	-0.018	-0.025	-0.021	-0.034	-0.009	-0.010
	(0.079)	(0.068)	(0.080)	(0.069)	(0.078)	(0.068)	(0.082)	(0.072)	(0.083)	(0.073)	(0.081)	(0.071)	(0.082)	(0.074)	(0.081)	(0.071)
Land lockedness	-0.281	-0.277*	-0.281	-0.278*	-0.282	-0.276*	-0.238	-0.236	-0.238	-0.233	-0.239	-0.238	-0.251	-0.264	-0.201	-0.160
	(0.178)	(0.152)	(0.180)	(0.153)	(0.177)	(0.151)	(0.177)	(0.162)	(0.178)	(0.167)	(0.176)	(0.158)	(0.180)	(0.163)	(0.176)	(0.176)
Latitude	-0.015	-0.014	-0.012	-0.011	-0.017	-0.016	-0.031	-0.062	-0.025	-0.061	-0.036	-0.064	-0.037	-0.076	-0.028	-0.052
	(0.053)	(0.046)	(0.052)	(0.046)	(0.053)	(0.047)	(0.056)	(0.081)	(0.054)	(0.082)	(0.058)	(0.080)	(0.057)	(0.087)	(0.053)	(0.068)
Area	-0.093	-0.086	-0.096	-0.092	-0.088	-0.081	-0.072	-0.116	-0.070	-0.132	-0.072	-0.103	-0.063	-0.096	-0.069	-0.104
	(0.057)	(0.054)	(0.058)	(0.057)	(0.055)	(0.051)	(0.059)	(0.075)	(0.061)	(0.088)	(0.057)	(0.066)	(0.056)	(0.066)	(0.059)	(0.068)
Unofficial economy	0.004	0.004	0.004	0.004	0.003	0.004	0.008	0.007	0.008	0.007*	0.007	0.006	0.008	0.007*	0.007	0.005
	(0.005)	(0.005)	(0.005)	(0.005)	(0.005)	(0.005)	(0.005)	(0.004)	(0.005)	(0.004)	(0.005)	(0.004)	(0.005)	(0.004)	(0.005)	(0.005)
Output gap	-11.270	-11.209*	-11.196	-11.163*	-11.330	-11.248*	-12.008	-13.554*	-11.953	-14.191*	-11.974	-13.066*	-11.483	-12.386*	-11.986	-13.312*
	(7.159)	(6.211)	(7.184)	(6.224)	(7.140)	(6.201)	(7.572)	(7.045)	(7.648)	(7.393)	(7.501)	(6.813)	(7.541)	(6.835)	(7.628)	(7.021)
Observations	58	58	58	58	58	58	58	58	58	58	58	58	58	58	58	58
R-squared	0.302	0.301	0.295	0.294	0.308	0.306	0.254	0.210	0.244	0.176	0.262	0.233	0.253	0.211	0.254	0.220
R2 (adjusted)	0.474	0.473	0.468	0.468	0.478	0.476	0.437	0.404	0.430	0.379	0.443	0.421	0.437	0.405	0.437	0.412
F-stat (1st stage)		20.335		19.624		20.544		10.340		8.330		12.095		9.719		9.622
Partial R-squared		0.374		0.375		0.369		0.158		0.142		0.170		0.160		0.182

Table 4.25: Large cross section: OLS/IV regressions, ln CIA unemployment

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)
	OLS	IV	OLS	IV	OLS	IV	OLS	IV	OLS	IV	OLS	IV	OLS	IV	OLS	IV
	Total trade (real)		Import (real)		Export (real)		Total trade (cur. p.)		Import (cur. p.)		Export (cur. p.)		Total trade (con. p.)		Total trade (merch.)	
Openness	-0.012***	-0.013**	-0.013***	-0.014**	-0.012***	-0.012**	-0.008***	-0.014**	-0.008**	-0.017**	-0.008***	-0.012**	-0.004	-0.018*	-0.005***	-0.008**
	(0.004)	(0.006)	(0.004)	(0.007)	(0.003)	(0.005)	(0.003)	(0.006)	(0.003)	(0.008)	(0.002)	(0.005)	(0.004)	(0.010)	(0.002)	(0.004)
Unemployment benefits	-0.264	-0.259*	-0.282	-0.272*	-0.250	-0.248	-0.350*	-0.339**	-0.389*	-0.413**	-0.312	-0.284*	-0.377*	-0.410**	-0.390**	-0.404**
	(0.177)	(0.154)	(0.180)	(0.155)	(0.176)	(0.155)	(0.193)	(0.166)	(0.196)	(0.177)	(0.191)	(0.164)	(0.204)	(0.200)	(0.188)	(0.162)
EPL	0.442	0.441	0.445	0.443	0.440	0.439	0.481	0.490*	0.492	0.519*	0.468	0.468*	0.471	0.482	0.431	0.406
	(0.327)	(0.285)	(0.326)	(0.286)	(0.328)	(0.285)	(0.300)	(0.268)	(0.305)	(0.277)	(0.298)	(0.264)	(0.314)	(0.305)	(0.293)	(0.259)
Minimum Wage	-0.063	-0.074	-0.041	-0.065	-0.078	-0.082	0.024	-0.072	0.058	-0.054	-0.001	-0.085	0.123	-0.002	0.045	-0.030
	(0.186)	(0.186)	(0.187)	(0.185)	(0.183)	(0.186)	(0.179)	(0.190)	(0.181)	(0.190)	(0.177)	(0.190)	(0.187)	(0.190)	(0.181)	(0.185)
Population	-0.022	-0.022	-0.021	-0.020	-0.023	-0.023	-0.017	-0.009	-0.021	-0.014	-0.013	-0.005	-0.041	-0.084	-0.007	0.006
	(0.067)	(0.059)	(0.070)	(0.061)	(0.066)	(0.057)	(0.071)	(0.067)	(0.074)	(0.073)	(0.069)	(0.063)	(0.076)	(0.092)	(0.071)	(0.067)
Land lockedness	0.021	0.016	0.036	0.026	0.010	0.008	0.065	0.030	0.085	0.053	0.049	0.014	0.102	0.063	0.132	0.143
	(0.214)	(0.188)	(0.216)	(0.191)	(0.212)	(0.185)	(0.213)	(0.208)	(0.215)	(0.219)	(0.210)	(0.201)	(0.208)	(0.232)	(0.219)	(0.209)
Latitude	0.060	0.059	0.068	0.066	0.053	0.053	0.020	-0.022	0.033	-0.019	0.012	-0.024	0.057	-0.021	0.030	-0.002
	(0.049)	(0.044)	(0.050)	(0.044)	(0.048)	(0.045)	(0.048)	(0.075)	(0.049)	(0.078)	(0.049)	(0.074)	(0.073)	(0.085)	(0.050)	(0.063)
Area	-0.127**	-0.132**	-0.133**	-0.145**	-0.120**	-0.121**	-0.113*	-0.173**	-0.112*	-0.202**	-0.109**	-0.152**	-0.062	-0.172*	-0.105*	-0.154**
	(0.057)	(0.060)	(0.060)	(0.066)	(0.054)	(0.055)	(0.058)	(0.077)	(0.063)	(0.095)	(0.054)	(0.066)	(0.058)	(0.100)	(0.057)	(0.070)
Unofficial economy	0.002	0.002	0.003	0.002	0.002	0.002	0.006	0.005	0.006	0.005	0.006	0.006	0.006	0.005	0.004	0.003
	(0.006)	(0.005)	(0.006)	(0.005)	(0.006)	(0.005)	(0.006)	(0.006)	(0.006)	(0.006)	(0.006)	(0.006)	(0.006)	(0.006)	(0.006)	(0.006)
Output gap	-14.048**	-14.109***	-14.263**	-14.438***	-13.817**	-13.834***	-15.359**	-17.182***	-15.721**	-18.929***	-14.824**	-15.897***	-13.962**	-17.883***	-14.621**	-15.806***
	(6.085)	(5.308)	(6.124)	(5.371)	(6.065)	(5.274)	(6.206)	(5.677)	(6.418)	(6.341)	(6.060)	(5.336)	(6.387)	(6.847)	(6.062)	(5.349)
Observations	60	60	60	60	60	60	60	60	60	60	60	60	60	60	60	60
R-squared	0.508	0.508	0.495	0.493	0.518	0.518	0.475	0.431	0.453	0.375	0.491	0.462	0.408	0.182	0.467	0.434
R-squared (adjusted)	0.625	0.625	0.614	0.613	0.632	0.632	0.599	0.566	0.583	0.524	0.612	0.590	0.549	0.376	0.593	0.568
F-stat (1st stage)		21.955		20.742		22.431		11.305		9.122		12.976		6.761		11.318
Partial R-squared		0.381		0.378		0.375		0.200		0.178		0.210		0.132		0.237

Table 4.26: Large cross section: OLS/IV regressions, ln IFS unemployment

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)
	OLS	IV	OLS	IV	OLS	IV	OLS	IV	OLS	IV	OLS	IV	OLS	IV	OLS	IV
	Total trade (real)		Import (real)		Export (real)		Total trade (cur. p.)		Import (cur. p.)		Export (cur. p.)		Total trade (con. p.)		Total trade (merch.)	
Openness	-0.007*	-0.008	-0.007*	-0.008	-0.006*	-0.007	-0.004	-0.010	-0.004	-0.011	-0.004*	-0.008	-0.004*	-0.010	-0.002	-0.005
	(0.003)	(0.005)	(0.004)	(0.006)	(0.003)	(0.005)	(0.002)	(0.007)	(0.002)	(0.008)	(0.002)	(0.006)	(0.002)	(0.007)	(0.001)	(0.004)
Unemployment benefits	0.314	0.306	0.315	0.304	0.313	0.307	0.316	0.245	0.317	0.225	0.316	0.259	0.319	0.258	0.305	0.227
	(0.249)	(0.222)	(0.248)	(0.222)	(0.249)	(0.222)	(0.250)	(0.248)	(0.249)	(0.257)	(0.250)	(0.242)	(0.249)	(0.246)	(0.244)	(0.245)
EPL	0.231	0.252	0.218	0.243	0.241	0.259	0.191	0.321	0.176	0.317	0.203	0.325	0.179	0.281	0.159	0.229
	(0.425)	(0.380)	(0.421)	(0.376)	(0.428)	(0.383)	(0.418)	(0.404)	(0.415)	(0.402)	(0.420)	(0.405)	(0.414)	(0.392)	(0.403)	(0.366)
Minimum Wage	0.072	0.049	0.087	0.058	0.061	0.041	0.164	0.087	0.178	0.107	0.151	0.073	0.169	0.105	0.170	0.111
	(0.158)	(0.160)	(0.158)	(0.157)	(0.158)	(0.163)	(0.150)	(0.155)	(0.149)	(0.153)	(0.150)	(0.158)	(0.148)	(0.148)	(0.150)	(0.151)
Population	-0.079	-0.079	-0.077	-0.076	-0.082	-0.082	-0.084	-0.087	-0.084	-0.086	-0.085	-0.087	-0.088	-0.096	-0.079	-0.074
	(0.079)	(0.069)	(0.080)	(0.070)	(0.079)	(0.069)	(0.079)	(0.073)	(0.079)	(0.075)	(0.079)	(0.071)	(0.079)	(0.073)	(0.078)	(0.072)
Land lockedness	-0.194	-0.201	-0.191	-0.201	-0.195	-0.201	-0.151	-0.152	-0.149	-0.146	-0.153	-0.156	-0.162	-0.178	-0.117	-0.070
	(0.184)	(0.161)	(0.186)	(0.162)	(0.183)	(0.160)	(0.183)	(0.173)	(0.184)	(0.179)	(0.182)	(0.168)	(0.185)	(0.174)	(0.183)	(0.184)
Latitude	-0.019	-0.019	-0.018	-0.016	-0.021	-0.021	-0.042	-0.073	-0.038	-0.072	-0.045	-0.073	-0.045	-0.078	-0.041	-0.066
	(0.055)	(0.048)	(0.055)	(0.048)	(0.055)	(0.048)	(0.055)	(0.076)	(0.054)	(0.078)	(0.055)	(0.074)	(0.055)	(0.074)	(0.053)	(0.066)
Area	-0.046	-0.055	-0.047	-0.061	-0.043	-0.050	-0.027	-0.091	-0.027	-0.111	-0.026	-0.077	-0.023	-0.076	-0.024	-0.077
	(0.070)	(0.069)	(0.072)	(0.072)	(0.069)	(0.066)	(0.069)	(0.094)	(0.070)	(0.108)	(0.067)	(0.084)	(0.066)	(0.087)	(0.064)	(0.084)
Unofficial economy	0.005	0.004	0.005	0.004	0.005	0.004	0.008	0.006	0.008	0.007	0.008	0.006	0.008	0.007	0.007	0.005
	(0.005)	(0.005)	(0.005)	(0.005)	(0.005)	(0.005)	(0.005)	(0.005)	(0.005)	(0.005)	(0.005)	(0.005)	(0.005)	(0.005)	(0.005)	(0.005)
Output gap	-9.604	-9.944	-9.457	-9.891	-9.705	-9.989*	-9.535	-12.629*	-9.388	-13.192*	-9.602	-12.205*	-9.445	-12.150*	-9.230	-11.542*
	(6.888)	(6.056)	(6.886)	(6.058)	(6.885)	(6.054)	(7.069)	(7.238)	(7.082)	(7.599)	(7.044)	(6.991)	(7.097)	(7.199)	(6.920)	(6.792)
Observations	61	61	61	61	61	61	61	61	61	61	61	61	61	61	61	61
R-squared	0.328	0.327	0.324	0.322	0.331	0.330	0.308	0.246	0.303	0.215	0.312	0.264	0.308	0.255	0.308	0.259
R2 (adjusted)	0.485	0.484	0.482	0.480	0.487	0.487	0.469	0.422	0.466	0.398	0.473	0.436	0.470	0.429	0.469	0.432
F-stat (1st stage)		18.690		17.839		19.106		9.473		7.426		11.296		9.194		8.949
Partial R-squared		0.395		0.392		0.392		0.146		0.126		0.160		0.159		0.168

Chapter 5

FDI and Skill-Specific Unemployment

5.1 Introduction

In this chapter we turn the focus to the interaction between labor market institutions, global sourcing, and skill-specific search unemployment. More precisely, instead of trade liberalization we focus on the effects of FDI on skill specific unemployment in a general equilibrium framework with low and high skill labor. An enormous reduction in transportation costs and barriers to trade and capital have fueled a debate about potential risks of job losses triggered by a reallocation of home production to low cost countries. The widespread belief that globalization is responsible for massive job destruction also rationalizes the recent surge in protectionism described by Scheve and Slaughter (2001) amongst others and therefore motivated a large and emerging literature on trade and unemployment. Our contribution to this debate is to shed light on the interaction between product and labor markets by studying how footloose capital flows between two countries affect equilibrium unemployment. Moreover, the second major contribution is to analyze institutional spillover effects that stem from labor market institutional changes in favor of the workers. Institutional changes that benefit the workers lead to massive capital outflows and open a channel through which changes in one economy's labor market affect labor markets in the rest of the world. Such a change in institutions is also a potential explanation for the recently observed reversing trend in FDI to China. After two decades of attracting an astonishing amount of capital inflows and strengthening of Chinese firms in the 80s and 90s, China more recently started to transform into an FDI sending country.[1] The comparative static implications drawn from the model presented in this paper imply a two-way relationship with wages being jointly determined by labor market institutions and international trade. Based on this outcome of the model, recent improvements in the Chinese security system and workers' labor rights can serve as a potential explanation for such a reversing trend.

Secondly, it will be shown that *FDI* affects labor demand on the extensive margin. At the extensive industry margin the widening of the *FDI* receiving country's range of active industries is due to increased competitiveness in industries located close to the former cutoff, which boosts labor demand and thus decreases equilibrium unemployment. The impact of such an industry-reallocation from one to the other country is expected to be much stronger in magnitude than the effects caused by a pure substitution between labor and capital. Conversely, adjustments in the standard Pissarides (2000) framework with capital but without a continuum of industries occur at the intensive margin only. *FDI-inflows* in such a simple model reduce capital costs and thus lead to a substitution of labor by capital.

To the best of my knowledge, the model presented in this chapter is the first focusing on the unemployment effects of global sourcing in a model with a continuum of industries. The model closest to mine is Beissinger (2001), who studies spillover effects of unilateral labor market reforms on capital flows between two countries. Conversely, Boulhol (2009) focuses on the pressure of trade liberalization on labor market deregulations. Lin and Wang (2008) empirically investigate this relationship by studying how capital-outflows affect unemployment using panel data.

5.2 The benchmark model

Product market equilibrium is determined in a a two-stage production process: In stage 1, final goods are assembled using intermediate goods produced by two different types of firms in stage 2, and capital. Firms producing high skill intermediates do this by solely using high skill labor, whereas low skill intermediate good producers employ low skill labor only. Stage 2 firms and workers take expected prices charged by stage 1 firms into consideration and bargain about wages. Search frictions drive a wedge between labor costs and prices charged for intermediate goods. The production and consumption side is interacted over all

[1] See Braunstein and Epstein (2002) for instance.

stages since labor and capital costs together pin down national income, world income, and (international) goods' prices.

Consumer demand. Aggregate demand for intermediate goods Y over all industries reads as

$$ln\ Y = \int_0^1 \varphi(z)\ ln\ x(z) dz \quad , \tag{5.1}$$

where $x(z)$ denotes the amount of intermediate goods demanded from industry z and $\varphi(z)$ is industry z's Cobb Douglas consumption share.[2] The aggregate consumption good is produced without costs and sold for an aggregate price level P. Since prices and wages are jointly determined at stage 1 and 2, aggregate demand for the final output good equals total expenditure $YP = E$. The aggregate demand function (5.1) implies that a constant fraction $\varphi(z)$ of world expenditure is spent on the consumption of good z. Thus, consumer demand for output generated in industry z reads as

$$x(z) = \frac{\varphi(z)E}{c(z)} \quad , \tag{5.2}$$

so that the share of expenditure spent for that particular industry z is equal to the revenue generated in the respective industry. Perfect competition implies that total revenue in industry z is equal to the quantity produced, $x(z)$, times unit costs, $c(z)$. One can solve the standard utility maximization problem of the representative consumer who maximizes utility (5.1) subject to the budget constraint, which depends upon prices, consumption, and income available for consumption. The first order conditions of the utility maximization problem yields equation (5.2).

Stage 1: Final consumption goods. Following Feenstra and Hanson (1996, 1997) goods are produced using the input factors capital, high-, and low-skill intermediates. The input coefficients that determine labor requirements for the production in z are given exogenously.[3] Goods in the continuum are ranked according to their skill intensities $a_h(z)$ and $a_l(z)$, both described by linear functions increasing in z. The assumption that the input coefficient curves that pin down low- and high-skill labor requirement are both steeper in

[2] Summing up the shares over the whole continuum of industries must equal unity.

[3] Demand for intermediate goods produced on stage 2 maps into labor requirement due to the small firm assumption and perfect competition. Each stage 2 firm hires exactly one worker.

the foreign country than in the home country give rise to gains from trade and determine the free trade pattern that stems from cross-country differences in production costs. Note, that technology plays a minor role in this setup since the results are not driven by differences in endowments or technology. Countries produce goods where they have a comparative advantage by means of lower unit costs compared to the unit costs in the competing country. However, it is sensible to link the input requirement curves to relative factor endowments so that, on average, low-skill abundant countries have a relatively higher low skill labor demand in all industries. In the following all countries are assumed to be low skill abundant and all industries therefore have higher low skill requirement on average.[4] The functional form of both input coefficient curves is

$$a_{li}(z) = \alpha_{li} + \gamma_{li}(z) \quad , \tag{5.3}$$

$$a_{hi}(z) = \alpha_{hi} + \gamma_{hi}(z) \tag{5.4}$$

where i is the country identifier, l denotes low-, and h denotes high-skill. For the input coefficients we assume that α is a country-specific constant and γ denotes the industry specific component of labor requirement depending on z. Similar to Feenstra and Hanson (1996, 1997) the final intermediate good is assembled according to the nested Leontief production function

$$x_i(z) = \left[\min\left\{\frac{l_i(z)}{a_{li}(Z)}, \frac{h_i(z)}{a_{hi}(z)}\right\}\right]^{\zeta} [k_i(z)]^{1-\zeta} \quad . \tag{5.5}$$

Input over high- and low skill intermediates is assumed to be Leontief, which implies that input-relation between high- and low-skill intermediates is fixed. The aggregated intermediate-good is nested into a Cobb Douglas production function that combines intermediates with capital to produce the final consumption good. Let $p(z)$ denote the price of each final intermediate input good, $l(z)$ is low skill labor demand in industry z, and $h(z)$ is high skill labor demand in industry z. Under autarky the whole continuum of goods is produced domestically. Under free trade however, both countries specialize and the range

[4] Whether a country is high or low skill abundant highly depends on how both categories are classified. On average the world is medium skill abundant. Using WDI data in order to decompose the total labor force into low, medium and high skill components we find that on average 33 percent of the labor force has a low skill education and only 16 percent of the work force hold a high skill qualification. Lumping high and medium skilled workers to skilled workers we find that all developed counties are skill abundant.

of active industries within each country is determined by the cutoff condition

$$p_d(z^*) = p_f(z^*) \quad . \tag{5.6}$$

Stage 1 prices equal production costs depending on stage 2 firm's input coefficients, wages earned by workers that produce the intermediates in stage 2, and search cost paid by stage 2 firms in order to recruit workers. Goods are ordered according to their relative skill intensity. We know that intermediate good prices are equalized over the whole continuum and set in stage 2. This implies that the unit cost ranking of industries solely depends on the input coefficients, which are exogenously given and increasing in z. Wages in both countries are equalized across sectors z but not across skill groups. Each firm has to pay q_h for high skill intermediate goods and q_L for low skill intermediates. Intermediate goods' prices are taken as given in the final production stage and set in the stage below where firms use high and low skill labor to produce the intermediates. Stage 1 firms adjust their labor demand with respect to prices charged by stage 2 firms. Perfect competition implies that the industry price level equals the respective industry unit costs

$$p_i(z) = c_i(z) = B(q_{hi}a_{hi}(z) + q_{li}a_{li}(z))^{\zeta} r_i^{1-\zeta} \quad , \tag{5.7}$$

where $B = \zeta^{-\zeta}(1-\zeta)^{-(1-\zeta)}$ and $c(z)$ denotes minimum unit costs in sector z obtained by solving the standard cost minimization problem for firms producing according to the production function (5.5).

Stage 2: Intermediate input producers. Firms in this final stage use labor to produce intermediate input goods. There are two different type of firms, one producing high skill intermediates by input of high skill labor, and one producing low skill intermediates by input of low skill labor. This assumption is consistent with the notion of firms producing different parts with different skill requirements in separated plants. The number of potential firms is given by L_i and H_i since each firm in stage 2 employs one worker, and since demand for high and low skill intermediates is dictated by the Leontief production function (5.5) in stage 1. However, search frictions reduce the number of firms since some of the workers are unemployed.[5]

Labor markets are not perfect. Employers and employees have to be matched to each other and firms have to post vacancies before hiring workers. Bargaining between firms and workers is separated according to the workers' skills without intra firm bargaining across skills. However, there is an interaction between high and low skill workers since stage 2 firms take stage 1 prices into consideration when negotiating wages. Equation (5.5) implies that there is no substitution between high and low skill workers since both inputs are used in a certain relation. Thus, firms' revenue is zero if bargaining with one or the other type of worker fails. Even if the relation in the production process is different, their importance for the revenue generated is equal since the real amount of both input factors is equal in production. Factors with higher input coefficients are more productive and therefore less units are used. Due to this complementarity in production firms cannot substitute the less efficient factor with more efficient ones which affects the bargaining process. Given that the price for the intermediate good in stage 1 depends on wages paid by stage 2 firms, labor market clearing hinges on a certain equilibrium market tightness to secure that revenue generated by firms in stage 2 is exactly equal to $p_i(z)x_i(z)$.

Wage bargaining and job creation in stage 2. In stage 2, one high (low) skill intermediate firm produces for the assembling process of good $x_i(z)$ in stage 1 and each firm employs exactly one worker. Firms have to post vacancies in order to recruit new workers, which incurs vacancy posting costs. In the following we assume that firms pay recruitment cost c in some common units p. This is a more general formulation as in Pissarides (2000) where vacancy costs are paid in terms of the individual price or Felbermayr, Prat, Schmerer (2011a) where vacancy costs are paid in terms of the aggregate price level. The common vacancy price index p is measured either in units of numeraire, intermediate good prices, the aggregate price level, or the wage rate.[6] In line with Pissarides (2000), We assume that vacancy posting costs are paid in terms of stage 1 prices when solving the general equilibrium of the model. The matching process itself is modeled according to a standard Cobb-Douglas

[5] See Ebell and Haefke (2004) on a further discussion why the small firm assumption is harmless under the assumption of perfect competition. Under monopolistic competition the number of firms is crucial for determining the equilibrium. Thus, the standard small firm assumption is not feasible anymore.

[6] One important feature of p is that it is measured in the common unit. Income, wages, and prices have the same units and are therefore valid.

matching function $m(\theta_k)$, which is concave and has constant returns to scale properties. We follow Pissarides (2000) in modeling the problem of the workers and the firms.

Job Creation J_k in (5.8) denotes the present discounted value of expected profits from an occupied job in skill group k, V_k in (5.9) denotes the value of a vacant job in skill group k, and η denotes the exogenously given discount rate.[7] The value of a vacant job negatively depends on unit recruitment costs, but increases in the difference between the value of the filled job and the opportunity costs given by the value of the vacant job. The matching function itself pins down the probability of a successful match due to the assumption of constant returns to scale. The flow value of the filled job is revenue generated by the worker minus the wage rate paid to the worker.[8] Job separation due to an exogenous shock hits the firm with poisson arrival rate λ and destroys the value associated with that firm, which reads as

$$\eta V_k = -cp + m(\theta_k)(J_k - V_k) \quad ; \tag{5.8}$$

$$\eta J_k = \varrho_k(z) - w_k - \lambda J_k \quad . \tag{5.9}$$

In equilibrium the value of unoccupied jobs is zero since firms continue to post vacancies until all profits are exploited

$$J_k = \frac{cp}{m(\theta_k)} \quad . \tag{5.10}$$

We can combine (5.9) and (5.10) in order to obtain the Job Creation condition under perfect competition with search frictions as

$$\varrho_k(z) - w_k - \frac{cp}{m(\theta_k)}(\eta + \lambda) = 0 \quad , \tag{5.11}$$

which states that the firm's revenue must equal variable production and recruitment costs. Wages are equalized across firms. This proposition is proved below and due to the definition of the equilibrium market tightness which is defined as the ratio of the number of vacancies posted and the number of unemployed workers. It is sufficient to compute the optimal wage/equilibrium market tightness for the cutoff firm. However, unit costs/prices

[7] k is either l for low or h for high skill.

[8] A firm's revenue $\varrho(z)$ equals the price charged for each intermediate good due to the small firm assumption. Prices still depend on z but it is possible to proof that prices do not hinge on industry specific parameters.

differ across firms since per worker costs for the intermediate good are equal but the input requirement of workers (intermediate good from stage 2) in z is lower than in z' if $z < z'$.

Wage Curve. To the worker the value of a job is worth the wage minus the opportunity cost of being employed. The firm might be destroyed with a certain probability. In that particular case the value of the job becomes zero and the worker receives her outside option worth ηU_k. Unemployed workers receive some unemployment benefits b and with a certain probability they successfully find a new job in another firm, which translates into

$$\eta W_k = w_k - \lambda(W_k - U_k) \ ; \tag{5.12}$$

$$\eta U_k = b_k + m(\theta_h)(W_k^e - U_k) \ . \tag{5.13}$$

We follow Dutt et al. (2009) and introduce W_k^e in order to take into account that workers are randomly matched to firms and therefore have to build expectations about W. This also implies that all firms pay the same wage rate and therefore only differ with respect to production.

Wages itself are bargained and satisfy the bargaining condition

$$W_k - U_k = \beta(J_k + W_k - V_k - U_k) \ . \tag{5.14}$$

Thus the distribution of total gains depends on both actors' bargaining power, which implies

$$w_k = \eta U_k + \beta(\varrho_k(z) - \eta U_k) \tag{5.15}$$

and

$$\eta U_k = b_k + \frac{\beta}{1-\beta} cp\theta_k \ . \tag{5.16}$$

We obtain a wage condition by combining the equilibrium conditions (5.16) and (5.15) as shown in the Appendix to solve for

$$w_k = (1-\beta)b_k + \beta cp\theta_k + \beta\varrho_k(z) \ , \tag{5.17}$$

which is the pendant to the labor supply curve in the standard Feenstra and Hanson (1996, 1997) model.

Equilibrium in stage 2's high skill intermediate sector. In equilibrium, the wage and the equilibrium market tightness θ_k are determined by interacting the wage curve and the job creation curve such that

$$(1-\beta)b_h + \beta c p \theta_h + \beta \varrho_h(z) = \varrho_h(z) - \frac{cp}{m(\theta_h)}(\eta+\lambda) \quad . \tag{5.18}$$

Simplifying then yields

$$\varrho_h(z) = \left(b_h + \frac{cp}{1-\beta}\left(\beta\theta_h + \frac{\eta+\lambda}{m(\theta_h)}\right)\right) \quad . \tag{5.19}$$

Therefore, equation (5.19) implies that all stage 1 firms pay the same price for intermediate goods denoted $q_h(z) = \varrho_h(z)$ so that $q_h(z') = q_h(z'')$ for $z' \neq z''$. Intermediate good prices only depend on exogenous parameters and the equilibrium market tightness, which is common to all firms in all industries. Moreover, we assume that the discount rate η and the capital rental r are tied to the capital rental and we assume that the discount rate is predetermined by the capital rental.

Equilibrium in stage 2's low skill intermediate good sector. Following the same line of reasoning we can derive the equilibrium condition for low skill intermediate input prices as

$$\varrho_l(z) = \left(b_l + \frac{cp}{1-\beta}\left(\beta\theta_l + \frac{\eta+\lambda}{m(\theta_l)}\right)\right) \quad . \tag{5.20}$$

We denote the price paid by stage 1 producers for the purchase of stage 2 low skill intermediate inputs $q_l(z) = \varrho_l(z)$, which is possible due to the small firm assumption. Each firm employs one worker and produced exactly one intermediate good. The firm's revenue is thus equal the intermediate good price paid by the final output good producers.

Properties of the labor market equilibrium condition. Since the latter product market equilibrium depends on the labor market equilibrium more clarification is needed to shed light on the implications from vacancy posting costs for intermediate input prices. Firms can pay vacancy posting costs in terms of income, in terms of the good produced by the respective firm, aggregate price or in terms of the wage rate. The Pissarides (2000) assumption that vacancy posting costs are paid in terms of goods' prices is used in the following chapters in order to solve for a unique equilibrium.

Proposition 1. *a) The intermediate input price is pinned down by*

$$q_{ld} = \frac{(1-\beta)b_{ld}}{(1-\beta) - c(\beta\theta_{ld} + \frac{\eta_d+\lambda}{m(\theta_{ld})})} \tag{5.21}$$

$$q_{hd} = \frac{(1-\beta)b_{hd}}{(1-\beta) - c(\beta\theta_{hd} + \frac{\eta_d+\lambda}{m(\theta_{hd})})} \tag{5.22}$$

b) An increase in the equilibrium market tightness θ_k leads to an increase in wages and thus intermediate input goods prices since $\frac{\partial q_i}{\partial \theta_k} > 0$. This proposition holds irrespective of whether vacancy posting costs are paid in terms of numeraire or in terms of intermediate input prices.

Proof. Part b) of proposition (1) is easily proved by deriving the first derivative of the stage 2 labor market equilibrium condition with respect to θ_k, which is increasing since the vacancy filling rate is decreasing in the equilibrium market tightness $\frac{\partial m(\theta_k)}{\partial \theta_k} < 0$. Thus the first derivative of (5.21) and (5.22) with respect to θ_k is positive. □

Solving the product and labor market equilibrium pins down the low- and high-skill equilibrium market tightness and unemployment in both countries via the Beveridge curve

$$u(\theta_{ki}) = \frac{\delta}{\delta + \theta_k m(\theta_{ki})} \quad . \tag{5.23}$$

The Beveridge curve relates the unemployment-to-vacancy ratio such that the flow into unemployment equals the flow out of unemployment and therefore pins down long-run equilibrium unemployment rates in the economy. The Beveridge curve is convex due to the concave matching technology. Thus, the magnitude of the relationship between θ_k and u is stronger for relatively low values of unemployment. The convexity of the Beveridge curve is also a potential explanation for the increase in the high to low skill employment ratio described by Feenstra (2010). High skill employment and thus equilibrium market tightness is usually higher than low skill unemployment. Shocks that hit both skill groups therefore translate into stronger changes in low skill employment and raise the employment ratio between both skill groups.[9]

[9] Search frictions give rise to unemployment. Both sides of the labor market clearing condition depend on θ_k and thus adjust simultaneously. The required change in wages is thus mitigated by the change in unemployment, which is stronger in the low skill sector.

5.2.1 Labor market clearing

The labor market clears when labor supply equals labor demand. However, due to search frictions labor supply is the fraction of matched workers outside the pool of unemployed workers. On the other hand, firms adjust their labor demand to the intermediate input prices that now do depend on wages and search cost. Thus, search costs drive a wedge between intermediate input prices and the wage earned by the firms' workers, but perfect competition still implies that prices are equal to production cost.

Proposition 2. *Firms in stage 1 are price takers and base their labor demand decision on the (already optimal) high and low skill intermediate goods' prices, given that wages are bargained on stage 2 between intermediate goods producers and workers, and given that those wages are optimal. Wages therefore map into intermediate goods' prices.*

Using Shephards Lemma we know that demand for intermediates produced in stage 2 is equal to

$$\frac{\partial c_k(q_h, q_l, r; z)}{\partial q_k(z)} = B\zeta a_k(z)(q_l a_l(z) + q_h a_h(z))^{\zeta-1} r^{1-\zeta} \quad . \tag{5.24}$$

Domestic labor market equilibrium requires that labor demand at the aggregate level is equal to total labor supply which is satisfied if

$$L_d(1 - u_{ld}) = \int_{\underline{z}_d}^{\bar{z}_d} B\zeta \left[\frac{r_d}{q_{ld}a_{ld}(z) + q_{ld}a_{ld}(z)} \right]^{1-\zeta} a_{ld}(z)x(z)dz \quad , \tag{5.25}$$

and

$$H_d(1 - u_{hd}) = \int_{\underline{z}_d}^{\bar{z}_d} B\zeta \left[\frac{r_d}{q_{hd}a_{hd}(z) + q_{hd}a_h(z)} \right]^{1-\zeta} a_{hd}(z)x(z)dz \quad , \tag{5.26}$$

holds. The right hand side is aggregate labor demand obtained by aggregating industry level labor demand over all industries depending on input prices following (5.24). The specialization pattern under free trade is ex-ante unknown and depends on the unit cost schedule over all industries, where $\bar{z}_i$ denotes the upper and $\underline{z}_i$ the lower bound of the continuum of active industries in the respective country. Prices of high and low skill intermediates determined in stage 2 depend on the endogenous equilibrium market tightness, and some exogenous parameters only. q can be substituted in the labor market clearing condition so that this condition only depends on θ_k. Following Feenstra and Hanson (1996, 1997) we exploit

$$x(z) = \varphi(z)E/p(z) \tag{5.27}$$

and equation (5.7) in order to link the aggregate demand, labor-, and product-market equilibrium via

$$
\begin{aligned}
L_d(1-u_{ld}(\theta_{ld})) &= \int_{\underline{z}_d}^{\bar{z}_d} \zeta \left[\frac{a_{ld}(z)\varphi(z)E}{q_{ld}(\theta_{ld})a_{ld}(z)+q_{hd}(\theta_{hd})a_{hd}(z)}\right] dz \quad , \qquad (5.28)\\
H_d(1-u_{hd}(\theta_{hd})) &= \int_{\underline{z}_d}^{\bar{z}_d} \zeta \left[\frac{a_{hd}(z)\varphi(z)E}{q_{ld}(\theta_{ld})a_{ld}(z)+q_{hd}(\theta_{hd})a_{hd}(z)}\right] dz \quad . \qquad (5.29)
\end{aligned}
$$

Thus, the number of matches equals the number of intermediate goods available. The consumption share for each industry z is constant and by assumption equalized over the whole continuum. In the continuous scenario the mass of one single industry is close to zero. It is thus necessary to compute the mass of a certain range of industries within the whole continuum. To understand the implications of the assumption made above we compare the continuous scenario with the discrete scenario. Suppose n, the number of goods produced, is large and each industry has the same constant Cobb Douglas expenditure share φ. This would allow us to approximate $\varphi(z) = 1/n$.[10] The approximation in the continuous case is similar but here we need the notion of a mass of industries over the range $\underline{z}$ and $\bar{z}$. The solution to the integral is determined by substitution and integration by parts. We define $f_k(z) = a_k(z)$ and $g'(z) = (q_l(\theta_l)a_l(z) + q_h(\theta_h)a_h(z))^{-1}$ to obtain a solution for (5.28) and (5.29) as

$$
\begin{aligned}
L_d(1-u_{ld}(\theta_{ld})) &= (\bar{z}_d-\underline{z}_d)\zeta E\left([a_{ld}(z)g(z)]_{\underline{z}}^{\bar{z}} - \int_{\underline{z}_d}^{\bar{z}_d} a'_{hd}(z)g(z)dz\right)\\
&= \frac{(\bar{z}_d-\underline{z}_d)\zeta E\theta_k}{\varpi'_d}\left([a_{ld}(z)ln\ \varpi(z)]_{\underline{z}_d}^{\bar{z}_d} - \frac{\gamma_{ld}}{\varpi'_d}\left[(\varpi(ln\varpi-1))\right]_{\underline{z}_d}^{\bar{z}_d}\right)\\
H_d(1-u_{hd}(\theta_{hd})) &= (\bar{z}_d-\underline{z}_d)\zeta E\left([a_{hd}(z)g(z)]_{\underline{z}_d}^{\bar{z}_d} - \int_{\underline{z}_d}^{\bar{z}_d} a'_{hd}(z)g(z)dz\right)\\
&= \frac{(\bar{z}_d-\underline{z}_d)\zeta E}{\varpi'_d}\left([a_{hd}(z)ln\ \varpi(z)]_{\underline{z}_d}^{\bar{z}_d} - \frac{\gamma_{hd}}{\varpi'_d}\left[(\varpi(ln\varpi-1))\right]_{\underline{z}_d}^{\bar{z}_d}\right)
\end{aligned}
$$

where we use $\varpi = q_{ld}(\theta_l)a_{ld}(z) + q_{hd}(\theta_h)a_{hd}(z)$ and $\varpi'(z) = q_l(\theta_l)\gamma_l + q_h(\theta_h)\gamma_h$. For the

[10] As in the continuous case, the consumption share of one particular industry goes to zero if n is large.

foreign country we obtain

$$
\begin{aligned}
L_f(1-u_{lf}(\theta_{lf})) &= (\bar{z}_f-\underline{z}_f)E\zeta\left([a_{lf}(z)g_f(z)]_{\underline{z}_f}^{\bar{z}_f}-\int_{\underline{z}_f}^{\bar{z}_f}a'_{hf}(z)g_f(z)dz\right)\\
&= \frac{(\bar{z}_f-\underline{z}_f)E\zeta}{\varpi'_f}\left([a_{lf}(z)ln\ \varpi_f(z)]_{\underline{z}_f}^{\bar{z}_f}-\frac{\gamma_{lf}}{\varpi'_f}\left[(\varpi_f(ln\varpi_f-1))\right]_{\underline{z}_f}^{\bar{z}_f}\right)\\
H_f(1-u_{hf}(\theta_{hf})) &= (\bar{z}_f-\underline{z}_f)E\zeta\left([a_{hf}(z)g_f(z)]_{\underline{z}_f}^{\bar{z}_f}-\int_{\underline{z}_f}^{\bar{z}_f}a'_{hf}(z)g_f(z)dz\right)\\
&= \frac{(\bar{z}_f-\underline{z}_f)E\zeta}{\varpi'_f}\left([a_{hf}(z)ln\ \varpi_f(z)]_{\underline{z}_f}^{\bar{z}_f}-\frac{\gamma_{hf}}{\varpi'_f}\left[(\varpi_f(ln\varpi_f-1))\right]_{\underline{z}_f}^{\bar{z}_f}\right)
\end{aligned}
$$

Proposition 3. *Labor market clearing requires that labor demand equals labor supply in each country and skill group. The labor market clearing conditions therefore pin down four θ_ks, and each θ_k in turn pins down the respective wage and skill-specific unemployment rate. The equilibrium is unique since there exists exactly one pair of equilibrium market tightness satisfying all 2×2 labor market clearing conditions for a given cutoff z^*.*

Proof. Let Γ_L denote the left-, and Γ_R the right hand side of the labor market clearing condition. We further define $f_k(z) = \frac{\varphi(z)Ea_k(z)}{q_l(\theta_l)a_l(z)+q_h(\theta_h)a_h(z)}$. The left hand side of both labor market clearing conditions has its origin at zero and converges to an upper bound. The right hand side is also well behaved. Labor demand is decreasing in θ_k. An increase in θ_k triggers an increase in intermediate input good prices, which in turn reduces demand for intermediates. Applying the Leibniz rule to the right hand side of the labor market clearing condition and assuming that the bounds of the integral being constant yields

$$
\frac{\partial \Gamma_R}{\partial q_k} = \int_{\underline{z}}^{\bar{z}} \frac{\partial f(z, q_l, q_h)}{\partial q_k} dz < 0 \tag{5.30}
$$

due to the normalization $E = 1$.[11] The first derivative approaches 0 when q_k goes to infinity and $\frac{\partial^2 \Gamma_R}{\partial q_k^2} > 0$. Therefore, firms' labor demand is decreasing in θ_k and converges to zero. Figure 5.1 illustrates the equilibrium. Notice, that there is an interaction between the low- and high-skill labor market clearing condition. The high-skill labor market tightness shifts low-skill labor demand Γ_R through the increase in the wage rate that enters both group's labor market clearing condition. Figure 5.1 draws low skill labor supply Γ_L and low skill

[11] Note that this normalization helps to solve some ambiguities. However, as shown later on world income does not change by much due to some countervailing effects of FDI on both countries' wages.

labor demand Γ_R for a given high skill equilibrium market tightness. The difference between Γ_{R1} and Γ_{R2} is that the given high skill intermediate input price is higher in Γ_{R2} than in Γ_{R1}. Therefore, an increase in the respectively other skill group's intermediate input price shifts down the labor demand schedule in the regarded skill group.

□

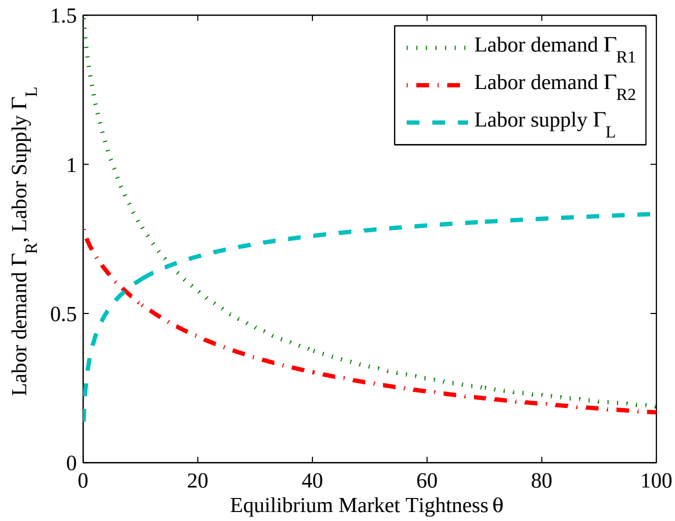

Figure 5.1: Labor market clearing condition

Figure 5.1 depicts the left and right hand side of the labor market clearing condition for one skill sector. The focus lies on the interaction between equilibrium market tightness θ_k and labor demand / supply in the regarded sector. We assume that the other sector's market tightness is in equilibrium. An increase in that sector's θ_k shifts the respective Γ_R downwards and leaves Γ_L unchanged. The equilibrium is unique since Γ_L has its origin at zero and converges to the upper bound whereas Γ_L converges to zero when θ_k goes to infinity.

Proposition 4. *a) The right hand side of the labor market clearing condition is increasing in z^* in the country where z^* determines the lower bound of active industries. Conversely, countries where z^* pins down the lower bound of industries suffer from a decrease in labor demand if z^* increases. b) The low skill sector's Γ_R increases faster in z^* than the low skill sectors Γ_R. c) Income proportionally shifts all labor market clearing conditions.*

Proof. Part one of this proposition follows directly from the first derivative of the right hand side of the labor market clearing condition with respect of z^*, which is positive or negative depending on whether z^* is the upper or lower bound of the integral. Part b) is due to the assumption that $a_h(z) > a_l(z)$, the slope of Γ_R in the low skill sector is always greater than in the high skill sector. For part c) it is enough to see that income proportionally shifts all labor market clearing conditions proportionally. As in Feenstra and Hanson (1996, 1997) we can sterilize those effects on the aggregate level by setting income as nummeraire so that the equilibrium is not affected by changes in world income. □

Proposition 5. *If we allow for free trade both countries are better off by specializing on production in sectors where they have an comparative advantage. A free trade equilibrium requires one unique cutoff $z^* \in (0,1)$ for which each of the four labor markets is in equilibrium and for which the cutoff condition*

$$p_d(z^*) = p_f(z^*) \quad \Leftrightarrow \quad c_d(\theta_{ld}, \theta_{hd}; z^*) = c_f(\theta_{ld}, \theta_{hd}; z^*) \tag{5.31}$$

is fulfilled.

However, proposition 4 states that each cutoff $z^* \in [0, \infty]$ is associated with one unique combination of θ_l and θ_h. Thus, a necessary requirement for the free trade equilibrium is a cutoff associated with a combination of equilibrium market tightness parameters for which all labor markets clear and for which domestic equals foreign unit costs. Obviously, there is no upper bound for z which means that - given the exogenous parameters - such a cutoff might be outside the feasible space of industries, which is restricted to lie within the continuum $z \in [0, 1]$. If the cutoff condition is fulfilled for $z^* > 1$ only, we would obtain a corner solution where one country could produce all goods cheaper. In that case there are no incentives for one of the countries to participate in international trade so that both economies remain under autarky and produce the whole continuum domestically. Both cost schedules are increasing in z. Thus, an increase in the capital rental or the intermediate goods shift the unit cost schedules up. This shift in unit costs over the whole continuum will result in a loss of the comparative advantage in some industries located close to the former cutoff, resulting in a shift of z^*.

5.3 General Equilibrium

To close the model we still have to determine world income and capital returns. Income is not normalized to unity and equals world factor payments

$$E = L_d(1-u_{ld})q_{ld}+H_d(1-u_{hd})q_{hd}+r_dK_d+L_f(1-u_{lf})q_{lf}+H_f(1-u_{hf})q_{hd}+r_fK_f \quad . \tag{5.32}$$

The capital rental is determined on stage 1 where capital is used as input factor by exploiting the Cobb Douglas shares and Shephards Lemma again

$$r_dK_d = (1-\zeta)(\bar{z}_d - \underline{z}_d)E \quad , \tag{5.33}$$

$$r_fK_f = (1-\zeta)(\bar{z}_f - \underline{z}_f)E \quad . \tag{5.34}$$

Thus, the fraction ζ is spend for intermediates which gives us

$$L_d(1-u_{ld})q_{ld} + H_d(1-u_{hd})q_{hd} = \zeta(\bar{z}_d - \underline{z}_d)E \quad , \tag{5.35}$$

$$L_f(1-u_{lf})q_{lf} + H_f(1-u_{hf})q_{hd} = \zeta(\bar{z}_f - \underline{z}_f)E \quad . \tag{5.36}$$

Both equilibrium conditions can be solves for E in order to derive

$$r_dK_d = \frac{(1-\zeta)}{\zeta}(L_d(1-u_{ld})q_{ld} + H_d(1-u_{hd})q_{hd}) \quad , \tag{5.37}$$

$$r_fK_f = \frac{(1-\zeta)}{\zeta}(L_f(1-u_{lf})q_{lf} + H_f(1-u_{hf})q_{hd}) \quad . \tag{5.38}$$

The equilibrium thus depends on 8 endogenous variables: 4 equilibrium market tightness, capital return in the foreign and home country, one cutoff, as well as world income. We follow Feenstra and Hanson (1996, 1997) setting world income as nummeraire so that we can drop one equilibrium condition as suggested by Walras' law.

5.4 Comparative statics

We now turn to the comparative statics of the model and analyze how FDI-flows affect the 2×2 equilibrium market tightness parameters. Second, the effects of a change in labor market institutions on FDI-flows and unemployment are analyzed. Endogenous interest rate adjustments are assumed in the first scenario, whereas interest rates in the latter scenario are treated as exogenous.[12] An increase in unemployment benefits for instance shifts the unit cost schedule upwards, followed by adjustments at the extensive margin. Capital must flow between the two economies to restore equilibrium since interest rates are fixed and equalized across countries. At the intensive margin firms will have an incentive to substitute labor with capital since capital becomes relatively cheaper when labor market institutions change in favor of the workers.

5.4.1 The effects of FDI on skill specific unemployment

In a globalized world without frictions in the financial markets, capital will flow between the economies as long as capital returns across countries are different. For the moment we maintain the assumption that the interest rates are endogenously determined in each country and study how capital in- and outflows affect labor markets.

FDI in the form of capital flows between countries induces a readjustment in the interest rate. FDI inflows for instance reduce the scarcity of capital and thus also reduce the respective interest rate, thereby affecting unit costs. Given that all other factor prices remain constant, the unit cost schedule shifts down associated with lower industry price level over the whole continuum. The opposite happens in the country that looses capital due to an interest rate that is lower than the interest rate in the foreign country. The FDI-out country's unit cost curve shifts up, accompanied by higher goods' prices in all active industries.

Thus, the former trade pattern is no longer optimal due to a shift of industries located around the initial cutoff. The new intersection of the domestic and the foreign unit cost schedule depends on former production pattern. One country has a comparative advantage in the continuum closer to 1 and the other country has a comparative advantage in the continuum closer to 0. Given the existence of an unique cutoff z^*, one country has zero as the lower bound and the other country has 1 as upper bound of active industries. The cutoff z^* will adjust so that the range of active industries in the FDI-out economy contracts whereas the range of active industries in the FDI-in economy expands. This also implies that the former labor market equilibrium is not optimal any more: unemployment, wages and the equilibrium market tightness have to adjust in order to restore equilibrium.

[12]One implication from scenario i) is that without capital barriers capital flows until capital costs are equal in both countries.

At the extensive margin whole industries get lost, which reduces labor demand on the aggregate level by destroying all jobs associated with those industries. At the same time the adjustments of capital costs and wages will also directly affect the equilibrium labor demand in stage 2, which results in a substitution between capital and labor.[13]

Proposition 6. *FDI outflows driven by cross-country differences in capital returns have an increasing effect upon domestic interest rates resulting in a substitution between capital and labor. The discount rate is tied to the capital rental, which influences labor demand at the intensive margin increases in both skill sectors. At the extensive margin the increase in the cutoff industry destroys all jobs associated with industries between the initial and the new cutoff. The opposite pattern can be found in the FDI-inflow country.*

Proof. To see this one has to compute the first derivative of labor demand Γ_r with respect to the cutoff z^*, which is positive for the receiving country and negative for the sending country. This holds for both skill factors and it translates into job creation (FDI-inflow country) and job destruction (FDI-outflow country) at the extensive margin.

In order to restore equilibrium labor supply must adjust, too. Since labor demand in the FDI-outflow country decreases at the extensive margin, a higher rate of unemployment is needed to restore equilibrium. Thus, the equilibrium market tightness must fall, wages go down and unemployment increases. This in turn boosts labor demand at the individual industry level and strengthens the increase in labor demand at the intensive margin. A third effect arises due to income adjustments. However, this effect is negligible since *i*) the magnitude of the effect is small and *ii*) income proportionally shifts all labor market clearing conditions in the domestic and foreign country. Notice that *i*) follows from the fact that domestic and foreign equilibrium market tightness evolve in opposite directions. An increase in foreign income is thus mitigated through a decrease in the domestic income, resulting in negligible changes in world income. Moreover, we set the world income as nummeraire. See the appendix for more details. □

[13]Substitution between high and low skill workers is excluded by assuming a Leontieff production function.

5.4.2 Changes in labor market institutions

Extending the Feenstra and Hanson (1996) framework by implementing a micro based wage setting mechanism in combination with search frictions allows us to study the implications of labor market institutional variables. Without loss of generality, interest rates are set exogenously and remain fixed in the comparative static exercise conducted below. Policies that intend to improve the workers' rights have an increasing effect on wages. As shown in the appendix, increases in unemployment benefits or bargaining power boost equilibrium wages in all industries and thus shift the unit cost schedule for stage 1 firms upwards. Although such changes in labor market institutions are unilateral, spillover effects might influence domestic labor markets in countries integrated via trade and FDI. It shall be shown that such spillover effects occur in the model presented above.

Adjustments with exogenous interest rates take place at the extensive margin only. An increase in b or β will increase the respective country's wages in all industries, inducing an upwards shift of the unit cost schedule in country i. Adjustment at the extensive margin further reduces labor demand since all jobs connected to those industries get lost in the home country. The destruction of industries also lead to excess capital supply in country i, which will be shifted to countries suffering from excess capital demand due to the enhanced production.

In country $i \neq j$ adjustments take place at the extensive margin only since interest rates do not change. The receiving country's unit cost schedule therefore remains constant. However, since production expands in the receiving country, labor demand goes up, accompanied by an increased labor supply. A higher wage rate is needed to trigger an increase in labor supply. Therefore, the new equilibrium requires a higher market tightness in both skill sectors to satisfy the increase in labor demand.

Proposition 7. *a) An unilateral increase in unemployment benefits b_i or bargaining power β_i leads to an increase in country i's unemployment and wages and triggers capital outflows. b) Country $j \neq i$'s capital inflows will reduce its equilibrium unemployment but increase its employees' wages.*

Proof. a) follows directly by $\frac{\partial w_{ki}}{\partial b_i} > 0$ or $\frac{\partial w_{ki}}{\partial \beta_i} > 0$ where we assume that the labor market institutions across high and low skill sectors are equal. Therefore, unit costs in all industries rise and labor is substituted with capital. Labor supply Γ_{li} must go down in both skill sectors, since labor demand $\frac{\partial \Gamma_{ri}}{\partial q_{hi}} < 0$ and $\frac{\partial \Gamma_{ri}}{\partial q_{li}} < 0$. Again we first assume that the cutoff remains constant. At the extensive margin, we know that the unit cost schedule shifts upwards in country i followed by adjustments in the cutoff. The adjustments at the extensive margin are already derived for the prove of proposition (3). For country $i \neq j$ the capital inflow and the expansion of its production to additional industries boosts labor demand and thus reduces unemployment, even if labor market institutions in that country remain unchanged. Again, a formal proof is already provided for proposition (3). To analyze how capital changes in the aftermath of institutional reforms we have to introduce capital market clearing conditions by aggregating individual industry demand for capital as

$$\frac{\partial c_i(z)}{\partial r_i} = B(1-\zeta)(q_{hi}a_{hi}(z) + q_{li}a_{li}(z))^{\zeta} r_i^{-\zeta} \quad . \tag{5.39}$$

On the aggregate level capital demand is pinned down by

$$K_i = \int_{\underline{\mathrm{Z}}_d}^{\bar{\mathrm{Z}}_d} \frac{(1-\zeta)\varphi(z)E}{r_i} dz \quad , \tag{5.40}$$

which is found by aggregating individual industry capital demand (5.39) over the whole continuum of active industries. The cutoff is therefore directly linked to capital demand since interest rates and world capital stock is fixed per assumption and $\frac{\partial K_i}{\partial \bar{\mathrm{Z}}} > 0$ and $\frac{\partial K_i}{\partial \underline{\mathrm{Z}}} < 0$. This follows from the two country scenario where z^* is always one country's upper and the other country's lower bound of active industries.

□

5.5 Conclusion

In a nutshell, this paper's main contribution is to extend the Feenstra and Hanson (1996, 1997) international trade model by Pissarides (2000) search frictions in a way that allows for a two-dimensional analysis where wages and the equilibrium market tightness link labor and product markets. This in turn implies that wages and capital flows are triggered by both, trade liberalization and changes in labor market institutions. Moreover, the notion of a continuum of industries not only permits the study of spillover effects across countries, it also gives rise to a new channel through which FDI affects labor demand at the extensive margin where whole industries are shifted abroad. This channel is new regarding the already existing literature on trade and unemployment, which is silent on adjustments at the extensive margin. As a result, we can show that FDI-in countries benefit from foreign capital investments by extending their production to industries formerly associated with other countries. This widening of the production to industries formerly inactive, combined with the adjustments at the intensive margin reduce unemployment and increase wages in the new equilibrium. However, the FDI sending country's workers suffer from the loss in competitiveness in some of its formerly active industries located close to the former cutoff. Without the continuum of industries adjustments would take place at the intensive margin only. The increased capital supply in the FDI-in countries would reduce capital cost and thus lead to a substitution of capital by labor, thereby unambiguously increasing unemployment. The novel micro-founded wage setting mechanism in the Feenstra and Hanson model also facilitates the study of changes in labor market institutions and its effects on FDI and labor market outcomes. Wages in the original Feenstra and Hanson (1997,1998) model adjust such that the labor market is in equilibrium. Institutional changes benefiting the workers directly influence FDI through wages. Surging labor costs render FDI more attractive and therefore lead to an increase in FDI outflows accompanied by higher wages and higher rates of unemployment.

5.6 Proofs

Derivation of equation (5.18). To derive the ETC conditions for both high and low skill intermediate producers we need to derive and interact the wage and the job creation curves. To solve for the job creation curve equation (5.10) and (5.9) are combined so that

$$(\eta+\lambda)\frac{cp}{m(\theta_k)} = \varrho_k(z) - w_k \tag{5.41}$$

which can be rearranged to equation (5.11). To solve for the wage curve we start with rearranging equation (5.14) as

$$W_k - U_k = \frac{\beta}{1-\beta}J_k \quad . \tag{5.42}$$

Equation (5.9) can be rewritten as

$$(\eta+\lambda)J_k \quad = \quad \varrho_k(z) - w_k \quad . \tag{5.43}$$

Expanding equation (5.12) by substracting $(\eta+\lambda)U_k$ on both sides gives

$$(\eta+\lambda)(W_k - U_k) \quad = \quad w_k + \lambda U_k - (\eta+\lambda)(U_k) \tag{5.44}$$

$$(\eta+\lambda)(W_k - U_k) \quad = \quad w_k - \eta U_k \tag{5.45}$$

A solution for the outside option is obtained by combining equation (5.13), equation (5.42), and equation (5.10) as

$$\eta U_k = b_k + \theta_k m(\theta_k)\frac{\beta}{1-\beta}\frac{cp}{m(\theta_k)} \tag{5.46}$$

Combining equation (5.45), (5.42), (5.43), and (5.46) gives

$$(\eta+\lambda)\frac{\beta}{1-\beta}J_k \quad = \quad w_k - \eta U_k \tag{5.47}$$

$$(\eta+\lambda)\frac{\beta}{1-\beta}\frac{\varrho_k(z)-w_k}{\eta+\lambda} \quad = \quad w_k - \eta U_k \tag{5.48}$$

$$(\eta+\lambda)\frac{\beta}{1-\beta}\frac{\varrho_k(z)-w_k}{\eta+\lambda} \quad = \quad w_k - b_k - \theta_k m(\theta_k)\frac{\beta}{1-\beta}\frac{cp}{m(\theta_k)} \tag{5.49}$$

$$\beta\varrho_k(z) - \beta w_k \quad = \quad (1-\beta)w_k - (1-\beta)b_k - \theta_k\beta cp \tag{5.50}$$

$$w_k \quad = \quad (1-\beta)b_k + \beta(\varrho_k(z) + \theta_k cp) \tag{5.51}$$

To solve for the equilibrium intermediate good price we can interact the wage curve (5.17) and the job creation curve (5.11) and solve for $\varrho_k(z)$

$$(1-\beta)b_k + \beta(\varrho_k(z) + \theta_k cp) = \varrho_k(z) - (\eta+\lambda)\frac{cp}{m(\theta_k)} \quad (5.52)$$

$$\varrho_k(z) = b_k + \frac{cp}{1-\beta}\left(\beta\theta_k + \frac{\eta+\lambda}{m(\theta_k)}\right) \quad (5.53)$$

Derivation of the LMC curve. We know that firms' demand for intermediate goods is given by equation (5.24). Aggregating low-skill labor demand over all industries and equating aggregate labor demand and supply yields

$$L_i(1-u_{li}) = \int_{\underline{z}_d}^{\bar{z}_d} l(z)x(z)dz \quad (5.54)$$

$$L_i(1-u_{li}) = \int_{\underline{z}_d}^{\bar{z}_d} B\zeta a_l(z)(q_l a_l(z) + q_h a_h(z))^{\zeta-1} r^{1-\zeta} x(z)dz \quad (5.55)$$

where we can use (5.2) to substitute out $x(z)$ and (5.7) to solve for (5.25) or (5.28) in order to derive a simpler version of the LMC and in order to calibrate the whole model. The assumption that all industries have equal share in the consumers' expenditure is made to solve the integral. See Feenstra (2010) for an equal treatment. This assumption allows us to introduce a constant instead of $\varphi(z)$ which is thus independent of z and instead depends on the bounds of the integral. To solve the integral by integration by parts we define $f_k(z) = a_k(z)$ and $g_k'(z) = (q_l a_l(z) + q_h a_h(z))^{-1}$, which gives us $\int f(z)g'(z) = [f(z)g(z)] - \int f'(z)g(z)$ and solves as

$$L_d(1-u_{ld}(\theta_{ld})) = (\bar{z}_d - \underline{z}_d)\zeta E\left([a_{ld}(z)g(z)]_{\underline{Z}}^{\bar{Z}} - \int_{\underline{z}_d}^{\bar{z}_d} a_{hd}'(z)g(z)dz\right)$$

$$= \frac{(\bar{z}_d - \underline{z}_d)\zeta E\theta}{\varpi_d'}\left([a_{ld}(z)ln\ \varpi(z)]_{\underline{z}_d}^{\bar{z}_d} - \gamma_{ld}\int_{\underline{Z}}^{\bar{Z}} ln\ \varpi(z)dz\right)$$

where we use $\varpi = q_{ld}(\theta_l)a_{ld}(z) + q_{hd}(\theta_h)a_{hd}(z)$ and $\varpi'(z) = q_l(\theta_l)\Gamma_l + q_h(\theta_h)\gamma_h$. The second integral is solved by substitution so that we obtain equation (5.30) as a final solution.

Proof of Proposition (3). First, notice that the left hand of the LMC curve Γ_L is well behaved due to the convexity of the Beveridge curve. For $\lim_{\theta\to\infty}\Gamma_L = L$ since $\lim_{\theta\to\infty}u(\theta) = 0$. Let the equilibrium market tightness go to zero and we find that $\lim_{\theta\to 0}\Gamma_L =$

0 since $\lim_{\theta\to 0}u(\theta) = 1$. Thus, for $\theta = 0$ we have full unemployment and no worker is willing to search for a job.

The right hand side of the LMC curve is also well behaved. Demand for intermediates hinges on the intermediate goods prices q_k and q_k depends on exogenous parameters and the equilibrium market tightness. However, equation (5.18) is asymptotic in θ so that the necessary restriction for θ_k is

$$\beta\theta_k + \frac{\eta+\lambda}{m(\theta_k)} < \frac{(1-\beta)}{c}$$

to secure that $q_k(\theta) > 0$. However, this is not a strong assumption for reasonable values of the exogenous parameters. The first derivative of equation (5.18) is positive since

$$\frac{\partial q(\theta_k)}{\partial \theta_k} = -\frac{-c\left[\beta + \alpha(r+\lambda)m\theta_k^{\alpha-1}\right](1-\beta)b_k}{\left[(1-\beta) - c(\beta\theta_k + \frac{\eta+\lambda}{m(\theta_k)})\right]^2} > 0$$

which is needed to derive $\frac{\partial \Gamma_R}{\partial \theta_k} < 0$. It is enough to apply the Leibniz rule on Γ_R in order to derive

$$\frac{\partial \Gamma_R}{\partial q_k} = \int_{\underline{z}_d}^{\bar{z}_d} -\frac{\zeta\varphi(z)E(a_k(z))^2}{[q_l a_l(z) + q_h a_h(z)]^2}dz < 0 \tag{5.56}$$

which implies that $\frac{\partial \Gamma_R}{\partial \theta_k} < 0$. To derive this proof the assumption that the upper and the lower bound remain constant was made. The intermediate good price for the other skill group is also implicitly assumed constant and optimal. However, there is an interaction between both skill groups. A change in the price of the other intermediate good shifts the regarded labor demand curve Γ_R. Therefore, given the upper and lower bounds of z there exists exactly one combination for both market tightness for which both skill group's LMC curves are jointly satisfied.

Proof of Proposition (4). Part a) follows immediately by deriving the first derivative of Γ_R with respect to z^*. Notice, that for each country we ex-ante know whether z^* is the upper or lower bound. In the two country scenario both countries have one constant bound (either 0 or 1) and one variable bound z^*. So it is important to determine whether z^* is the upper or lower bound for each country, which depends on the regarded country's comparative advantage. For the moment we assume that home has a comparative advantage in the production of goods closer to 1 and foreign has a comparative advantage in the production of goods closer to 0. For the home country z^* is therefore the lower bound of active industries. Changing the bounds and deriving the first derivative with respect to z^* therefore yields

$$\frac{\partial \Gamma_R}{\partial z^*} = -\frac{a_{kd}(z^*)\varphi(z^*)E}{q_{ld}a_{ld}(z^*) + q_{hd}a_{hd}(z^*)} < 0 \tag{5.57}$$

for Home and respectively

$$\frac{\partial \Gamma_R}{\partial z^*} = \frac{a_{kf}(z^*)\varphi(z^*)E}{q_{lf}a_{lf}(z^*) + q_{hd}a_{hf}(z^*)} > 0 \tag{5.58}$$

for Foreign. An increase in the cutoff industry thus reduces labor demand at the extensive margin due to a reduction in active industries.

Part b) follows from the assumption made about relative skill endowments and technology that $a_h > a_l$ and c) is also straightforward.

Proof of Proposition (6). This Proposition follows from Proposition 4 and 3. The assumption that interest rates are endogenously determined implies that capital flows must be compensated by a change in the capital rentals. Capital outflows for instance makes capital more scarce. The reduction in supply therefore must be compensated by a readjustment in capital cost. Suppose that everything else remains equal for the moment. Such an increase in capital cost shifts the unit cost curves upward. The reverse applies for the capital inflow country where the increases capital supply will shift the unit cost curves downward. The former cutoff z^* cannot be optimal anymore and must change. The capital outflow country loose its comparative advantage in some industries close to the former cutoff and the capital inflow country will extend its production to industries formerly associated to the outflow country and z^* will readjust. Proposition 4 immediately implies that Γ_R in the outflow country will fall and Γ_L in the inflow country will rise for both input factors. To restore equilibrium, wages and thus unemployment have to readjust so that $\Gamma_L = \Gamma_R$ again. Wages and thus intermediate good prices in the outflow country must decrease and wages in the inflow country must increase. An increase in the wage rate will reduce firms' labor demand which has a countervailing effect on Γ_R and it will decrease the unemployment rate so that γ_L goes down.

Proof of Proposition (7). The first derivative of the ETC curve with respect to b is

$$\frac{\partial q_k}{\partial b_k} = \frac{(1-\beta)}{(1-\beta) - c(\beta\theta_k + \frac{\eta+\lambda}{m(\theta_k)})} > 0 \tag{5.59}$$

Thus, the intermediate good's price q_k increases for each θ_k which shifts the respective unit cost curve upwards. Again the former equilibrium z^* is not optimal anymore and the adjustments are similar to the adjustments in Proposition 6. Take for instance an increase in the bargaining power. Again, the first derivative reads

$$\begin{aligned}
\frac{\partial q_k}{\partial \beta} &= \frac{-b_k\left[(1-\beta) - c(\beta\theta_k + \frac{\eta+\lambda}{m(\theta_k)})\right] + (1-\beta)b_k c\theta_k + (1-\beta)b_k}{\left[(1-\beta) - c(\beta\theta_k + \frac{\eta+\lambda}{m(\theta_k)})\right]^2} && (5.60)\\
&= \frac{-b_k(1-\beta) + b_k c\beta\theta_k + b_k c\beta\frac{\eta+\lambda}{m(\theta_k)} + (1-\beta)b_k c\theta_k + (1-\beta)b_k}{\left[(1-\beta) - c(\beta\theta_k + \frac{\eta+\lambda}{m(\theta_k)})\right]^2} && (5.61)\\
&= \frac{+b_k c\beta\frac{\eta+\lambda}{m(\theta_k)} + b_k c\theta_k}{\left[(1-\beta) - c(\beta\theta_k + \frac{\eta+\lambda}{m(\theta_k)})\right]^2} > 0 && (5.62)\\
& && (5.63)
\end{aligned}$$

The shift of the unit cost schedule and the change in the cutoff industry also affects the other countries through spillover effects according to Proposition 6. Firstly, the unit cost schedule in the country where labor market institutions change in favor of the workers shift up. The unit cost schedule in the other country remains unchanged. The cutoff changes exactly as already described for the increase in the capital rental, so that Γ_R and Γ_L have to adjust accordingly. See the proof for Proposition 6 for more details.

Chapter 6

FDI and Unemployment: Empirics

To further contribute to the debate on FDI and unemployment highlighted in the previous chapter we now turn to the interactions between product and labor markets by studying how footloose capital flows between two countries affect unemployment from both an empirical and a theoretical perspective. The ongoing internationalization of product and labor markets has stimulated a debate about the pros and cons of globalization. Supporters often stress the beneficial effects that arise due to increased export opportunities, whereas globalization's detractors are often more concerned about job losses due to heightened competition with workers from less developed countries. Economics can contribute to this debate in that it can rationalize the fear that more intensive global economic-interdependency generates by identifying the merits and downsides of this process and by quantifying the labor market outcomes of the potentially opposing effects. The public debate that surrounds these issues has frequently been characterized by a lack of clarity regarding the definition of globalization and a failure to account for different elements of this process which may have contrasting implications for domestic and international labor markets. In this chapter we devote our attention to the implications of capital mobility for domestic and international labor markets by proposing an empirical test on the FDI and unemployment nexus. Besides the direct effects of FDI on unemployment we also analyze institutional spillover effects that stem from unilateral improvements in labor market institutions favoring the workers. The model presented in the theory chapter departs from previous studies in that the effect is ex-ante ambiguous and highly depends on whether a country is the FDI receiving or sending country.

The main contribution is to test the two-edged outcome of the model outlined in the next chapter, which is akin to Schmerer (2010 a) but which does not feature the distinction between low and high skill workers.[1] Such a procedure is justified by the outcome of skill-specific version of the model in the previous chapter where we show that both skill-groups are equally affected mainly due to the effects at the extensive margin. We thus show that the same effects can be replicated on the aggregate level in order to bring the model to the data using high quality OECD data. Skill-specific unemployment rates are used in the additional results chapter in order to test the complementarity described in the skill-specific version of the model. However, the results are somewhat superior to the aggregate unemployment regression results since the data quality is less convincing and since the relatively short time span of the data does not allow us to purge the data from short-run fluctuations.

It will be shown that *FDI* directly affects labor demand on both the intensive and extensive margin. At the extensive industry margin the widening of the *FDI* receiving country's range of active industries is due to increased competitiveness in industries located close to the former cutoff, which boosts labor demand and thus decreases equilibrium unemployment. The impact of such an industry-reallocation from one to the other country is expected to be much stronger in magnitude than the effects caused by pure substitution between labor and capital. The effect is ambiguous and thus addressed in a numerical simulation.

To the best of my knowledge, the research presented in this chapter is the first focusing on the unemployment effects of global sourcing in a model with a continuum of industries from an empirical and a theoretical perspective. Lin and Wang (2008) present some empirical evidence on the effects of capital-outflows on equilibrium unemployment. However, their paper lacks a theoretical foundation and their analysis does not feature the distinction between FDI-net stocks and flows. This distinction is crucial at least in the model presented in the theory chapter where we show that the sign of the effect is different depending on whether a country is the receiving or the sending country. Moreover, our empirical exercise extends Lin and Wang (2008) in that we control for other important drivers behind unemployment as proposed by numerous studies on labor market institutions on unemployment.

Two closely related papers are the studies Felbermayr, Prat and Schmerer (2011 b) and

[1] As shown in the previous chapter, the effects of *FDI* or a change in labor market institutions equally evolves in both skill groups. The empirical strategy is therefore twofold. We nevertheless exploit data on skill-specific unemployment rates to show some evidence on the complementarity between high and low skilled workers as established in Schmerer (2010 a). However, the main empirical investigation focuses on aggregate data for reasons of data availability.

Dutt, Mitra, and Ranjan (2009) both providing empirical evidence on the trade and unemployment nexus. We use the same methodology as proposed in both papers in order to test the relationship between FDI and unemployment highlighted in the theory section of this chapter.

6.1 The benchmark model

We assume a two-stage production process with a continuum of final consumption goods assembled using intermediate inputs, and capital. Intermediates are produced in the second stage of the model using the homogeneous input factor labor. Labor markets are imperfect due to search frictions so that firms have to post vacancies in order to recruit new workers. Once met, employers and employees engage in wage bargaining, and in case of a successful match the firm is established and starts producing the intermediate good. The standard Pissarides small firm assumption applies, wherefore each firm in stage 2 employs exactly one worker and produces one unit of the intermediate good. Stage 1 prices charged for the final consumption good and wages paid to workers producing the intermediates are closely related. Wages, goods prices, and thus world income are jointly determined in general equilibrium, thereby linking the different production stages.

Consumer demand. The whole continuum of goods is consumed by the representative household according to a standard aggregate demand function

$$ln\ Y = \int_0^1 \varphi(z)\ ln\ x(z)dz \quad , \tag{6.1}$$

where $x(z)$ is the quantity of the goods purchased from industry z and $\varphi(z)$ is the Cobb Douglas share in z.[2] Aggregate demand evaluated by the price P must equal total expenditure $YP = E$. A fraction $\varphi(z)$ of world expenditure is spent on the consumption of good z and consumer demand is thus pinned down by

$$x(z) = \frac{\varphi(z)E}{c(z)} \quad , \tag{6.2}$$

[2]Summing up the shares over the whole continuum of industries must equal unity.

which states that total expenditure for z equals revenue generated in z. Perfect competition implies that revenue in industry z equals quantity times unit costs as in (6.2) and thus allows us to interact the consumption and production parts (stage 1 and 2) of the model.

Stage 1: Final good producers. Final goods are produced using the input factors capital and intermediate goods. The industries are ordered according to the input coefficients $a(z)$, which exogenously determine the requirement of intermediates needed to produce one unit of the consumption good. Each country specializes in producing in industries where it has a comparative advantage by means of lower unit costs compared to that in the competing country. Input coefficients in z are given by

$$a_i(z) \quad = \quad \alpha_i + \gamma_i(z) \quad , \tag{6.3}$$

where index i denotes domestic (d) or foreign (f). The labor requirement comprises a non-industry specific component α and an industry-specific component that varies over the continuum. As in Dornbusch et al. (1977) technology differences across countries are necessary to derive a clear trade pattern according to each country's comparative advantage.[3]

To model final good production we postulate a Cobb Douglas production function

$$x_i(z) = [a_i(z)]^{\zeta} \, [k_i(z)]^{1-\zeta} \quad . \tag{6.4}$$

The final industry output good is sold for a price $p(z)$. Perfect competition implies that the industry price level equals the respective industry unit costs

$$p_i(z) = c_i(z) = B(q_i a_i(z))^{\zeta} r_i^{1-\zeta} \quad , \tag{6.5}$$

where $c(z)$ denotes minimum unit costs in sector z obtained by solving the cost minimization problem of the firm. Cost depend on prices paid for the intermediate inputs and capital. $B = \zeta^{-\zeta}(1-\zeta)^{-(1-\zeta)}$ and $a(z)$ are given exogenously.

Wages are determined in stage 2 and equalized across industries. Stage 1 firms take prices charged by stage 2 firms as given and adjust their labor demand based on the price

[3]Another approach close to the Dornbusch et al. (1977) model is Eaton and Kortum (2002) where countries draw their productivity parameter from a country-specific distribution. Using equation (6.3) instead allows us to determine a clear industry ranking that facilitates extensions such as mine.

q (in common units) charged by stage 2 firms for the intermediate good.

Stage 2: Intermediate input producers. In this final stage labor is the sole input factor used to produce the intermediate input goods. Firms have to post vacancies in order to recruit new employees which incurs vacancy posting costs c prior to a successful match. We assume that vacancy posting costs are paid in terms of stage 1 prices when solving the general equilibrium of the model.[4] The matching process $m(\theta_i)$ is concave and has constant returns to scale properties. The problem of the firm and worker depends on firms' revenue, unemployment benefits b, the bargaining power β, vacancy posting costs c, the interest rates r, the discount rate η, and job destruction rate λ. See the detailed solution in the Appendix for further details on how to derive the equilibrium.

Lemma 3. *a) To derive a unique solution for intermediate goods' prices, q, the wage and job creation curves are interacted and solved as*

$$q_i = \frac{(1-\beta)b_i}{(1-\beta) - c(\beta\theta_i + \frac{\eta+\lambda}{m(\theta_i)})} \tag{6.6}$$

b) Wages, and therefore intermediate good prices, are increasing in θ_i since $\frac{\partial q}{\partial \theta_i} > 0$.

Proof. The solution for a) is obtained as for the skill specific version in chapter 5. See chapter 5.7 for more details on how to derive the exact solution for the wage and the job creation curves. We can exploit $\frac{\partial m(\theta_i)}{\partial \theta_i} < 0$ in order to show that $\frac{\partial q_i}{\partial \theta_i} > 0$. The higher the vacancy to unemployment ratio, θ_i, the higher must be the equilibrium wage rate in order to attract enough workers to fill the vacancies. Higher wages in turn are linked to higher intermediate good prices paid by stage 1 final good assemblers. □

6.1.1 Labor market clearing

The existence of search frictions in the labor market gives rise to a situation where firms adjust their labor demand to the intermediate input prices depending on wages and search costs. Perfect competition with search frictions imply that the intermediate good's price comprises production costs plus expected recruitment costs.

[4]This assumption is in line with Pissarides (2000).

Firms in stage 1 are price takers and base their labor demand decision on the already optimal intermediate input goods' prices. Using Shephards Lemma, stage 1 firms' labor demand reads as

$$\frac{\partial c_i(q,r;z)}{\partial q_i(z)} = B\zeta a_i(z)(q_i a_i(z))^{\zeta-1} r_i^{1-\zeta} \quad . \tag{6.7}$$

The economy's total labor demand can be found by aggregating industry labor demand over the whole continuum of active industries

$$L_i(1-u_i(\theta_i)) = \int_{\underline{z}_i}^{\bar{z}_i} B\zeta \left[\frac{r_i}{q_i a_i(z)}\right]^{1-\zeta} a_i(z)x_i(z)dz \quad , \tag{6.8}$$

where $\bar{z}_i$ and $\underline{z}_i$ represents the upper and lower bound of industries where the respective country has a comparative advantage. Intermediate goods' prices q are determined in stage 2 and depend on the equilibrium market tightness. Equation (6.2) allows us to simplify the Labor Market Condition *(LMC)* such that the equilibrium depends only on the endogenous parameters z and θ_i as well as other exogenous parameters and reads as

$$L_i(1-u_i(\theta_i)) \quad = \quad \int_{\underline{z}_i}^{\bar{z}_i} \zeta \frac{\varphi(z)E\left\{(1-\beta)-c(\beta\theta_i+\frac{\eta+\lambda}{m(\theta_i)}\right\}}{\{(1-\beta)b_i\}} dz \quad . \tag{6.9}$$

The standard Pissarides (2000) assumption that each firm employs one worker links stage 2 firms' demand for intermediate goods in (6.9) and stage 2 labor demand which is equal to the number of firms. The specialization pattern under free trade is ex-ante unknown and depends on the unit cost schedule over all industries. The mass of one single industry approaches zero in the continuous scenario. A sensible interpretation therefore demands the computation of the mass of a certain range of industries within the whole continuum. The consumption share for industry output in z is constant and equalized over the whole continuum, which allows us to solve the integral in (6.9).

Lemma 4. *Labor markets are in equilibrium if labor demand equals labor supply. The LMC conditions therefore pin down equilibrium market tightness, wages, and unemployment. The equilibrium is well-defined as there exists a unique combination of home and foreign market tightness such that both LMC curves are fulfilled given the cutoff z^*.*

Proof. Let Γ_L denote the left, Γ_R the right hand side of the labor market clearing condition. The left hand side of both conditions has its origin at zero and converges to an upper bound.

The intuition is the following. Let θ_i go towards zero. Wages would approach zero, whereas unemployment would go towards infinity such that the left hand side of the LMC curve has its origin in zero and converges towards full employment. The right hand side is also well behaved. Labor demand is positive for θ_i approaching zero and decreases in θ_i. An increase in θ_i triggers an increase in intermediate input goods' prices, which in turn reduces demand for the intermediates. Thus, there is a unique solution for the LMC curve determined by the intersection of Γ_L and Γ_R. $\square$

6.2 General Equilibrium

The general equilibrium requires a framework that pins down the endogenous parameters. To close the model income is normalized to unity and determined by adding up world factor payments to workers in and outside of the unemployment pool given by

$$E = L_d(1-u_d)q_d + r_d K_d + L_f(1-u_f)q_f + r_f K_f \quad , \tag{6.10}$$

Capital rentals are determined using the Cobb Douglas shares and the capital market clearing conditions

$$r_d K_d = \frac{1-\zeta}{\zeta} L_d(1-u_d)q_d \quad , \tag{6.11}$$

$$r_f K_f = \frac{1-\zeta}{\zeta} L_f(1-u_f)q_f \quad . \tag{6.12}$$

Interest rates are such that capital markets are in equilibrium. The equilibrium then depends on 6 endogenous variables: 2 equilibrium market tightness, capital return in the foreign country, capital return in the home country, one cutoff that pins down the trade pattern between both countries, and income. Without loss of generality we can use world income as nummeraire. To close the model one still has to solve for the optimal free trade pattern.

Corollary 1. *The trade pattern between both countries hinges on one unique cutoff* $z^* \in (0,1)$ *satisfying*

$$p_d(z^*) = p_f(z^*) \quad \Leftrightarrow \quad c_d(\theta_d; z^*) = c_f(\theta_d; z^*) \quad . \tag{6.13}$$

6.3 Comparative statics analysis

For the comparative statics analysis we focus on two closely related scenarios. Firstly, we analyze how footloose capital flows triggered by differences in international capital returns affect equilibrium unemployment. For this particular scenario interest rates are endogenously determined. Secondly, we turn to the implications of labor market institutional reforms on capital flows. For this second exercise interest rates are exogenous by assumption. Notice, that the comparative statics presented are closely related to that presented in the previous chapter and in Schmerer (2010 a) where we already derived those effects for low and high skill workers. We therefore briefly state the main implications without going into more details.

6.3.1 The effects of *FDI* on equilibrium market tightness.

FDI in the form of capital inflows and outflows necessarily induce interest rate readjustments so that the capital clearing conditions are in equilibrium again. Capital inflows for instance reduce the scarcity of capital and thus precipitate a reduction in interest rates, thereby decreasing unit costs. Given that all other factor prices remain constant, the unit cost function shifts down associated with lower final good prices over the whole continuum. The opposite happens in the country that looses capital due to a relatively lower interest rate.

The trade pattern is no longer optimal and the new intersection of the domestic and the foreign unit cost schedules is pinned down by $z^{*'} > z^{*}$. The range of active industries contracts in the *FDI-out* economy and expands in the *FDI-in* economy. This implies that the former labor market equilibrium is not optimal any more: unemployment, wages and the equilibrium market tightness have to adjust.

In the following We distinguish between the adjustments at the extensive and intensive margin. At the extensive margin some industries die, which gives rise to a reduction in labor demand on the aggregate level. At the same time the adjustments of capital costs also directly affect the equilibrium by triggering a substitution between capital and labor.

Proposition 2. *FDI outflows result in capital cost adjustments. Firms' labor demand increases at the intensive margin due to higher capital costs triggering a substitution effect. At the extensive margin the increase in the cutoff destroys all jobs associated with industries* *formerly belonging to the sending country. The opposite pattern applies for the FDI-receiving country.*

Proof. This proposition is identical to Proposition 6 in chapter 5. See also chapter 5.7 for more details. To proof this one has to derive the first derivative of the right hand side of the LMC curve with respect to the cutoff z^*, which is positive for the receiving and negative for the sending country, translating into job creation (*FDI-in* country) and job destruction (*FDI-out* country) at the extensive margin. Note that the distinction between the case where z^* is the upper or lower bound of active industries is necessary. Suppose for instance that the home country's fixed bound of active industries is the upper bound $\bar{z}_d = 1$ so that its lower bound is z^*. A contraction of the range of active industries in the respective country would mean that z^* is increasing. The first derivative of Γ_R with respect to z^* would therefore be negative. The same logic applies for the foreign country with one important difference being that z^* is now the upper bound of active industries whereas the lower bound is pinned down by $\underline{z}_d = 0$, giving rise to the fact that the first derivative of Γ_r in the foreign economy is positive.

In order to restore equilibrium labor supply must adjust too. Since labor demand in the FDI-out country decreases at the extensive margin, a higher rate of unemployment is needed to restore equilibrium. Thus, the equilibrium market tightness must fall, wages go down and unemployment goes up. This in turn boosts labor demand on the individual industry level and strengthens the increase in labor demand on the intensive margin. Income adjustments do not matter in my setup since income is set as nummeraire. A formal proof can be found in the Appendix to chapter 5. □

6.3.2 Changes in labor market institutions

Proposition 3. *Changes in institutions that benefit the workers by increasing their wages due to higher bargaining power β or higher unemployment benefits b triggers capital outflows.*

Again this proposition is already derived for the skill-specific version of the model in chapter 5 and stems from 5.55 and 5.59 where we show that institutional changes benefiting the workers increase their wages and thus increase the intermediate goods' prices. Suppose that cutoff z^* and the equilibrium market tightness remain constant. An increase in unemployment benefits or the bargaining power of workers for instance result in higher equilibrium wages, provided all other variables remain constant. The effect of positive institutional changes is therefore identical to an increase in the interest rate and the unit cost schedule shifts upwards so that the former equilibrium cutoff is no longer optimal and must adjust, too. Furthermore, capital allocation is no longer optimal since interest rates remain fixed, resulting in capital flows between countries in order to restore equilibrium. The intuition is straightforward. A contraction of active industries without adjustments in the interest rate sets capital free which will be shifted abroad where capital is needed due to the expansion of production. Unemployment and wages must adjust until the new equilibrium is reached. These spillover effects stem from the interdependency between countries connected via trade. However, a new capital market clearing condition is necessary to solve for the new equilibrium. Again we use Shephards Lemma to derive industry level capital demand which reads as

$$\frac{\partial c_i(z)}{\partial r_i} = B(1-\zeta)(q_i(z)a_i(z))^{\zeta} r_i^{-\zeta} \quad . \tag{6.14}$$

Aggregating industry level capital demand over all active industries yields

$$K_i = \int_{\underline{Z}_d}^{\bar{Z}_d} k_i(z)x(z)dz \quad , \tag{6.15}$$

similar to the solution for the LMC curve we use equation (6.14) and (6.2) in (6.15) to obtain

$$K_i = \int_{\underline{Z}_d}^{\bar{Z}_d} B(1-\zeta)(q_i(z)a_i(z))^{\zeta} r_i^{-\zeta} x(z)dz \tag{6.16}$$

$$= \int_{\underline{Z}_d}^{\bar{Z}_d} \frac{B(1-\zeta)\varphi(z)E(q_i(z)a_i(z))^{\zeta} r_i^{-\zeta}}{B(q_i a_i(z))^{\zeta} r_i^{1-\zeta}} dz \tag{6.17}$$

$$= \int_{\underline{Z}_d}^{\bar{Z}_d} (1-\zeta)\varphi(z)E\left[r_i^{-1}\right] dz \quad . \tag{6.18}$$

Compare this solution to the aggregate capital market clearing conditions used to endogenize the interest rates in both countries. It is easy to show that both conditions are equal by simply combining the labor and capital market clearing conditions via equations (6.11) and (6.12). With endogenous interest rates the effects of an institutional change on capital is unambiguous and depends solely upon the adjustments at the extensive margin. World capital endowments are fixed. Using the Leibniz rule we can derive the first derivative of the right hand side with respect to the cutoff z^* which is negative for the contracting, and positive for the expanding economy. The effect is thus unambiguous and we therefore neglect the calibration.

6.4 Empirical evidence

For the second part of this study, data from Bassanini and Duval (2005) and the UNCDAT is used to test the main implications of the model presented in the theory chapter. First, the model predicts that inward-FDI are associated with a lower rate of equilibrium unemployment, whereas outward-FDI can be linked to surging rates of unemployment. Second, improvements in labor market institutions that benefit the workers by increasing their rights and/or wages tend to trigger capital outflows. This result stems from the fact that institutional changes in favor of the workers reduce firms competitiveness in some of the industries close to the cutoff through their direct and indirect effects on wages. A successful test that support the theoretical findings will be presented in this chapter, where we use panel data on in- and outward FDI, aggregate and skill-specific unemployment, labor market institutions and other control variables for 19 OECD countries in order to analyze the relationship highlighted in the theory chapter. Theory does not allow for simultaneous capital in- and outflows. This issue is addressed by constructing FDI-net stocks/flows as difference between FDI-in and FDI-out relative to GDP. Negative signs for FDI net flows/stocks indicate that a net-increase in capital-imports is associated with a reduction in unemployment. Two major concerns remain: Unemployment fluctuates with the business cycle and the analysis might be biased due to omitted variables. We address the first problem by controlling for the output gap measuring the difference between GDP and its long run trend as well as other macroeconomic shocks. Five-year averages were taken in a second step, which purges short run fluctuations from the data. The second problem is by far more involved and addressed by including various control variables that capture labor market institutions, as well as dummy variables to control for country and time specific effects. Since FDI might be endogenous to unemployment, the time dimension of the data is used to construct instruments for the diff-GMM regressions, which allows us to tackle the endogeneity problem by treating FDI as endogenous.[5]

[5] The requirement on diff-GMM regressions are rather demanding and not always fulfilled. Several test statistics permit the evaluation of the GMM results. Sys-GMM results are not presented since it produces instruments that are not valid due to the over identification problem.

The empirical setup is closely related to the empirical strategy in Felbermayr et al. (2011b) or Dutt et al. (2009) both of which focus on trade liberalization and aggregate unemployment.

6.4.1 Empirical strategy and data

Empirical strategy. Inspired by numerous labor market studies that analyze the effects of institutional changes on labor market outcomes we estimate a linear model with total unemployment as the dependent variable to shed light on proposition 1 from an empirical perspective. The model reads as

$$u_{it} = \alpha + \beta \times FDI_{it} + \gamma_1 \times LAB_{it} + \gamma_2 \times CON_{it} + CCC_i + YYY_t + \epsilon_{it} \quad , \tag{6.19}$$

where α is a constant, FDI is the variable of interest measuring FDI-net intensity as the difference between in- and outward FDI relative to GDP, LAB contains various labor market institutional variables, where Bassanini and Duval provide measures on the replacement rate, tax wedge, employment protection, and union density. Additional control variables gathered in CON include product market regulations[6], and the output gap to cope with short run fluctuations. The panel structure of the data facilitates purging the regressions of country and time invariant effects by including dummy variables in the regressions.

The second proposition that states that changes in labor market institutions affect FDI flows is tested using the same empirical strategy but with FDI replacing unemployment as the dependent variable and reads as

$$FDI_{it} = \alpha + \gamma_1 \times LAB_{it} + \gamma_2 \times CON_{it} + CCC_i + YYY_t + \epsilon_{it} \quad . \tag{6.20}$$

The variables of interest when testing the interaction between labor market institutions and FDI are those measuring the direct and indirect effect of institutional changes on wages. The preferred estimator in both parts of the analysis is a consistent fixed effects estimator including additional time dummies to control for trends common to all countries. Additional feasible least square and diff-GMM models are used as a robustness check. In a last step, the endogeneity issue is addressed by use of a diff-GMM estimator where the LAB variables

[6] As shown by Felbermayr, and Prat (2011) product market regulations have an significant impact on unemployment.

are treated as endogenous.

Generally speaking, the data dimension necessitates five-year averages in order to run diff-GMM regressions, and further reduces the impact of short run business cycle fluctuations. The first problem stems from the fact that the our data has a relatively larger cross-sectional than time-dimension. Usually the instruments preform badly when $T > C$), which stems from over identification due to too many instruments. Obviously, this requirement is not fulfilled by the original Bassanini and Duval data set which covers observations from 1983 - 2003 for 20 OECD countries. Five-year averages ease this problem by reducing the number of instruments and structural breaks in the data. However, notice that the structure of the data is still not optimal indicated by the number of instruments and the Sargan test statistics reported when preforming diff-GMM. We skip sys-GMM since the additional level equation would further increases the instrument count and drive the test on over identification towards a p-value equal to 1.0.

Data. To bring the model to the data we use measures from the OECD, UNCDAT, and WDI. The dependent variable in part A is OECD total unemployment including 15 - 64 years old male and female observations. As additional robustness check we use skill-specific unemployment rates from the World Development Indicators to decompose aggregate unemployment into its primary-, secondary-, and tertiary-educational components. The purpose of this exercise is to show the complementarity between both skill groups respective of the effects of FDI on unemployment.[7] To construct skill-specific unemployment rates we multiply total unemployment from the World Development Indicators with a variable measuring the fraction of total unemployment with primary, secondary, and tertiary eduction. To transfer the data into skill-specific rates we multiply the result with the ratio of total workers relative to the number of workers with respective education in order to obtain the number of workers unemployed relative to the number of workers available within the respective skill group. However, one major drawback is the sparse data availability ranging from 1994 - 2004 with lags.

The variable of interest in part A is FDI-net stocks and flows constructed using measures

[7] Theory in Schmerer (2010) requires low and high skill unemployment wherefore we classify unemployed with secondary and tertiary education as high skill-specific unemployment. Moreover, theory predicts that both skill groups are equally affected by FDI. This stems from the Leontief production function, which is in line with Feenstra and Hanson (1996, 1997) model where high and low skill inputs are used according to a Leontief production function.

on in- and outward FDI from the UNCDAT database. FDI-net is measured as the difference between inward-FDI and outward-FDI relative to GDP. FDI includes transactions of firms from foreign countries holding a share of at least 10% in a domestic company. Inward FDI is an investment from abroad in the reporting country, whereas FDI-out measures FDI from the reporting country to other countries. FDI stocks and flows are measured in current U.S. dollars so that a measure for GDP from the Penn World Table can be used to construct FDI-net intensities in order to create a comparability across countries. Portfolio investment assets and real openness, both in U.S. dollars relative to GDP, are included as additional control variables to proxy financial integration and globalization, where the data was taken from the International Monetary Fund and the World Bank.

Various measures of labor market institutions available through the OECD were exploited to reduce the omitted variable bias caused by other unobserved variables that drive unemployment. Bassanini and Duval provide and discuss a data set that contains the most important variables. We control for tax wedge, replacement rate, employment protection (EPL), and union density. Unfortunately the OECD stopped updating those variables so that labor market institutions are available for the period 1983 - 2003 only and therefore also determine the time dimension of our sample.

Part B of the analysis focuses on the role of labor market institutions by including them as variables of interest in regressions with FDI as the dependent variable. Two variables are available that directly measure how labor market institutions affect wages: the replacement rate and the tax wedge. The replacement rate is a measure for compensation paid to workers after losing their job and tax wedge measures taxation on wages by computing the difference between wages paid by employers and wages earned by employees. Moreover, union density and employment protection are also potential drivers behind FDI-flows through their indirect effects on the labor market flexibility and thus through their indirect effects on wages. Union density is a variable on the percentage share of workers associated with unions which is also often used as a proxy for the workers' bargaining power, and EPL measures the stringency of employment protection legislation indirectly affecting wages by protecting workers with productivity below their marginal product from being expelled. PMR is a measure of the stringency of product market regulation in the respective country.

We will distinguish between employment protection for regular and temporary contracts, and for two different measures for union density when institutional spillover effects are thrust into the spotlight of our analysis.

An output gap measure and various macroeconomic shocks purge short run fluctuations from the data and thus help to reduce the omitted variable bias. A total factor productivity shock is constructed as the derivation of total factor productivity from its trend using a Hodrick-Prescott filter, terms of trade shocks that measure the relative price of imports weighted by the share of imports in GDP, real interest rate shocks that measure the difference between the 10-year nominal government bond yield and the annual change in the GDP deflator, as well as labor demand shocks constructed as the logarithm of the labor share in business sector GDP purged from the short-run influence of factor prices.[8] The output gap variable measures the difference between actual and potential GDP as percentage of potential output.

6.4.2 Results

According to theory, the predicted sign of the *net-FDI* coefficient is negative when regressing upon unemployment. Regressing labor market institutions on FDI similarly requires negative signs for the LAB variables.

Theory predicts that *net-FDI* inflows tend to lower the rate of unemployment due to a reallocation of industries, which causes job creation in the receiving and job destruction in the sending country. Thus, *net-FDI* receiving countries should have relatively lower unemployment rates and an increase in *net-FDI* over time is expected to lower equilibrium unemployment rates. For part B of the analysis the sign for the labor market institutional variables is expected to be negative since one of the predictions derived from theory states that improvements of the workers' situation results in higher wages and thus trigger capital outflows by rendering investments to foreign countries more lucrative due to relatively lower labor costs.

Indeed, the data reveals exactly the same pattern as theory suggests. Regressing FDI on unemployment yields a negative and highly significant coefficient for *net-FDI*. Regressing labor market institutions on *net-FDI* also reveals the right coefficients for the institutional variables of interest. In the following, results are discussed in more detail.

[8]Data description taken from Bassaninin and Duval (2010).

Table 6.1: Aggregate unemployment and FDI-net

Dependent variable: Total unemployment
Variable of interest: FDI-net (FDI-in minus FDI-out relative to GDP)

	I	II	III	IV	V	VI	VII
	FE	FE	FE	FE	FE	FE	FE
FDI-net	−0.048**	−0.041**	−0.030**	−0.029**	−0.045***	−0.033*	−0.026
	(0.018)	(0.019)	(0.012)	(0.012)	(0.016)	(0.018)	(0.023)
Portfolio investment	−0.570***			−0.145		−0.005	0.186
	(0.121)			(0.115)		(0.156)	(0.134)
Openness			−0.156***	−0.131**		−0.151**	−0.128*
			(0.046)	(0.058)		(0.058)	(0.064)
EPL					−1.281	−1.182	−1.281
					(1.384)	(1.400)	(1.031)
Union density					−0.055	0.001	−0.007
					(0.064)	(0.061)	(0.063)
PMR					0.297	0.636	0.659
					(0.618)	(0.644)	(0.576)
Replacement rate					−0.031	−0.025	−0.053
					(0.043)	(0.050)	(0.043)
Tax wedge					0.315***	0.240**	0.145*
					(0.098)	(0.112)	(0.080)
Output gap		−0.566***	−0.552***	−0.577***	−0.616***	−0.591***	−0.786***
		(0.092)	(0.087)	(0.085)	(0.061)	(0.055)	(0.060)
R-square	0.348	0.509	0.578	0.584	0.594	0.663	0.730
N	428	456	456	428	386	368	338

Robust standard errors in parentheses, *significant at 10%, ** significant at 5%, *** significant at 1%. Data is available for 19 OECD countries. time dummies included in all regressions. Fixed effects always preferred according to the Hausman test.

Benchmark results Table (6.1) presents the benchmark regression results for the preferred regression model, which is a consistent fixed effects estimator. The full set of available observations is employed without averaging the data. This gives us more than 400 observations for 19 OECD countries, available for the period 1983-2003. Purging the regressions from fixed effects allows us to capture the changes on the individual country level by taking out the level effect. In regression (I) the focus lies on the measures net-FDI and portfolio investment, without controlling for any other shocks, institutional variables, business cycle effects, or the time trend. The variable of interest is *net-FDI*. Portfolio investment is a proxy for financial integration and the dependent variable is total OECD unemployment. We obtain a significant coefficient for net-FDI in regression (I). The relation is rather strong and likely reflects a spurious correlation driven by the variation in the business cycle. Portfolio investment is also negative and highly significant. We additionally include time dummies and the output gap in column (II). Regression (III) contains controls for the output gap and openness as an additional controls for globalization. In regression (IV) the whole globalization control bundle is included. All regressions reveal the same picture. FDI-net is negative and turns out significant in all regressions. Portfolio investment is less robust and becomes insignificant in (IV), where we control for the business cycle and trade openness. As in Felbermayr, Prat, and Schmerer (2011b) openness in regression (III) and (IV) have the expected signs and and are also highly significant. We also find that magnitude of the effect of FDI-net is much stronger once business cycle fluctuations are controlled for by including the output gap variable, which indicates a huge impact of the business cycle on unemployment. Regression (V) and (VI) compare the outcome of regressions where we control for labor market institutions (V), and where we additionally include the entire set of globalization controls in (VI). Comparing regression (II) and (V) reveals another interesting finding. Both coefficients for the output gap and for FDI-net are higher when we control for labor market institutions. Respectively, the magnitude of the effect of FDI is also stronger in (VI) than in (IV). In regression (VII) all controls and macroeconomic shocks are included which yields insignificant results for net-FDI.

To conclude this first part of benchmark regression discussion, all regressions except of (VII) yield significant and negative coefficients for the net-FDI measures. The sign of the effect is statistically different from zero and robust, but the coefficients reveal a relatively weak magnitude of the effect. Moreover, the magnitude highly depends upon whether we control for the business cycle or not. Another problem is the structure of the data, which neither allows us to tackle potential endogeneity problems using GMM, nor does it allow us to purge the data from short run effects in an adequate way. This problem is addressed by averaging the data. The results can be found in Table (6.2). Regression (I) only includes net-FDI and indicates that a one standard deviation increase in *net-FDI* reduces unemployment by roughly 0.8 percentage points. Including the institutional controls increases the magnitude of the effect. Controlling for financial integration reduces the significance in net-FDI, whereas additionally controlling for openness restores its significance. Next, more

Table 6.2: Aggregate unemployment and FDI-net (5-year averaged data)

Dependent variable: Total unemployment
Variable of interest: FDI-net (FDI-in minus FDI-out relative to GDP)

	I	II	III	IV	V	VI	VII	VIII
	FE	FE	FE	FE	DIFF-GMM	DIFF-GMM	DIFF-GMM	FGLS
FDI-net	−0.039*	−0.049***	−0.026	−0.043**	−0.114**	−0.139***	−0.087**	−0.034**
	(0.019)	(0.014)	(0.026)	(0.019)	(0.056)	(0.049)	(0.041)	(0.014)
port			−0.440*	0.203	1.767**	1.533**	1.547**	0.133
			(0.241)	(0.283)	(0.754)	(0.632)	(0.691)	(0.201)
Openness				−0.175**	−0.420***	−0.263**	−0.422***	−0.199***
				(0.078)	(0.131)	(0.132)	(0.114)	(0.038)
Lag dep. var.					0.565**	0.475*	0.549**	
					(0.221)	(0.280)	(0.221)	
Replacement rate		−0.034	−0.008	−0.027	−0.083	−0.079	−0.079	−0.006
		(0.046)	(0.061)	(0.054)	(0.052)	(0.055)	(0.051)	(0.025)
Tax wedge		0.376***	0.286**	0.296**	0.090	0.179*	0.072	0.191***
		(0.109)	(0.108)	(0.117)	(0.100)	(0.104)	(0.106)	(0.062)
EPL		−0.890	−0.551	−0.920	−0.569	−0.937	−0.447	−0.682
		(1.356)	(1.517)	(1.453)	(1.261)	(1.178)	(1.221)	(0.511)
Union density		−0.069	0.008	0.007	−0.085	−0.155**	−0.036	0.007
		(0.056)	(0.054)	(0.056)	(0.084)	(0.076)	(0.074)	(0.037)
PMR		0.431	0.651	0.760	0.142	0.166	0.198	0.845***
		(0.645)	(0.632)	(0.690)	(0.668)	(0.672)	(0.658)	(0.291)
Output gap	−0.710***	−0.649***	−0.595***	−0.583***	−1.102***	−1.139***	−1.006***	−0.616***
	(0.117)	(0.093)	(0.083)	(0.075)	(0.190)	(0.214)	(0.194)	(0.064)
R-square (within)	0.684	0.625	.	.	.	.		
AR (1)	.	.	.	.	0.037	0.078	0.032	.
AR (2)	.	.	.	.	0.417	0.212	0.522	.
Sargan OID-test	.	.	.	.	0.464	0.167	0.238	.
N	89	89	89	89	69	69	69	89

Robust standard errors in parentheses, *significant at 10%, ** significant at 5%, *** significant at 1%. Data is available for 19 OECD countries. time dummies included in all regressions. Fixed effects always preferred according to the Hausman test.

attention is paid to the endogeneity problem by preforming various diff-GMM setups. Setup (V) treats net-FDI and the output gap as endogenous. The performance of the instruments is rather good compared to the results obtained for the non-averaged data. The test on first and second order autocorrelation of the instruments with the error term yields p-values equal to 0.037 and 0.417, and the Sargan test p-value is higher than 0.1 but below 0.5, which indicates that the instruments are valid. However, the other globalization measures are also a potential sources for endogeneity, which will be tackled in regression (VI), where openness, net-FDI and the output gap are treated as endogenous. In (VII) we treat FDI, openness, the output gap, and portfolio investment as endogenous. All setups yield the same robust finding. FDI-net and openness are both negative and significant. Moreover, we also find that portfolio investment is positive and significant which further supports our story by indicating that more financial market integration with investors holding foreign portfolio assets having the same effects as FDI-outflows. However, the finding is interesting but unfortunately it is not robust and only appears in the GMM regressions. FGLS in (VIII) also yields comparable results.

Table 6.3: FDI-net stocks and labor market institutions (5-year averages)

Dependent variable: FDI-net
Variable of interest: Labor Market Institutions

	I	II	III	IV
	FE	FE	FE	FE
EPL (regular contracts)	−10.141**	−18.460***	−15.078***	−20.419***
	(3.909)	(5.939)	(5.182)	(4.571)
EPl (temporary contracts)	−2.128	−3.376	−3.110	−3.304
	(2.090)	(2.576)	(2.592)	(2.154)
Union density	−0.351	−1.009**	−0.774***	−1.039***
	(0.235)	(0.357)	(0.215)	(0.355)
PMR	−3.075	−2.347	−1.941	−1.772
	(5.881)	(4.612)	(4.728)	(4.208)
High union coverage	−26.565***			
	(8.799)			
Replacement rate		−0.412		−0.565
		(0.519)		(0.419)
Tax wedge		0.524		1.144**
		(0.751)		(0.467)
Wage distortion			−0.634	
			(0.375)	
Openness				−1.010***
				(0.349)
Portfolio investment				8.850***
				(1.668)
Output gap	1.369	1.342	0.585	0.651
	(0.869)	(0.959)	(0.712)	(0.666)
R-squared	0.278	0.273	0.305	0.599
N	96.000	93.000	96.000	89.000

Robust standard errors in parentheses, *significant at 10%, ** significant at 5%, *** significant at 1%. Data is available for 19 OECD countries.

In a last step the role of labor market institutions is analyzed by replacing the dependent variable unemployment with net-FDI in order to shed light on the role of labor market institutions. Results are reported in Table (6.3). Potential candidates that are expected to lead to an increase in FDI outflows relative to inflows are employment protection, union density, and all kind of wage distortions, which potentially distract investments from Home. We disentangle employment protection into $EPL(regular)$ which measures the protection for regular contracts, and $EPL(temporary)$ for temporary contracts. A dummy for high union coverage is included in (I), where we find negative coefficients for all variables of interest. However, only high union coverage and employment protection for regular contracts turn out to be significantly different from zero. Different setups with different controls yield the same robust finding that high union activity and employment protection are negatively associated with FDI inflows relative to FDI-outflows. Replacement rate and tax wedge measures are included in (II) but both are not significant. In (III) we try to combine the replacement rate and tax wedge measure as wage distortion. The coefficients are again insignificant. Finally in (IV) we control for all variables of interest and the globalization controls openness and financial market integration. However, the measures on the direct effect of institutions on the workers' wages remain insignificant but employment protection for real contracts and union density is negative and highly significant in all regressions.

A large number of robustness checks can be found in the appendix.

6.5 Conclusion

The model presented in this chapter advances a simple multi-industry trade model with imperfect labor markets due to Mortensen and Pissarides type of search frictions. Wages in this setup are jointly determined by labor market institutions and international trade, thereby affecting the equilibrium rate of unemployment at the intensive and extensive margin of labor demand. This two-dimensional causality between foreign direct investments and wages (unemployment) also permits the study of changes in the exogenously given labor market institutional environment. Institutions itself remain unaffected by firm behavior or trade so that wages are set according to the conditions in the labor market. Conversely, policy makers may influence labor market outcomes for whatever reason by readjusting labor market institutions. The model proposed above suggests that such a reform would necessarily affect trade, wages and unemployment in all countries integrated through the trade in goods and capital.

This chapter's major contribution is to test and to quantify the opposing effects at the intensive and extensive margin of labor demand by confronting the model with data taken from the OECD. We successfully test the main hypothesis derived in the theory chapter in that we show that the FDI-receiving countries tend to have lower rates of unemployment, whereas an increase in FDI-outflows increase equilibrium unemployment.

The newly introduced Mortensen and Pissarides (1994) search and matching mechanism within the Feenstra and Hanson model also opens a novel channel through which changes in the workers' wage rate initiated by changes in labor market reforms induce capital flows between the countries. For instance an increase in the workers' income reduces the respective countries competitiveness in all industries. However, the reduced competitiveness only affects some of the industries located near the cutoff which will be sifted abroad. Given that interest rates are exogenously given, such a loss in competitiveness leads to excess capital supply in the contracting and excess-demand in the expanding country. Our results support this finding in that it suggest that countries with less stringent labor market institutions tend to have larger FDI-inflows and thus have lower rate of unemployment.

6.6 Appendix

6.6.1 Robustness checks

Table 6.4: Aggregate unemployment and FDI-net stocks

Dependent variable: Total unemployment rate
Variable of interest: FDI-net (FDI-in minus FDI-out in stocks relative to GDP)

	I	II	III	IV	V	VI
	FE	FE	FE	FE	FE	FE
FDI-net	−0.061*	−0.072***	−0.043**	−0.050***	−0.049***	−0.047***
	(0.03)	(0.02)	(0.02)	(0.01)	(0.01)	(0.02)
Replacement rate				−0.025	−0.034	−0.031
				(0.05)	(0.05)	(0.05)
Tax wedge				0.383***	0.375***	0.355***
				(0.11)	(0.11)	(0.11)
EPL				−0.577	−0.889	−0.920
				(1.28)	(1.40)	(1.40)
Union density				−0.065	−0.068	−0.073
				(0.05)	(0.06)	(0.06)
PMR					0.429	0.444
					(0.70)	(0.73)
TFP						20.190
						(16.40)
Output gap			−0.745***	−0.652***	−0.648***	−0.733***
			(0.12)	(0.10)	(0.10)	(0.09)
R-squared	0.086	0.267	0.522	0.603	0.607	0.612
Observations	91	91	91	91	91	91
Time dummies		x	x	x	x	x
Country dummies	x	x	x	x	x	x

Robust standard errors in parentheses, *significant at 10%, ** significant at 5%, *** significant at 1%. Data is available for 19 OECD countries. Country dummies included in all regressions, time dummies included in all regressions except in I.

Table 6.4. reports the coefficients for the benchmark fixed-effects estimates where we first regress *net-FDI* on total OECD unemployment without controlling for the omitted variable bias caused by neglecting potential unemployment drivers as short-run macroeconomic shocks, the business cycle, trade openness or labor market regulations. In column (2) we additionally include time dummies, and in (3) we also control for business cycle effects. Notice that five-year averages were taken in order to derive long-run variables.

The coefficients in all regressions are statistically different from zero and negative, but the magnitude of the effect is highly dependent upon whether we control for the business cycle or not. Regression (I) indicates that a one-standard deviation increase in *net-FDI* reduces unemployment by roughly 1 percentage point. Additionally including time dummies reveals a downward bias caused by omitting trends from the data. Conversely, regression (III) shows that omitting business cycle effects creates an upward bias in the results. The results obtained by inclusion of the output gap variable yields results that suggest that a one-standard deviation of *net-FDI* reduces unemployment by a robust 0.56 percentage points. Including further control variables as labor market institutions or shocks also yields coefficients that indicate a relationship between *net-FDI* and unemployment of the same magnitude. We conclude this first discussion of the benchmark results by comparing the magnitude of the effect of FDI on unemployment to the effects of a one-standard deviation increase in the output gap that reduces unemployment by 1.8 percentage points. The benchmark regression results therefore support theory, but the magnitude of the effect is rather weak.

Table 6.5 reports the results where total trade openness is included as additional control variable. However, the results have to be treated with caution. Firstly, there might be some collinearity between FDI and trade openness, which makes it difficult to disentangle the individual effects. The coefficients for openness and FDI is less stable when both measures are included.[9] Secondly, as discussed in chapter 3 openness is likely to be endogenous. Nevertheless, we obtain the same sign pattern as in Table 6.4. The FDI-net measure is significant and negative when controlling for FDI-net and current price openness.

[9] For a related discussion see chapter 3 where we investigate the role of TFP.

Table 6.5: Aggregate unemployment and FDI-net stocks

Dependent variable: Total unemployment rate
Variable of interest: FDI-net (FDI-in minus FDI-out (stock) relative to GDP)

	I FE	II FE	III FE	IV FE	V FE	VI FE
FDI-net	-0.049^{**}	-0.046^{**}	-0.022	-0.039^{**}	-0.036^{**}	-0.032^{**}
	(0.02)	(0.02)	(0.01)	(0.01)	(0.01)	(0.02)
Openness	-0.207^{***}	-0.195^{*}	-0.167^{*}	-0.110	-0.116	-0.131^{*}
	(0.06)	(0.10)	(0.08)	(0.06)	(0.07)	(0.07)
High corporatism				-2.787^{***}	-2.834^{***}	-2.819^{***}
				(0.93)	(0.88)	(0.89)
Replacement rate				0.028	0.017	0.021
				(0.04)	(0.04)	(0.04)
Tax wedge				0.375^{***}	0.363^{***}	0.333^{***}
				(0.10)	(0.10)	(0.10)
EPL				-0.864	-1.298	-1.306
				(1.34)	(1.36)	(1.41)
Union density				-0.011	-0.014	-0.018
				(0.04)	(0.05)	(0.05)
PMR					0.612	0.613
					(0.57)	(0.65)
TFP						28.345^{**}
						(11.17)
Output gap			-0.687^{***}	-0.534^{***}	-0.529^{***}	-0.650^{***}
			(0.11)	(0.09)	(0.08)	(0.07)
R-square	0.264	0.317	0.563	0.667	0.674	0.683
N	96	96	96	93	93	91

Robust standard errors in parentheses, *significant at 10%, ** significant at 5%, *** significant at 1%. Data is available for 19 OECD countries over the period 1983 - 2003. Time dummies included in all regressions except of regression I.

Table 6.6: Aggregate unemployment and FDI-net, stocks and flows

Dependent variable: Total unemployment
Variable of interest: FDI-net (FDI-in minus FDI-out relative to GDP)

	I	II	III	IV	V	VI	VII	VIII	IX	X
	FE	RE	FGLS	diff-GMM	diff-GMM	FE	RE	FGLS	diff-GMM	diff-GMM
	FDI-net (stock)					FDI-net (flow)				
FDI-net	−0.047***	−0.010	−0.040***	−0.098***	−0.071***	−0.306**	−0.184*	−0.291***	−0.905***	−0.696**
	(0.02)	(0.02)	(0.01)	(0.03)	(0.02)	(0.14)	(0.11)	(0.09)	(0.33)	(0.31)
Lag dep. var.				0.074	0.190*				0.210	0.155
				(0.23)	(0.11)				(0.25)	(0.19)
Replament rate	−0.031	−0.013	−0.014	−0.049	−0.035	−0.016	−0.007	0.009	−0.011	−0.145
	(0.05)	(0.04)	(0.03)	(0.05)	(0.13)	(0.05)	(0.04)	(0.03)	(0.08)	(0.14)
Tax wedge	0.355***	0.210***	0.251***	0.239***	0.380**	0.325***	0.189***	0.278***	0.132	0.550**
	(0.11)	(0.07)	(0.06)	(0.09)	(0.19)	(0.10)	(0.07)	(0.06)	(0.09)	(0.24)
EPL	−0.920	−0.757	−0.880	−1.080	−1.366	−1.096	−0.756	−0.875	−2.050	−2.798
	(1.40)	(0.66)	(0.63)	(1.27)	(1.69)	(1.37)	(0.67)	(0.60)	(1.70)	(1.99)
Union density	−0.073	−0.088***	−0.110***	−0.214***	−0.189***	−0.081	−0.087***	−0.131***	−0.241***	−0.239***
	(0.06)	(0.03)	(0.04)	(0.07)	(0.04)	(0.05)	(0.03)	(0.03)	(0.05)	(0.07)
PMR	0.444	0.712	0.275	0.421	0.262	0.624	0.791	0.534	0.386	0.367
	(0.73)	(0.53)	(0.36)	(0.66)	(0.85)	(0.65)	(0.55)	(0.33)	(0.57)	(0.71)
TFP	20.190	34.915	23.672*	66.205***	41.252**	36.111**	42.245	32.388***	88.113***	62.591**
	(16.40)	(25.99)	(14.21)	(19.89)	(16.61)	(14.90)	(26.24)	(11.71)	(33.10)	(31.34)
Output gap	−0.733***	−0.933***	−0.808***	−1.124***	−0.954***	−0.814***	−0.953***	−0.830***	−1.223***	−1.068***
	(0.09)	(0.18)	(0.10)	(0.19)	(0.13)	(0.11)	(0.18)	(0.09)	(0.26)	(0.28)
R-squared	0.612	0.569				0.619	0.590			
Hausman	0.000					0.000				
Observations	91	91	91	70	70	93	93	92	73	73

Robust standard errors in parentheses, *significant at 10%, ** significant at 5%, *** significant at 1%. Data is available for 19 OECD countries over the period 1983 - 2003. Time dummies included in all regressions. Output gap and additional macroeconomic shocks capture short run fluctuations. FGLS with correction for heteroskedastic panels and cross-country correlation. Diff-GMM treats FDI-net and output gap as endogenous in IV and IX and additionally treats replacement rate and tax wedge as endogenous in V and X.

In (II) we also include time dummies, in (III) we additionally include the output gap which yields an insignificant coefficient for FDI. Once we additionally control for labor market institutions in (IV), PMR in (V), and TFP shocks in (VI) FDI-net becomes significant again.

Table 6.6 applies different models of the benchmark specification in order to investigate the robustness of the results. We distinguish between FDI-net stocks (left panel of Table 6.6) and flows (right panel of Table 6.6) and compare the outcome with the benchmark fixed-effects regression reported in (I) and (VI). Employing a random-effects estimator yields the expected sign but the coefficient is not significant when using the FDI flow measure. The Hausman test p-value strongly suggests the superiority of the consistent fixed effects estimator. Using flows instead of stocks yields a significant and negative coefficient for both the fixed- and the random-effects estimates reported in column (VI) and (VII). In (III) and (VIII) a feasible least squares estimator is employed and allows us to control for heteroscedasticity across the countries and panel. The coefficients are close to the coefficients obtained in (I) and (VI) and indicate an effect similar to that obtained from the benchmark fixed effects regressions. The time dimension of the data is exploited to run GMM with lags of the endogenous variables used as instruments. One potential pit fall of GMM is over identification caused by too many instruments. Hence, the number of instruments is limited by focusing on variables that are potentially endogenous instead of building instruments for all variables included in the regressions.[10] Instrumenting FDI-flow in a GMM approach indicates a (long run) relationship that is two times higher then that from the standard benchmark regressions. Including stocks in (IX) and (X) reveals the same picture.

Table 6.7 shows regression results for a first-difference approach. A negative sign indicates that an increase in FDI inflows (inflows minus outflows) is associated with a decrease in unemployment. The distinction between regressions that include country dummies and regressions that exclude them helps to assess the role of fixed effects. The omitted variable bias due to time invariant fixed effects should be neglible since the time dimension of the data is rather short and due to the fact that time invariant fixed effects are already purged by first differencing the data. Country dummies in this particular application allow for dif-

[10] In a first step we instrument output gap and openness, and in a second step we also build instruments for the wage distortion.

ferent country intercepts which is more or less important since theory predicts that a change over time influences unemployment. We start with a simple OLS estimator in column (1) neglecting differences in the country intercepts. Concerning the *LAB* measures we get the same unsatisfying picture as many other studies on labor market institutions before. Higher replacement rates tend to decrease unemployment which contradicts search theory, but the coefficient is insignificant. Tax wedge and employment protection have the right sign but the effect is not statistically significant and thus meaningless. FDI-in (net of FDI-out) exhibit the right sign by indicating that positive changes of FDI (capital) inflows are indeed associated with a higher equilibrium rate of unemployment in the long run. Allowing for country specific intercepts increases the fit of the model. This is not surprising since we forced all countries in regression (I) to have the same constant, somehow obscuring the country specific relationship between FDI and unemployment. Notice, that both regressions yield results that are equal in magnitude. Including country dummies however reduce the standard errors indicating that the regression line fits the data. In regression (III) and (IV) we use a GLS estimator instead of OLS, and in (V) and (VI) we instrument net-FDI with its lags. The results are basically the same in all regressions.

Labor market institutions and FDI. We preform additional regressions with net-FDI as dependent variable as a robustness check for Table (6.3). However, we use the full set of observations without averaging the data, we use the aggregated employment protection variable instead of the decomposed one for regular and temporary contracts, and we lump replacement rate and the tax wedge together to construct a wage distortion measure as proposed by Costain and Reiter. Fixed-effects in (I) yield insignificant results for all variables of interest. We thus also try random-effects and evaluate both by a Hausman test which indicates that random-effects is efficient. Diff-GMM does not work either. We thus report IV-regressions where we instrument the labor market institutions using its lags. The institutional variable wage distortion for instance indicate that higher unemployment benefits are linked to lower FDI-net flows/stocks. All labor market institutions reveal a negative sign, and only a few of them are insignificant. Using a fixed effects estimator in column (I) we find that the coefficients for wage distortion, union density, and employment protection are negative but not significant. Random effects in column (II) reveal the same sign pattern, but the coefficients are now significant for wage distortion and employment

Table 6.7: Aggregate unemployment and FDI-net flows

Dependent variable: Total unemployment rate
Variable of interest: FDI-net (FDI-in minus FDI-out (stock) relative to GDP)

	I	II	III	IV	V	VI
	OLS	FE	FGLS	FGLS	IV	IV
ΔFDI-net	−0.016*	−0.016**	−0.014*	−0.013	−0.020	−0.027*
	(0.01)	(0.01)	(0.01)	(0.01)	(0.02)	(0.01)
ΔReplacement rate	−0.040	−0.063	−0.021	−0.047**	−0.042	−0.064*
	(0.04)	(0.04)	(0.02)	(0.02)	(0.04)	(0.04)
ΔTax wedge	0.045*	0.041	0.031	0.030	0.045*	0.041*
	(0.03)	(0.03)	(0.02)	(0.02)	(0.03)	(0.02)
ΔEPL	−0.590	−0.704*	−0.432	−0.532*	−0.595*	−0.703**
	(0.36)	(0.38)	(0.30)	(0.29)	(0.34)	(0.35)
ΔPMR	0.244	0.232	0.038	0.061	0.247	0.248
	(0.28)	(0.28)	(0.17)	(0.17)	(0.27)	(0.26)
ΔTFP (shock)	27.820***	28.694***	26.776***	26.608***	27.777***	28.595***
	(3.66)	(3.57)	(2.29)	(2.29)	(3.48)	(3.32)
ΔToT (shock)	1.215	0.046	1.320	1.607	1.296	0.117
	(2.95)	(3.14)	(2.33)	(2.31)	(2.82)	(2.91)
ΔLabor demand (shock)	8.793*	14.627**	8.314**	12.229**	9.313**	15.026***
	(4.69)	(5.99)	(3.93)	(4.92)	(4.59)	(5.65)
ΔInterest rate (shock)	0.038**	0.036**	0.013	0.011	0.039***	0.037***
	(0.02)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
ΔOutput gap	−0.647***	−0.641***	−0.596***	−0.581***	−0.646***	−0.638***
	(0.04)	(0.05)	(0.03)	(0.03)	(0.04)	(0.05)
R-squared	0.587	0.612			0.587	0.611
Partial R-squared					0.313	0.388
F-stat (1st stage)					9.853	17.037
Country dummies		x		x		x
Time dummies	x	x	x	x	x	x
Observations	365	365	365	364	364	364

Robust standard errors in parentheses, *significant at 10%, ** significant at 5%, *** significant at 1%. Data is available for 19 OECD countries over the period 1983 - 2003 with gaps and first differenced to purge country specific fixed effects. Time dummies included in all regressions. FGLS with correction for heteroskedastic panels and cross-country correlation. IV uses first lags of FDI-net as instrument to adress endogeneity.

protection. Union density reveals the right sign but the effect is not significant and thus zero. The Hausman test strongly favors the random effects estimation. This result supports our theory by indicating that countries with lower labor market institutions seem to attract more FDI inflows than countries that have a tendency to protect their workers. Moreover, addressing cross panel heteroscedasticity by running FGLS yields significant and negative coefficients for all labor market institutional variables. Even union density has the right sign and is significant for FGLS. Running IV regressions and instrumenting lags of the variable wage distortion and employment protection as instruments confirm the findings in column (1) and even the magnitude of the effects do not vary by much. Partial R-squares in all regressions range from 0.6 to 0.8 indicating that the instruments are valid. In columns (5) -

(8) we redo the whole procedure with FDI-flows instead of stocks, which support the findings discussed so far.

Table 6.8: FDI net-flows and labor market institutions

Dependent variable: FDI-net (FDI-in minus FDI-out relative to GDP)
Variable of interest: Replacement rate, tax wedge, and EPL

	I	II	III	IV	V	VI	VII	VIII
	FE	RE	FGLS	IV	FE	RE	FGLS	IV
	FDI-net (stock)				FDI-net (flow)			
Wage distortion	−0.247	−0.126**	−0.074*	−0.245***	−0.099**	−0.012	−0.042***	−0.124***
	(0.22)	(0.05)	(0.04)	(0.09)	(0.04)	(0.01)	(0.01)	(0.03)
Union density	−0.322	−0.089	−0.442***	−0.387***	−0.096**	−0.006	−0.055**	−0.112***
	(0.38)	(0.09)	(0.07)	(0.14)	(0.05)	(0.02)	(0.03)	(0.03)
EPL	−5.235	−3.363***	−3.623***	−6.519***	−2.636***	−0.504**	−0.952***	−3.087***
	(3.53)	(1.11)	(0.98)	(1.81)	(0.70)	(0.21)	(0.35)	(1.00)
Output gap	0.752	0.971***	0.065	0.734***	0.062	0.141***	0.034	0.061
	(0.58)	(0.24)	(0.13)	(0.24)	(0.07)	(0.05)	(0.05)	(0.05)
PMR	−0.806	−0.178	1.127*	−0.635	0.629	0.200	0.408*	0.741**
	(2.46)	(1.06)	(0.64)	(0.95)	(0.41)	(0.26)	(0.22)	(0.34)
TFP (shock)	−36.409	−51.992**	−9.154	−36.486*	0.952	−6.647	−1.042	1.540
	(35.71)	(20.69)	(11.51)	(19.79)	(6.30)	(5.79)	(4.58)	(5.66)
ToT (shock)	13.894	23.728	−10.472	12.447	7.129	9.462***	1.828	8.061**
	(37.57)	(17.26)	(7.51)	(15.40)	(5.30)	(3.57)	(2.45)	(4.03)
Labor demand (shock)	63.573	67.770***	15.795*	60.668***	13.217	8.910**	7.529**	14.977***
	(61.56)	(20.67)	(8.15)	(19.09)	(9.05)	(3.64)	(3.07)	(4.47)
R-square	0.417			0.897	0.197			0.419
Hausman		1.000				0.852		
N	355	355	355	338	364	364	364	348

Robust standard errors in parentheses, *significant at 10%, ** significant at 5%, *** significant at 1%. Data is available for 19 OECD countries over the period 1983 - 2003. Time dummies included in all regressions. Outputgap and additional macroeconomic shocks capture short run fluctuations. First lags of i) replacement rate *(rr)*, ii) tax wedge *(tw)* and iii) EPL *(epl)* used as instruments for the IV regressions.

Additional results. Regressions with *skill-specific* unemployment rates as the dependent variable and *net-FDI* flows as a variable of interest are presented to test the complementarity theoretically derived in chapter 5. Findings in Table 6.9 indicate that FDI net flows equally affect both skill groups. Countries with increasing FDI-in tend to have lower low- and high-skill unemployment rates, whereas net exporters of capital exhibit higher rates of unemployment in both skill groups.[11] However, as discussed before the regressions might be plagued by endogeneity, especially when using low-skill unemployment rates. High rates of low-skill unemployment may be an alarming signal for policy makers that could lead them to protect domestic labor markets from global competition. This is to a great extend perceived as a risk for the low skilled rather than for the high-skill work force.

The results support the complementarity between both skill groups and reveals a negative sign for both type of workers. Moreover, the magnitude of the effect is stronger for the low-skilled than for high-skilled. We find that a one-standard deviation increase in net FDI reduces low skill unemployment by 1.66 percentage points and 1.44 percentage points for the high-skilled. The result stems from the fact that the high skill unemployment rate is lower and exhibits less variation than low-skill unemployment. Again, we also find that the magnitude of the effect becomes smaller once we reduce the omitted variable bias by including additional control variables. Controlling for the full set of variables reduces the effect of a one-standard deviation of net-FDI to 1.17 percentage point for high-skill and 0.97 percentage points for low-skill unemployment. Concerning product market regulation we find the opposite effect. PMR tends to increase both rates of unemployment but the effect appears to be stronger for high skill than for low skill workers. Derivations in GDP from its long run trend also harms low skill workers more than high skill workers in all models.

[11] *skill-specific* unemployment rates are computed as ratio between the number of unemployed worker and the total number or workers, both with either low skill or high skill education. Simply dividing the total rate of unemployment into primary, secondary and tertiary unemployment is not enough since the basis would still be total labor. For *skill-specific* unemployment rates we need the information on the number of workers available with a certain education. This data is also provided through the WDI database.

Table 6.9: Skill Specific Unemployment and FDI net-flows

Dependent variable: skill-specific unemployment
Variable of interest: FDI-net (FDI-in minus FDI-out (stock) relative to GDP)

	FE regressions					
VARIABLES	u (low)	u (high)	u (low)	u (high)	u (low)	u (high)
FDI-net	−0.106**	−0.092*	−0.085***	−0.070**	−0.075**	−0.062*
	(0.043)	(0.052)	(0.028)	(0.033)	(0.029)	(0.031)
Wage distortion			0.169*	0.104	0.130	0.070
			(0.088)	(0.064)	(0.093)	(0.066)
EPL			−0.606	−1.783	−1.133	−2.267**
			(0.916)	(1.093)	(0.876)	(1.030)
PMR			1.986**	2.573**	2.145***	2.736**
			(0.829)	(1.126)	(0.724)	(1.020)
Interestrate shock					0.066*	0.036**
					(0.036)	(0.017)
TFP					39.810***	38.152***
					(10.025)	(11.750)
ToT (shock)	63.081***	45.840	51.557***	31.535*	50.639***	31.450*
	(20.843)	(27.422)	(14.684)	(17.441)	(13.290)	(15.410)
Labor demand (shock)	35.501**	25.797	29.778*	18.374	38.359***	26.497
	(14.274)	(18.466)	(15.019)	(18.736)	(12.525)	(17.071)
Output gap	−0.813***	−0.536***	−0.720***	−0.472***	−0.850***	−0.598***
	(0.143)	(0.134)	(0.144)	(0.101)	(0.145)	(0.105)
Observations	125	125	125	125	125	125
R-squared	0.777	0.682	0.838	0.783	0.875	0.827

Robust standard errors in parentheses, *significant at 10%, ** significant at 5%, *** significant at 1%. Data is available for 19 OECD countries over the period 1993 - 2003. Outputgap and additional macroeconomic shocks included to capture short run fluctuations. Country and time dummies included in all regressions.

Table 6.10: Skill Specific Unemployment and FDI net-flows

Dependent variable: skill-specific unemployment
Variable of interest: FDI-net (FDI-in minus FDI-out (stock) relative to GDP)

	IV regressions							
VARIABLES	u (low)	u (high)	u (low)	u (high)	u (low)	u (high)	u (low)	u (high)
FDI-net	−0.096**	−0.080***	−0.102**	−0.084**	−0.087*	−0.069**	−0.074	−0.065*
	(0.045)	(0.031)	(0.051)	(0.036)	(0.048)	(0.035)	(0.045)	(0.034)
Wage distortion	0.040	0.022	0.068	0.036	0.029	0.017	0.049	0.022
	(0.045)	(0.034)	(0.043)	(0.031)	(0.060)	(0.045)	(0.055)	(0.038)
EPL	−1.889***	−1.205	−1.635	−1.089	−2.218***	−1.452*	−1.809*	−1.211
	(0.716)	(0.742)	(1.042)	(0.775)	(0.759)	(0.786)	(1.047)	(0.791)
PMR	1.355**	1.185*	1.274**	1.200*	1.408**	1.113	1.220*	1.071
	(0.625)	(0.643)	(0.648)	(0.676)	(0.695)	(0.679)	(0.669)	(0.711)
TFP	18.121*	14.302**	24.678**	16.960***	28.024***	21.449***	39.423***	25.421***
	(9.527)	(5.825)	(11.593)	(6.264)	(9.412)	(5.590)	(9.704)	(5.358)
Union density	−0.061	0.050	0.009	0.094*	−0.116	−0.004	−0.021	0.050
	(0.079)	(0.051)	(0.081)	(0.051)	(0.088)	(0.065)	(0.077)	(0.055)
ToT (shock)	22.837**	10.317	15.569	4.210	8.897	4.017	6.902	2.420
	(11.596)	(6.603)	(10.821)	(6.139)	(10.978)	(6.521)	(10.172)	(6.573)
Real interest (shock)	0.029	−0.007	0.029	0.008	0.031	−0.002	0.026	0.006
	(0.044)	(0.021)	(0.032)	(0.018)	(0.045)	(0.018)	(0.031)	(0.015)
Output gap	−0.761***	−0.347***	−0.778***	−0.420***	−0.855***	−0.443***	−0.908***	−0.541***
	(0.120)	(0.085)	(0.111)	(0.078)	(0.168)	(0.089)	(0.121)	(0.071)
Year dummies	x		x		x		x	
R-squared	0.608	0.454	0.523	0.381	0.638	0.535	0.571	0.495
Partial R-squared	0.198		0.192		0.199		0.196	
F-stat (1st stage)	20.304		20.501		9.958		10.429	
OID-test					0.902		0.661	
Observations	92	92	92	92	74	74	74	74

Robust standard errors in parentheses, *significant at 10%, ** significant at 5%, *** significant at 1%. Data is available for 20 OECD countries over the period 1993 - 2003. Output gap and additional macroeconomic shocks included to capture short run fluctuations. All variables are first differenced and FDI is instrumented with its second lag (Anderson and Hsiao 1981, 1982). Additional first lag used in regression (5) - (6).

Table 6.10 As a further robustness check we preform regressions using the methodology proposed in Anderson and Hsiao (1981, 1982) to address the endogeneity issue by first-differencing the data and by using the second lag of the FDI variable as an instrument. Several setups were tested but only those setups where the second lag of the endogenous variable is included as instrument yield satisfying instruments concerning the test statistics. The first-stage F-statistic is between 10 and 20 for all regressions and the partial R-square is around 0.2. Again, the robust finding that *i*) both skill groups are equally affected by FDI and *ii*) that the magnitude of the effect is stronger for low skilled than for high skill is also apparent when controlling for endogeneity. First differenced *net-FDI* is instrumented with the second lag of *net-FDI* in Column (I) - (IV). Time dummies are included in (I) and (II) but excluded in (III) and (IV). Excluding the time dummies yields better results for the test statistics concerning the instruments' validity. Excluding time dummies is the preferred setup given that the time dimension is rather short. Nevertheless, we always report both type of regressions as further robustness checks. In column V to VIII we also include the second lag in first differences which allows us to run a test on exogeneity.

6.6.2 Data description

Unemployment rates For our OECD benchmark regressions we use total unemployment, measuring the percentage share of unemployed workers in total labor force (15 - 66 years old individuals). Data taken from Bassanini and Duval. Original Source: OECD, Database on Labour Force Statistics; OECD, Annual Labour Force Statistics.

To estimate the effects of FDI on *skill-specific* unemployment rates we use data from the WDI to disentangle the WDI total unemployment rate into its *skill-specific* components. Low skill labor is constructed using data on workers with primary education only. High skill labor is an averaged variable gathering workers with secondary and tertiary education.

FDI measures FDI-net is measured as difference between inward-FDI and outward-FDI relative to GDP. *FDI* is taken form the UNCDAT data base and includes transactions of firms from foreign countries with a share of at least 10% in a domestic company. *FDI* stocks and flows are measured in current U.S. Dollar so that real GDP from the Pennworld table 6.4 was used to construct FDI-net intensities in order to make the data comparable across countries. We distinguish between stocks and flows of *FDI*. *Inward-FDI* are investments from abroad into the reporting country. FDI-outflows denotes FDI from the reporting country made in other countries.

Wage distortion Wage distortion lumps replacement rate and tax wedge together. Both variables affect unemployment through the same channel, namely wages. Therefore lumping both variables together further reduces the number of instruments when estimating GMM regressions.

Replacement rate Average unemployment benefits taken from the Bassanini and Duval data set. Original source: OECD Benefits and Wages Database. According to Bassanini and Duval data is available for odd years only, so that they had to fill the gaps by linear interpolation.

Tax wedge This variable measures taxation on wages by computing the difference between wages paid by employers and wages earned by employees. The variable on tax wedge is constructed using the OECD taxing wages data. Some observations were adjusted by B&D in order to fill the gaps in the data, thus providing a complete sample for the period 1982 - 2003.

Union density Union density measures the percentage share of workers associated to unions. According to B&D the data was taken from the OECD Employment Outlook 2004 and inter / extrapolated in order to maximize the sample.

High corporatism Dummy variable that takes the value one if wage bargaining is highly centralized. Source: Bassanini and Duval.

EPL Measures the stringency of employment protection legislation, taken from Bassanini and Duval. Original source: OECD, Employment Outlook 2004.

PMR Measures the regulation on product markets and competition, taken from Bassanini and Duval. Original source: Conway et al. (2006).

Total factor productivity shock a macroeconomic shock variable that measures the derivation of total factor productivity from its trend using a Hodrick-Prescott filter. Data on TFP is obtained by computing the Solow residual. Source: Bassanini and Duval.

Terms of trade shock Terms of trade measure the relative price of imports weighted by the share of imports in GDP.

Real interest shock Measure of the difference between the 10-year nominal government bond yield and the annual change in the GDP deflator.

Labour demand shocks Definition: logarithm of the labour share in business sector GDP purged from the short-run influence of factor prices.

Output gap Output gap measures the difference between actual and potential GDP as percentage of potential output. As source B&D cite the OECD Economic outlook and IMF International finance statistics.

OECD panel			OECD panel (5 year averages)			OECD Skill-Specific Sample		
Variable	Mean	Std. Dev.	**Variable**	Mean	Std. Dev.	**Variable**	Mean	Std. Dev.
Unemployment *(total)*	8.028	4.460	Unemployment *(total)*	7.056	3.827	Unemployment *(total)*	7.796	4.170
Unemployment *(low skill)*	–	–	Unemployment *(low skill)*	11.269	7.812	Unemployment *(low skill)*	11.053	4.378
Unemployment *(high skill)*	–	–	Unemployment *(high skill)*	8.591	3.961	Unemployment *(high skill)*	6.291	3.943
FDI-net stocks *(FDI-in minus FDI-out)*	−1.065	15.718	FDI-net stocks *(FDI-in minus FDI-out)*	−0.205	20.580	FDI-net stocks *(FDI-in minus FDI-out)*	−7.108	17.472
FDI-net flows *(FDI-in minus FDI-out)*	−0.547	2.360	FDI-net flows *(FDI-in minus FDI-out)*	−0.287	2.283	FDI-net flows *(FDI-in minus FDI-out)*	27.092	22.315
Wage distortion *(replace. r. + tax wedge)*	58.234	18.499	Wage distortion *(replace. r. + tax wedge)*	58.213	17.835	Wage distortion *(replace. r. + tax wedge)*	57.662	17.371
Replacement rate *(index)*	29.175	13.090	Replacement rate *(index)*	28.403	12.73	Replacement rate *(index)*	29.078	12.295
Tax wedge *(index)*	29.058	9.026	Tax wedge *(index)*	28.712	8.928	Tax wedge *(index)*	28.583	8.673
Union density *(index)*	39.577	21.019	Union density *(index)*	41.653	20.301	Union density *(index)*	37.387	21.323
High corporatism *(dummy)*	0.557	0.497	High corporatism *(dummy)*	0.561	0.486	High corporatism *(dummy)*	0.576	0.496
EPL *(index)*	2.026	1.058	EPL *(index)*	2.086	1.091	EPL *(index)*	1.840	0.906
PMR *(index)*	3.875	1.236	PMR *(index)*	3.848	1.293	PMR *(index)*	2.723	0.975
Output gap *(actual - potential GDP)*	−0.899	2.473	Output gap *(actual - potential GDP)*	−0.718	1.739	Output gap *(actual - potential GDP)*	−0.550	1.844
TFP *(shock)*	−0.0004	0.021	TFP *(shock)*	−0.0009	0.011	TFP *(shock)*	0.003	0.015
Interest rate *(shock)*	4.873	2.183	Interest rate *(shock)*	3.534	2.834	Interest rate *(shock)*	3.613	2.103
Labor demand *(shock)*	0.0301	0.059	Labor demand *(shock)*	0.025	0.060	Labor demand *(shock)*	0.0470	0.065
Terms of trade *(shock)*	−0.039	0.062	Terms of trade *(shock)*	−0.028	0.070	Terms of trade *(shock)*	−0.080	0.055

Figure 6.1: Summary statistic

6.7 Numerical illustration

Purpose of this simulation exercise is to solve the remaining ambiguity arising due to the countervailing effect of FDI on labor demand at the intensive and extensive margin. Table 6.2 summarizes all parameters used for the benchmark calibration where labor and capital markets are in equilibrium so that the foreign interest rate is equal to the domestic interest rate.

We then simulate simultaneous capital flows from the foreign to the home country triggered by differences in foreign and home capital returns that attract FDI away from Foreign. To calibrate the benchmark we target the unemployment rate equal to 7 percentage points. Besides unemployment we exploit the interest rates as targets for the calibration. Parameters related to the labor market are set according to the empirical evidence found in the relevant search and matching literature, whereas product market related parameters are set somewhat arbitrarily. The only anchor we have for the product market parameters is the interest rate.

Product market related parameters. Calibrating the product market related parameter remains a difficult task since no reliably data exists. We set the parameters of the labor requirement curves so that Home has a comparative advantage in industries located closer to the upper bound of the continuum. The α and γ parameters of the intermediate input requirement curves are set as required to secure the existence of a unique cutoff within the set of feasible z. The Cobb-Douglas share in stage 1 is set equal to $\zeta = 0.5$ and equilibrium interest rates are targeted to approach 2 percentage points.

Labor market related parameters. Calibrating the labor market parameters is possible due to numerous studies that shed light on the search and matching framework from an empirical perspective. Most important, Hall (2005) estimates the U.S. equilibrium market tightness equal to 0.5. Petrongolo and Pissarides (2001) find that setting the elasticity of the matching function equal to 0.5 is a good approximation for the U.S. economy. The equilibrium market tightness, the elasticity of the matching function, and the monthly job destruction rate equal to $s = 0.034$ pin down the scaler of the matching function at $m = 0.64$ so that the $u_{US} = 7$ percentage points. Unemployment benefits b and search costs c are set arbitrarily and do not influence the outcome of the calibration.

Parameters used for the simulation		
Parameter	Description	Value
Labor market parameters		
λ	Job destruction rate	0.034
α	Elasticity of the matching function	0.50
b	Unemployment benefits	0.1
m	Scale parameter of the matching function	0.64
c	Vacancy posting costs	0.72
Industry Input Coefficients		
α_d	Constant of the input coefficient curve (domestic)	1.9
α_f	Constant of the input coefficient curve (foreign)	0.6
γ_d	Slope of the input coefficient curve (domestic)	0.1
γ_f	Slope of the input coefficient curve (foreign)	2.9
ζ	Cobb Douglas share (stage 1 production)	0.50
Endowment		
L_d	Labor force (domestic)	0.5
L_f	Labor force (foreign)	0.5
K_d	Kapital stock (domestic)	4.6
K_f	Kapital stock (foreign)	4.4

Figure 6.2: Benchmark calibration parameters

Endowment. Given all other parameters discussed we set endowments so that the labor market and the capital market equilibrium conditions are in equilibrium, the rate of unemployment lies around 7 percentage points, whereas the interest rates are about 0.02. We find that $L_d = 0.5$, $L_f = 0.5$, $K_d = 4.6$, and $K_f = 4.4$ yields outcomes for the endogenous variables in line with those targets and in line with the calibration of the other labor market parameters.

Simulation results. Figure 6.3 shows the simulation results. Foreign and home capital stocks in the initial point (FDI=0) are such that the interest rates are not in equilibrium. Starting from that point we simulate symmetric capital flows from the foreign to the domestic country until the benchmark equilibrium is reached. At $FDI = 0$ the initial capital stocks are $K_d = 3$ and $Kf = 6$. Given the parameters presented above the Home interest rate is higher than the foreign interest rate, which attracts capital in form of FDI. Capital flows from Foreign to Home up to the point $FDI = 1.6$, where both the capital and the labor market are in equilibrium as $r_d = r_f$ and unemployment is approximately equal to 7 percentage points matching the equilibrium market tightness $\theta = 0.5$. The assumption that FDI-flows are symmetric gives rise to a benchmark equilibrium associated with $FDI = 1.6$ where the domestic capital stock increased from 3 to 4.6, and the foreign capital stock decreased from 6 to 4.4. Unemployment, wages, and interest rates are equal in both countries due to symmetric calibration of the labor market parameters. In Foreign, the adjustments at the intensive margin are not enough to outweigh the decrease in labor demand at the extensive margin. Wages have to decrease and unemployment has to increase in order to restore labor market equilibrium. The opposite happens in the receiving home country. As indicated in the upper panel of Figure 6.3 the home equilibrium market tightness goes up associated with a higher wage and thus a lower equilibrium unemployment rate as can be seen in the lower panel of Figure 6.3. The magnitude of the effect is rather weak. Symmetric capital flows equal to $FDI = 1.6$ reduce equilibrium unemployment in the receiving country by approximately 0.5 percentage points. The sending country sees its rate of unemployment increasing by exactly the same amount. Those results are in line with the outcome of the empirical analysis in the next chapter. Using OECD data we find that a one-standard-derivation of net-FDI (in- minus outward FDI) reduces unemployment by a robust 0.5 percentage points.

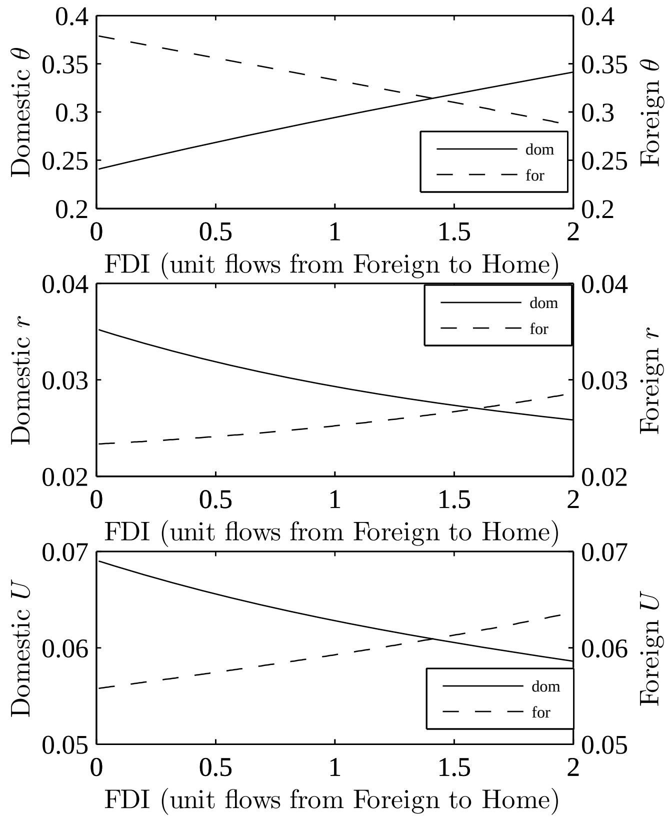

Figure 6.3: Nummerical illustration

Chapter 7

Concluding remarks

I want to conclude this doctoral thesis on globalization and labor market outcomes by summarizing the main findings and by giving a brief outlook on further research projects linked to the research presented above.

Melitz meets Pissarides. Building on Felbermayr, and Prat (2011) we incorporate search frictions into an open economy version of the Melitz model to study how trade liberalization can affect unemployment through *i*) a reduction in transport costs, *ii*) higher number of trade relations, and *iii*) a reduction in fixed foreign market access. We find that all three scenarios yield the same unambiguous outcome. More exposure to trade trigger a reduction in equilibrium unemployment on the aggregate level. The effect is causal and the intuition behind the result is that more productive firms are relatively more efficient in recruiting new workers which reduces unemployment in the long run.

We also analyze the role of external economies of scale and find that the magnitude of the positive employment effect is much stronger in economies with a higher degree of external economies of scale. In the additional results section we also investigate the role of the wage setting mechanism and compare the collective bargaining scenario to the benchmark scenario where firms and workers bargain individually.

For all scenarios we find that trade liberalization reduces equilibrium unemployment through an increase in the average productivity. However, the magnitude of the effect highly depends upon the assumptions made.

Trade and Unemployment: What Do the data Say? Using data made available by the OECD we test the trade and unemployment nexus highlighted in Felbermayr, Prat, and Schmerer (2011b). Employing different models and instruments we find a causal and negative relationship between openness and unemployment for 20 OECD countries, which is in line with the theory presented in chapter 2. We construct a large cross section that also includes non-OECD countries, which allows us to use the Frankel and Romer instrument for openness. The findings are robust and indicate that a 10 percentage point increase in openness reduces unemployment by roughly 1 percentage point. However, we are also able to show that this positive effect is mainly driven by a reduction in the high-skill unemployment rate. We also test the channel highlighted in the theory, where average productivity is the variable through which globalization has an effect on unemployment. Our empirical findings suggest that the results are mainly driven by total factor productivity, which is in line with theory.

FDI and Skill-Specific Unemployment. In this chapter we propose a multi-industry trade model with high- and low-skill labor and search frictions in the labor market. We can show that FDI affects labor demand at the extensive margin, which dominate the within-industry effects at the intensive margin. Thus the sign of the effect highly depends on whether a country is the FDI sending or receiving country. Moreover, the magnitude is strong enough to affect both skill groups equally. The twoway-causality with wages and unemployment being jointly determined by exogenous labor market institutions and FDI also facilitates the study of institutional spillover effects triggered by changes in labor market institutions, thereby also affecting capital flows and unemployment. The findings suggest that institutional changes in favor of the workers tend to increase FDI-outflows, which somehow mitigates the rather optimistic findings in the first part of the thesis.

FDI and Unemployment: Empirics. In chapter 6 we present an empirical test for the relationship between FDI and unemployment highlighted in chapter 5 using the same methodology as in chapter 3, or in Felbermayr, Prat, and Schmerer (2011b). Due to the lack of reliable data for skill-specific unemployment rates the main predictions from the model are replicated for the non-skill specific case with homogeneous labor. The main part of the paper then focuses on an empirical test for the predictions derived from the model, where we find that *i*) FDI-out countries exhibit higher rates of unemployment, and *ii*) more stringent labor market institutions are associated with capital-outflows. Our results confirm this less optimistic view on globalization. Countries which are relative FDI-exporters reveal a relatively higher rate of unemployment. As additional result we also show that the complementarity between high- and low-skilled workers can be found in the skill-specific unemployment data.

Future research. So far, our research focused on the implications on the aggregate level by mostly focusing on homogeneous workers and aggregate unemployment data, where we find rather optimistic results. Obviously, those results oppose the widespread belief that globalization is bad for employment. Does that mean that people do not have to fear any bad consequences of globalization? Does that also mean that the worries described in the introduction are for no reason? Future research should focus more on the role of heterogeneous workers in order to shed light on the skill-specific effects, where our first glimpse at the disentangled data suggests that the effects highly depend on the workers' qualification. So it would be sensible to put more effort into the analysis on how different measures of globalization affect low- and high-skill rates of unemployment.

Using data on overall trade restrictiveness we are already able to present some evidence on heterogeneity within the work force regarding the effects of trade on unemployment. Our results indicate that high skill workers benefit from a tariff reduction, whereas low-skill workers tend to lose in terms of unemployment.

Another interesting research agenda could look at the interaction between trade and assortative matching. The standard Melitz (2003) model limits the analysis to firm heterogeneity and lacks a further insight into the role of worker heterogeneity. Helpman, Itskhoki, and Redding (2011 a.b) relax this assumption by incorporating worker heterogeneity and search frictions into the Melitz (2003) model. Such an extension facilitates the study of the effects of trade liberalization on assortative matching and unemployment, and would also allow us to bring the main findings to the data using matched employer-employee data.

As outlined in the introduction, most of the research on the labor market effects of globalization dealt with trade liberalization. Another extension of the theoretical contribution could be to allow for outsourcing in order to analyze how it affects unemployment. This can be done in the asymmetric country version of the model proposed by Larch and Lechthaler

(2011) or Felbermayr, Larch, and Lechthaler (2009). The advantage of the first approach is that it already features heterogeneous workers which would allow to asses the effects on low- and high-skilled workers.

Kohler and Wrona (2010) find a non-monotonic relationship between offshoring and labor demand. To shed light on that issue from an empirical perspective could help to asses the pros and cons of offshoring. Such an empirical analysis would allow us to quantify the threshold for which the marginal effect changes its sign, provided that there is evidence for the two opposing effects at the intensive and extensive margin of labor demand.

Finally, we already identified Total Factor Productivity as potential channel variable through which trade can affect unemployment in theory and empirics. However, more work has to be done in order to make the results convincing. Especially the measures for Total Factor Productivity need some updates. In our future research we want to use the perpetual inventory method in order to construct better measures of TFP for reassasing this particular channel.

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