

Unemployment in an Interdependent World*

Gabriel J. Felbermayr[†], Mario Larch[‡] and Wolfgang Lechthaler[§]

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Abstract

We introduce search unemployment into a model of trade in differentiated goods and heterogeneous firms. Countries differ with respect to size, geographical location, and labor market institutions such as hiring costs, unemployment benefits, and the efficiency of the matching process. Contrary to the literature, our single-sector perspective pays special attention to the role of income effects. We show that bad institutions in one country worsen labor market outcomes not only in that country but also in its trading partners. First, the decrease in the global *market size* reduces exports and lowers demand for labor. Second, reduced *competitive pressure* reallocates market shares to inefficient firms, so that the average firm's labor productivity and hence its willingness to create vacancies is diminished. This spill-over effect is conditioned by trade costs and country sizes: smaller and/or more central nations suffer less from inefficient policies at home than large and/or peripheral ones, whereas the spill-over effect is stronger for smaller/more central nations. Carefully controlling for business cycle comovement between countries and institutional features, we empirically confirm these relationships in a panel of 20 rich OECD countries.

Keywords: Spill-over effects of labor market institutions; unemployment; international trade; search frictions; heterogeneous firms

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[†]Economics Department, University of Stuttgart-Hohenheim, 70593 Stuttgart, Germany. E-mail: gfelberm@uni-hohenheim.de.

[‡]Ifo Institute for Economic Research at the University of Munich and CESifo, Poschingerstrasse 5, 81679 Munich, Germany. E-mail: larch@ifo.de.

[§]Kiel Institute for the World Economy, Duesternbrooker Weg 120, 24105 Kiel, Germany. E-mail: wolfgang.lechthaler@ifw-kiel.de.

1 Introduction

“In the flat world, one person’s economic liberation could be another’s unemployment.” (Thomas Friedman, The World is Flat, 2005, p. 205)

“Globalization” is one of the key words in the popular press as well as in the academic literature in international economics.¹ One reason for this might be the very different things that are captured under the umbrella of “globalization”: Increased trade in goods and services, more and larger preferential trading blocks, increased multinational activity, rising migration flows, internationalized capital markets, to name just a few. At the heart of all these facets of globalization is one important common feature: Countries and their actions are no longer independent from each other. Rather, the economic, political, and social performance of one country also depends on the policies taken by other countries. Essentially, the study of these *interdependencies* is the epitome of international economics, whether countries are linked via trade in final goods or inputs or through international mobility of capital or labor. These interdependencies also seem to be at the core of widespread popular fears related to the globalization phenomenon.

This paper offers a theoretical and empirical perspective on how changes in labor market institutions in some country affect labor market outcomes in that same country as well as in those countries with which there is trade in goods. It identifies conditions under which some country’s outcomes depend more or less on its trading partners’ labor market institutions. The theoretical framework combines the widely used model of trade in differentiated goods (Krugman, 1979; Melitz, 2003) with the canonical search and matching approach (Pissarides, 2000). We generalize the description of product markets so that countries may differ with respect to labor endowments, geographical position, and labor market institutions. Moreover, we go beyond the canonical search and matching approach as firms’ monopoly power on the goods markets triggers strategic bargaining. We do not add any other structural elements, shortcuts or simplifications.

This no-frills model of the trade-unemployment relation predicts that bad institutions in one country worsen labor market outcomes not only in that country but also in those that are related through trade in goods. This spill-over effect is conditioned by trade costs and country sizes: smaller and/or more central nations suffer less from inefficient policies at home than large and/or peripheral ones, whereas the spill-over effect is stronger for smaller/more central nations. We empirically confirm the negative spill-over effect of bad labor market institutions.

There is an emerging consensus in the macroeconomic labor literature that institutions

¹A key word search in Google lead to 25,5 million hits, whereas a search in Google Scholar gave 859,000 hits. To compare it with other key words, we did a similar search for the key words “unemployment” and “inflation”, two widely used economic terms in the popular as well as academic press. For the former we received 31,1 million hits in Google and nearly 1,5 million hits in Google Scholar, and for the latter 49,9 million and about 1,8 million hits. The search was conducted on October 6th, 2008.

matter for unemployment rates; in particular, product market regulation is important.² Since trade liberalization is just one aspect of product market deregulation, one expects that more open economies indeed have lower structural unemployment rates. The data strongly supports this view, see Dutt, Mitra and Ranjan (2007) or Felbermayr, Prat and Schmerer (2009). Moreover, to the extent that labor market institutions affect the volume and pattern of trade between countries, it is likely that trade acts as a vehicle through which institutional features of one country also affect labor market outcomes in the other.

Conceptually, one may distinguish between three potential channels through which trade in goods leads to interdependence of countries' labor market outcomes. The first and best understood link is related to the effect that labor market institutions have on the pattern of *comparative advantage*. Davidson, Martin, and Matusz (1999) have incorporated search unemployment into a two-sector two-factor two-country ($2 \times 2 \times 2$) Heckscher-Ohlin framework. If labor market institutions in one country deteriorate, unemployment increases. This lowers the effective labor endowment relative to the available stock of capital. If that country is relatively capital-rich compared to its trading partner, it will specialize more strongly on the capital-intensive good while the trading partner produces more of the labor-intensive good. Hence, labor demand in the partner country goes up, the marginal value product of labor increases, firms find it optimal to create more vacancies, and unemployment goes down. However, if the country with the deteriorating institutions is labor-rich, it will have to produce more of the capital intensive good since its effective labor endowment shrinks. The partner, in turn, has to produce more of the labor intensive good. The marginal value product of labor falls, firms restrict vacancy creation and unemployment rises. Hence, whether the correlation of unemployment rates between countries is positive or negative depends on their relative capital-labor ratios.

The second channel runs through the effective *market potential* of countries. Consumers spend their income partially on domestic goods and partially on foreign goods. If labor market institutions in one country worsen, unemployment will rise and aggregate income will fall. As part of the income is spent on foreign goods, the demand for foreign goods will also shrink. Less demand in the foreign countries also leads to less production and employment. Hence, the market potential channel leads to a *positive correlation* of unemployment rates induced by labor market changes between countries. This market potential channel is well known in the "new economic geography" literature (see for an overview Fujita, Krugman and Venables (1999) or Baldwin, Forslid, Martin, Ottaviano and Robert-Nicoud (2003)). However, it was hardly explored in models of trade and unemployment. Its presence relies crucially on the existence of *income effects* and hence on a full-fledged general equilibrium model.

A third potential link operates through a *competitiveness effect*. It is most visible in partial equilibrium models of strategic interaction. Bad labor market institutions in one country drive up labor costs, thereby decreasing the degree of international competitiveness for all firms from that country. Hence, consumers switch to foreign suppliers, reducing derived labor demand in one country and increasing it in the other. It follows

²See for example Layard, Nickell, and Jackman (1991); Nickell (1997); Ljungquist and Sargent (1998); Nickell and Layard (1999) and Blanchard and Wolfers (2000).

that the correlation of unemployment rates induced by labor market institutions should be *negative*. However, with heterogeneous firms in general equilibrium, the effect reverses. As import pressure faced by foreign firms falls and residual demands go up, new firms will enter and the number of firms goes up. However, this process reallocates market share from efficient to inefficient firms, and the average firm's incentive to create vacancies is diminished. Hence, unemployment rises. Note, however, that the market potential effect and the competitiveness effect interact, with the latter diminishing the relative strength of the former.

Our paper features the second and the third channels, the well-understood comparative advantage link being absent due to the one-sector structure of the model. We show that the most straightforward combination of the Krugman/Melitz framework with the search-unemployment mechanism à la Pissarides implies a positive conditional correlation of unemployment rates across countries. We document this finding in simulations of the calibration model and confirm its empirical validity in an econometric exercise.

Related literature. A large number of papers studies the effect of cross-country differences in labor market institutions on the *pattern of trade*, and subsequently, on welfare, factor income distribution, and unemployment. Not surprisingly, early contributions built on frameworks of comparative advantage, in particular on the two-country, two-factor, two-good ($2 \times 2 \times 2$) Heckscher-Ohlin model. Brecher (1974) was the first to study the incidence of minimum wages in such a framework. Davis (1998) has famously generalized the Brecher model and has shown that minimum wages in a capital-abundant country can lead to higher wages in the labor-abundant country. In that model, trade exacerbates the adverse effects of minimum wages. Davidson, Martin, and Matusz (1988, 1999) introduce search and matching unemployment into multi sector models of international trade. For the reasons sketched above, they find that strict labor market regulation in the domestic economy induces that country to increase production of capital intensive goods, while the foreign country produces more of the labor intensive good. Hence, demand for labor goes up and the rate of unemployment falls. More recently, Cuat and Melitz (2007) study the effect of cross-country differences in firing restrictions on patterns of comparative advantage in a Ricardian setting, but they do not address the issue of unemployment.³

Since the empirical success of the Heckscher-Ohlin model is arguable, the more recent literature focuses on a different engine for trade, namely firm-level increasing returns to scale and product differentiation. A number of authors have integrated unemployment into the Krugman (1979) model and into its generalization to heterogeneous firms due to Melitz (2003). Two labor market paradigms have been most extensively used: fair wage preferences (and the closely related efficiency wage approach) and the search and matching approach. A central limitation of Krugman-type models with asymmetric trade costs consists in the absence of closed form solutions due to the fact that labor market clearing conditions are transcendental. Hence, Egger and Kreickemeier (2008a,b) and Felbermayr, Prat and Schmerer (2008), henceforth FPS, focus on models of perfect symmetry where

³The paper of Cuat and Melitz (2007) contains an excellent discussion of papers that address the effect of labor market institutions on trade patterns.

equilibrium outcomes can be completely characterized analytically. However, this practice makes it impossible to address the effect of asymmetries in labor market institutions and their cross-country implications. Analytical tractability is maintained when expected wages are fixed by a numeraire sector that remains unaffected by labor market frictions and trade costs, and which typically absorbs all income effects due to quasilinear preferences. This strategy blends the comparative advantage channel with Krugman/Melitz mechanisms. Our paper does not follow this path: it allows for income effects to be fully operative and focuses entirely on intra-sector reallocation (with intersectoral reallocation absent). In order to see how our approach differs, it is useful to consider three recent papers that use a multi-sector structure.

Helpman and Itskhoki (2008) have used a two-sector, two-country model, where one sector produces varieties of differentiated goods under conditions of firm-level economies of scale, monopolistic competition, iceberg trade costs, heterogeneous firms à la Melitz (2003) and industry externalities in the sense that aggregate productivity depends directly on the number of varieties available. This sector also features search unemployment. The other (numeraire) sector has a linear production function, perfect competition, no trade costs, and employment of workers is not subject to any search frictions. Families are large enough such that they can allocate members to sectors where in equilibrium expected wage rates must be equalized. In most of the paper, Helpman and Itskhoki focus on a situation where consumers' preferences are quasi-linear in the numeraire good. Countries are identical except for labor market frictions, which are parameterized such that both economies are diversified.

In this setup, the less sclerotic country specializes on the differentiated good. Trade liberalization triggers a reallocation of workers into the differentiated sector, thereby pushing up aggregate unemployment. However, there are additional effects due to increased exit and entry of firms and changes in terms of trade, so that the net effect is ambiguous. However, it is well possible that unemployment in both countries goes up. Helpman and Itskhoki show numerically that a reduction of search frictions in one country leads to a hump-shaped response in this country's unemployment rate but unambiguously decreases the unemployment rate in the other country. It is unclear whether unemployment rates move in the same or in opposite directions; moreover, it can actually be that the more flexible country has the lower rate of unemployment.⁴ Helpman and Itskhoki acknowledge that "the unemployment results depend on certain structural features of the model" (p. 4). The central motivation of our work is to reduce the number of structural assumptions and bring a more parsimonious model to bear on the trade-unemployment nexus.

Helpman, Itskhoki, and Redding (2008) build on the paper by Helpman and Itskhoki, but assume that workers differ according to an exogenously given ability. In order to observe their skills, firms invest into the screening of their potential workers' abilities before the wage bargain occurs. Their result concerning the effect of bad home labor market institutions on home unemployment is ambiguous, with a slight favorable prediction for a *negative* relationship. Higher home screening costs lead unambiguously to

⁴However, whenever the more flexible country also has the lower rate of unemployment, a reduction in one country's search frictions lowers unemployment in both.

a lower unemployment rate, whereas higher search costs have an ambiguous effect on unemployment. Higher search costs lead to a decrease in labor market tightness which raises unemployment, but also induce a decrease of the fraction of exporting firms, which lowers unemployment. The result about the international consequences of labor market institutions is summarized in their Proposition 6, part (iii): “... *a rise in the foreign country’s labor market frictions raises unemployment in the home country while a rise in the home country’s labor market frictions raises unemployment in the foreign country*”. The key to understand this result is to recognize that foreign labor market institutions affect unemployment in the domestic market only through trade openness and the fraction of firms that export. Lower variable trade cost and higher foreign labor market frictions increase unemployment in the domestic country by raising the fraction of home firms that export. The increase of firms that export in the domestic market leads to a shift of the industry composition of low- to high-productivity firms. As in their model more productive firms are more selective, this change in industry composition raises unemployment. To sum up, bad labor market institutions tend to lead to a decrease of home unemployment (specifically if screening costs raise), whereas unemployment in the foreign country goes up.

A similar relationship between labor market institutions and unemployment at home and abroad in a very different model was obtained by Egger, Greenaway, and Seidel (2008). They use a multi-country, new economic geography model of trade with mobile capital in general equilibrium, where labor markets are constrained due to fair wage preferences of workers. Besides their main focus on the value of bilateral trade as well as the share of intra-industry trade, they also obtain predictions regarding the interdependence of labor market institutions. They are summarized in their Proposition 1 : “*A marginal increase in the fair wage parameter unambiguously compresses relative factor returns in all countries. This goes along with an increase in the unemployment rate of [the home] country while more employment is generated in all other countries. A marginal variation in the replacement rate has similar effects.*”

Hence, theoretical predictions so far seem mostly to suggest a negative relationship between the effects of labor market institutions at home and abroad.⁵ However, as we will show in the empirical section of this paper, the conditional correlation of structural unemployment rates across rich OECD countries is positive. By the same token, the correlation between foreign labor market distortions and domestic structural unemployment is positive, too. Therefore, we want to suggest a model that copes with the empirical stylized fact of a positive correlation of bad labor market institutions and raising unem-

⁵Note that the model from Helpman, Itzhak, Redding (2008) would suggest that the correlation between bad labor market institutions at home and home unemployment would be negative, whereas the correlation with foreign unemployment would be positive. The predictions from the model of Egger, Greenaway, and Seidel (2008) would exactly be the opposite: The correlation of bad labor market institutions with home unemployment would be positive, whereas it would be negative with foreign unemployment. The paper by Beissinger and Busse (2002) is the only contribution where the correlation between domestic and foreign unemployment is unambiguously positive. In contrast to this paper, we allow for entry and exit of heterogeneous firms, do not assume a frictionless economy, and focus on the dependence between trade costs and labor market spill-overs.

ployment rates, both, at home and abroad. Our model is general enough to investigate the impact of the economic size of countries, the geographical location, and the labor market institutions such as hiring costs, unemployment benefits, and the efficiency of the matching process.

The remainder of the paper is structured as follows. Section 2 outlines the theoretical model. Section 3 explores the interdependence of labor market outcomes and unemployment of our theoretical model. In section 4 we provide empirical evidence for the key predictions of our model. The last section concludes.

2 A Heterogeneous Firms Model with Search and Matching Frictions and Asymmetric Countries

Our world consists of N potentially asymmetric countries with firms that differ by an exogenously drawn productivity à la Melitz (2003). The labor market is considered to be imperfect due to search and matching frictions as suggested by Mortensen and Pissarides (1999). Hence, we extend the model from FPS to allow for asymmetries regarding the country size, the geographical locations of countries, and various labor market institutions.

We will describe the various model features in the following sequence: First we explain the production process in the economy, then we state our assumptions about the labor market and finally the entry- and export decision of firms is depicted.

2.1 The Production Process in the Economy

We assume N countries, indexed by subscript i , with $i = 1, \dots, N$. Similar to Egger and Kreickemeier (2008b) and FPS, we assume a single final output good in every country, Q_i , which is produced under perfect competition. The final output good can either be consumed or used as an input in the production process. Good Q_i is assembled from a continuum of intermediate inputs, which are partly provided from domestic firms and partly imported from abroad. Denoting the quantity of an intermediate input with $q_i(\omega)$, we can write the production function as follows:

$$Q_i = \left\{ (\bar{M}_i)^{\frac{\nu-1}{\sigma}} \int_{\omega_i \in \Omega_i} q[\omega_i]^{\frac{\sigma-1}{\sigma}} d\omega_i \right\}^{\frac{\sigma}{\sigma-1}}, \quad (1)$$

where σ denotes the elasticity of substitution between any two varieties of inputs with $\sigma > 1$, and the measure of the set Ω is the mass $\bar{M}_i$ of available intermediate inputs in country i . Each intermediate input is produced by a distinct monopolistically competitive firm. ν parameterizes the external scale effect through which input diversity affects aggregate productivity, with $\nu \in (0, 1)$. If $\nu = 0$ the number of available varieties is irrelevant for total output. If $\nu = 1$ we are back to the “traditional” case discussed by Krugman (1980) or Melitz (2003).

The price index dual to (1) is given by:

$$P_i = \left(\frac{1}{\bar{M}_i^{1-\nu}} \int_{\omega_i \in \Omega_i} p[\omega_i]^{1-\sigma} d\omega_i \right)^{\frac{1}{1-\sigma}}, \quad (2)$$

where $p[\omega_i]$ is the price of a variety ω_i . We choose the final output good in country 1 as the numéraire, hence $P_1 = 1$.

Based on the production function given in (1) and the price index given in (2), the demand function for each variety of intermediate good is given by:

$$q[\omega_i] = p[\omega_i]^{-\sigma} (P_i)^{\sigma-1} \left(\frac{Y_i}{\bar{M}_i^{1-\nu}} \right), \quad (3)$$

where Y_i is total income of country i . Note that aggregate production needs not only cover final consumption but also the fixed costs of production and vacancy posting costs.

Similar to Melitz (2003), intermediate input firms have different productivity levels $\varphi[\omega_i]$. There is a continuum of monopolistically competitive firms which produce each a unique variety. Hence, we also index firms by φ_i . Labor, L , is the unique factor of production. Hence, a firm with productivity level φ_i has output $q(\varphi_i) = \varphi_i L[\varphi_i]$, where $L[\varphi_i]$ is the level of employment at firm φ_i . In addition to the marginal costs of production, input producers have to pay a sunk set-up cost of f in order to start production at home. Besides the domestic market, intermediate input producers can serve each of the N foreign markets via exports. Entry into each of the export markets leads to additional fixed costs of f^x . In addition to these fixed export costs, serving customers in country j from country i entails variable iceberg trade costs $\tau_{ij} \geq 1$.

Hence, we may write the domestic and foreign inverse demand for the intermediate goods producer φ_i as follows:⁶

$$\begin{aligned} p_d[\varphi_i] &= q_d[\varphi_i]^{-\frac{1}{\sigma}} (P_i)^{\frac{\sigma-1}{\sigma}} \left(\frac{Y_i}{\bar{M}_i^{1-\nu}} \right)^{\frac{1}{\sigma}}, \\ p_x[\varphi_i] &= q_x[\varphi_i]^{-\frac{1}{\sigma}} (P_j)^{\frac{\sigma-1}{\sigma}} \left(\frac{\tau_{ij} Y_j}{\bar{M}_j^{1-\nu}} \right)^{\frac{1}{\sigma}}. \end{aligned} \quad (4)$$

If a firm decides to serve domestic and foreign markets, it allocates its output so as to maximize its total revenues. Equating marginal revenues across markets therefore yields $p_x[\varphi_i] = \tau_{ij} p_d[\varphi_i]$ (see Appendix A1).

Operating revenues of a firm in country i with productivity φ_i from sales on the domestic (foreign) market are therefore equal to $R_d[\varphi_i] = p_d[\varphi_i] q_d[\varphi_i]$ ($R_x[\varphi_i] = p_x[\varphi_i] q_x[\varphi_i] / \tau_{ij}$). Total revenue of an intermediate input producer with productivity φ_i , $R[\varphi_i]$, is then given by:

$$R[\varphi_i] = q_d[\varphi_i]^{\frac{\sigma-1}{\sigma}} (P_i)^{\frac{\sigma-1}{\sigma}} \left(\frac{Y_i}{\bar{M}_i^{1-\nu}} \right)^{\frac{1}{\sigma}}$$

⁶Note that $p_x[\cdot]$ is the cif price in the foreign market and $q_x[\cdot]$ is the quantity produced for the foreign market, including the iceberg transport costs.

$$+I[\varphi_i]q_x[\varphi_i]^{\frac{\sigma-1}{\sigma}}(P_j)^{\frac{\sigma-1}{\sigma}}\left(\frac{\tau_{ij}^{1-\sigma}Y_j}{M_j^{1-\nu}}\right)^{\frac{1}{\sigma}}, \quad (5)$$

where $I[\varphi_i]$ is an indicator function that takes value one when a firm in country i with productivity φ_i exports and zero otherwise.

2.2 The Labor Market

In order to allow for unemployment in our model, we follow the approach of Mortensen and Pissarides (1994) and assume search frictions on the labor market. Our model is in discrete time and all payments are made at the end of each period. At the end of each period, firms and workers are hit by two different type of shocks: Firms in country i are forced to leave the market with a probability of δ_i and with probability χ_i each job is destroyed because of a match-specific shock. Assuming independence of these shocks, the actual rate of job separation is given by $\eta_i = \delta_i + \chi_i - \delta_i\chi_i$.

Each period any intermediate input producer in country i decides about the optimal number of vacancies v_i , taking the wage rate as given. The costs of posting a vacancy in country i are proportional to the parameter c_i and measured in units of the final good. However, from the posted vacancies v only a certain share $m_i[\theta_i]$ is filled, where θ_i is the vacancy-unemployment ratio in country i and $m'_i[\theta_i] < 0$.⁷ We can solve the game by backward induction, hence we first describe the firm's optimal vacancy setting behavior, and then discuss the bargaining problem.

The value of an intermediate input producer solves:

$$\begin{aligned} J[L_i, \varphi_i] &= \max_v \frac{1}{1+r} \left(R[\varphi_i] - w_i L[\varphi_i] - fP_i - v c_i P_i \right. \\ &\quad \left. - I[\varphi_i] f^x P_i + (1-\delta) J'_i \right), \\ \text{s.t. } (i) \quad &R[\varphi_i] \text{ given in equation (5),} \\ (ii) \quad &L'_i = (1-\chi_i)L_i + m_i(\theta_i)v_i, \end{aligned} \quad (6)$$

where r denotes the interest rate, w_i is the wage rate in country i , and L'_i is the level of employment in the next period. Constraint (i) is the revenue function and constraint (ii) gives the law of motion of employment at the firm level. The first order condition for vacancy posting can be stated as follows:

$$\frac{c_i P_i}{m_i[\theta_i]} = (1-\delta) \frac{\partial J[L, \varphi_i, t+1]}{\partial L_{i,t+1}}. \quad (7)$$

This first order condition shows that the firm equalizes marginal recruitment costs (given on the left hand side) and the shadow value of labor (given on the right hand side).

⁷We assume the following standard properties $\lim_{\theta_i \rightarrow \infty} m_i(\theta_i) = 0$ and $\lim_{\theta_i \rightarrow 0} m_i(\theta_i) = \infty$. In some applications, we write $m_i(\theta_i) = \bar{m}_i \mu(\theta_i)$ where $\bar{m}_i$ parameterizes the overall efficiency of the search technology.

Substituting the constraints into the objective function of the firm (6), differentiating with respect to L_i and employing the optimality condition (7) yields:

$$\frac{\partial J[L_i, \varphi_i, t]}{\partial L_i} = \frac{1}{1+r} \left(\frac{\partial R[\varphi_i]}{\partial L_i} - w_i - \frac{\partial w_i}{\partial L_i} L[\varphi_i] + \frac{c_i}{m_i[\theta_i]} (1 - \chi_i) \right). \quad (8)$$

Replacing the first order condition (7) into the left-hand side of equation (8), we obtain an expression that implicitly determines the optimal pricing behavior of the intermediate input producer:

$$\frac{\partial R[\varphi_i]}{\partial L_i} = w_i + \frac{\partial w_i}{\partial L_i} L[\varphi_i] + \frac{c_i}{m_i[\theta_i]} \left(\frac{r + \eta_i}{1 - \delta} \right).$$

Before production takes place, wages are individually bargained. As in Stole and Zwiebel (1996) every worker is treated as the marginal worker, i.e. as the last worker employed by the firm. The total surplus from a successful match is split between the employee and the intermediate input producer. The worker's surplus is equal to the difference between the value of being employed $E[L_i, \varphi_i]$ by a firm with productivity φ_i in country i and workforce L_i and the value of being unemployed U_i . The firm's surplus is equal to the marginal increase in the firm's value $\partial J[L_i, \varphi_i, t]$, which results from the assumption that every worker is treated as the marginal worker. The outcome of the bargaining process over the division of the surplus follows the following “surplus-splitting” rule:

$$(1 - \beta_i) (E[L_i, \varphi_i] - U_i) = \beta_i \frac{\partial J[L_i, \varphi_i, t]}{\partial L_i}, \quad (9)$$

where the parameter β_i measures the bargaining power of the workers and belongs to $(0, 1)$.

We now can use the shadow value of labor as given in equation (8) in the bargaining solution (9). This leaves us with a differential equation in the wage rate, which can be solved and leads to a *wage curve* (see FPS for a similar procedure):

$$\frac{w_i}{P_i} = b_i \Phi_i + \frac{\beta}{1 - \beta} \frac{c_i}{1 - \delta} \left(\frac{r + \eta_i}{m_i[\theta_i]} + \theta_i \right),$$

where b_i are unemployment benefits and

$$\Phi_i \equiv \tilde{\varphi}_{ii} p_i (\tilde{\varphi}_{ii}) / P_i \quad (10)$$

relates the marginal value product of labor at the average domestic firm $\tilde{\varphi}_{ii} p_i (\tilde{\varphi}_{ii})$ to the cost of vacancy posting P_i .⁸ Hence, Φ_i measures the relative attractiveness of creating an additional vacancy.

The equilibrium real wage w_i/P_i and labor market tightness θ_i are found by interacting the wage curve with the *job creation curve*, which is given by:

$$\frac{w_i}{P_i} = \frac{\sigma - 1}{\sigma - \beta_i} \Phi_i - \frac{c_i}{m_i[\theta_i]} \frac{r + \eta_i}{1 - \delta}. \quad (11)$$

⁸The productivity of the average *domestic* firm is $\tilde{\varphi}_{ii}^d$. As in Melitz (2003), the upper-tier CES aggregate implies $p[\varphi_i] \varphi_i = p[\varphi'_i] \varphi'_i$ for all values of φ_i and φ'_i . Hence, specifically for $\tilde{\varphi}_{ii}^*$.

The job creation curve implies that workers are paid similarly across firms with different productivity levels. Hence, as in Stole and Zwiebel (1996) firms exploit their monopsony power until employees are paid their outside option.

We can now state a first Lemma.

Lemma 1 [Labor market equilibrium]

- (a) For given Φ_i , there is a unique labor market equilibrium $\{w_i/P_i, \theta_i\}$ if $\frac{\sigma-1}{\sigma-\beta_i} > b_i$.
- (b) An increase in Φ_i increases the real wage w_i/P_i and the degree of labor market tightness θ_i .
- (c) For given Φ_i , variation in institutional parameters b_i , c_i or $\bar{m}_i$ leads to qualitatively equivalent results as regards the degree of labor market tightness θ_i .

Part (a) in Lemma 1 follows from the fact that the job-creation curve is strictly downward sloping in θ , while the wage curve is upward-sloping. An equilibrium exists only if the flow-value of non-employment b_i is smaller than the share of the value of the match that will accrue to the worker.

Part (b) holds true under the condition established in part (a). The intuition is that any decrease in the relative profitability of job-creation will lead to less vacancy-posting, to a lower degree of market tightness, and, eventually, to a higher rate of unemployment and a lower real wage. Figure 1 illustrates this effect. Hence, in order to show how some country i is affected by institutional changes in some other country j , it suffices to understand the impact of this change on Φ_i . In other words, country i 's labor market outcomes are only affected by changes in Φ_i .

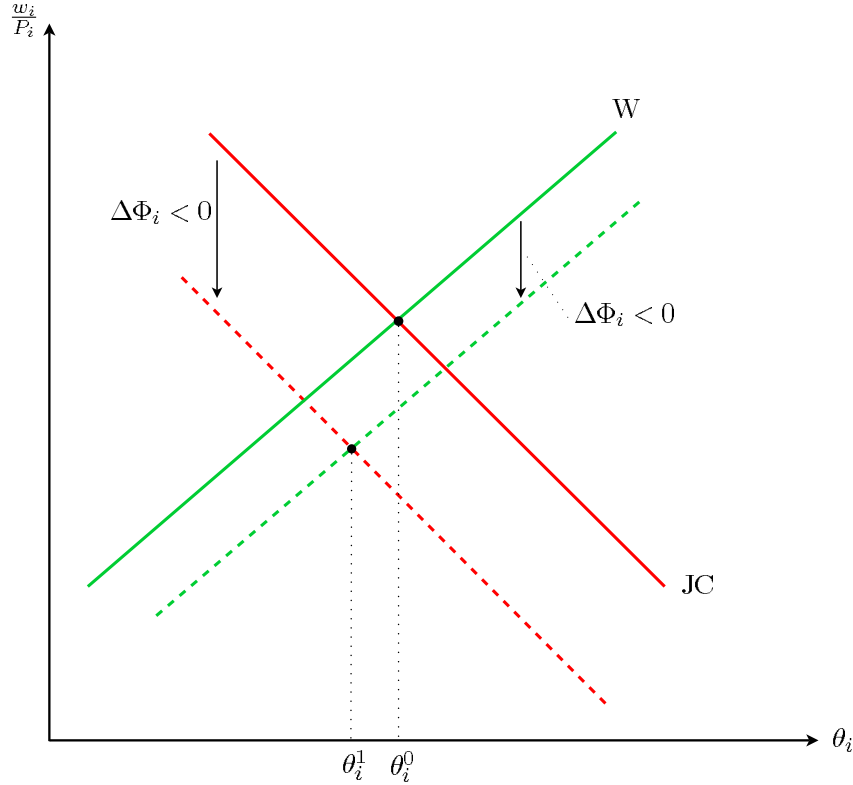


Figure 1: The effect of a fall in Φ on labor market tightness.

Part (c) establishes that, whatever the equilibrium value of Φ_i turns out to be, changes in the most relevant labor market institutions – the replacement rate b_i , hiring costs c_i , and the efficiency of the matching process $\bar{m}_i$ – have similar qualitative effects on labor market tightness and, hence, on the rate of unemployment.⁹ We will see below that the determination of Φ_i does not directly depend on b_i, c_i , or $\bar{m}_i$ but only on labor market outcomes such as the real wage or the rate of unemployment. It follows that variation in b_i, c_i , or $\bar{m}_i$ affects equilibrium outcomes in qualitatively similar ways. In our comparative statics exercise, we will therefore focus on b_i as a representative institutional variable.

2.3 Entry- and Export Decision of Firms

There is an infinite number of potential firms which can enter the market after paying a fixed and sunk entry cost f^e , measured in terms of the final consumption good. Only after entering they are able to draw their productivity φ_i from a known distribution with c.d.f. $G[\varphi_i]$ and p.d.f. $g[\varphi_i]$. The productivity stays the same as long as the firm exists. Only firms which draw a φ_i favorable enough to make non-negative profits, will start production.

In order to describe the entry-decision, we first define the discounted firm level profits

$$\begin{aligned}\Pi[\varphi_i] &= (1 - \delta) \sum_{t=0}^{\infty} (1 - r - \delta)^t \pi[\varphi_i] - \frac{c_i P_i}{m_i[\theta_i]} L[\varphi_i] - f P_i \\ &= (1 - \delta) \frac{\pi[\varphi_i]}{r + \delta} - \frac{P_i c_i}{m_i[\theta_i]} L[\varphi_i] - f P_i.\end{aligned}\quad (12)$$

$\pi[\varphi_i]$ are the per-period profits of a firm in country i with productivity φ_i , given by:

$$\pi[\varphi_i] = p_i[\varphi_i] q_i[\varphi_i] - w_i L[\varphi_i] - f P_i - \frac{c_i P_i}{m_i[\theta_i]} \chi_i L[\varphi_i], \quad (13)$$

which is revenue minus wage payments, fixed costs and search costs for a firm in country i with productivity φ_i . A firm will decide to start up production whenever its productivity exceeds a certain threshold-value φ_{ii}^* . The marginal operative firm φ_{ii}^* is found by solving $\Pi[\varphi_{ii}^*] = 0$. Hence, the cut-off level productivity of firms entering the market is defined by:

$$(1 - \delta) \frac{\pi[\varphi_{ii}^*]}{r + \delta} = \frac{c_i P_i L[\varphi_{ii}^*]}{m_i[\theta_i]} + f P_i, \quad (14)$$

where $L[\varphi_{ii}^*]$ are the workers needed for domestic production in country i of the firm with productivity φ_{ii}^* . At the beginning of its existence the firm has to “invest” in its stock of workers, i.e. all the workers have to be newly hired.¹⁰ The discounted value of future profits has to be large enough so that a firm wants to undertake this up-front investment.

⁹We have $\partial \theta_i / \partial b_i < 0$, $\partial \theta_i / \partial c_i < 0$, and $\partial \theta_i / \partial \bar{m}_i > 0$.

¹⁰Note that due to the linearity of adjustment costs the work-force immediately jumps to the optimal value.

Otherwise, the firm immediately exits. Equivalently to equation (14), we can determine the export threshold as:

$$(1 - \delta) \frac{\pi[\varphi_{ij}^*]}{r + \delta} = \frac{c_i P_i L[\varphi_{ij}^*]}{m[\theta_i]} + f^x P_i, \quad (15)$$

where $L[\varphi_{ij}^*]$ are the additional workers needed to produce for foreign market j for a firm in country i with productivity φ_{ij}^* . $\pi[\varphi_{ij}^*]$ is the additional profit from serving the export market j , defined similarly as the profit from serving the local market i (see equation (13)). Using the revenue functions and the zero-profit conditions, we can derive a relationship between the zero-profit productivity cut-off and the exporting productivity cut-off:

$$\varphi_{ij}^* = \Lambda_{ij} \varphi_{ii}^* \quad \text{with} \quad (16)$$

$$\Lambda_{ij} = \tau_{ij} \frac{P_i}{P_j} \left(\frac{Y_i f^x}{Y_j f} \right)^{\frac{1}{\sigma-1}} \left(\frac{\bar{M}_j}{\bar{M}_i} \right)^{\frac{1-\nu}{\sigma-1}}. \quad (17)$$

The profits from serving the foreign market have to be large enough to justify the extra fixed costs f^x . Empirical evidence strongly supports selection into export markets.¹¹ Hence, we focus on parameter values where only the most productive firms export and therefore $\varphi_{ij}^* > \varphi_{ii}^*$.

Following Melitz (2003), we define the average productivity of a domestic firm serving the domestic market i and any of the foreign markets j as:

$$\tilde{\varphi}[\varphi_{ij}^*] = \left(\frac{1}{1 - G[\varphi_{ij}^*]} \int_{\varphi_{ij}^*}^{\infty} (\varphi_i)^{\sigma-1} g[\varphi_i] d\varphi_i \right)^{1/(\sigma-1)} \quad \text{for all } i, j. \quad (18)$$

Based on this definition we can write down the free entry condition as:

$$\begin{aligned} f^E P_i &= (1 - G[\varphi_{ii}^*]) \left((1 - \delta) \frac{\pi[\tilde{\varphi}_{ii}]}{r + \delta} - \frac{c_i P_i L[\tilde{\varphi}_{ii}]}{m_i[\theta_i]} - f P_i \right) \\ &+ (1 - G[\varphi_{ij}^*]) \left((1 - \delta) \frac{\pi[\tilde{\varphi}_{ij}]}{r + \delta} - \frac{c_i P_i L[\tilde{\varphi}_{ij}]}{m_i[\theta_i]} - f^x P_i \right), \end{aligned} \quad (19)$$

where we have the costs of entering a market on the left-hand side and the expected profits on the right-hand side. The profits of the firm are not yet known at the time of the entry-decision because the productivity level is unknown. With probability $1 - G[\varphi_{ii}^*]$ the productivity will be high enough to make production profitable in the home country i . With probability $1 - G[\varphi_{ij}^*]$ the productivity will be high enough so that even exporting to country j is profitable. The term in brackets indicate how much a firm will earn in these cases.

Equality in equation (19) is assured by the entry of new firms. As long as average profits exceed the entry cost, new firms will enter the market, increasing competition,

¹¹For empirical evidence on selection into the export markets, see Bernard and Jensen (1995, 1999, 2004) ; Roberts and Tybout (1997); and Clerides, Lach and Tybout (1998).

thereby driving down profits until they have reached the entry cost (and vice versa if profits are too low).

The ex ante probability of successful entry into country i is $(1 - G[\varphi_{ii}^*])$, whereas the ex ante probability of exporting conditional on successful entry is $\varrho_{ij} = (1 - G[\varphi_{ij}^*]) / (1 - G[\varphi_{ii}^*])$. The mass of available varieties in country i is given by $\bar{M}_i = M_i + \sum_{h \neq i} \varrho_{hi} M_h$, and M_h is the mass of active producers in country h .

With these definitions, the price index can be written as:

$$P_i = \left(\frac{M_i p_i^{1-\sigma} + \sum_{j \neq i} \varrho_{ij} M_j \left(\tau_{ji} \frac{\tilde{\varphi}_{jj}}{\tilde{\varphi}_{ji}} p_j \right)^{1-\sigma}}{\bar{M}_i^{1-\nu}} \right)^{1/(1-\sigma)}, \quad (20)$$

which collapses to the standard form when $\nu = 1$.

Using the condition that profits of φ_{ii}^* -firms are zero, the log-linear relationship between firm sizes, i.e. $L[\tilde{\varphi}_{ij}] = (\tilde{\varphi}_{ij}/\varphi_{ij}^*) L[\varphi_{ij}^*]$ for all i, j , and the job creation curve given in equation (11), we can derive an expression for the labor demand:

$$L[\tilde{\varphi}_{ij}] = \left(\frac{\tilde{\varphi}_{ij}}{\varphi_{ij}^*} \right)^{\sigma-1} \left(\frac{1+r}{1-\delta} \right) \left(\frac{\sigma-\beta}{1-\beta} \right) \frac{f P_i}{\Phi_i}. \quad (21)$$

2.4 Unemployment

The labor market in all countries is described by a Cobb-Douglas matching function:

$$m[\theta_i] = \bar{m} (\theta_i)^{-\alpha_i}, \quad (22)$$

where the parameter $\bar{m}$ measures the efficiency of the labor market, while α_i is the elasticity of the matching function in country i . The matching function gives the probability that a vacancy is filled in dependence of θ_i , the tightness of the labor market. In turn, the probability that a worker finds a job in country i can be written as $\theta_i m[\theta_i]$. Noting that the exogenous rate of job-destruction is given by η_i , the equilibrium unemployment rate is given by the Beveridge curve:

$$u_i = \frac{\eta_i}{\eta_i + \theta_i m[\theta_i]}. \quad (23)$$

The labor market clearing condition is given by:

$$L_i^e = (1 - u_i) L_i, \quad (24)$$

where L_i^e is aggregate employment and L_i is labor supply in country i .

Finally, the mass of active domestic firms adjusts so that the labor market clears:

$$M_i = \frac{L_i^e}{L[\tilde{\varphi}_{ii}] + \sum_{j \neq i} \varrho_{ij} L[\tilde{\varphi}_{ij}]}. \quad (25)$$

2.5 Income and Multilateral Trade Balance

Total spending on the aggregate output good, i.e. total nominal income, is defined as the sum of payments to employed workers (aggregate consumption expenditure), on flow fixed costs f and f^x , on appropriately discounted up-front investments f^e , and on search costs:

$$Y_i = w_i L_i^e + P_i M_i \left(\frac{1+r}{1-\delta} \left(f + f^x \sum_{j \neq i} \varrho_{ij} \right) + \frac{r+\delta}{1-G[\varphi_{ii}^*]} \frac{1}{1-\delta} f^e \right) + \frac{\eta_i + r}{1-\delta} \frac{L_i^e}{M_i P_i} \frac{c_i P_i}{m_i [\theta_i]} \quad (26)$$

We assume that, in equilibrium, every country maintains multilateral (though not bilateral) trade balance. The formal multilateral trade balance constraint for country i (or, balance of payments, BOP_i) is given by:

$$BOP_i = \sum_{j \neq i} P_i^{\sigma-1} \tau_{ji}^{1-\sigma} \left(\frac{\tilde{\varphi}_{jj}}{\tilde{\varphi}_{ji}} p_j \right)^{1-\sigma} \left(\frac{Y_i}{\bar{M}_i} \right)^{1-\nu} \varrho_{ji} M_j - \sum_{j \neq i} P_j^{\sigma-1} \tau_{ij}^{1-\sigma} \left(\frac{\tilde{\varphi}_{ii}}{\tilde{\varphi}_{ij}} p_i \right)^{1-\sigma} \left(\frac{Y_j}{\bar{M}_j} \right)^{1-\nu} \varrho_{ij} M_i. \quad (27)$$

2.6 General equilibrium

To obtain analytical results, the literature usually assumes quasi-linear preferences of the existence of a freely-traded numéraire good which is produced in every country under conditions of perfect competition and where there are no labor market frictions. We are not opting for such a short-cut, since this would relegate the effect of changes in market sizes into the numéraire sector. Another way toward a full-fledged analytical solution of the model is to assume perfect symmetry in all respects which yields a recursive model structure. Under these latter circumstances, the present model perfectly coincides with FPS. The existence and uniqueness results, as well as all the comparative statics, presented in FPS carry over. One key insight in that model is that lower variable trade costs increase the relative reward to vacancy posting, Φ_i , in every country.

When countries are asymmetric, the Φ 's depend, amongst other things, on all the countries' disposable incomes. The disposable incomes are in part determined by the respective rates of unemployment, hence $\Phi_i = f(u_1, u_2, \dots, u_N, \dots)$. The wage and job creation curves imply that $u_i = g(b_i, c_i, \bar{m}_i; \Phi_i)$. Through Φ_i , country i 's rate of unemployment depends on all the other countries' unemployment rates as well. This, in turn, implies a structural dependence of u_i on the whole world's collection of institutional labor market variables.

The proposed model is a generalized version of Krugman (1979), in which the labor market clearing conditions give rise to transcendental equations which do not possess any analytical solution. Note that the underlying problem in this type of model does not stem from the existence of external economies of scale; it also does not vanish when the price

of the final output good P_i is equalized by frictionless international trade. Hence, in order to assess the properties of the model, we need to resort to calibration and simulation.¹²

3 Interdependence of Labor Market Outcomes

3.1 Model Calibration

We calibrate the model such that each country's initial steady state reproduces a number of key empirical moments of the United States: for example, we parameterize the economies such that the average firm size, firm turnover rates, or job separation rates are matched. In order to avoid the obvious counterfactual negative correlation between country size and unemployment, we disallow for external economies of scale.

Productivity Distribution. Following the literature on heterogeneous firms (see for example Axtell (2001); and Helpman, Melitz, and Yeaple (2004)), we assume that firms sample their productivity from a Pareto distribution, so that

$$g(\varphi) = \frac{\gamma}{\varphi} \left(\frac{\bar{\varphi}}{\varphi} \right)^\gamma. \quad (28)$$

The shape parameter γ measures the rate of decay of the sampling distribution and $\bar{\varphi} > 0$ is the minimum possible value of φ . The assumption of Pareto distributed productivities is justified by the observation that the log-density of firms's log-sizes is well approximated by an affine function.

Using the Pareto distribution, average productivities (18) can be written as:

$$\tilde{\varphi}_{ij} = \left(\frac{\gamma}{\gamma - \sigma + 1} \right)^{1/(\sigma-1)} \varphi_{ij}^*. \quad (29)$$

Note that the average productivity is an increasing function of the cut-off productivity φ_{ij}^* .

Given the distributional assumption, the cut-off level productivity can now be explicitly stated:

$$\varphi_{ii}^* = \left(f + \sum_{j \neq i} f^x \Lambda_{ij}^{-\gamma} \right)^{1/\gamma} (1/f^e)^{1/\gamma} \left[\frac{1+r}{r+\delta} \left(\frac{\gamma}{\gamma - \sigma + 1} - 1 \right) \bar{\varphi}^\gamma \right]^{1/\gamma}. \quad (30)$$

In order to parameterize the Pareto distribution, we have to set two values: (i) the minimum possible value of φ , $\bar{\varphi}$, and (ii) the shape parameter γ . In order to pin down $\bar{\varphi}$,

¹²This is what many authors in the economic geography literature do; see Fujita, Krugman, and Venables (1999) do. Also compare the multi-country heterogeneous trade cost model of Anderson and van Wincoop (2003)

note that the absolute value of φ is not informative. Hence, we can chose $\bar{\varphi}$ arbitrarily and set it to 0.5. Concerning the shape parameter we follow Bernard, Redding, and Schott (2007) and set it equal to 3.4.

Matching Function. Given that wages are paid at the end of each period, we set the time interval to one month. The matching function is assumed to be Cobb-Douglas as given in Equation (22). We follow the standard practice in the search-matching literature and set the elasticity parameter α to 0.5. In the absence of well-established estimates, we set the bargaining power $\beta = \alpha$.¹³

To calibrate the scale parameter $\bar{m}$, we use empirical estimates of the job finding rate and labor market tightness. Given the constant returns to scale property of the matching function, the equilibrium tightness must be equal to the ratio of these two rates. Shimer (2005) estimates the monthly rate at which workers find a job to be equal to 0.45. Hall (2005) finds an average ratio of vacancies to unemployed workers of 0.539 over the period going from 2000 to 2002. Accordingly, we match an equilibrium tightness of 0.5 by setting the monthly job filling rate to 0.9. Reinserting these values into Equation (22), we find that $\bar{m} = 0.636$.

Separation shocks. Job separations occur either because the firm leaves the market or because the match itself is destroyed. We consider that the first type of shock arrives at a Poisson rate of 0.916% per month. This implies that the annual gross rate of firm turnover is equal to 22%, as suggested by the estimates in Bartelsman, Haltiwanger, and Scarpetta (2004). The match-specific shocks account for the job separations which are left unexplained by the firm-specific shock. Given that Shimer (2005) estimates the monthly rate of job separation to be 0.034, it follows that the rate of arrival of match-specific shocks χ_i should be equal to 0.025 per month.

Cost parameters. As it is common in the real business cycle literature, we set the interest rate to 4% per year. In order to calibrate the value of non-market activity, we follow Shimer (2005) and set $b_i = 0.4$ to match an earnings replacement ratio close to 40%. The cost of posting a vacancy, c_i , is set 50% above the vacancy filing rate. Given that the equilibrium wage is around $w_i = 1.137$, this value yields an average recruitment cost of around 5.7 weeks of workers' earnings, as suggested by empirical estimates.

Variable and fixed costs of trade and entry. We choose variable trade costs τ_{ij} equal to 1.3 as Ghironi and Melitz (2005). Given the Pareto distribution, the share of firms that export is given by

$$\varrho_{ij} = \tau_{ij}^{-\gamma} \left(\frac{f}{f_x} \right)^{\frac{\gamma}{1-\sigma}}. \quad (31)$$

¹³The equality of the bargaining power and matching function elasticity is known as the ‘Hosios condition’ (Hosios, 1990) in the search-matching literature. Note, however, that in our case this condition is not sufficient to ensure an efficient allocation because of the over-hiring externality.

That number is put at about 21% by Bernard, Eaton, Jensen, and Kortum (2003). Together with $\tau_{ij} = 1.3$, this pins down the ratio f^x/f at about 1.7.

We use the values of entry costs, f^e , and the flow fixed costs, f , to match the following two moments. Firstly, we ensure that the equilibrium tightness $\theta = 0.5$. Secondly, we target an average firm size equal to 21.8 employees, as estimated by Axtell (2001). These two moments are perfectly matched for the set of parameters reported in Table 1. The calibrated entry costs are equivalent to 2.82 years of income per capita. This figure can be compared to the assessment by Ebell and Haefke (2006) that regulatory barriers to entry in the US amount to 0.6 month of yearly income. The parametrization therefore suggests that technological innovation costs outweigh entry fees by an order of magnitude.

A summary of all chosen parameter values is given in Table 1.

3.2 The Role of Interdependence in a Symmetric World

We now deviate from the symmetric benchmark equilibrium and allow for differences in unemployment benefits, trade frictions, and country size. We pay particular attention to cross-country differences in unemployment benefits as, in contrast to search costs and the parameter of the matching functions, unemployment benefits are readily observable. Moreover, we know that the model reacts similarly to changes in search costs c_i or the search technology $\bar{m}_i$ (see Lemma 1). Specifically, we study what effects an increase in unemployment benefits of country 1 has on unemployment in country one and, more importantly, in its trading partners. For this we vary b_1 from 0.4 to 0.8 and hold unemployment benefits for countries 2 and 3 constant at 0.4. Further, trade costs vary from no trade costs up to 60%, i.e. $\tau_{ij} = \tau$ varies from 1 to 1.6 for all i, j . For our first investigation we assume $L_i = L$, hence countries are symmetric with respect to all things except the unemployment benefits. The main insights from these experiments are summarized in Result 1:

Result 1a [Globalization and labor markets]

Trade liberalization will lead to lower unemployment and higher real wages, even when countries are asymmetric

Result 1b [Labor market reform]

If one country increases its unemployment benefits, then in that country unemployment will fall and real wages will increase.

Result 1c [Institutional spill-overs]

If one country increases its unemployment benefits, then unemployment will rise and real wages will fall in all other countries.

Result 1a is basically a generalization of the effects found by FPS for the case of symmetric countries. Result 1b restates a well-known result from labor economics. The core new insight is Result 1c: A change in labor market institutions in one country will have negative effects for its trading partners, resulting in higher unemployment and lower wages.

The results are illustrated in Figure 2. The left-hand diagram shows the unemploy-

Table 1: Base-line Calibration of Parameters Values

Parameter	Description	Value	Source
r	Discount rate	0.33%	4% annual discount rate
ν	Parameter of external scale economies	0	Blanchard and Giavazzi (2003)
σ	Elasticity of Substitution	3.8	Bernard, Redding, Schott (2007)
b_i	Unemployment benefits	0.4	Standard
$\bar{m}$	Efficiency of matching function	0.636	Job finding rate=0.45; Shimer (2005) and Hall (2005)
α	Elasticity of the matching function	0.5	Hosios (1990)
β	Bargaining power	0.5	Hosios (1990)
δ	Rate of firm exit	0.91%	Firm turnover rate=1.8%; Bartelsmann, Haltiwanger and Scarpetta (2004)
χ_i	Rate of match-specific separation	2.5%	Job separation rate=3.4%
$\bar{\varphi}$	Minimum value of productivity	0.5	Arbitrary.
γ	Shape of Pareto Distribution	3.4	Bernard, Redding, Schott (2007)
c	Cost of posting a vacancy	1	To match $\theta = 0.5$ (Hall, 2005)
f^e	Fixed entry cost	39.57	To match $\theta = 0.5$ (Hall, 2005)
f	Fixed cost of production	0.116	Average firm size = 21.8
f^x	Fixed foreign market access costs	0.193	Bernard, Eaton, Jensen and Kortum (2003)
τ	Iceberg trade costs	1.3	Ghiromi & Melitz (2005)
L_i	Size of population	1	Size normalization
P_1^H	Numraire	1	Normalization
N	Number of countries	3	Allows for direct and indirect spill-overs

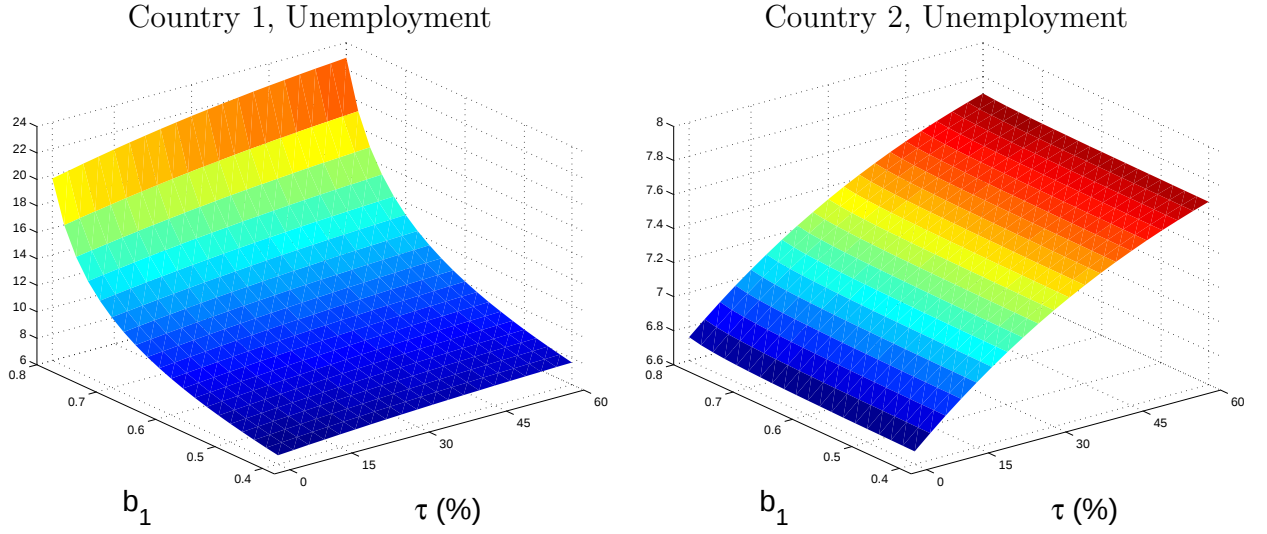


Figure 2: Country 1 labor market regulation and unemployment in countries 1 and 2 (=3). [Rate of unemployment on the vertical axis.]

ment rate in country 1 for various values of trade costs on the x-axis and unemployment benefits on the y-axis. Note that in all figures following, trade costs are in percent, i.e., $\tau(\%) = (\tau - 1) \times 100$. Unemployment is lowest for zero trade costs and an unemployment benefit parameter b_1 of 40%. If trade costs increase or unemployment benefits raise, unemployment in country 1 goes up.

Result 1a is driven by the increased demand for labor in the economy. As economies open up to trade, there is more demand for every single firm, producing a specific variety. The price for a variety will raise, leading to a higher Φ_i . As we explained in connection with Figure 1, a higher Φ_i leads to higher labor market tightness and therefore to a lower unemployment rate in the whole economy. Additionally, lower trade costs intensify import competition leading to a lower residual demand, hence firms will exit the market and the number of firms goes down. Due to productivity heterogeneity of firms, this process reallocates market share from inefficient to efficient firms, leading to an increase of the average firm's incentive to create vacancies. This effect also raises Φ_i , reinforcing the first effect.

This result has to be seen in the light of the recent literature. There are only two recent papers that are very explicit about the trade liberalization effects on unemployment. Helpman, Itzhak, Redding (2008) summarize their finding about unemployment in the differentiated sector in Proposition 3: “*In the differentiated sector, the hiring rate is strictly lower and the unemployment rate is strictly higher in a trade equilibrium than in autarky.*” The main intuition for their result is that after opening up to trade there is a shake out of unproductive firms. As more productive firms are more selective (screen to a higher ability cutoff), this change in industry composition raises sectoral unemployment. In contrast, FPS note, also in Proposition 3, that “... 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”. Hence, there is a sharp contrast between

the theoretical predictions.

Where do these differences come from? In Helpman, Itskhoki, Redding (2008) there are two sectors, one homogeneous sector with a perfect labor market, and one differentiated sector. It is assumed via a quasi-linear utility function, that all changes in income only affect the demand for the homogeneous good. In contrast, in the model from FPS as well as in the presented one, there is only one sector, which is also the sector where search and matching frictions on the labor market occur. The main driving force for the negative effect found by Helpman, Itskhoki, Redding (2008) is also present in FPS (2008) and in the presented model. Even though in the latter there are no screening costs, there is a shift to more productive firms after opening up to trade. This reduces demand for workers. However, there is an additional force at work in the latter models: Opening up to trade leads to an increased demand for differentiated goods, which is due to the (increased) demand of the foreign market as well as to the additional income spend which is generated due to the gains from trade. The increased demand leads to a reduction of aggregate unemployment and explains why the models lead to different predictions. We think that it is important to account for these income and general equilibrium effects, which also has a long tradition in international trade, specifically when it comes to the evaluation of trade liberalization effects.¹⁴

Result 1b is the direct effect of changing labor market institutions on home unemployment. If labor market institutions at home worsen, home unemployment goes up. The reason is that with higher unemployment benefits (or higher search costs, more inefficient matching at the labor market), the outside option for workers is better, leading to higher wages and, in equilibrium, to higher aggregate unemployment. More interesting in this regard is the spill-over effect of bad labor market institutions to unemployment abroad, highlighted in Result 1c. What we find here is an increase of unemployment in the foreign country. If labor market institutions at home worsen, unemployment rises, leading to an overall decrease of income in that country. As part of the income is spent on foreign varieties, this leads to reduced exports from the foreign country to the home country. Bad labor market institutions are propagated abroad via reduced demand for foreign varieties and via a decrease of average productivity due to less important competition. In the foreign country we can also distinguish two effects: (i) The reduced export demand leads to lower demand for workers, (ii) and as labor market institutions in the foreign country stay constant and the bad labor market institutions at home raise prices of differentiated goods relative to the foreign differentiated goods price, there is a shift from foreign to domestic varieties. This leads to an increased demand of workers. As the first effect is a direct effect of the bad labor market institutions and the second effect is an indirect effect of bad labor market institutions, working through changes in prices of differentiated goods, the first effect will outweigh the second. Hence, demand for workers will be lower, leading to an increase in aggregate unemployment.

The effects on real wages of trade liberalization are positive in both countries (see Figure 3). More trade leads to more specialization and product variety, lowering overall

¹⁴See for a recent example of the importance of income and general equilibrium effects in the evaluation of trade barriers for international trade Anderson and van Wincoop (2003).

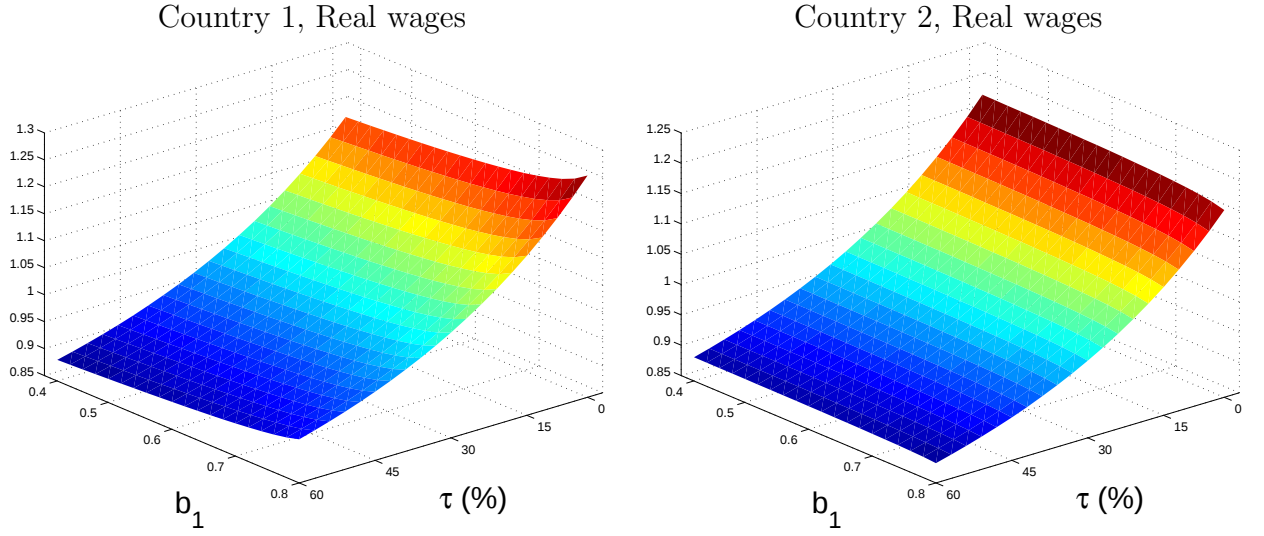


Figure 3: Country 1 labor market regulation, trade costs, and real wages [on vertical axis] in countries 1 and 2 ($=3$).

consumer prices. Further, gains from trade lead, overall, to raising nominal wages. Hence, real wages raise in both countries. This is in line with the findings of Melitz (2003) and FPS.

However, focusing on an increase in unemployment benefits, we see that while real wages in country 1 raise, real wages in country 2 fall. Higher unemployment benefits lead to better outside options of workers, strengthening their bargaining power. This leads to higher bargained wages and to a shake out of the most unproductive firms. In the foreign country, the outside option does not change, however, the export demand shrinks, whereas domestic demand grows. This leads less productive firms to enter the market and a greater share of firms only sale their products locally. As shown in FPS in Corollary 1, a fall in aggregate productivity leads to a fall in the vacancy-unemployment ratio, θ_i . This leads to a lower real wage.

For the remainder of this section we will concentrate on the illustration of unemployment-effects, while a discussion of the effects of wages can be found in the Appendix.

3.3 The Role of Geography and Relative Size

So far we assumed symmetric countries in all respects but the labor market institutions. Our results suggest that it is possible for a country with bad labor market institutions to spill-over part of the burden on the labor market to foreign countries (unemployment is lower when trade costs are lower, given the labor market institutions). Hence, foreign countries also suffer from bad labor market institutions abroad in terms of higher unemployment, i.e., there is a positive correlation of the degree of unemployment at home and abroad that stem from bad labor market institutions.

Bringing these predictions to the data, we have to take into account that countries are not alike concerning their geographic location and size. Hence, we next want to investigate how geography conditions the spill-over effects of labor market institutions, and how the relative size of the reforming country affects the interdependence between countries.

To analyze the consequences of geography we change the centrality of country one, the country with higher unemployment benefits. By changing the centrality of one country we mean changes in the trade costs of that country to all trading partners, while trade costs among the trading partners remain constant. Furthermore, we assume that the trade costs are the same in both directions, i.e. trading from country one to country two yields the same costs as trading from country two to country one. Put formally, we assume $\tau_{jk} = \tau_{kj}$ and $\tau_{1j} = \tau_{1k} = \tau_{j1} = \tau_{k1} = \tau_1$ for $j, k \neq 1$ and solve the model for different values of τ_1 . The outcome is summarized in the following result:

Result 2a [Geography and spill-overs]

A more central country can spill-over more of the effects of "bad" institutions: The increase in unemployment due to an increase in unemployment benefits in one country will become lower in the "bad" country and higher in all other countries, with the centrality of the "bad" country.

To analyze the effects of country size we change the share of country one's population. We "measure" country size in terms of population, as income, i.e., gross domestic product, is endogenous in our model. Specifically, we assume a constant world population L , and then change country 1's share of world population from 10% to 90%. The remaining population is distributed equally between countries 2 and 3. This allows us to study the effect of changing absolute country size of country 1 relative to countries 2 and 3, holding the relative size between countries 2 and 3 constant.

Result 2b [Relative size and spill-overs]

The increase in unemployment due to an increase in unemployment benefits in one country will become higher in all countries with the size of the "bad" country.

The results are illustrated in Figure 4. Here we assume in the base case a rate of unemployment benefits in all countries of 0.4. In the counterfactual we assume an increase in unemployment benefits in country 1 from 0.4 to 0.8. Then we plot the percentage change in unemployment resulting from this increase of unemployment benefits in country 1 for different values of trade costs and country sizes of country 1. On the x-axis of the diagrams depicted in Figure 4 we vary trade costs between country 1 and countries 2 and 3, i.e., change $\tau_{1j} = \tau_{1k}$ for $j, k \neq 1$, but hold constant trade costs between countries 2 and 3, i.e., $\tau_{jk} = \tau_{jk}$ for $j, k \neq 1$. Decreasing trade costs of country 1 with countries 2 and 3 but holding constant trade costs between 2 and 3 reflects an increased centrality of country 1. On the y-axis we vary the country size of country 1.

First note that the change in unemployment is always positive for all countries. As we have seen for the symmetric world already, bad labor market institutions lead not only to an increase of unemployment at home but also abroad. However, the interesting new information is how strong the spill-overs are for varying degrees of centrality and country sizes. Hence, we study how centrality and country size *condition* the strength of labor market institution spill-overs.

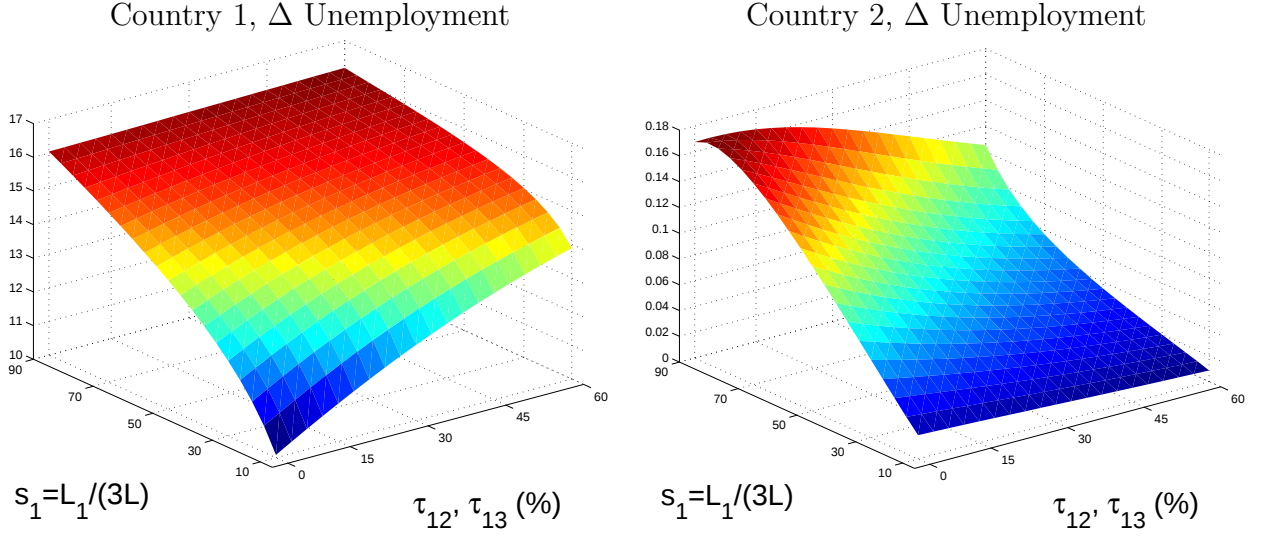


Figure 4: Change in unemployment [on the vertical axis] as a function of centrality and size of the “bad” country 1 for a given change of b_1 from 0.4 to 0.8.

We see that an increase of the centrality of country 1 for a given change in unemployment benefits, $db_1 > 0$, leads to a weaker increase of unemployment in country 1 but a stronger increase of unemployment in countries 2 and 3 when unemployment benefits rise in country 1 (figures for country 3 are suppressed, as countries 2 and 3 are perfectly symmetric). If country 1 is more central, it trades more with both other countries, 2 and 3. Hence, falling domestic demand can be compensated via two channels: (i) Firms can export to the rest of the world, which is easier the lower trade costs are, i.e., if country 1’s centrality is high. (ii) Falling domestic demand hurts the home country most in autarky. If it is well integrated in the world economy, part of the burden of lower domestic demand falls on the foreign countries. This also explains why unemployment rises more if trade costs fall for a given change in labor market institutions.

Increasing the size of country 1 with respect to the rest of the world, we find that the increase in unemployment is stronger in all countries (see Figure 4). The reason for the increase in the home country 1 is that if its country size is large, hence, the rest of the world comparably small, only a small fraction of the burden of bad labor market institutions can be transferred to foreign countries. Hence, the negative effect of the bad institutions fully rests in the home country. For the foreign country, even though they only take a smaller share of the burden if they are small compared to country 1, a larger country 1 means that country 1 is a more important trading partner. Hence, changes in demand in country 1, as the ones that result from changing labor market institutions, are more severe for countries 2 and 3.

Note that we assumed that $\nu = 0$ so far. Hence, there are no direct size effects on the rate of unemployment. Doubling world population in all countries, for example, would not change the rate of unemployment with $\nu = 0$ (see also Blanchard and Giavazzi, 2003). We will discuss the role of changing the degree of external economies of scale, ν , in Section

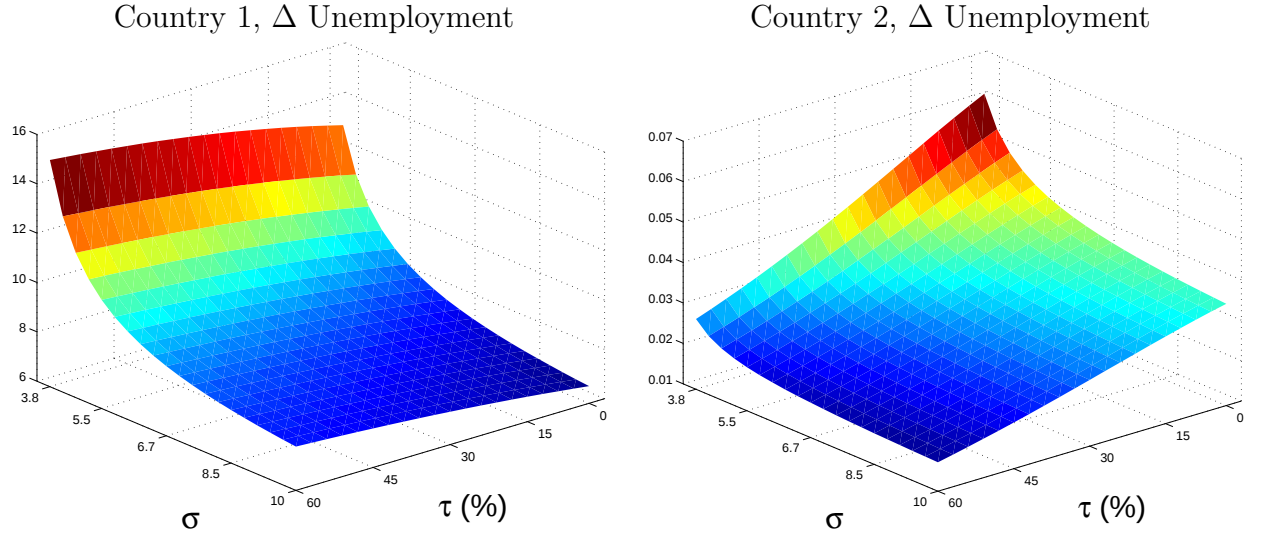


Figure 5: Change in unemployment [on the vertical axis] as a function of trade costs and the elasticity of substitution for a given change of b_1 from 0.4 to 0.8.

3.6. Hence, the resulting effects are not driven by absolute size effects, but rather by the relative magnitude of the home versus the foreign market.

3.4 The Role of the Elasticity of Substitution

In order to gain further insights into the mechanisms underlying the spill-overs described above, we will have a closer look on key parameters in our model. Specifically, we will investigate the effects of changes in the elasticity of substitution, σ , followed by a discussion of the importance of firm heterogeneity and the role of external economies of scale.

The main insights from an increase of the elasticity of substitution can be summarized as follows:

Result 5 [The elasticity of substitution and spill-overs]

The increase in unemployment due to an increase in unemployment benefits in one country will become lower in all countries with increases in the elasticity of substitution.

The result is illustrated in Figure 5. Similar as in the previous subsections, we assume in the base case a rate of unemployment benefits in all countries of 0.4. In the counterfactual we assume an increase in unemployment benefits in country 1 from 0.4 to 0.8. Then we plot the percentage change in unemployment resulting from this increase of unemployment benefits in country 1 for different values of trade costs and different values of the elasticity of substitution. On the x-axis of the diagrams depicted in Figure 5 we vary trade costs for all countries, i.e., change $\tau_{ij} = \tau$. On the y-axis we vary the elasticity of substitution between 3.8 and 10.¹⁵

¹⁵Note that σ is bounded from below by the condition $\frac{\sigma-1}{\sigma-\beta_i} > b_i$ for given b_i and β_i .

First note that the change in unemployment is always positive for all countries. Hence, changes in σ do not change the sign of the spill-over effect. However, changes in σ influence the strength of the spill-over. We see that an increase of the the elasticity of substitution for a given change in unemployment benefits, $db_1 > 0$, leads to a weaker increase of unemployment in all countries. A higher σ implies a lower love for variety of consumers and lower mark-ups for firms. Hence, exports will in general be lower, as consumers are not willing to pay more for foreign varieties, but producers have to incur trade costs when serving the foreign market. If trade costs are high, exports are very low, leading to a higher autarky of countries. This leads to a larger increase of unemployment in country 1 where the labor market institutions worsen, but a lower increase of unemployment in the trading partners.¹⁶

3.5 The Role of Firm Heterogeneity

In this subsection we explore the role of firm heterogeneity. To do so we analyze changes in γ , the shape parameter of the Pareto distribution. We vary γ between 3.8 and 10. A shape parameter of the Pareto distribution of $\gamma = 3.8$ with a lower bound of $\bar{\gamma} = 0.5$ implies a variance of 0.067, a standard deviation of 0.260 and an coefficient of variation of 0.382, whereas a $\gamma = 10$ implies a variance of 0.004 a standard deviation of 0.062 and an coefficient of variation of 0.112.¹⁷ Hence, a higher γ is associated with less firm heterogeneity. Our main findings can be summarized as follows:

Result 6 [How firm heterogeneity conditions spill-overs]

The increase in unemployment due to an increase in unemployment benefits in one country will become lower in all countries with decreases in the heterogeneity among firms (due to an increase of the shape parameter of the Pareto distribution).

The more equal firms are concerning their productivity, the less changes in unemployment benefits affect unemployment in both, the country where the change occurs and the trading partner country. The effect of unemployment changes shrinks with more equal firms, as changes in unemployment benefits have only a minor effect on average productivity. Hence, the competitiveness channel due to lower import competition is weakened, leading to a smaller reaction of unemployment.

For the trading partner, a second fact is important. If firms are nearly homogenous, then only few firms are productive enough to incur the fixed costs for both, the home market and the foreign market. Hence, there is fewer trade when firms are more equal. With a $\gamma = 10$ and trade costs of $\tau = 1.6$, the spill-over nearly vanishes, as hardly any firm from country 1 serves the foreign customers.

¹⁶For a $\sigma = 10$ and $\tau = 1.6$, the spill-over nearly vanishes, as hardly any trade takes place. There would be no spill-overs if $\tau = +\infty$. Similarly, with $\sigma = +\infty$, i.e., perfect competition in the product market, there would be no trade between symmetric countries.

¹⁷Note that for a Pareto distribution, the variance is given by $\frac{\bar{\gamma}^2 \gamma}{(\gamma-2)(\gamma-1)^2}$ for $\gamma > 2$, the standard deviation is given by $\frac{\bar{\gamma}}{\gamma-1} \sqrt{\frac{\gamma}{\gamma-2}}$, and the coefficient of variance is given by $\frac{1}{\sqrt{\gamma(\gamma-2)}}$. Further we assume that $\gamma > \sigma - 1$ so that the variance of log productivity is finite.

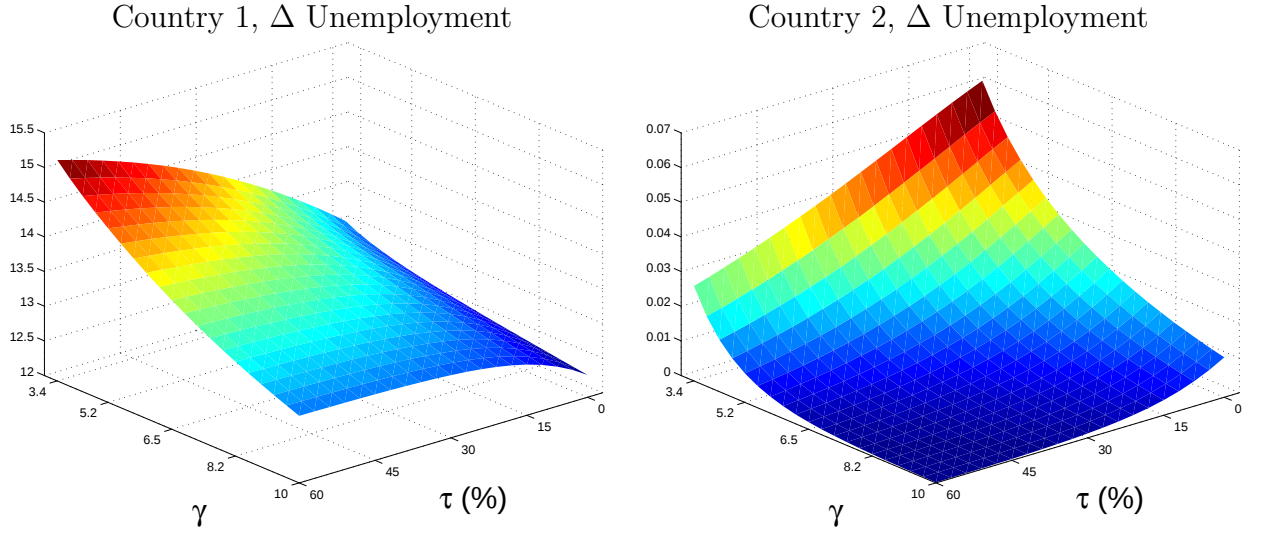


Figure 6: Change in unemployment [on the vertical axis] as a function of trade costs and the shape parameter of the Pareto distribution for a given change of b_1 from 0.4 to 0.8.

Note that a $\gamma = 10$ does still imply firm heterogeneity. We will discuss the implication of our model if firms are homogenous in Subsection 3.7.

3.6 The Role of External Economies of Scale

Up to now we analyzed our model for the case of $\nu = 0$, which implies that absolute size effects do not influence the level of unemployment. Hence, whenever we would increase the population in all countries, the rate of unemployment would not change. However, new trade theory (see for example, Helpman and Krugman, 1985) and the new economic geography (see for example, Fujita, Krugman and Venables, 1999; or Baldwin, Forslid, Martin, Ottaviano and Robert-Nicoud, 2003) emphasize the role of market size for explaining the pattern of trade as well as the agglomeration of industries and activities.

Hence, we next investigate how change in the degree of external economies of scale, ν , change the spill-over. Result 7 summarizes our findings:

Result 7 [External economies of scale and spill-overs]

The increase in unemployment due to an increase in unemployment benefits in one country will become higher in all countries with the importance of external economies of scale.

Figure 7 reveals that a higher ν implies a larger change in unemployment in all countries. The reason is that now additional to the competitiveness channel and the change in relative demand from home and foreign customers, the absolute size of the countries matters. A larger market implies higher demand, leading to more production and, therefore, lower unemployment with external economies of scale.

However, if unemployment benefits raise, the demand shrinks due to higher bargained wages. External economies of scale reinforce this process, leading in the end to higher

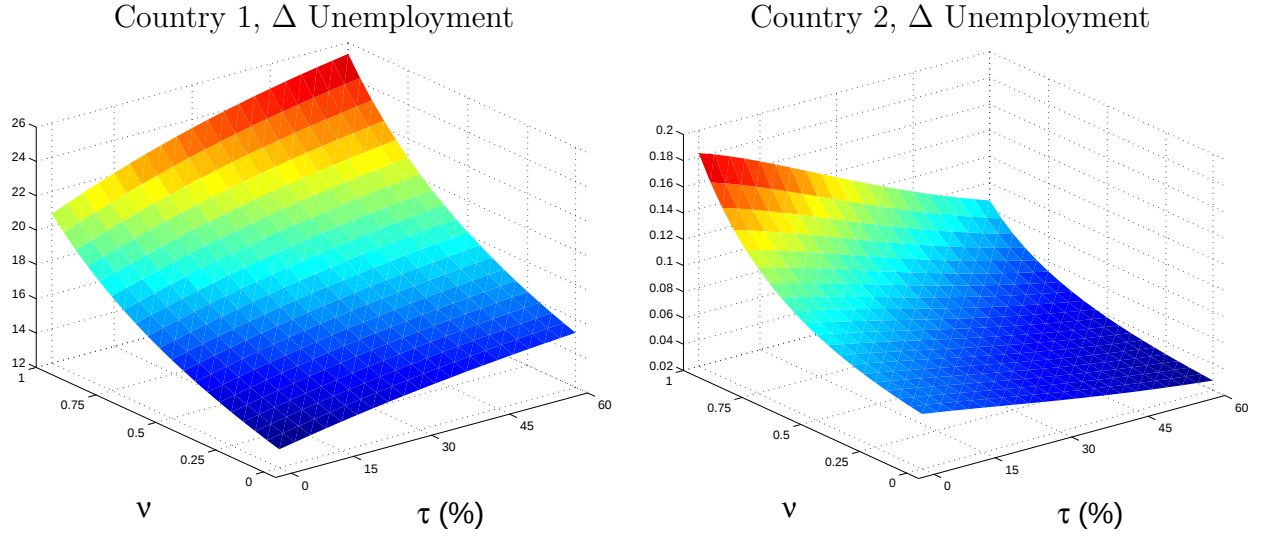


Figure 7: Change in unemployment [on the vertical axis] as a function of trade costs and external economies of scale for a given change of b_1 from 0.4 to 0.8.

unemployment in the country where the unemployment benefits raise. The spill-overs for the trading partner are also larger with external economies of scale due to the shrinking export market. Hence, lower demand in the foreign country now affects unemployment in the trading partner via two channels: i) As in the previous subsections, via the competitiveness channel, leading to less productive firms which post fewer vacancies and ii) due to the external economies of scale, leading to less demand for every firm, hence, fewer firms that survive and a lower equilibrium firm size, both leading to higher unemployment due to lower labor demand.

3.7 Interdependencies in the Krugman model

In the previous subsections we discussed the importance of firm heterogeneity and external economies of scale. In this subsection we want to step back to the traditional new trade theory model as introduced by Krugman (1979) and compare the predictions from this model with our previous results.

Hence, we now assume that firms are homogenous. In the Krugman economy, either all firms export or no firm does so. If no firm exports, there are no spill-overs at all. Hence, we assume that all firms export, implying that the free entry condition given in equation (19) holds for all firms.¹⁸ Without selection, there are many more firms left that export, as every firm that enters the market also serves the customers abroad. The competitiveness effect described above has, in connection with firm heterogeneity, actually two different effects on the magnitude of institutional spill-overs. On the one hand, due to the selection effect, there is a positive spill-over of institutions. On the other hand, if

¹⁸Note that with homogenous firms $G[\varphi_{ii}^*] = 0$, and equations (14) and (15) are superfluous.

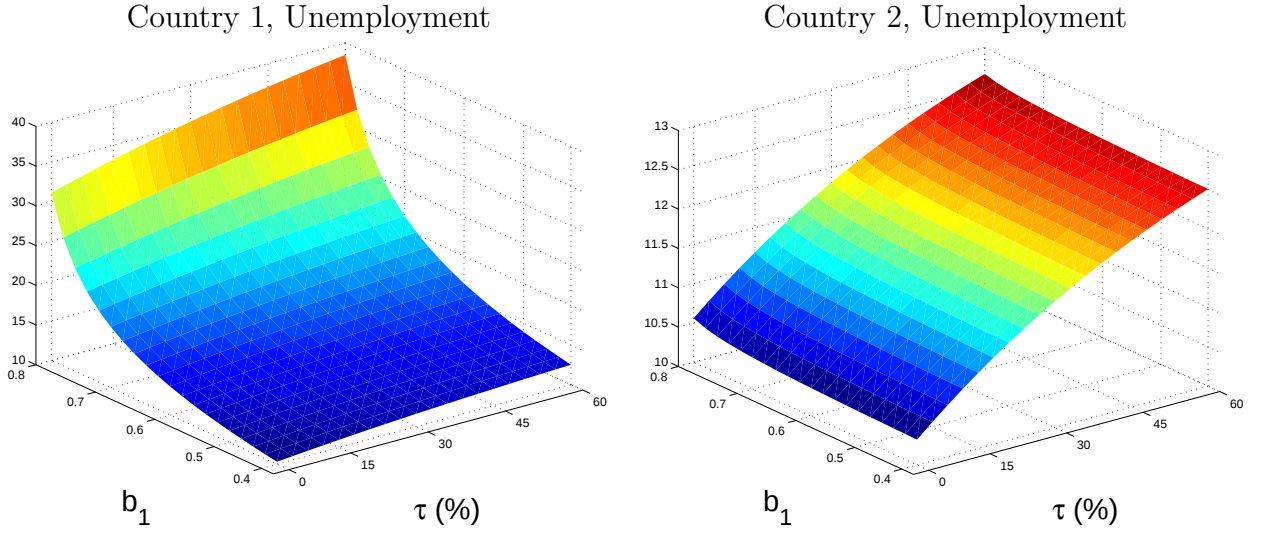


Figure 8: Country 1 labor market regulation and unemployment in countries 1 and 2 ($=3$), when $\nu = 1$ and firms are homogeneous. This corresponds to a Krugman (1979) economy. [Rate of unemployment on the vertical axis.]

firms become very equal, only few exporting firms are left, leading to a weakening of the spill-over.

Focussing on the Krugman economy, where firms are homogenous, but market size is important, we find the following effects for unemployment and real wages:

Result 8 [Spill-overs in the Krugman economy]

If firms are homogenous and external economies of scale are important, then an increase of unemployment benefits in one country leads to increases of unemployment in all countries.

Figure 8 shows the effects of changes of unemployment benefits in country 1 on unemployment for countries 1 and 2 when firms are homogenous and external economies of scale are important, i.e. $\nu = 1$. We see that the changes in unemployment are quite large for both countries. The mechanism underlying the spill-over is the change in the market size which results from higher unemployment in country 1. Hence, the Krugman model highlights the market potential effect, whereas there is no competitiveness effect at work here.

It is interesting to contrast this result with the results discussed in section 3.5. In section 3.5 firms become more equal as γ becomes larger. The spill-over there becomes smaller with higher γ as only few firms are productive enough to export. If we focus on the Krugman economy, every firm that enters the market also exports. In other words, the home and foreign market in the Krugman model are not separated, rather firms maximize joint profits over these two markets.¹⁹ Hence, as it is always profitable for some

¹⁹Or one may argue that firms indeed maximize profits for the home and foreign market separately, but due to the homogeneity of firms, either all firms export or no firm does. There is no co-existence of exporting firms and domestic firms as in the case with heterogeneous firms.

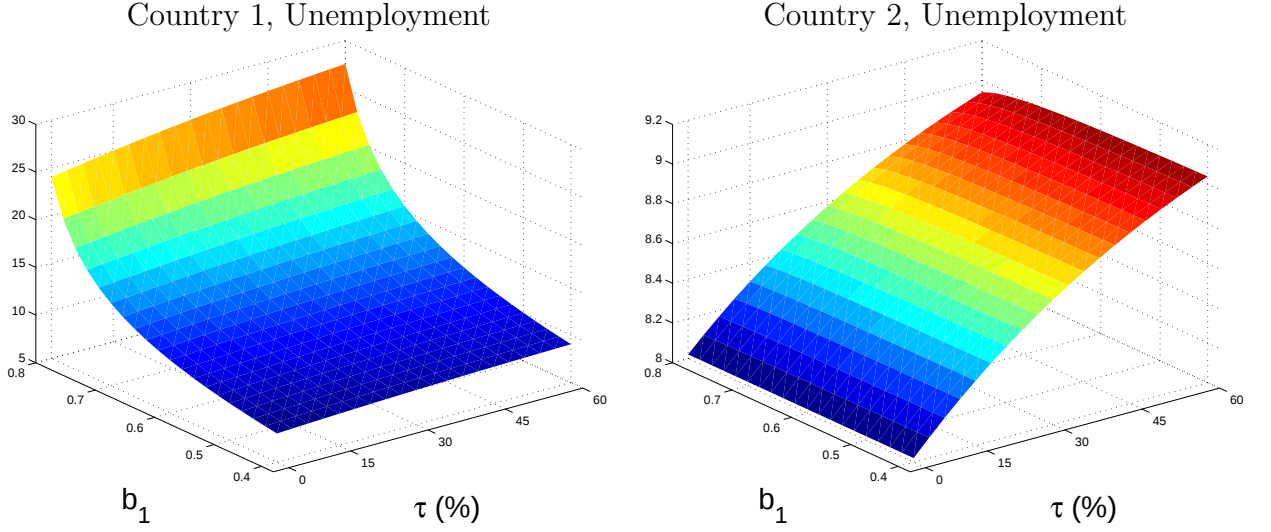


Figure 9: Country 1 labor market regulation and unemployment in countries 1 and 2 ($=3$), when $\nu = 0$ and firms are homogeneous. [Rate of unemployment on the vertical axis.]

firms to enter the market, spill-overs do not vanish. Rather, there is another effect at work, namely, the market potential effect.

One may ask the question, what would happen in a world with homogenous firms, if the market potential effect were not at work? This case is summarized in Result 9:

Result 9 [Spill-overs when firms are homogenous and external economies of scale are not present]

If firms are homogenous and external economies of scale are not important, then an increase in unemployment benefits in one country will increase unemployment in that country while unemployment in all other countries is (almost) unaffected.

As you can see in Figure 9, if we shut down the external economies of scale channel when firms are homogenous, no spill-overs are left on the unemployment rate in country 2 when $\tau = 1$, and the effects are very small if $\tau > 1$. If $\tau = 1$, all varieties in the world enter the price index and utility symmetrically. As absolute size differences do not matter with $\nu = 0$ and the competitiveness effect is not at work if firms are homogenous, changes in the unemployment benefits in country 1 do not affect the unemployment rate in country 2. However, if $\tau > 1$, one channel is still at work, namely changes in the relative composition of the consumption bundle. With changing unemployment benefits in country 1, the price for varieties abroad changes. Hence, when varieties do not enter perfectly symmetric, as is the case with $\tau > 1$, there will be a compositional change in the consumption bundle. Varieties produced at home become relatively cheaper, hence, consumers will switch from foreign varieties to home varieties, which will lead to more production at home and less unemployment.

4 Empirical evidence

In this section, we use panel data on labor market institutions and unemployment rates for 20 rich OECD countries for 1982-2003. Our aim is not to provide a formal test of our theoretical model, but rather to check whether the empirical evidence is in line with three key predictions of our model, namely: (i) controlling for business cycle comovement, unemployment rates are positively correlated across countries; (ii) the unemployment rate of a country is not only determined by its own labor market institutions but also by those of other countries; (iii) the relative importance of foreign countries' institutional features depends crucially on openness and relative size.

4.1 Econometric specification

Our starting point is a standard cross-country unemployment regression. Bassanini and Duval (2006) provide a comprehensive survey of different empirical models and methods. Typically, researchers have estimated equations of the type

$$u_{it} = \lambda \cdot \mathbf{LMR}_{it} + \pi \cdot pmr_{it} + \gamma \cdot gap_{it} + \mathbf{S}_{it} + \nu_i + \nu_t + \varepsilon_{it}, \quad (32)$$

where $\mathbf{LMR}_{it}$ is a vector of variables describing the stance of labor market regulations, pmr_{it} measures the intensity of product market regulations and gap_{it} is the output gap (calculated as the difference between actual output and the HP-filtered series). The vector ν_i collects the comprehensive set of country fixed-effects, and ν_t is a vector of year dummies while $\mathbf{S}_{it}$ includes orthogonal shocks (TFP, real interest rates, terms of trade, and labor demand shocks). The construction of the latter variables is detailed in Bassanini and Duval (2006) and is in line with common practice in the literature. The error term ε_{it} is assumed to have the usual properties.

Bassanini and Duval (2006) do not survey a single study which would address the possibility that the foreign rate of unemployment or foreign labor market regulations might matter for domestic labor market outcomes. The existing literature has found robust and quantitatively relevant effects on the rate of unemployment only for a very limited number of labor market institutions. The most important is the participation tax rate, or tax wedge (see Costain and Reiter (2008)). It 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 (Saez (2002); Immervoll, Kleven, Kreiner and Saez (2007)). Other measures relating to the nature of wage bargaining, employment protection legislation, or the prevalence of minimum wages have a more mixed empirical support. This is not necessarily surprising, given the ambiguity of theoretical results (see, e.g., the discussion in Blanchard and Wolfers, 2000). Hence, in our regressions, we mostly focus on a single labor market variable, the *tax wedge* (b_{it}), but we also include additional controls as robustness checks. A number of variables in (32) may seem endogenous; the existing literature, however, almost always treats them as exogenous and we follow this tradition as we lack natural instruments.

Our theoretical model predicts that the effect of labor market regulations of some country j on country i 's rate of unemployment is conditioned by the amount of bilateral

trade between the two countries. It is therefore natural to compute a trade-weighted average of the regulatory variable. A similar logic applies to the unemployment rates. In order to ensure exogeneity of the trade weights, we proxy the amount of bilateral trade between i and j by

$$\tilde{\omega}_{ijt} = \frac{POP_{it}^{\alpha_1} POP_{jt}^{\alpha_2}}{DIST_{ij}^{\delta}}, \quad (33)$$

where POP_{it} denotes population of country i , $DIST_{ij}$ is the great circle distance between the two countries' most populated cities; α_1, α_2 , and δ are parameters. $\tilde{\omega}_{ijt}$ varies with time as population changes. It mimics the simplest possible gravity formulation, but substitutes population for GDP which is potentially endogenous.²⁰ Standard gravity predictions suggest that $\alpha_1 = \alpha_2 = 1$. Overman, Redding and Venables (2003) state that δ , "the elasticity of trade volumes with respect to distance is usually estimated to be in the interval 0.9 to 1.5." In their meta analysis of 1,467 estimates from 103 papers, Disdier and Head (2008) find that the mean effect is about 0.9, with 90% of estimates lying between 0.28 and 1.55. However, they also show that δ has increased substantially over time. Hence, we choose $\delta = 1$ as our benchmark case, but conduct robustness checks with respect to the assumptions on α_1, α_2 , and δ .

We calculate $\tilde{\omega}_{ijt}$ for all countries for which population and distance data is available (i.e., not only the 20 OECD countries for which we have reliable labor market data). There are several possible ways to *normalize* the data; the choice of normalization has interpretational consequences but should not affect our qualitative findings. In our preferred setting, we normalize the weights such that $\sum_j \omega_{ijt} = 1$ for all countries in the world. Then, we construct the trade-weighted average of foreign unemployment rates, $u_{it}^* = \sum_j \omega_{ijt} u_{jt}$, where country i 's rate of unemployment is excluded by definition ($\omega_{iit} = 0$) and the summation only involves the 20 OECD countries for which high-quality unemployment rates are available. Similarly, we construct the trade-weighted average tax wedge of all countries other than i as $b_{it}^* = \sum_j \omega_{ijt} b_{jt}$ (and similarly for all other labor market variables $\mathbf{LMR}_{it}$, denoted by $\mathbf{LMR}_{it}^*$), and the average foreign output gap as $gap_{it}^* = \sum_j \omega_{ijt} gap_{jt}$. Note that this strategy implies that the foreign variables have smaller sample means than the domestic ones.

A natural alternative normalization would normalize the weights such that $\sum_{k \in K} \omega_{ikt} = 1$, where K is the set of 20 OECD countries. Compared to the above normalization, this choice has the advantage that u_{it} and u_{it}^* should have the same sample means (but not, obviously, the same standard deviations). One could also normalize weights by $\max_j \omega_{ijt}$. In a series of robustness checks, we will show that the choice of normalization has little qualitative effect on our results.

²⁰We have also fitted a more complete gravity equation, i.e., one that includes additional covariates such as common language and contiguity, to bilateral trade data, using Poisson Pseudo maximum likelihood methods. Results are qualitatively and quantitatively comparable. We prefer our specification as bilateral trade volumes may be endogenous to unemployment rates.

4.2 Data

Bassanini and Duval (2006) have assembled the most comprehensive data set on labor market variables. It reflects intensive efforts at the OECD to come up with harmonized measures. Unfortunately, it covers only 20 countries²¹ for the years 1982 to 2003. However, it should be mentioned that virtually all cross-country unemployment regressions in the literature make use of exactly this data set (or its numerous precursors), see for example Nickell, Nunziata and Ochel (2005). The key problem with unemployment rates from a wider specter of countries is their lack of comparability across time and space. Moreover, detailed data on labor market institutions does not exist, except for a cross-section (Botero et al., 2002). Data on the degree of product market regulation (PMR), the output gap, and the array of exogenous shocks also come from Bassanini and Duval (2006).

Data on geographical distances comes from CEPII.²² Population data has been retrieved from the Penn World Tables mark 6.2. Capital stocks have been approximated following the perpetual inventory method; see Benhabib and Spiegel (2005). Summary statistics are in the Appendix.

4.3 The role of foreign unemployment rates

As a first step, we show that our data reproduces the typical results found in the empirical literature. Column (1) in Table 2 shows the results of estimating (32) using OLS. The coefficient on the tax wedge b_{it} , our key labor market variable of interest, implies that a 20 percentage point increase (approximately equal to one standard deviation of b in the data) increases the equilibrium rate of unemployment by about 18 percentage points. Union density and employment protection legislation (EPL) do not have any measurable influence on equilibrium unemployment. This is a standard finding; see Bassanini and Duval (2006) or Baker, Glyn Howell and Schmitt (2004). Countries featuring a high degree of corporatism (such as the Scandinavian countries or Austria) have a rate of unemployment that is by about 1.7 percentage point lower. Finally, the output gap (gap) is an important determinant of the unemployment rate. Note that country fixed effects alone explain about 78 percent of the total variation (adjusted R^2) of unemployment rates in our sample (not shown). Accounting for the common business cycle by including year fixed effects adds five percentage points of explanatory power; adding country-specific estimates of the output gap adds another five so that these three variables already generate an adjusted R^2 of 88. The additional covariates used in (1) of Table 2 increase the adjusted R^2 to 93 percent. Hence, controlling for business cycle effects and fixed country characteristics, the pure time-variation in labor market institutions does not explain a large fraction of variance of the unemployment rate since their entire cross-sectional variance is absorbed

²¹Australia (AUS), Austria (AUT), Belgium (BEL), Canada (CAN), Switzerland (CHE), Germany (DEU), Denmark (DNK), Spain (ESP), Finland (FIN), France (FRA), Great Britain (GBR), Ireland (IRL), Italy (ITA), Japan (JPN), Netherlands (NLD), Norway (NOR), New Zealand (NZL), Portugal (PRT), Sweden (SWE), and the United States of America (USA).

²²www.cepii.fr/anglaisgraph/bdd/distances.htm.

by the country fixed effects.

In the next step, we include the trade-weighted average foreign unemployment rate u_{it}^* and estimate versions of

$$u_{it} = \rho u_{it}^* + \lambda \cdot \mathbf{LMR}_{it} + \pi \cdot pmr_{it} + \gamma_1 \cdot gap_{it} + \gamma_2 \cdot gap_{it}^* + \mathbf{S}_{it} + \nu_i + \nu_t + \varepsilon_{it}. \quad (34)$$

The domestic unemployment rate is not used in the calculation of u_{it}^* . However, if shocks to the unemployment rate exhibit correlation between countries, then estimation of (34) via OLS would yield a biased value for ρ . To avoid this *endogeneity bias*, we instrument u_{it}^* by lagged foreign regulatory variables, $\mathbf{LMR}_{i,t-1}^*$, $pmr_{i,t-1}^*$.²³ The underlying assumption is that past *foreign* regulation is exogenous to *domestic* contemporaneous labor market outcomes.

Columns (2) and (3) show the most parsimonious specifications, using only u_{it}^* along with gap_{it} , ν_i , $\mathbf{S}_{it}$, and ν_t . The OLS estimate and the IV estimate are both positive; the former is $\rho^{OLS} = 0.072$; the latter, being somewhat smaller, is $\rho^{IV} = 0.067$. The sign of the bias $\rho^{OLS} - \rho^{IV}$ is not surprising, since one would have expected that unemployment shocks are correlated positively between countries so that OLS should overestimate. However, the difference between the estimates is very small and will remain so in more complete specifications. Note that adding u_{it}^* increases the adjusted R^2 relative to a model with gap_{it} , ν_i , $\mathbf{S}_{it}$, and ν_t as the only controls from 88 to 92 percent. Also note that the IV strategy works well: invalidity of instruments or model specification is rejected with high degrees of statistical significance.

Columns (4) and (5) add an array of labor market controls. They also include gap_{it}^* in order to control for the direct effect of the foreign business cycle on domestic unemployment. Qualitatively and quantitatively, results are comparable to those presented in column (1). However, the measured coefficient ρ is somewhat larger now than in the specification without controls. The sign of the endogeneity bias of ρ changes, but the difference between the OLS and the IV estimate is minor. Interestingly, while the coefficient on gap_{it}^* is estimated with low precision, its sign is positive.

Columns (6) and (7) drop the insignificant labor market controls. Results do not change much, but the overidentification test (while easily passed) becomes less convincing. Hence, we prefer specification (5) over (7). It implies that an increase of the average foreign unemployment rate by one percentage point increases the domestic unemployment rate by about 0.09 percentage points. The average effect, therefore seems small. In terms of the (different) underlying standard deviations of u_{it} and u_{it}^* , the effect is 0.06 ($0.088 \times 3.144 / 4.294$). However, this average effect may hide substantial variation across countries.

Columns (8) to (10) include the ratio of capital intensities $(K^*/L^*) / (K/L) = k^*/k$ and the interaction term $u^* \times k^*/k$.²⁴ This is motivated by the prediction of the Heckscher-

²³This vector of instruments usually satisfies tests for instrument validity.

²⁴Capital intensities are proxied by the stock of capital computed as described above relative to the total population instead of employment in order to mitigate the potential endogeneity of k^*/k . The variable $u^* \times k^*/k$ is instrumented by the interactions of k_{t-1}^*/k_{t-1} with exogenous foreign variables $\mathbf{LMR}_{i,t-1}^*$ and $pmr_{i,t-1}^*$.

Table 2: The role of foreign unemployment

Dep.var.: level of unemployment rate											
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
	OLS	OLS	IV	OLS	IV	OLS	IV	OLS	IV	OLS	IV
u^*		0.072 ^a (0.028)	0.067 ^b (0.030)	0.083 ^a (0.029)	0.088 ^a (0.032)	0.071 ^a (0.025)	0.077 ^a (0.028)	0.139 ^a (0.032)	0.138 ^a (0.039)	0.119 ^a (0.026)	0.133 ^a (0.030)
$u^* \times k^*/k$								0.049 ^b (0.023)	0.162 ^a (0.094)	0.056 ^b (0.023)	0.145 (0.120)
k^*/k								-1.010 ^a (0.248)	-1.622 ^a (0.484)	-0.986 ^a (0.241)	-1.536 ^b (0.651)
b	0.091 ^a (0.019)			0.085 ^a (0.020)	0.098 ^a (0.019)	0.092 ^a (0.018)	0.104 ^a (0.017)	0.075 ^a (0.020)	0.100 ^a (0.022)	0.085 ^a (0.017)	0.102 ^a (0.019)
PMR	0.745 ^a (0.198)			0.878 ^a (0.212)	0.948 ^a (0.203)	0.774 ^a (0.187)	0.868 ^a (0.175)	0.917 ^a (0.214)	0.927 ^a (0.214)	0.789 ^a (0.183)	0.880 ^a (0.170)
High corporatism	-1.739 ^a (0.412)			-1.615 ^a (0.420)	-1.827 ^a (0.394)	-1.581 ^a (0.367)	-1.810 ^a (0.353)	-1.616 ^a (0.407)	-1.712 ^a (0.387)	-1.597 ^a (0.357)	-1.693 ^a (0.379)
Union density	-0.001 (0.023)			-0.004 (0.023)	-0.005 (0.022)			-0.013 (0.026)	0.004 (0.028)		
EPL	-0.193 (0.340)			-0.419 (0.367)	-0.314 (0.351)			-0.506 (0.375)	-0.180 (0.425)		
gap	-0.620 ^a (0.044)	-0.646 ^a (0.046)	-0.632 ^a (0.044)	-0.621 ^a (0.044)	-0.611 ^a (0.039)	-0.621 ^a (0.040)	-0.609 ^a (0.035)	-0.624 ^a (0.043)	-0.615 ^a (0.039)	-0.620 ^a (0.038)	-0.618 ^a (0.034)
gap^*				0.024 (0.075)	0.067 (0.070)	0.020 (0.072)	0.060 (0.067)	0.148 (0.100)	0.423 ^a (0.218)	0.151 (0.100)	0.387 (0.285)
2nd stage statistics											
RMSE	1.134	1.234	1.139	1.129	1.010	1.168	1.061	1.106	0.998	1.145	1.062
adj. R^2	0.930	0.917	0.919	0.931	0.935	0.926	0.929	0.934	0.937	0.929	0.929
F	146.7	125.2		147.4		155.4		134.2		139.1	
1st stage statistics (p-values)											
partial $R^2(u^*)$			0.757		0.752		0.777		0.6801		0.7561
partial $R^2(u^* \times k^*/k)$									0.0636		0.0239
χ^2 -overidentification			0.889		0.792		0.220		0.356		0.437
χ^2 -endogeneity			0.727		0.947		0.833		0.432		0.542
Robust standard errors in parentheses, ^a $p < 0.01$, ^b $p < 0.05$, ^c $p < 0.1$. Number of observations: 397 in OLS and 374 in IV regressions. All regressions contain a full set of country fixed-effects, year dummies, and an array of orthogonal shocks (TFP, terms of trade, real interest rate, and labor demand shocks) as additional controls for business cycle comovements. Trade-weighted averages for foreign variables (denoted by asterisks) are computed using $\alpha_1 = \alpha_2 = 1, \delta = 1$. In IV regressions, the foreign unemployment rate u^* is instrumented by b_{t-1}^*, PMR_{t-1}^* and gap_{t-1}^* . The χ^2 -endogeneity test tests the null that u^* is exogenous (and rejects in all presented IV models). Overidentification is tested for using the Wooldridge robust Score test (invalidity of instruments or model misspecification is rejected in all presented IV models).											

Ohlin-framework, where the spill-over depends on the relative capital-to-labor ratios form the home country k and the foreign country k^* . More precisely, suppose that a bad shock on foreign institutions drives up foreign unemployment. If the foreign economy is relatively capital-abundant relative to the domestic economy, after the shock its effective capital to labor ratio is even higher than before and it produces more of the capital-intensive good. The domestic economy, in turn, produces more of the labor-intensive good so that labor demand goes up, and ultimately unemployment falls. This is, however, not what we observe in the data, where an increase in u^* drives up domestic unemployment by more when the domestic economy appears relatively capital poor. However, the effect is weak, and inference is possibly problematic since k and hence k^*/k may be endogenous. Moreover, results rely on a fairly small country sample. While not offering a conclusive test, our results at least suggest that empirical support for the comparative advantage view is probably weak. Given the well-known poor empirical performance of the Heckscher-Ohlin model, this is not a surprise. Also note that Dutt, Mitra and Ranjan (2007) have not found any effect of comparative advantage motives in the determination of unemployment rates in a large cross-section of countries. The standard deviation of k^*/k relative to its mean (the coefficient of variation) is 1.91, while that of u is 0.54. Hence, our results do not hinge on the absence of variance in k^*/k in our sample.

Interestingly, the direct effect of k^*/k on the equilibrium unemployment rate is negative and statistically significant. However, the direct effect is hard to interpret. The overall extent of comparative advantage of the domestic economy could be measured by $|1 - k^*/k|$ or $(1 - k^*/k)^2$. Both variables have no clear empirical effect on the unemployment rate.

4.4 The role of foreign institutions

In the next step, we analyze the direct effect of foreign labor market institutions on the domestic rate of unemployment. We estimate an equation of the form

$$u_{it} = \lambda \cdot \mathbf{LMR}_{it} + \lambda^* \cdot \mathbf{LMR}_{i,t}^* + \pi \cdot pmr_{it} + \gamma_1 \cdot gap_{it} + \gamma_2 \cdot gap_{it}^* + \mathbf{S}_{it} + \nu_i + \nu_t + \varepsilon_{it}, \quad (35)$$

where $\mathbf{LMR}_{it}^*$ collects foreign labor market variables.

Column (1) in Table 3 shows the most parsimonious specification, where we include only the domestic and the foreign tax wedges (b_{it}, b_{it}^*) as well as the controls for the domestic and the foreign business cycles and the complete set of fixed effects. We find that the own and the foreign tax wedges help explain the domestic unemployment rate. Both have coefficients with the signs predicted by our theoretical model and are accurately estimated. Column (2) adds PMR as an additional control. PMR reflects different types of entry regulations that limit competition on goods markets. Hence, PMR should be a good proxy for overall openness to trade, as well. Not surprisingly, it correlates well with conventional openness measures. It should, however, be less prone to endogeneity concerns.

The estimates presented in column (2) imply that a one standard-deviation increase of b_{it} and of b_{it}^* leads to an increase in domestic unemployment by 0.171 and 0.035 standard

Table 3: The role of foreign labor market distortions

<i>Dep.var.: level of unemployment rate</i>								
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
b	0.081 ^a (0.017)	0.075 ^a (0.017)	0.103 ^a (0.019)	0.086 ^a (0.019)	0.081 ^a (0.020)	0.083 ^a (0.020)	0.072 ^a (0.016)	0.077 ^a (0.019)
b^*	0.009 ^a (0.003)	0.012 ^a (0.003)	0.004 (0.003)	0.009 ^b (0.003)	0.027 (0.042)	0.057 (0.037)	0.013 ^a (0.003)	0.013 ^a (0.004)
$b^* \times k^*/k$							0.016 ^a (0.004)	0.011 ^a (0.003)
k^*/k							-1.216 ^a (0.274)	-1.219 ^a (0.263)
PMR		0.706 ^a (0.193)		0.856 ^a (0.207)	0.894 ^a (0.219)	0.847 ^a (0.217)	0.743 ^a (0.188)	0.899 ^a (0.209)
Union density			0.008 (0.024)	-0.005 (0.023)	-0.013 (0.023)			-0.009 (0.026)
Union density*					0.062 (0.038)			
High corporatism			-1.545 ^a (0.415)	-1.617 ^a (0.420)	-1.603 ^a (0.445)	-1.655 ^a (0.393)		-1.558 ^a (0.407)
High corporatism*					2.270 (2.001)	1.371 (1.916)		
EPL			0.234 (0.343)	-0.418 (0.371)	-0.574 (0.380)	-0.448 (0.383)		-0.500 (0.382)
EPL*					-2.465 ^a (0.828)	-1.904 ^b (0.837)		
gap	-0.613 ^a (0.044)	-0.608 ^a (0.042)	-0.622 ^a (0.045)	-0.622 ^a (0.044)	-0.627 ^a (0.045)	-0.619 ^a (0.040)	-0.635 ^a (0.039)	-0.642 ^a (0.042)
gap^*	-0.021 (0.070)	-0.014 (0.073)	-0.034 (0.070)	-0.024 (0.072)	-0.042 (0.077)	-0.107 (0.074)	0.032 (0.073)	0.005 (0.072)
RMSE	1.191	1.169	1.158	1.130	1.123	1.123	1.134	1.098
adj. R ²	0.923	0.926	0.927	0.931	0.932	0.932	0.930	0.935
F	139.5	154.2	136.8	146.8	147.8	151.1	133.3	129.0
Robust standard errors in parentheses, ^a $p < 0.01$, ^b $p < 0.05$, ^c $p < 0.1$. Number of observations: 397 in all models. All regressions contain a full set of country fixed-effects, year dummies, and an array of orthogonal shocks (TFP, terms of trade, real interest rate, and labor demand shocks) as additional controls for business cycle comovements. Trade-weighted averages for foreign variables (denoted by asterisks) are computed using $\alpha_1 = \alpha_2 = 1, \delta = 1$.								

deviations, respectively.²⁵ Hence, on average, the domestic tax wedge is about 5 times as important quantitatively than the foreign one. This seems like a sensible result which, however, hides potentially large differences across countries; see below.

Column (3) adds additional labor market institutions but drops PMR. This has an important effect on the coefficients of both b and b^* , where the former grows substantially larger and the latter loses statistical significance. However, as shown in column (4), the inclusion of PMR restores the picture that we have already found in column (2). One reason for the importance of PMR may lie in the fact, that the construction of the weights ω_{ijt} relies on exogenous geographical and demographic data only; it does not reflect trade regulations that may curb the amount of trade between nations. Including PMR mitigates this problem.

Columns (5) and (6) add foreign labor market institutions to the regression. Not surprisingly, adding variables for which the direct effect on home unemployment is already dubious (union density or EPL), does not improve accuracy of estimation. The coefficients on b^* are insignificant and seem unplausibly large; not to speak of the coefficient on EPL^* to name only the most striking case. Hence, the lack of a robust relationship between these variables in standard equations such as (32) also impairs inference when using their spatial lags.

Finally, columns (7) and (8) replicate our preferred specifications (2) and (4) with the exception that they now also include the Heckscher-Ohlin relative capital-abundance k^*/k and its interaction with the foreign wedge b^* . Theoretical considerations suggest that a higher foreign wedge should lower the domestic rate of unemployment if the foreign economy is on average more capital-rich than the domestic. Our results suggest that the opposite holds: the more capital-rich the foreign country is, the *stronger* is the adverse effect of foreign distortions on domestic unemployment. As in Table (2), we do not find evidence in favor of the Heckscher-Ohlin view. In line with (2), we find a strong negative direct effect of k^*/k on domestic unemployment.

4.5 The role of entry regulation and country size

Table (4) sheds additional light on the channels through which foreign institutions affect domestic unemployment. First, we discuss the interaction between entry regulation and the wage wedge. The analysis is motivated by the following considerations. If pmr^* is high, domestic firms can rely very little on foreign demand. Hence, whenever b goes up, they have to bear most of the induced reduction in demand themselves; we therefore expect that the effect of the interaction $pmr^* \times b$ on domestic unemployment is positive. However, domestic unemployment would depend less on foreign distortions since the foreign economy plays a smaller role for domestic firms. Therefore, the coefficient on $pmr^* \times b^*$ should be negative. Column (1) in Table (4) tests these predictions in a parsimonious specification; column (2) adds additional labor market controls. In both cases, we find the correct signs on the interaction terms. In the richer model, both terms

²⁵ $0.075 \times 18.21/7.99 = 0.171$ and $0.012 \times 23.39/7.99 = 0.035$.

are (albeit weakly) statistically significant. Moreover, the direct effect of b^* on u disappears. This suggests, that the effect of foreign institutions on domestic unemployment really works through the trade channel. Column (3) adds the additional interaction terms $pmr \times b^*$ and $pmr \times b$ for which we have no unambiguous predictions.

Second, we discuss the interaction between country size and the wage distortion. Here, the logic is that the larger the domestic economy is, the more strongly should it be negatively affected by bad domestic labor market institutions and the less by foreign ones. Conversely, the larger the foreign economy is (weighted by bilateral trade potentials), the more strongly should foreign distortions increase the domestic unemployment rate while domestic distortions should be less important. Hence, we expect that the coefficients on $\ln(pop) \times b^*$, $\ln(pop) \times b$, $\ln(pop^*) \times b^*$, and $\ln(pop^*) \times b$ should be negative, positive, positive, and negative, respectively. Column (4) in Table (4) is nicely in line with this sign pattern. However, statistical precision is not very high, most likely due to the large degree of correlation between those interaction terms. Including the degree of product market regulation into the regression (column (5)) leaves the sign pattern and magnitudes intact but only partially improves statistical accuracy. Column (6) focuses on statistically significant effects only. In line with our theory, distortions are more harmful when they have their origins in large countries. Interestingly, the direct effect of the own and the foreign wage distortions is now negative. There is also fairly strong evidence that – everything else equal – large countries have smaller unemployment rates. This is also in line with the theoretical model, where larger home markets are associated with fiercer competition, more varieties, and hence higher productivity of the average firm and, consequently, with lower unemployment.

4.6 Robustness checks

Tables 5 and 6 contain robustness checks on our preferred specifications. Columns (1) to (6) in Table 5 refer to regressions that include the foreign unemployment rate on the right-hand-side; columns (7) and (8) use foreign exogenous variables. The regressions in columns (1) and (2) use the log of unemployment $\ln u$ as the dependent variable instead of the level in an regression of domestic unemployment on foreign one, but are otherwise perfectly similar to the regressions (4) and (5) presented in Table 2. Compared to the benchmark case where the level of u is used, this transformation ensures that the dependent variable takes values on the entire real line. There is no clear consensus in the empirical cross-country unemployment literature as to whether $\ln u$ or u is to be preferred. In the case of our regressions, the log specification has the drawback that our IV strategy does not work well here; see the overidentification test associated to the regression in column (2). However, qualitatively, our main result holds up in the OLS and the IV model.

Column (3) in Table 5 reverts to the level of the unemployment rate as the dependent variable and uses contemporaneous instruments rather than the lagged ones. This does not change the qualitative findings relative to the benchmark of Table 2. Column (4) presents an OLS model, using $u_{i,t-1}^*$ as the dependent variable. Results change very little.

Columns (5) and (6) add an EU dummy to the regressions, but otherwise leaves the regressions identical to those in Table 2. Inclusion of the dummy does not change the

Table 4: Unemployment spillovers: the role of country size and openness

	$z = pmr$			$z = \ln(pop)$		
	(1)	(2)	(3)	(4)	(5)	(6)
b	0.091 ^a (0.018)	0.097 ^a (0.020)	0.051 ^c (0.030)	-0.096 (0.153)	-0.160 (0.153)	-0.240 ^c (0.143)
b^*	-0.019 (0.016)	-0.006 (0.014)	0.017 (0.016)	-0.324 (0.213)	-0.319 (0.205)	-0.382 ^c (0.202)
Interaction terms						
$z^* \times b^*$	0.015 ^a (0.005)	0.012 ^a (0.005)	0.020 ^a (0.006)	0.036 ^c (0.021)	0.032 (0.020)	0.038 ^c (0.020)
$z^* \times b$	-0.005 (0.003)	-0.005 ^c (0.003)	-0.003 (0.003)	-0.008 (0.005)	-0.006 (0.005)	
$z \times b^*$			-0.015 ^a (0.005)	-0.003 (0.006)	0.001 (0.006)	
$z \times b$			0.007 (0.005)	0.029 ^c (0.015)	0.031 ^b (0.015)	0.035 ^b (0.014)
Other controls						
PMR	0.587 ^a (0.214)	0.744 ^a (0.229)	0.675 ^c (0.396)		0.878 ^a (0.228)	0.889 ^a (0.222)
PMR*	-0.272 (0.381)	-0.316 (0.371)	-0.357 (0.371)		-0.039 (0.250)	0.165 (0.228)
$\ln(pop)$				-16.357 ^a (5.075)	-17.798 ^a (5.206)	-19.642 ^a (4.939)
$\ln(pop^*)$				0.110 (0.278)	0.048 (0.269)	-0.239 (0.146)
Union density		-0.002 (0.024)	0.023 (0.027)	0.005 (0.024)	-0.011 (0.023)	-0.017 (0.023)
High corporatism		-1.455 ^a (0.425)	-1.594 ^a (0.436)	-1.788 ^a (0.616)	-1.986 ^a (0.656)	-2.002 ^a (0.638)
EPL		-0.383 (0.375)	-0.406 (0.421)	0.569 (0.395)	-0.037 (0.418)	-0.031 (0.407)
gap	-0.617 ^a (0.039)	-0.627 ^a (0.043)	-0.625 ^a (0.044)	-0.630 ^a (0.043)	-0.630 ^a (0.042)	-0.633 ^a (0.043)
gap^*	0.101 (0.086)	0.038 (0.080)	0.043 (0.083)	-0.019 (0.062)	-0.020 (0.072)	0.012 (0.070)
RMSE	1.136	1.104	1.104	1.120	1.091	1.091
adj R ²	0.930	0.934	0.934	0.932	0.935	0.935
F	133.4	131.6	136.0	149.4	155.7	160.4

Robust standard errors in parentheses, ^a $p < 0.01$, ^b $p < 0.05$, ^c $p < 0.1$. Number of observations: 397 in all regressions. All estimations use OLS and contain a full set of country fixed-effects and year dummies, and an array of orthogonal shocks (TFP, terms of trade, real interest rate, and labor demand shocks) as additional controls for business cycle comovements. Trade-weighted averages for foreign variables (denoted by asterisks) are computed using $\alpha_1 = \alpha_2 = 1, \delta = 1$.

Table 5: Robustness Checks: Semi-log specification and different IV strategy

Dep.var.	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	$\ln u$	$\ln u$	u	u	u	u	$\ln u$	u
Instruments / Proxy	OLS	IV	IV	OLS	OLS	IV	OLS	OLS
$\ln u^*, u^*$		b_{t-1}^*, pmr_{t-1}^*	b_t^*, pmr_t^*	u_{t-1}^*		b_{t-1}^*, pmr_{t-1}^*		
	0.018 (0.013)	0.022 ^c (0.013)	0.080 ^a (0.028)	0.075 ^a (0.027)	0.086 ^a (0.030)	0.087 ^a (0.032)		
b^*							0.002 ^a (0.001)	0.009 ^a (0.003)
b	0.017 ^a (0.003)	0.018 ^a (0.003)	0.085 ^a (0.018)	0.099 ^a (0.020)	0.078 ^a (0.020)	0.095 ^a (0.019)	0.018 ^a (0.003)	0.079 ^a (0.020)
PMR	0.184 ^a (0.037)	0.198 ^a (0.033)	0.875 ^a (0.196)	0.939 ^a (0.215)	0.843 ^a (0.210)	0.920 ^a (0.203)	0.182 ^a (0.036)	0.821 ^a (0.206)
Union density	-0.003 (0.003)	-0.003 (0.003)	-0.004 (0.022)	-0.003 (0.023)	-0.005 (0.023)	-0.004 (0.022)	-0.003 (0.003)	-0.005 (0.023)
High corporatism	-0.129 ^b (0.057)	-0.150 ^a (0.056)	-1.619 ^a (0.390)	-1.865 ^a (0.427)	-1.527 ^a (0.415)	-1.781 ^a (0.390)	-0.124 ^b (0.057)	-1.525 ^a (0.415)
EPL	-0.012 (0.054)	0.007 (0.049)	-0.413 (0.342)	-0.300 (0.375)	-0.458 (0.366)	-0.326 (0.351)	-0.020 (0.056)	-0.461 (0.371)
EU dummy					0.724 ^c (0.383)	0.438 (0.355)	0.732 ^c (0.383)	
gap	-0.091 ^a (0.009)	-0.090 ^a (0.008)	-0.621 ^a (0.041)	-0.609 ^a (0.042)	-0.639 ^a (0.043)	-0.617 ^a (0.039)	-0.091 ^a (0.009)	-0.641 ^a (0.043)
gap^*	-0.008 (0.015)	-0.002 (0.014)	0.021 (0.070)	0.015 (0.067)	0.034 (0.073)	0.073 (0.070)	-0.008 (0.015)	-0.015 (0.070)
2nd stage statistics								
RMSE	0.210	0.188	1.046	1.095	1.123	1.008	0.210	1.124
adj. R ²	0.893	0.896	0.931	0.935	0.932	0.936	0.893	0.931
F	72.41			158.7	150.0		73.06	149.7
1st stage statistics (p-values)								
partial R ²		0.633	0.972				0.753	
χ^2 -overidentification		0.0190	0.680				0.970	
χ^2 -endogeneity		0.695	0.623				0.886	

Robust standard errors in parentheses, ^a $p < 0.01$, ^b $p < 0.05$, ^c $p < 0.1$. Number of observations: 397 in OLS and 374 in IV regressions. All regressions contain a full set of country fixed-effects, year dummies, and an array of orthogonal shocks (TFP, terms of trade, real interest rate, and labor demand shocks) as additional controls for business cycle comovements. Trade-weighted averages for foreign variables (denoted by asterisks) are computed using $\alpha_1 = \alpha_2 = 1, \delta = 1$. In IV regressions, the foreign unemployment rate u^* is instrumented by b_{t-1}^*, PMR_{t-1}^* and gap_{t-1}^* . The χ^2 -endogeneity test tests the null that u^* is exogenous (and rejects in all presented IV models). Overidentification is tested for using the Wooldridge robust Score test (invalidity of instruments or model misspecification is rejected in all presented IV models).

results of the OLS and the IV model. Comfortingly, the EU dummy is only marginally significant in the OLS model and insignificant in the IV specification, so that the accession to the EU does not have any effects on the unemployment rate other than those already captured by the institutional variables in the model.²⁶

Finally, columns (7) and (8) carry out two robustness checks relative to Table 3. First, instead of using the level of the unemployment rate, its logarithm is used. This has no effect on the signs of the right-hand-side variables nor on their statistical significance. Second, the EU dummy is introduced into column (8), with the level of the unemployment rate again as the dependent variable. Again, results do not change. Here, however, we do have some evidence that joining the EU does drive up the equilibrium rate of unemployment.

Table 6 carries out extensive robustness checks with respect to the choice of normalization of the weights. Columns (1) to (6) vary the elasticities of country size α_1 and α_2 , as well as that of distance in the bilateral trade flow proxies shown in equation (33). Odd-numbered columns refer to equation (5) in Table 2, even-numbered columns to equation (5) in Table 3. First, the coefficient of the distance variable in the computation of the weights to the lower bound of estimates found in the gravity literature, i.e., $\delta = 0.75$ (Disdier and Head, 2008). Then a higher bound, i.e., $\delta = 1.50$ is used. Qualitatively, these modifications have little effect on the estimates. To achieve a quantitative comparison, we need to take into account that the sample moments of u^* depend on the weights. The standardized beta coefficient of u^* in column (1) is $0.096 * 2.47/4.29 = 0.055$ and in column (3) $0.065 * 4.63/4.29 = 0.070$ which nicely bounds the benchmark results obtained in Table 2 (column (5), 0.06) from above and from below. Using a finer grid on δ shows that the obtained standardized beta coefficients systematically fall in δ . In the limit, when δ is infinite, the effect of u^* vanishes. A similar effect is observed in columns (2) and (4), where the variable of interest is b^* instead of u^* .

Columns (5) and (6) modify the weights in that they close down the direct size effect: $\alpha_1 = \alpha_2 = 0$. Now, in both models, the signs of the interesting coefficients remain unchanged. In terms of their economic significance, the standardized beta coefficients are $0.006 * 36.07/4.29 = 0.050$ in the case of column (5) and $0.052 * 8.07/4.29 = 0.098$ in the case of (6). Hence, taking out country size from the construction of the bilateral weights reduces the estimated effects, but only in a very limited amount.

The remainder of Table 6 modifies the normalization of bilateral weights. In columns (7) and (8) the weights are normalized by $\max_i (\omega_{ijt})$, for each year t and country j , while in columns (9) and (10) are normalized such that weights add up to one for the 20 OECD countries that our panel regressions draw upon. These different normalizations do not have any bearing on the qualitative results. The economic significance, however, is affected. The standardized beta coefficient of u^* in column (9) is $0.006 * 32.33/4.29 = 0.045$, which is again surprisingly much in line with our previous findings.

²⁶Note that the effect of EU membership is identified using time-variation only since the model features country fixed-effects.

Table 6: Robustness Checks: Alternative construction of weighting matrix

Normalization over all countries, by $\sum_i \omega_i$												Normalization over all, by $\max_i \omega_i$		Normalization over 20 OECD countries, by $\sum_i \omega_i$	
$\delta = 0.75, \alpha_i = 1.00$				$\delta = 1.50, \alpha_i = 1.00$				$\delta = 1.00, \alpha_i = 0.00$				$\delta = 1.00, \alpha_i = 1.00$			
(1) IV	(2) OLS	(3) IV	(4) OLS	(5) IV	(6) OLS	(7) IV	(8) OLS	(9) IV	(10) OLS						
u^*	0.096 ^b (0.042)		0.065 ^a (0.021)		0.582 ^a (0.178)		0.011 ^b (0.005)		0.026 ^b (0.011)						
b^*		0.011 ^b (0.005)		0.006 ^a (0.002)		0.052 ^a (0.019)		0.001 ^b (0.000)		0.003 ^b (0.001)					
b	0.098 ^a (0.019)	0.085 ^a (0.020)	0.098 ^a (0.019)	0.087 ^a (0.019)	0.098 ^a (0.018)	0.089 ^a (0.019)	0.101 ^a (0.019)	0.088 ^a (0.019)	0.100 ^a (0.019)	0.087 ^a (0.020)					
PMR	0.939 ^a (0.206)	0.864 ^a (0.211)		0.837 ^a (0.204)	0.799 ^a (0.190)	0.774 ^a (0.199)	0.917 ^a (0.200)	0.839 ^a (0.208)	0.910 ^a (0.201)	0.844 ^a (0.210)					
Union density	-0.002 (0.022)	-0.003 (0.023)	-0.007 (0.022)	-0.006 (0.023)	0.001 (0.021)	-0.002 (0.023)	-0.007 (0.022)	-0.007 (0.023)	-0.005 (0.022)	-0.005 (0.023)					
High corporatism	-1.860 ^a (0.394)	-1.635 ^a (0.420)	-1.800 ^a (0.395)	-1.608 ^a (0.421)	-1.774 ^a (0.381)	-1.594 ^a (0.411)	-1.833 ^a (0.392)	-1.619 ^a (0.419)	-1.849 ^a (0.393)	-1.638 ^a (0.419)					
EPL	-0.271 (0.349)	-0.392 (0.367)	-0.349 (0.350)	-0.431 (0.373)	-0.283 (0.330)	-0.374 (0.355)	-0.282 (0.353)	-0.387 (0.372)	-0.257 (0.352)	-0.369 (0.369)					
gap	-0.608 ^a (0.039)	-0.620 ^a (0.044)	-0.614 ^a (0.039)	-0.624 ^a (0.044)	-0.610 ^a (0.038)	-0.614 ^a (0.044)	-0.611 ^a (0.039)	-0.622 ^a (0.044)	-0.611 ^a (0.039)	-0.622 ^a (0.044)					
gap^*	0.028 (0.096)	-0.070 (0.097)	0.063 (0.045)	-0.004 (0.045)	0.924 ^a (0.298)	0.596 ^b (0.269)	0.015 (0.011)	0.004 (0.011)	0.007 (0.008)	0.000 (0.008)					
2nd stage statistics															
RMSE	1.011	1.130	1.008	1.130	1.000	1.116	1.012	1.132	1.013	1.132					
adj. R ²	0.935	0.931	0.936	0.931	0.937	0.933	0.935	0.931	0.935	0.930					
F		145.7		147.2		161.3		144.1		143.7					
1st stage statistics (p-values)															
partial R ²	0.762		0.741		0.714		0.759		0.766						
χ^2 -overidentification	0.667		0.843		0.0153		0.825		0.687						
χ^2 -endogeneity	0.927		0.976		0.155		0.997		0.965						
Robust standard errors in parentheses, ^a $p < 0.01$, ^b $p < 0.05$, ^c $p < 0.1$. Number of observations: 397 in OLS and 374 in IV regressions. All regressions contain a full set of country fixed-effects, year dummies, and an array of orthogonal shocks (TFP, terms of trade, real interest rate, and labor demand shocks) as additional controls for business cycle comovements. Trade-weighted averages for foreign variables are denoted by asterisks. In IV regressions, the foreign unemployment rate u^* is instrumented by b_{t-1}^* , PMR_{t-1}^* and gap_{t-1}^* . The χ^2 -endogeneity test tests the null that u^* is exogenous (and rejects in all presented IV models). Overidentification is tested for using the Wooldridge robust Score test (invalidity of instruments or model misspecification is rejected in all presented IV models).															

4.7 [Simulation results: beyond average effects: tba]

5 Conclusions

In this paper, we have introduced search unemployment into a multi-country single-sector trade model with firm-level increasing returns to scale and product differentiation. In order to guarantee existence and uniqueness of the equilibrium, we abstract from the usual assumption of external economies of scale which characterizes models of the Krugman (1979) type. Firms are heterogeneous with respect to their (constant) productivities, and trade liberalization affects economies through selection effects as in Melitz (2003).

Allowing for asymmetric country sizes, asymmetric labor market institutions, and asymmetric trade costs, we ask how an institutional change in one country affects labor market outcomes in other countries. Countries are linked via the product markets and maintain multilateral trade balance. We find that an increase of the tax wedge (unemployment benefits plus tax rate on wages) unambiguously increases unemployment and the real wage in the country that enacts the institutional change. In the other countries, unemployment goes up as well, but the real wage falls. Other labor market variables such as the efficiency of the search process or search costs have similar effects. Hence, an exogenous shock on labor market institutions triggers a positive correlation between countries' unemployment rates. In contrast, real wages are negatively correlated.

The key mechanism that drives these results is the reduction in market size that a bad institutional reform yields in the country that enacts the reform. Since workers are pushed out of employment, total demand in that market falls, and foreign firms find it harder to recoup their fixed costs of distribution in that country. Some of them – the least efficient – withdraw, which lowers the degree of competition in that economy so that inefficient domestic firms find it easier to survive. The productivity of the average domestic firm falls as does average revenue. Search costs being fixed in terms of the numéraire, the average firm posts less vacancies and the aggregate rate of unemployment goes up. The other countries are also adversely affected, since they are less strongly exposed to import competition from the domestic economy, which leads to lower productivity there as well.

We also find that the adverse effects of bad institutions depends on the degree of geographical centrality of the “bad” country: the more central it is, the more strongly other countries are exposed to the “bad” country, and the more severe are the adverse spill-overs on their own labor market outcomes. By the same token, the larger the “bad” country is, the more strongly other countries are affected: again, the reason is their relatively larger exposure to that country.

We include trade-weighted foreign variables into otherwise standard cross-country unemployment regressions run on panel data for 20 rich OECD countries. The empirical evidence is in line with our theoretical findings. Instrumenting the average foreign unemployment rate by foreign exogenous variables and their time lags, and controlling for business cycle effects and own labor market variables, we find a strong positive correlation between unemployment rates of countries. Regressing the domestic unemployment rate directly on foreign institutions confirms this finding. Moreover, we document that

the importance of the foreign variables for domestic outcomes is larger, the less domestic product markets are protected and the more open the domestic economy is. The positive correlation between foreign regulation and domestic unemployment disappears when country sizes are omitted from the construction of foreign variables. We conclude that our empirical results are in line with our theoretical treatment. In contrast, we do not find any support for the prediction of multi-sector Heckscher-Ohlin type models, namely, that the correlation between domestic labor market outcomes and foreign labor market regulation depends on the capital-labor ratio.

Appendix

A1 Equalization of Marginal Revenues

To show that $p_x[\varphi_i] = \tau_{ij}p_d[\varphi_i]$, we proceed as follows. First, according to equation (4):

$$p_d[\varphi_i] = q_d[\varphi_i]^{-\frac{1}{\sigma}} (P_i)^{\frac{\sigma-1}{\sigma}} \left(\frac{Y_i}{\bar{M}_i^{1-\nu}} \right)^{\frac{1}{\sigma}}, \quad (\text{A1})$$

$$p_x[\varphi_i] = q_x[\varphi_i]^{-\frac{1}{\sigma}} (P_j)^{\frac{\sigma-1}{\sigma}} \left(\frac{\tau_{ij}Y_j}{\bar{M}_j^{1-\nu}} \right)^{\frac{1}{\sigma}}. \quad (\text{A2})$$

Hence, revenues on the domestic and foreign market are given by:

$$R_d[\varphi_i] = q_d[\varphi_i]^{\frac{\sigma-1}{\sigma}} (P_i)^{\frac{\sigma-1}{\sigma}} \left(\frac{Y_i}{\bar{M}_i^{1-\nu}} \right)^{\frac{1}{\sigma}}, \quad (\text{A3})$$

$$R_x[\varphi_i] = q_x[\varphi_i]^{\frac{\sigma-1}{\sigma}} (P_j)^{\frac{\sigma-1}{\sigma}} \left(\frac{\tau_{ij}^{1-\sigma}Y_j}{\bar{M}_j^{1-\nu}} \right)^{\frac{1}{\sigma}}. \quad (\text{A4})$$

Now taking partial derivatives with respect to L_i and using equation $q(\varphi_i) = \varphi_i L[\varphi_i]$ leads to:

$$\begin{aligned} \frac{\partial R_d[\varphi_i]}{\partial L_{id}} &= \frac{\sigma-1}{\sigma} q_d[\varphi_i]^{-\frac{1}{\sigma}} (P_i)^{\frac{\sigma-1}{\sigma}} \left(\frac{Y_i}{\bar{M}_i^{1-\nu}} \right)^{\frac{1}{\sigma}} \varphi_i, \\ \frac{\partial R_x[\varphi_i^H]}{L_{ix}} &= \frac{\sigma-1}{\sigma} q_x[\varphi_i]^{-\frac{1}{\sigma}} (P_j)^{\frac{\sigma-1}{\sigma}} \left(\frac{\tau_{ij}^{1-\sigma}Y_j}{\bar{M}_j^{1-\nu}} \right)^{\frac{1}{\sigma}} \varphi_i. \end{aligned}$$

Using the demand function, we can reformulate as follows:

$$\frac{\partial R_d[\varphi_i]}{\partial L_{id}^H} = \frac{\sigma-1}{\sigma} p_d[\varphi_i], \quad (\text{A5})$$

$$\frac{\partial R_x[\varphi_i]}{\partial L_{ix}^H} = \frac{\sigma-1}{\sigma} \tau_{ij}^{-1} p_x[\varphi_i]. \quad (\text{A6})$$

This shows that when firms want to equalize marginal revenues across markets, $p_x[\varphi_i] = \tau_{ij}p_d[\varphi_i]$ immediately follows.

A2 Summary statistics

Table 7: Summary statistics

Variable	Description	Mean	Std. Dev.	Min	Max
u	unemployment rate (percent)	7.994	4.294	0.396	24.042
b	tax wedge (percent)	58.385	18.212	21.008	96.973
PMR	Product market	3.864	1.290	1.050	6.000
	regulation (index, 1-10)	3.864	1.290	1.050	6.000
Union density	(percent)				
High corporatism	(dummy)	0.554	0.498	0.000	1.000
EPL	employment protection	2.080	1.082	0.200	4.188
	legislation (index, 1-10)				
gap	Output gap (percent)	-1.019	2.538	-12.211	6.297
u^*	W x u	2.399	3.144	0.037	13.875
b^*	W x b	18.182	23.394	0.269	89.783
PMR*	W x PMR	1.230	1.679	0.011	8.181
Union density*	W x union density	12.426	15.974	0.180	71.088
High corporatism*	W x high corporatism	0.176	0.245	0.001	1.096
EPL*	W x EPL	0.657	0.882	0.009	4.252
gap^*	W x gap	-0.303	0.990	-5.803	2.699
k^*/k	(W x (K/L)) / (K/L)	0.942	1.798	0.000	9.474
TFP Shock		-0.002	0.023	-0.099	0.054
TOT Shock		-0.037	0.066	-0.217	0.187
Real interest rate Shock		4.759	2.194	-9.282	14.122
Demand shock		0.033	0.062	-0.138	0.236
All data (except weighting matrix W) are from Bassanini and Duval (2006). Number of observations $N = 397$. Weights are based on $\alpha_1 = \alpha_2 = 1$ and $\delta = 1$; standard normalization. Foreign variables are not to be interpreted as means, since weights do not add up to 1 (due to inclusion of rest of the world in calculation of weights).					

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