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Unemployment in an Interdependent World*

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May 9, 2012

Abstract

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Keywords: Spillover effects of labor market institutions; unemployment; international trade; search frictions; heterogeneous firms

JEL-Codes: F11, F12, F16, J64, L11

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1 Introduction

In a world, where countries are increasingly linked via trade in goods, labor market outcomes become more strongly interdependent: one country's institutions will not only affect its own rate of unemployment but also that of its trading partners. This has important implications for labor market reforms and for the normative effects of trade liberalization. In this paper we therefore shed light on the direction and magnitude of spillover effects on unemployment due to changes of labor market institutions in a trading partner country.

Our contribution is twofold. First, we develop a very tractable two-country, asymmetric general equilibrium framework that combines an Armingtonian model of national product differentiation with the canonical search and matching approach of Mortensen and Pissarides (1994). In our setup, structural (i.e., non-cyclical) unemployment rates are positively correlated across countries. The strength of the correlation depends on the size and openness of countries as well as on the degree of real wage flexibility. Relatively larger and less open countries are harmed more by own labor market frictions and less by foreign ones, whereas small and open countries are hit relatively harder by foreign labor market frictions and less by own frictions.

Second, we empirically investigate cross-country labor market linkages using panel data for 20 rich OECD countries for 1982-2003. Using instrumental variable panel estimators and controlling for institutions as well as for business cycle comovement, we confirm our theoretical findings and reject alternative approaches based on multi-sector comparative advantages.

There is an emerging consensus in the macroeconomic labor literature that institutions matter for structural unemployment; in particular, pervasive *product market regulation* increases unemployment.[1] One may therefore conjecture that trade barriers also foster unemployment. Recent econometric evidence supports this view, see Dutt, Mitra, and Ranjan (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 other countries.

[1] See for example Layard, Nickell, and Jackman (1991); Nickell (1997); Nickell and Layard (1999); Blanchard and Wolfers (2000); or Ebell and Haefke (2009).

A large strand of the theoretical literature uses the $2 \times 2 \times 2-$Heckscher-Ohlin model to study the effect of labor market institutions on the pattern of trade. Brecher (1974) studied minimum wages; Davis (1998) has provided a generalization. Due to factor price equalization, if a capital-abundant country has a binding minimum wage, trade exacerbates job losses there, while the labor-abundant country with perfect labor markets benefits from higher wages without the incidence of unemployment. The precise nature of labor market imperfections matters little for the direction of linkages: Models with search frictions and wage bargaining, such as Davidson, Martin, and Matusz (1988, 1999) and Helpman and Itskhoki (2010) come to similar conclusions as Davis (1998).[2] Models explaining trade based on *comparative advantages* predict that an increase in labor market frictions at home leads to higher unemployment at home. The effects on the trading partner depend on the relative capital-labor endowments: Higher domestic unemployment increases capital-labor abundance at home. A relatively capital-rich home economy specializes more strongly on capital-intensive goods while the foreign country produces more of the labor-intensive goods. Labor demand in the foreign country goes up and the marginal value product of labor increases. Firms create more vacancies, which leads to a fall in unemployment. The opposite logic applies if the home country is labor-rich. Hence, the sign of the correlation of unemployment rates between countries depends crucially on the comparison of capital-labor ratios across countries. We therefore include capital-labor ratios in our empirical specifications. It will turn out that the predictions of the models based on comparative advantages are not supported by our empirical analysis.

The more recent literature focuses on firm-level increasing returns to scale and product differentiation (Krugman, 1980) and the generalization to heterogeneous firms (Melitz, 2003). Some papers draw on the fair wage or efficiency wage approach, others use the search and matching approach. A well-known limitation of Krugman-type models with *asymmetries* is their lack of analytical tractability. Hence, Egger and Kreickemeier (2008, 2009), Eckel and Egger (2009) or Felbermayr, Prat, and Schmerer (2011) concentrate on symmetric countries, so that institutional asymmetries and their cross-country implications cannot be studied. Helpman and Itskhoki (2010) have maintained analytical tractability by introducing a *numéraire* sector that remains

[2]More recently, Cuñat 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.

unaffected by monopoly power and trade costs.[3] This strategy blends the comparative advantage channel with Krugman/Melitz mechanisms. Often income effects are ruled out as preferences are quasilinear in the *numéraire* good. However, when studying macroeconomic implications of trade, such as on unemployment, it is important to take *income effects* into account. Generally, higher unemployment at home reduces demand for imports from foreign countries. This leads to a *positive correlation* of unemployment rates. Effects of this type operate in the new economic geography literature[4] but have hardly been explored in models of trade and unemployment.[5] The effect relies crucially on the use of a full-fledged general equilibrium model.

Our focus lies in deriving *empirically testable predictions* on observable market characteristics, like unemployment benefits, size, geography, and real wage flexibility and their conditioning effect on labor market spillovers. No existing model provides predictions about all these facts. Hence, we develop a simple, full-fledged general equilibrium trade model, in which we are able to obtain analytical results for all hypotheses of interest. More precisely, we use a one-shot matching version of Pissarides (2000) in an Armingtonian trade model. Recent theoretical work by Arkolakis, Costinot and Rodriguez-Clare (2011) compares the Armington model to more elaborate setups such as the Krugman (1980) or Melitz (2003) model. Their work suggests that the Armingtonian model provides a good reduced form of more complicated models. In particular, the link between welfare and trade volume has the same functional form. Moreover, the model can be easily extended to allow for trade costs and gives rise to a gravity equation, implying that the predictions of bilateral trade flows of the model will do a reasonable good job in explaining observed bilateral trade flows.[6]

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[3] Moreover, they assume quasi-linear preferences.

[4] See for an overview Fujita, Krugman, and Venables (1999) or Baldwin, Forslid, Martin, Ottaviano, and Robert-Nicoud (2003).

[5] Egger, Egger, and Markusen (2010) form an exception. They use a two-country heterogeneous firms model with homogeneous workers, no trade costs, and a fixed number of potential entrants. Their model also yields a positive correlation between countries' unemployment rates resulting from binding real minimum wages. In their set-up firm heterogeneity is crucial for their result, as minimum wages affect the composition of producers and allows for binding minimum wages in both countries. With homogeneous firms in a Krugman (1980)-type model without trade costs and diversified production, minimum wages could only be binding in one country.

[6] Helpman and Itskhoki (2010) and Egger, Egger and Markusen (2010) use versions of the Melitz model. They achieve tractability by either ignoring trade costs altogether or disallowing them in the perfect-competition no-frictions sector. Neither Helpman and Itskhoki (2010) nor Egger, Egger, and Markusen (2010) do investigate the role of economic geography or relative country size, nor do they carry out any empirical investigations.

The remainder of the paper is structured as follows. Section 2 outlines the theoretical model. Section 3 derives theoretical predictions. Section 4 provides empirical evidence for these predictions. The last section concludes. The Appendix provides analytical proofs to all theoretical propositions and robustness checks for the empirical analysis.

2 Model Setup

We use a simple, analytically tractable theoretical framework that is able to deliver our key predictions. Since our focus is on international spillovers of labor market institutions we need a model with at least two large, potentially asymmetric countries. Countries can differ with respect to labor market institutions and their relative size. To allow for geography, we include trade costs. We rely on the static perfect competition Armingtonian model with one-shot matching frictions on the labor market.

2.1 Goods markets

Denote Home by a subscript H and Foreign by a subscript F, and let $i, j \in \{H, F\}$. According to the Armington assumption, each country produces a single intermediate input good under perfect competition one-to-one from labor, the only factor of production. Labor supply is exogenous and given by L_j. Domestic and imported intermediate inputs are assembled to a final output good using a constant elasticity of substitution production function

$$Q_j = \left[\sum_i (y_{ij})^{\frac{\sigma-1}{\sigma}} \right]^{\frac{\sigma}{\sigma-1}}, \tag{1}$$

where the elasticity of substitution is $\sigma > 1$.[7] y_{ij} denotes the use of an input produced in country i in country $j's$ final good assembly.

The total value of output (GDP) in economy j is $Y_j = Q_j P_j$, where $P_j = \left(\sum_i p_{ij}^{1-\sigma} \right)^{1/(1-\sigma)}$ is the aggregate price index. Prices of domestic and imported varieties differ due to iceberg

[7] In contrast to monopolistic competition models, the assumption $\sigma > 1$ is not required for the existence of a profit-maximizing choice of output by firms. It is needed to ensure that foreign sales fall in trade costs.

transportation costs $\tau_{ij} \geq 1$; hence, $p_{ij} = \tau_{ij} p_i$.[8] Expenditures of country j for an intermediate input from country i are denoted by X_{ij}. By the aggregate income constraint, total expenditure is equal to GDP, $Y_j = \sum_i X_{ij}$ which is in turn equal to the production value of the only active sector, hence $Y_j = p_j S_j$, where S_j is output of country j.

Profit maximization implies the following demand (D_{ij}) and expenditures (X_{ij}) for intermediate inputs

$$D_{ij} = \tau_{ij} \left(\frac{p_{ij}}{P_j} \right)^{-\sigma} \frac{Y_j}{P_j}, \qquad X_{ij} = \left(\frac{p_{ij}}{P_j} \right)^{1-\sigma} Y_j. \tag{2}$$

2.2 Labor market

Our description of the labor market is a static version of Pissarides (2000).[9] The search-and-matching setup has the advantage that it generates a rather parsimonious link between labor market institutions and the equilibrium rate of unemployment. Moreover, the simultaneous existence of unfilled vacancies and searching workers is one of the most pervasive and well-documented features of modern labor markets.

We assume that at the beginning of a period, all potential workers L_j in country j search for jobs. Firms post V_j vacancies. The number of realized matches is given by the constant returns to scale matching function $M_j = m_j L_j^{\mu} V_j^{1-\mu}$, where $\mu \in (0,1)$ is the elasticity of the matching function and m_j measures the efficiency of the labor market.[10] Let $\theta_j \equiv V_j / L_j$ denote the degree of labor market tightness in country j. Then, the share $M_j/V_j = m_j \left(V_j/L_j \right)^{-\mu} = m_j \theta_j^{-\mu}$ of all vacancies is filled at the end of the period, when all output is realized. Similarly, the share $M_j/L_j = m_j \left(V_j/L_j \right)^{1-\mu} = m_j \theta_j^{1-\mu}$ of all workers is employed; the remainder is without a job at the end of the period, so that the unemployment rate is given by $u_j = 1 - m_j \theta_j^{1-\mu}$. We assume that the matching efficiency is sufficiently low to assure that job finding rates and job filling rates are strictly within zero and one at any time.

Let $\gamma_j \in (0,1)$ denote the unemployment benefit replacement rate and w_j the wage rate in

[8] To save notation we write p_i instead of p_{ii}. Similarly for other variables.

[9] See Keuschnigg and Ribi (2009) or Helpman and Itskhoki (2010) for recent models using a similar static approach.

[10] Constant returns to scale is a common assumption in the search matching context. It has received ample support in empirical studies; see Petrongolo and Pissarides (2001).

country j. Then, unemployment benefits are given by $b_j = \gamma_j w_j$. As usual, wages are determined in a generalized Nash bargaining process after matching has occurred. The total surplus from a successful match is given by $p_j - b_j$, while the firm's rent is given by $p_j - w_j$ and the worker's by $w_j - b_j$. Let the worker's bargaining power be $\beta_j \in (0,1)$. Nash bargaining implies $w_j - b_j = \beta_j (p_j - b_j)$. Together with $b_j = \gamma_j w_j$,[11] one obtains the **wage equation**

$$w_j = \frac{\beta_j}{1-(1-\beta_j)\gamma_j} p_j. \tag{3}$$

This equation illustrates the advantage of assuming one-shot matching as it does not depend on θ_j.[12] The worker appropriates a portion of the value of output and $w_j < p_j$. The bargained wage increases in the value of output p_j, in the worker's bargaining power β_j (since $\gamma_j \in (0,1)$) and in the replacement rate γ_j.

Firms create vacancies until all rents are dissipated. The free entry (zero profit) condition is given by $M_j/V_j (p_j - w_j) = P_j c_j$, where c_j is the cost of posting one vacancy, which is in terms of the final good. It states that expected rents (the probability of filling a vacancy times the rent per filled vacancy) have to be equal to the upfront cost of creating the vacancy. Rewriting, one finds the **job creation curve**

$$w_j = p_j - \frac{P_j c_j}{m_j \theta_j^{-\mu}}. \tag{4}$$

As the wage curve, this curve is increasing in the value of output. It is decreasing in the expected costs of filling a vacancy $P_j c_j/(m_j \theta_j^{-\mu})$, which is, in turn, an increasing function of θ_j: as labor market tightness goes up, the probability of filling a vacancy falls.

Using the job creation curve and the wage equation, one can express labor market tightness as a function of relative output prices and model parameters

$$\theta_j^{\mu} = \left(\frac{p_j}{P_j}\right)^{1/\mu} \left(\frac{c_j}{m_j}\Omega_j\right)^{-1/\mu}, \tag{5}$$

[11] We assume that workers and firms take the level of unemployment benefits as exogenously given; i.e., they do not take into account that a higher wage would imply higher unemployment benefits.

[12] In the dynamic specification, the wage rate would be a positive function of labor market tightness as forward-looking agents factor in a lower duration of unemployment in the case negotiations break down.

where $\Omega_j := \frac{1/(1-\beta_j)-\gamma_j}{1-\gamma_j} \geq 1$ summarizes the effective bargaining power of workers. Ω_j is increasing in the worker's bargaining power β_j and in the replacement rate γ_j. A decrease in m_j, an increase in Ω_j or an increase in the cost of vacancy posting c_j lowers labor market tightness and increases the unemployment rate. An increase in the relative price of output p_j/P_j makes vacancy creation more worthwhile and therefore leads to higher labor market tightness and lower unemployment. Note that equilibrium unemployment in country j is not directly affected by variables of country i but only indirectly via the relative price p_j/P_j.

2.3 Terms of trade

Employing the definition of the aggregate price index, defining Home's terms of trade as $\pi \equiv p_H/p_F$ and assuming $\tau = \tau_{ij} = \tau_{ji}$ if $i \neq j$ and $\tau = 1$ if $i = j$, it is straightforward to express the relative price p_H/P_H as a function of terms of trade π:

$$p_H/P_H = \left[1 + (\pi/\tau)^{\sigma-1}\right]^{1/(\sigma-1)}. \tag{6}$$

Hence, Home's terms of trade π and the relative price p_H/P_H are positively related. The larger trade costs τ are, the weaker is that link as the share of imported goods in Home's price index goes down. A similar relation exists for p_F/P_F, which is of course negatively related to π.

Using equation (5) one can express Home's labor market tightness as

$$\theta_H = \left[1 + (\pi/\tau)^{\sigma-1}\right]^{\frac{1}{\mu(\sigma-1)}} \left(\frac{c_H}{m_H}\Omega_H\right)^{-1/\mu}. \tag{7}$$

This shows that, *ceteris paribus*, an increase in Home's terms of trade (π) yields a higher degree of labor market tightness θ_H and hence lower unemployment. This effect is lower, the higher trade costs τ are. If Home increases the effective bargaining power of workers (Ω_H) or the costs of vacancy creation (c_H), its labor market tightness falls and, thus, the equilibrium unemployment rate goes up. A similar relation exists for Foreign:

$$\theta_F = \left[1 + (\pi\tau)^{1-\sigma}\right]^{\frac{1}{\mu(\sigma-1)}} \left(\frac{c_F}{m_F}\Omega_F\right)^{-1/\mu}. \tag{8}$$

Again, an increase in Foreign's terms of trade $(1/\pi)$ improves labor market outcomes there; the effect is lower, the higher τ.

2.4 Relative demand and relative supply

In the next step of the analysis, we discuss how Home's labor market institutions affect the terms of trade. For this purpose, we derive the relative demand and the relative supply schedules for the world economy. Using $S_j = m_j L_j \theta_j^{1-\mu}$ and equations (7) and (8), the supply of Home's input relative to the supply of Foreign's input is given by

$$RS(\pi) \equiv \frac{S_H}{S_F} = \lambda B^{-\frac{(1-\mu)}{\mu}} \left[\frac{1 + (\pi/\tau)^{\sigma-1}}{1 + (\pi\tau)^{1-\sigma}} \right]^{\frac{1-\mu}{\mu(\sigma-1)}}, \tag{9}$$

where $\lambda \equiv L_H/L_F$ is relative country size and $B \equiv (c_H \Omega_H / (c_F \Omega_F))(m_F/m_H)^{1/(1-\mu)}$ measures the relative importance of labor market frictions at Home as compared to Foreign. Clearly, relative supply (RS) is strictly increasing in π since $\sigma > 1$; see Appendix A1 for detailed derivations.

Relative demand (RD) can be found by using (2) and imposing the balanced trade condition $p_{FH} D_{FH} = p_{HF} D_{HF}$. The RD locus is given by

$$RD(\pi) \equiv \frac{D_H}{D_F} = \pi^{1-2\sigma} \frac{1 + (\pi/\tau)^{\sigma-1}}{1 + (\pi\tau)^{1-\sigma}}. \tag{10}$$

Clearly, due to identical and homothetic preferences, relative demand depends only on relative prices and trade costs. It does not directly depend on variables that affect Home's income relative to Foreign's. In particular, labor market related variables do not play a role here. Relative demand takes a particularly simple form if there are no trade costs (i.e., if $\tau = 1$). Then, $RD(\pi, .) = \pi^{-\sigma}$, and the slope of the locus in π is straightforwardly signed as negative. Strictly positive trade costs complicate the picture, but only reinforce the negative slope of the RD schedule as detailed in Appendix A1.

3 Theoretical Insights

3.1 Trade liberalization and unemployment

Before we turn to the comparative statics with respect to labor market institutions, it is worthwhile to investigate the effects of trade liberalization.

Proposition 1 ***(Trade liberalization and unemployment.)*** *In a neighborhood of the symmetric equilibrium, a decrease in iceberg trade costs leads to a decrease in equilibrium unemployment rates in both countries.*

Proof. In Appendix A2. ■

Trade liberalization – modeled as a reduction in iceberg trade costs – has fairly complicated effects on the terms of trade. However, starting in the symmetric equilibrium where $\pi = 1$, a change in τ leaves π unchanged, which makes perfect sense because a cut in trade costs affects both countries equally and thus cannot imply a deviation from symmetry (the proof is in Appendix A2). In that case, Proposition 1 follows directly from equations (7) and (8). The intuition for this result is simple. When τ falls, given π, the price of the final good (the price index) in both countries has to fall, since imports become cheaper. Therefore, p_j/P_j goes up and firms in both countries find that the price of output relative to the costs of vacancy creation has increased. As a consequence, they create more vacancies (see equation (5)). The equilibrium unemployment rate goes down.

If countries are asymmetric so that $\pi > 1$ in the initial equilibrium (e.g., because Home is smaller than Foreign, $\lambda < 1$), both relative demand RD and relative supply RS shift upwards with lower τ. Making the reasonable assumption that $\sigma > 1/\mu$, the exponent in equation (9) is smaller than one, implying that relative demand increases by more than relative supply.[13] In order to establish a new equilibrium, π has to increase, as relative demand is decreasing and relative supply increasing in π. In that case, Home (the smaller country) benefits by more from falling trade costs than in the symmetric case ($\pi = 1$) as terms of trade move in its favor. Foreign

[13] The condition $\sigma > 1/\mu$ requires that the matching elasticity μ be larger than the elasticity of inverse demand $1/\sigma$. For the standard value of $\mu = 1/2$ (see Hosios, 1990), σ needs to exceed 2, which is a very realistic assumption (see Anderson and van Wincoop, 2004).

(the larger economy), in turn, benefits by less and it is theoretically possible that the terms of trade deterioration offsets the gains from lower trade costs.

3.2 Institutional spillovers

We now come to the core interest of this paper, namely how a change in labor market institutions in one country affects the other country. To start, note that the parameter B in RS summarizes all labor market variables in the model: search costs c_j, bargaining power β_j, the efficiency of the labor market m_j and the generosity of unemployment insurance γ_j. An increase in B signals that labor market frictions in Home have increased relative to Foreign. So, without loss of generality one can focus on any labor market variable, or on the summary statistic B. The following proposition summarizes the international spillover effects of labor market frictions.

Proposition 2 ***(Institutional spillovers).*** *An increase of labor market frictions in Home leads, ceteris paribus, to a decrease in labor market tightness in both Home and Foreign. Hence, unemployment goes up in both countries.*

Proof. In Appendix A3. ■

In terms of elasticities, the labor market effects of Home's institutions are given by:

$$\varepsilon_{\theta_H,B} = -\frac{1}{\mu} + \varepsilon_{\theta_H,\pi}\varepsilon_{\pi,B} < 0, \tag{11}$$

$$\varepsilon_{\theta_F,B} = \varepsilon_{\theta_F,\pi}\varepsilon_{\pi,B} < 0, \tag{12}$$

where $\varepsilon_{\pi,B}$ measures the effect of Home's institutions on the terms of trade and $\varepsilon_{\theta_j,\pi}$ measures the effect of the terms of trade on labor market tightness. The intuition for the results is as follows. For given relative prices, an increase in the importance of labor market frictions in Home relative to Foreign leads to a reduction in Home's labor market tightness and hence to higher unemployment (equation (7)). At given π, the elasticity of Home's tightness with respect to B is just $-1/\mu$, the inverse of the elasticity of the matching function. Higher unemployment in Home obviously reduces the supply of Home's good. This, in turn, implies that Home's terms of trade improve $\partial\pi/\partial B > 0$, which works towards an increase in labor market tightness (equation (7)), thus counteracting the direct effect. However, this positive indirect effect can never dominate the direct negative effect. Foreign is not directly affected by a change in Home's labor market institutions. The indirect effect is negative since its terms of trade deteriorate.[14]

The important insight from Proposition 2 is that, in an open economy setup, changes in labor market institutions in one country have effects on labor market outcomes not only in that economy but in its trade partners as well. Through the adjustment of terms of trade, the unemployment costs of more severe labor market frictions are partly exported, so that the trading partner takes over part of the unemployment increase. Conversely, the benefits of labor market reforms are exported as well so that the trading partners share the benefits of reforms. This fact has immediate implications for the political economy of labor market institutions: without coordination, countries will have insufficiently low incentives to reform institutions. In this paper we do not pursue this possibility further; see Felbermayr, Larch and Lechthaler (2012) for an analysis in a Melitz (2003) environment with search frictions on the labor market.

3.3 The roles of relative country size, trade costs, and wage rigidity

In this section, we are interested in the effect of a change in relative country size (λ) and transportation costs (τ) on the spillovers caused by labor market reforms in the Home country, i.e., we want to understand how the elasticities $\varepsilon_{\theta_i,B}$ depend on λ and τ. Moreover, we also highlight the role of wage flexibility for the magnitude of spillovers.

3.3.1 The role of country size

Proposition 3 ***(Institutional spillovers and country size.)*** *In a neighborhood of the symmetric equilibrium, the higher the relative size of Home, the stronger is the increase in unemployment in all countries due to more severe labor market frictions in Home.*

Proof. In Appendix A4. ■

[14] The flipside of the terms of trade effect we have just described is an income effect. The increase in unemployment in Home decreases income in Home and thus reduces demand for Foreign's products. Foreign's unemployment goes up and, thus, Foreign's income goes down too.

To understand the proposition, we discuss the elasticities in (11) and (12) separately. The elasticities $\varepsilon_{\theta_H,\pi}$ and $\varepsilon_{\theta_F,\pi}$ both become unambiguously smaller when Home becomes bigger. The reason is that Home becomes more important for demand in both countries and thus Home's unemployment depends less on the terms of trade, while Foreign's unemployment depends more on the terms of trade (remember that $\varepsilon_{\theta_F,\pi} < 0$).

However, it is not easy to tell whether $\varepsilon_{\pi,B}$ becomes bigger or smaller with country size. From the expression given in Appendix A3 it is immediately clear that country size does not have a direct effect on $\varepsilon_{\pi,B}$. However, country size can have an indirect effect via its effect on the terms of trade. It is easy to show that larger countries have lower terms of trade, i.e., $\partial\pi/\partial\lambda < 0$. But the effect of the terms of trade on the elasticity $\varepsilon_{\pi,B}$ is ambiguous and depends on country size and other model parameters. However, in the neighborhood of the symmetric equilibrium (where $\pi = 1$), it can be shown that $\partial\varepsilon_{\pi,B}/\partial\pi = 0$ and, thus, $\partial\varepsilon_{\pi,B}/\partial\lambda = 0$: A change in the terms of trade (and thereby country size) has no first-order effect on the elasticity $\varepsilon_{\pi,B}$. This does not mean that labor market institutions do no longer have an effect on the terms of trade, but that this effect is constant with respect to changes in the terms of trade at the symmetric equilibrium.

It follows that in a neighborhood of the symmetric equilibrium, the effects of country size on $\varepsilon_{\theta_i,\pi}$ dominate. Thus, if Home becomes bigger, more severe labor market frictions in Home trigger a larger increase in unemployment in both countries.

3.3.2 The role of geography

Proposition 4 ***(Institutional spillovers and geography.)*** *In a neighborhood of the symmetric equilibrium, and if $\mu > 1/\sigma$, higher trade costs decrease the importance of spillovers. So, more severe labor market frictions in Home increase Home's unemployment rate by more and Foreign's unemployment rate by less.*

Proof. In Appendix A5. ■

It is easy to show that the effect of a change in π on Home's labor market tightness ($\varepsilon_{\theta_H,\pi} > 0$) is weaker the higher trade costs are (i.e., $\partial\varepsilon_{\theta_H,\pi}/\partial\tau < 0$). This is intuitive since a change in relative world market prices has a smaller domestic impact when trade barriers are strong. The same logic holds true for Foreign, where $\varepsilon_{\theta_F,\pi} < 0$. That elasticity is reduced in absolute value, i.e., terms of trade movements have a lower impact on Foreign's unemployment (i.e., $\partial\varepsilon_{\theta_F,\pi}/\partial\tau > 0$).

It is more difficult to ascertain the effect of higher trade costs on the elasticity $\varepsilon_{\pi,B}$, the effect of B on the terms of trade. Two effects have to be distinguished. On the one hand, trade costs directly affect the elasticity $\varepsilon_{\pi,B}$. On the other hand, trade costs potentially have an effect on the terms of trade, which in turn can have an effect on the elasticity. As in the previous subsection, we focus on the symmetric equilibrium (where $\pi = 1$) to get clear-cut results. In this case the second, indirect effect vanishes altogether because trade costs do not affect the terms of trade.

The first, direct effect depends on the relative size of the parameters σ and μ. The crucial question is whether trade costs make relative supply (equation (9)) or relative demand (equation (10)) relatively more sensitive to changes in the terms of trade. Assuming again that $\sigma > 1/\mu$, rising trade costs imply a smaller impact of labor market institutions on relative supply than on relative demand. This in turn implies that the terms of trade react less strongly to changes in labor market institutions, i.e., $\partial\varepsilon_{\pi,B}/\partial\tau < 0$.

It follows that Foreign is less affected by Home's labor market institutions, if trade costs are larger. On the one hand, an increase in labor market frictions at Home has a smaller impact on the terms of trade. On the other hand, the terms of trade become less important for Foreign's unemployment rate. Exactly the same relationship holds for Home, but for Home this means that unemployment depends more strongly on its own labor market institutions and so an increase in labor market frictions increases unemployment by more.

3.3.3 The role of wage rigidity

Finally, we take a look at the role of wage rigidity for the magnitude of the spillover effect. We do not intend a fully fledged comparative statics analysis, because, due to the one-shot nature of our labor market, the theoretical model does not feature a simple exogenous parameter that governs the sensitivity of wages with respect to, say, unemployment. However, one can simply assume that real wages do not adjust at all in both countries.

Proposition 5 ***(Institutional spillovers and real wage rigidity.)*** *The more rigid wages are, the more moderate is the adjustment in the terms of trade π. However, for a given change in π, the reaction in Foreign's tightness and unemployment is stronger if real wages are rigid.*

Proof. In Appendix A6. ■

In this price-constrained economy, a cost shock yields a stronger reaction in quantities than in prices. So relative employment falls by more than in the flexible case. While the terms of trade effect of a change in Home's labor market institutions is more moderate under rigid wages, it is also clear that the quantity adjustment in each economy needs to be larger. Any shock – be it the initial B shock in Home or the resulting terms of trade shock in Foreign – translates into a stronger quantity adjustment on labor markets. Under flexible wages the increase in the terms of trade will lead to a lower wage in Foreign, thus dampening the negative effect of the terms of trade movement on unemployment. If wages are rigid, this dampening effect does not take place and thus the reaction in unemployment has to be stronger the more rigid wages are.

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 to check whether the empirical evidence is in line with the five key predictions of our model, namely: (1) lower trade costs (higher openness) lead to lower unemployment in Home and Foreign; (2) higher search costs – or equivalently more generous unemployment benefits or a higher bargaining power of workers – in one economy leads to an increase in equilibrium unemployment rate in all economies; (3) the larger the relative size of Home, the stronger are the spillovers of Home's labor market institutions on Foreign; (4) the larger trade costs, the smaller are spillovers; (5) the more rigid real wages are, the stronger are spillovers. Note that our theoretical model implies that changes in search costs or unemployment benefits have similar effects both domestically and in trading partners. Because the generosity of unemployment benefits is more easily measured and data is available for a larger number of countries, we focus on them in the subsequent exercise.

4.1 Econometric specification

Our starting point is the standard cross-country unemployment regression framework:[15]

$$u_{it} = \boldsymbol{\lambda}\cdot\mathbf{LMR}_{it} + \pi \cdot PMR_{it} + \delta \cdot OPEN_{it} + \gamma \cdot GAP_{it} + F_i + T_t + \mathbf{S}_{it} + \varepsilon_{it}, \tag{13}$$

where the vector $\mathbf{LMR}_{it}$ collects labor market variables such as union density, the degree of corporatism, employment protection legislation (EPL_{it}), a proxy for the flow value of non-employment (b_{it}) and a proxy for the degree of real wage flexibility ($FLEX_{it}$). To cover product market characteristics, we include the variable PMR_{it} which measures the intensity of product market regulations and an indicator of openness to trade ($OPEN_{it}$) computed as imports plus exports over GDP in constant prices. GAP_{it} refers to the output gap.[16] F_i and T_t are country and year effects, respectively, while $\mathbf{S}_{it}$ controls for exogenous shocks (total factor productivity (TFP), real interest rates, terms of trade (TOT), 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. Inclusion of macroeconomic variables and shocks is crucial to control for business cycles so that estimated coefficients relate to structural (or equilibrium) unemployment rates.[17] 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 unemployment effects only for a very limited number of labor market institutions. The most important is the participation tax rate, or tax wedge (i.e., the sum of the average wage tax burden and social benefits; see Costain and Reiter, 2008). This will be our preferred measure of b_{it}. Other measures relating to the nature of wage bargaining, employment protection legislation, or the prevalence of minimum wages receive mixed empirical support. This is not necessarily surprising, given the ambiguity of theoretical results (see, e.g., the discussion in Blanchard and

[15]See the survey by Bassanini and Duval (2006, 2009).

[16]Calculated as the difference between actual output and the HP-filtered series.

[17]Due to the data limitations, using five-year averages instead of yearly data is difficult. In the robustness checks, we provide some estimates based on three-year averages.

Wolfers, 2000). Hence, we focus on the *tax wedge* (b_{it}) and include other controls in robustness checks. Costain and Reiter (2008) argue that the tax wedge can be considered as exogenous in the present context.

We also work with a measure of real wage flexibility based on Holden and Wulfsberg (2009). Using data on hourly earnings at the industry level, those authors have measured the frequency of real wage cuts for a sample of 19 OECD countries from 1973-1999. They find that real wage flexibility is "less prevalent in countries with strict employment protection legislation and high union density" (p. 605). Unfortunately, their country and time coverage is not identical to ours. Since the data from Holden and Wulfsberg (2009) are the only recent source of comparable time-series information on wage rigidity, we model the likelihood of real wage cuts as a function of observable variables (union density, employment protection legislation, the output gap) as well as time and country effects. Including year and country dummies into the regression, we infer the missing data.

Our theoretical model gives rise to a gravity-type relation between bilateral trade volumes and explanatory variables related to countries' market size (Proposition 3) and bilateral trade costs (Proposition 4). It 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. We proxy the amount of bilateral trade between i and j by the strictly exogenous measure

$$\tilde{\omega}_{ijt} = \frac{POP_{it}^{\alpha_1} POP_{jt}^{\alpha_2}}{DIST_{ij}^{\delta}}, \tag{14}$$

where POP_{it} denotes population of country i, $DIST_{ij}$ is geographical distance;[18] α_1, α_2, and δ are parameters. $\tilde{\omega}_{ijt}$ varies with time as population changes.[19] Standard gravity predictions suggest that $\alpha_1 = \alpha_2 = 1$. In their meta analysis, Disdier and Head (2008) find that the mean elasticity of distance is about 0.9, with 90% of estimates lying between 0.28 and 1.55. Hence, we choose $\delta = 1$ as our benchmark case, but conduct robustness checks with respect to the

[18]Great circle distance between the two countries' most populated cities

[19]We have also worked with predicted bilateral trade volumes obtained by regressing observed bilateral trade on exogenous variables such as population, distance, and other typical covariates such as common language, contiguity, joint membership of countries in currency unions, free trade areas, and GATT/WTO. Results are qualitatively and quantitatively comparable.

assumptions on α_1, α_2, and δ.

We calculate $\tilde{\omega}_{ijt}$ for all 168 countries for which population and distance data are 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 $\sum_{j=1}^{168} \omega_{ijt} = 1$ for all 168 countries. Then, we construct the trade-weighted average of foreign unemployment rates, $u_{it}^* = \sum_{j=1}^{20} \omega_{ijt} u_{jt}$, 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 $b_{it}^* = \sum_{j=1}^{20} \omega_{ijt} b_{jt}$ (and similarly for all other labor market variables $\mathbf{LMR}_{it}$, denoted by $\mathbf{LMR}_{it}^*$), and the average foreign output gap as $GAP_{it}^* = \sum_{j=1}^{20} \omega_{ijt} GAP_{jt}$.[20]

With the exception of the real wage flexibility measure of Holden and Wulfsberg (2009), labor market and macro variables come from Bassanini and Duval (2006). This dataset reflects intensive efforts at the OECD to come up with harmonized measures. Unfortunately, it covers only 20 countries[21] for the years 1982 to 2003.[22] Data on geographical distance come from CEPII.[23] Population data is from the Penn World Tables mark 6.2. Table 1 provides summary statistics.

4.2 The role of domestic and foreign institutions

As a first step, we show that our data replicates the typical results found in the empirical literature. Column (1) in Table 2 shows the results of estimating (13) using OLS. The coefficient

[20] A natural alternative normalization would set the weights such that $\sum_{k \in K} \omega_{ikt} = 1$, where K is the set of our 20 OECD countries. 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.

[21] Australia (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).

[22] For larger country samples, data on unemployment rates and institutions are scarce and data lack comparability across time and space.

[23] www.cepii.fr/anglaisgraph/bdd/distances.htm.

Table 1: 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
$FLEX$	real wage flexibility (index)	0.413	0.351	-0.547	1.296
Union density	(percent)	29.763	20.654	8.200	83.863
High corporatism	(dummy)	0.554	0.498	0.000	1.000
EPL	employment protection legislation (index, 1-10)	2.080	1.082	0.200	4.188
PMR	product market regulation (index, 1-10)	3.864	1.290	1.050	6.000
$OPEN$	(percent)	59.149	30.731	12.223	166.353
u^*	$W \times u$	2.399	3.144	0.037	13.875
b^*	$W \times b$	18.182	23.394	0.269	89.783
$FLEX^*$	$W \times FLEX$	0.121	0.187	-0.009	1.024
Union density*	$W \times$Union density	12.426	15.974	0.180	71.088
High corporatism*	$W \times$High corporatism	0.176	0.245	0.001	1.096
EPL^*	$W \times EPL$	0.657	0.882	0.009	4.252
PMR^*	$W \times PMR$	1.230	1.679	0.011	8.181
$OPEN^*$	$W \times OPEN$	59.149	30.731	12.223	166.353
GAP	output gap (percent)	-1.019	2.538	-12.211	6.297
GAP^*	$W \times GAP$	-0.303	0.990	-5.803	2.699
POP	Population (in mio)	43.239	62.145	3.306	292.617
POP^*	$W \times POP$	10.524	12.285	0.140	52.803
k^*/k	$(W \times (K/L))/(K/L)$	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 are from Bassanini and Duval (2006), except $FLEX$ which is from Holden and Wulfsberg (2009) and the weighting matrix W which comes from own calculations. 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).

on the tax wedge b, our key labor market variable of interest, implies that a 20 percentage point increase in b (approximately equal to one standard deviation of b in the data) increases the equilibrium rate of unemployment by about 1.8 percentage points, confirming parts of Proposition 2. Also the degree of real wage flexibility ($FLEX$) is strongly correlated with unemployment. An increase in the flexibility index by one standard deviation (0.35) lowers unemployment by about 1.4 percentage points. Union density, employment protection legislation (EPL), and the degree of corporatism do not have any measurable influence on equilibrium unemployment. This is a standard finding; see Bassanini and Duval (2006) and the references therein. Finally, the output gap (GAP) is an important determinant of the unemployment rate. Note that country effects, year effects, the output gap, and macroeconomic shocks alone explain about 87 percent of the total variation (adjusted R^2) of unemployment rates in our sample (not shown). Hence, time-variation in labor market institutions has a limited role in explaining variance in unemployment rates.

Next, we study the effect of trade openness on the rate of unemployment. Proposition 1, derived from our model, suggests a negative relation. Column (2) in Table 2 therefore introduces $OPEN$ into the regression. It also introduces the OECD index of product market regulation which strongly correlates (negatively) with $OPEN$ but accounts for domestic product market distortions as well as for foreign entry regulation. $OPEN$ turns out statistically significant and with a negative sign. The estimate of -0.046 implies that a one standard deviation increase in $OPEN$ (30.7) lowers the structural rate of unemployment by about 1.4 percentage points. Recent empirical literature discusses the potential endogeneity of $OPEN$ in unemployment regressions.[24] This literature does not find evidence that OLS overestimates the true causal effect of $OPEN$. They also come up with point estimates that very much resemble the one found in column (2). However, in the remainder of this paper we still choose to instrument $OPEN$. For this purpose, column (3) uses the fifth to tenth lags of $OPEN$ as well as similarly lagged first differences as instruments. The Sargan score test is insignificant, so that the IV strategy appears valid. The Durbin-Wu-Hausman test on exogeneity rejects that $OPEN$ can be treated as an exogenous variable, but only at a very marginal level of significance.[25]

[24] See Dutt, Mitra, and Ranjan (2009).

[25] Instrumentation of openness has very little effect on the estimates of λ, our parameter of interest. Results of

The next regressions analyze the direct effect of foreign labor market institutions on the domestic rate of unemployment in order to check Proposition 2. We estimate an equation of the form:

$$u_{it} = \boldsymbol{\lambda}\cdot\mathbf{LMR}_{it} + \boldsymbol{\lambda}^{*}\cdot\mathbf{LMR}^{*}_{i,t} + \pi\cdot PMR_{it} + \delta\cdot OPEN_{it} + \gamma_1\cdot GAP_{it} + \gamma_2\cdot GAP^{*}_{it} + F_i + T_t + \mathbf{S}_{it} + \varepsilon_{it}, \tag{15}$$

where $\mathbf{LMR}^{*}_{it}$ collects foreign labor market variables and GAP^{*}_{it} is the foreign output gap.

Column (4) in Table 2 shows the most parsimonious specification, where we include only the domestic and the foreign tax wedges (b, b^{*}) 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: a marginal increase in the domestic wedge has an effect about 9 times as large as a marginal increase in the foreign wedge. A one-standard-deviation increase in the domestic or foreign wedge adds about 1.5 (0.081×18.21) or 0.2 (0.009×23.39) percentage points to the equilibrium unemployment rate, respectively. This confirms Proposition 2.

Column (5) adds $OPEN$ (instrumented as above) and the OECD measure of product market regulation. These additional variables show up with the expected signs and increase the adjusted R^2 by about one percentage point. Qualitatively, the unemployment increasing effects of the domestic and foreign wedges are unaffected by this, but the relative importance of foreign institutions grows. This may be an indication that product markets matter for the transmission of foreign institutions.

Columns (6) and (7) add more domestic and foreign labor market institutions to the regression. Not surprisingly, adding variables for which the direct effect on Home unemployment is already inconclusive (union density or EPL), does not improve accuracy of estimation. The coefficients on b^{*} become insignificant, others seem implausibly large (see the coefficient on EPL^{*} for the most striking case). Hence, the lack of a robust relationship between these variables in standard equations such as (13) also impairs inference when using their spatial lags. Moreover,

OLS regressions are available upon request.

Table 2: The role of foreign labor market institutions

Dep.var.: level of unemployment rate	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	OLS	OLS	IV	OLS	IV	IV	IV	IV
b	0.093^a	0.075^a	0.071^a	0.081^a	0.059^a	0.053^a	0.063^a	0.050^a
	(0.019)	(0.017)	(0.017)	(0.017)	(0.014)	(0.017)	(0.016)	(0.016)
b^*				0.009^a	0.016^a	0.006	0.015^a	0.021^a
				(0.003)	(0.003)	(0.040)	(0.003)	(0.004)
$b^* \times k^*/k$								0.009^a
								(0.003)
k^*/k								-1.062^a
								(0.224)
$OPEN$		-0.046^a	-0.059^a		-0.082^a	-0.075^a	-0.060^a	-0.071^a
		(0.015)	(0.017)		(0.016)	(0.019)	(0.015)	(0.017)
PMR		0.499	0.497		0.633^a	0.784^b	0.632^c	0.589
		(0.384)	(0.357)		(0.154)	(0.385)	(0.364)	(0.372)
$FLEX$	-4.019^a	-1.217	-1.140			-0.910	-1.445	-1.992
	(1.037)	(2.073)	(1.936)			(2.175)	(2.038)	(2.082)
$FLEX^*$						-0.469		
						(0.451)		
Union density	-0.035	-0.023	-0.026			-0.039	-0.037	-0.052^c
	(0.024)	(0.026)	(0.025)			(0.027)	(0.026)	(0.028)
*Union density**						0.095^a		
						(0.036)		
High corporatism	-0.459	-0.952	-0.862			-0.643	-0.548	-0.224
	(0.497)	(0.759)	(0.715)			(0.798)	(0.753)	(0.785)
*High corporatism**						0.413		
						(2.017)		
EPL	-0.564	-0.431	-0.453			-0.955^b	-0.861^b	-1.077^b
	(0.387)	(0.412)	(0.388)			(0.430)	(0.426)	(0.437)
EPL^*						-1.558^b		
						(0.762)		
GAP	-0.693^a	-0.655^a	-0.658^a	-0.613^a	-0.626^a	-0.659^a	-0.667^a	-0.697^a
	(0.048)	(0.053)	(0.050)	(0.044)	(0.035)	(0.051)	(0.050)	(0.049)
GAP^*				-0.021	-0.028	0.042	-0.013	0.012
				(0.070)	(0.072)	(0.076)	(0.074)	(0.075)
2nd stage statistics								
RMSE	1.136	1.112	1.032	1.191	1.041	1.010	1.013	0.990
adj. R^2	0.930	0.933	0.933	0.923	0.932	0.934	0.935	0.937
F/χ^2	160.4	160.9	10386	139.5	11345	13028	11328	10574
1st stage statistics								
partial R^2			0.646		0.661	0.578	0.903	0.613
χ^2-overidentification			0.665		0.821	0.813	0.104	0.239
χ^2-endogeneity			0.120		0.042	0.047	0.504	0.032

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, TOT, real interest rate, and labor demand shocks) as additional controls for business cycle comovements. Openness is instrumented by its 5th to 10th time lags. Trade-weighted averages for foreign variables (denoted by asterisks) are computed using $\alpha_1 = \alpha_2 = 1$, and $\delta = 1$.

b^* correlates strongly with other measures of foreign labor market institutions. Hence, in column (7), we drop the spatial lags of LMR except for the labor market wedge. This restores the significance of the latter.

Finally, column (8) includes the ratio of capital intensities $(K^*/L^*)/(K/L) = k^*/k$ and the interaction term $u^* \times k^*/k$.[26] This is motivated by the prediction of the Heckscher-Ohlin framework where higher unemployment benefits in the capital-rich home country increase unemployment there but reduce it in the labor-abundant foreign country, and vice versa. This is, however, not what we observe in the data, where an increase in b^* drives up domestic unemployment by more when the domestic economy appears relatively capital-poor. While not offering a conclusive test, our results suggest that empirical support for the comparative advantage view is probably weak.[27]

4.3 The role of country size, openness, and real wage rigidity

Table 3 sheds additional light on the channels through which foreign institutions affect domestic unemployment, thereby bringing Propositions 3 to 5 to an empirical validation. Note that all regressions contain macroeconomic variables (the domestic and the foreign output gaps and our four macro shock variables), year dummies and country dummies (not shown). They may also contain additional labour market controls (not shown), indicated by "yes".

The role of country size (Proposition 3). First, we discuss the interaction between country size and labor market frictions. We measure country size by population, just as in our theoretical analysis. This variable has the advantage that it is exogenous. The logic is that the larger the domestic economy is, the more it should be affected by more severe frictions in the Home labor market and the less by foreign ones. Conversely, the larger the foreign economy is (weighted

[26] Capital 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 $PMR^*_{i,t-1}$. See Dutt, Mitra, and Ranjan (2009) for a related empirical strategy.

[27] Note that Dutt, Mitra and Ranjan (2009) have not found any effect of comparative advantage motives in the determination of unemployment rates in a large cross-section of countries. Also note that the standard deviation of k^*/k relative to its mean 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.

by bilateral trade potentials), the more strongly should foreign labor market frictions increase the domestic unemployment rate while domestic labor market frictions 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 positive, negative, negative and positive, respectively. Column (1) in Table 3 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 (2)) does not alter the sign of significant coefficients or their magnitudes and only partially improves statistical accuracy. Column (3) focuses on statistically significant effects only. In line with our theory, frictions are more harmful when they have their origins in large countries. Interestingly, the direct effect of own and foreign frictions is now negative. There is also fairly strong evidence that – everything else equal – large countries have smaller unemployment rates. Notice that all regressions contain our openness measure instrumented using its fifth to tenth time lags.

The role of openness (Proposition 4). Second, we address Proposition 4 which predicts a link between countries' openness and the strength of institutional spillovers. In our empirical exercise, we need to adopt a broader perspective, since in reality trade costs may be political as well as geographical. Hence, we take the product of domestic and foreign openness measures, $z = OPEN^* \times OPEN$ as an indicator of mutual market access. If this term is high, domestic firms have easy access to foreign markets ($OPEN^*$ high) and foreign firms have easy access to the domestic market ($OPEN$ high). Then, domestic labor market frictions are easy to offload to foreign countries while foreign labor market frictions are more likely to contribute to domestic unemployment. We therefore expect that the interaction term $z \times b$ has a negative sign and the interaction term $z \times b^*$ has a positive sign. Column (4) in Table 3 confirms these expectations in a very parsimonious model and finds exactly this sign pattern with satisfactory degrees of statistical accuracy. The results imply that b^* affects domestic unemployment only if z is positive. This is again in line with our theory where there are no spillovers without international trade. At the average level of $OPEN^* \times OPEN$ (1.15), the effect of the foreign wedge is quite comparable to the one estimated in earlier tables. It takes an increase in the openness measure of about two standard deviations beyond the mean for the country to totally offload the effect of b onto

Table 3: Unemployment spillovers: the role of country size, openness, and real wage flexibility

Dep.var.: level of unemployment rate	$z = ln(POP)$			z =OPEN× openness*			$z = pmr$			z =FLEX		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
	IV	IV	IV	OLS	IV	OLS	OLS	OLS	OLS	OLS	OLS	IV
b	-0.162	-0.277^b	-0.406^a	0.093^a	0.091^a	0.116^a	0.058^c	0.042	0.099^a	0.110^a	0.104^a	0.082^a
	(0.136)	(0.136)	(0.124)	(0.016)	(0.017)	(0.019)	(0.031)	(0.028)	(0.020)	(0.018)	(0.021)	(0.017)
b^*	-0.223	-0.170	-0.332^c	-0.012	-0.000	-0.114^a	0.028	0.041^b	0.005	0.015^a	0.016^a	0.025^a
	(0.190)	(0.181)	(0.189)	(0.008)	(0.011)	(0.034)	(0.020)	(0.020)	(0.018)	(0.005)	(0.005)	(0.006)
Interaction terms												
$z \times b$	34.012^a	40.885^a	49.120^a	-0.022^a	-0.014^b	-0.020^a	0.006	0.010^b				
	(13.050)	(12.805)	(12.639)	(0.004)	(0.006)	(0.006)	(0.005)	(0.004)				
$z \times b^*$	-1.239	0.773		0.012^a	0.011^a	0.021^a	-0.014^a	-0.008^c		-0.024^c	-0.026^b	-0.009
	(5.657)	(5.981)		(0.003)	(0.003)	(0.005)	(0.005)	(0.004)		(0.013)	(0.013)	(0.012)
$z^* \times b$	-10.548^b	-7.857					-0.001		-0.004	-0.081^a	-0.073^a	-0.071^a
	(4.928)	(4.991)					(0.003)		(0.003)	(0.025)	(0.025)	(0.025)
$z^* \times b^*$	25.214	16.607	32.436^c				0.017^a		0.012^b			
	(18.636)	(17.993)	(18.461)				(0.007)		(0.006)			
Controls												
$ln(POP)$	-12.603^a	-14.044^a	-17.780^a			-18.256^a	-17.798^a	-19.496^a	-19.131^a			-12.923^a
	(4.601)	(4.808)	(4.619)			(4.995)	(4.835)	(4.765)	(4.856)			(4.653)
$ln(POP^*)$	0.305	0.202	-0.167			0.113	-0.050	-0.298^c	0.060			-0.153
	(0.247)	(0.253)	(0.128)			(0.165)	(0.184)	(0.164)	(0.180)			(0.139)
PMR		0.838^b	0.917^b			0.621	0.511	0.216	0.729^c			
		(0.370)	(0.363)			(0.392)	(0.507)	(0.479)	(0.395)			
PMR^*		0.293	0.439^b			1.159^a	-0.395	0.370	-0.557			
		(0.214)	(0.198)			(0.370)	(0.436)	(0.285)	(0.417)			
$FLEX$		-0.527	-0.002			-0.308	-1.357	-1.322	-0.361	-2.626^a	-3.346^b	-3.915^a
		(1.968)	(1.958)			(1.993)	(2.106)	(2.116)	(2.082)	(1.010)	(1.392)	(1.166)
$FLEX^*$			-0.886^c			-2.209^a	-0.780	-0.657	-0.968^c	5.851^a	5.381^b	4.769^b
			(0.519)			(0.574)	(0.532)	(0.543)	(0.524)	(2.115)	(2.078)	(2.140)
$OPEN^{\#}$	-0.073^a	-0.085^a	-0.075^a	1.090^b	0.379	0.951						-0.057^a
	(0.016)	(0.017)	(0.019)	(0.430)	(0.568)	(0.499)						(0.015)
LMR	yes	yes	yes			yes	yes	yes	yes		yes	yes
F/χ^2	11314	12768	13103	155.1	9743	164.4	149.8	147.8	160.0	176.1	166.3	13649
RMSE	1.004	0.975	0.975	1.137	1.052	1.077	1.084	1.093	1.097	1.129	1.121	0.986
adj. R^2	0.935	0.938	0.939	0.930	0.930	0.937	0.936	0.935	0.935	0.931	0.932	0.937

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 regressions contain the domestic and the foreign output gap, a full set of country fixed-effects, year dummies, and an array of orthogonal shocks (TFP, TOT, 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 $\alpha_1 = \alpha_2 = 1$, and $\delta = 1$. In IV regressions, openness measures are instrumented by their fifth to tenth lags. LMR "yes" indicates that union density, high corporatism, and EPL are used as additional controls.
$^{\#}OPEN^* \times OPEN$ in columns (4) to (6).

foreign countries. Column (5) instruments $OPEN^* \times OPEN$ and the interaction terms using time lags. The sign pattern remains intact, but the coefficient of $z \times b$ is reduced by about a third. Column (6) adds a large array of controls rather than applying IV estimation. The sign pattern remains unchanged and parameters remain significant.

An alternative measure of openness commonly employed is product market regulation. The measure of domestic entry regulation (PMR) provided by the OECD strongly correlates with other openness measures (e.g., the share of trade over GDP), but has the advantage that it is unrelated to geography and size. Hence, we next discuss the interaction between entry regulation and the wage wedge as an alternative to the openness measure. The analysis is motivated by the following considerations. If domestic entry regulation is strong, interactions with foreign countries should be weak. In other words, we would expect that the interaction $PMR \times b$ has a positive sign and the interaction $PMR \times b^*$ a negative one. If foreign regulation 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 frictions since the foreign economy plays a smaller role for domestic firms. Therefore, the coefficient on $PMR^* \times b^*$ should be negative. Column (7) in Table 3 tests these predictions in a model with all four potential interaction terms. Interaction terms with domestic regulation come out with the right sign while those for foreign regulation do not. Column (8) focuses on domestic regulation and the respective interaction terms. They are statistically significant and show up with the right signs: for a more closed economy the domestic institutions are more important and the foreign ones less. This is in line with our theory. Column (9) concentrates on foreign regulation. Interestingly, the more closed the foreign economy is the stronger are the domestic unemployment-creating effects of foreign labor market frictions.

The role of real wage flexibility (Proposition 5). Our theoretical model suggests that foreign labor market institutions should affect domestic unemployment more when domestic real wages are rigid (see Proposition 5). Hence, we interact the Holden-Wulfsberg measure of real wage flexibility $FLEX$ with the foreign wage wedge b^* and expect a negative sign. Similarly, the interaction of $FLEX^*$ with the domestic wage wedge b should also result in a negative effect:

when real wages are flexible, spillovers caused by institutions are smaller. These expectations are confirmed by the data, see columns (10) to (12) in Table 3. The results imply that, when domestic wages are more flexible by one standard deviation (0.35), the effect of the foreign wedge on domestic unemployment is more than halved. While column (10) uses a parsimonious model, column (11) adds a host of labor market controls (not shown), and column (12) additional controls for multilateral openness (instrumented) and country size. While the quantitative results fluctuate somewhat, the sign pattern is preserved.

4.4 Indirect evidence on labor market spillovers

As an alternative way to analyze cross-country labor market spillovers, we capture institutional spillovers indirectly by including the trade-weighted average foreign unemployment rate u^*_{it} on the right hand side of our regressions. This strategy does not make foreign institutions explicit. However, since we are controlling for cyclical determinants of unemployment, the structural component of u^*_{it} reflects foreign labor market institutions. We estimate the following model:

$$u_{it} = \rho u^*_{it} + \boldsymbol{\lambda} \cdot \mathbf{LMR}_{it} + \pi \cdot PMR_{it} + \delta \cdot OPEN_{it} + \gamma_1 \cdot GAP_{it} + \gamma_2 \cdot GAP^*_{it} + F_i + T_t + \mathbf{S}_{it} + \varepsilon_{it}, \quad (16)$$

where ρ is now the parameter of interest. We expect $\hat{\rho}$ to be positive. The domestic unemployment rate is not used in the calculation of u^*_{it}.

If shocks to the unemployment rate exhibit correlation between countries, then estimation of (16) via OLS would yield a biased value for ρ. To avoid this *endogeneity bias*, we instrument u^*_{it} by the lagged foreign regulatory variables, $\mathbf{LMR}^*_{i,t-1}$ and $PMR^*_{i,t-1}$. The underlying assumption is that *past foreign* regulation (i) is exogenous to *domestic* contemporaneous labor market outcomes and that (ii) it has no effect on domestic unemployment other than through foreign unemployment. As usual, this identifying assumption cannot be formally tested. Exogeneity may be problematic if institutions are sticky and domestic unemployment determines foreign unemployment which in turn affects labor market policies in the foreign country. Similarly, labor market reforms may be spatially correlated across countries. The exclusion restriction could also be violated; however, when one adds foreign institutions to (16) instead of using them as instruments, they remain non-significant while the spatial lag of unemployment retains its positive and statistically significant effect.

Table 4 presents the results. Due to possible issues concerning the instruments, we regard the regressions as robustness checks. Comfortingly, none of the results depends on whether or not the spatial lag of unemployment is instrumented. Column (1) ignores the potential endogeneity of u^* and includes regressors similar to the ones used in Table 2. The coefficient on u^* is positive and statistically significant at the 1% level. It implies that a one-standard-deviation increase in foreign unemployment (3.144) increases domestic unemployment by 0.431 percent (or 0.1 times one-standard-deviation of the domestic unemployment rate). The estimated coefficients of other regressors resemble qualitatively and quantitatively those obtained in Table 2.

Column (2) turns to IV estimation to account for the possible endogeneity of lagged unemployment and openness. The 1st stage statistics signal that the IV strategy works: the overidentification test is easily passed, the partial R^2s associated to both endogenous variables $(u^*, OPEN)$ are above 50%. Quantitatively, the IV results replicate our findings in column (1). Columns (3) and (4) propose more parsimonious models. Omitting labor market controls lowers the measured amount of spillovers; additionally omitting the openness index reduces $\hat{\rho}$ even further. However, the sign and statistical significance are preserved, thereby indirectly confirming Proposition 2.

Relative size. Column (5) adds the interaction term $u^* \times POP/POP^*$. Proposition 3 suggests that a higher relative domestic market size lowers the size of spillovers. The estimated coefficient on the interaction is indeed negative. If the domestic and the foreign markets are of equal size, the partial derivative of u with respect to u^* is about 0.059, somewhat smaller but still comparable to the coefficients $\hat{\rho}$ obtained before.

Openness. Column (6) interacts u^* with $OPEN \times OPEN^*$, paralleling the procedure in columns (4) to (6) in Table 3. As suggested by our theoretical model (Proposition 4), the coefficient on the interaction is positive and estimated with good precision: higher openness increases spillovers. We find that the foreign unemployment rate ceases to matter when $OPEN$ approaches zero. With average openness measures, the effect returns to the magnitude reported in columns (2) to (4).

Table 4: The spatial lag of unemployment

Dep.var.: level of unemployment rate	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	OLS	IV	IV	IV	IV	IV	IV	IV
Interaction with					$z=\frac{POP}{POP^*}$	$z=OPEN$	$z=FLEX$	$z=\frac{k^*}{k}$
u^*	0.137^a	0.177^a	0.148^a	0.073^b	0.081^b	-0.018	0.168^a	0.227^a
	(0.030)	(0.043)	(0.035)	(0.029)	(0.035)	(0.067)	(0.051)	(0.041)
$u^* \times z$					-0.022^b	0.110^a	-0.144^b	0.050
					(0.011)	(0.037)	(0.066)	(0.084)
z					0.0001	-0.616^a	-5.000^a	-0.982^b
					(0.0201)	(0.212)	(1.740)	(0.438)
$OPEN$	-0.059^a	-0.087^a	-0.079^a					-0.081^a
	(0.015)	(0.018)	(0.017)					(0.018)
PMR	0.648*	0.633^c	0.318	-0.044	0.634^c	0.599	-0.085	0.644^c
	(0.390)	(0.362)	(0.242)	(0.268)	(0.372)	(0.385)	(0.266)	(0.378)
b	0.062^a	0.056^a	0.070^a	0.100^a	0.098^a	0.104^a	0.108^a	0.051^b
	(0.017)	(0.018)	(0.016)	(0.018)	(0.019)	(0.020)	(0.020)	(0.022)
$FLEX^{\#}$	-1.555	-1.940	-2.028^b	-4.293^a	-1.566	-1.303		-1.977
	(2.188)	(1.994)	(0.985)	(0.975)	(1.926)	(2.049)		(2.124)
Union density	-0.036	-0.052^b			-0.019	-0.030	-0.069^b	-0.058^c
	(0.028)	(0.026)			(0.027)	(0.026)	(0.027)	(0.033)
High corporatism	-0.530	-0.391			-1.283^c	-1.237^c	0.209	-0.418
	(0.810)	(0.768)			(0.721)	(0.747)	(0.619)	(0.805)
EPL	-0.862^c	-1.078^b			-0.483	-0.776^c	-1.049^a	-1.112^b
	(0.453)	(0.447)			(0.406)	(0.422)	(0.400)	(0.524)
GAP	-0.666^a	-0.666^a	-0.634^a	-0.654^a	-0.622^a	-0.651^a	-0.694^a	-0.669^a
	(0.054)	(0.048)	(0.036)	(0.039)	(0.053)	(0.051)	(0.055)	(0.050)
GAP^*	0.065	0.153^c	0.109	0.054	0.056	0.175^c	0.113	0.281
	(0.084)	(0.091)	(0.082)	(0.069)	(0.076)	(0.090)	(0.077)	(0.189)
2nd stage statistics								
RMSE	1.094	0.985	1.007	1.042	1.018	1.016	1.035	0.963
adj. R^2	0.935	0.938	0.936	0.932	0.934	0.934	0.932	0.941
F/χ^2	170.8	11460	11665	10115	10434	10526	12384	10747
1st stage statistics								
partial $R^2(a)$		0.577	0.621	0.621	0.623	0.718	0.443	0.447
partial $R^2(b)$		0.553	0.570	0.570	0.612	0.617	0.595	0.125
partial $R^2(c)$						0.670		0.307
χ^2−overidentification		0.918	0.765	0.655	0.483	0.573	0.000	0.503
χ^2−endogeneity		0.096	0.276	0.669	0.892	0.124	0.010	0.105

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, TOT, 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 $\alpha_1 = \alpha_2 = 1$, and $\delta = 1$. In IV regressions, the foreign unemployment rate u^* is instrumented by b^*_{t-1}, PMR^*_{t-1} and GAP^*_{t-1}. Openness is instrumented by its 5th to 10th time lags. 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).

$^{\#}$ corresponds to z in column (6).

Real wage flexibility. Next, we turn to the Holden and Wulfsberg (2009) measure of real wage flexibility. Interacting $FLEX$ with u^*, we expect that a higher degree of flexibility lowers the strength of the spillover. Confirming our earlier results, the data again validates Proposition 5.

Comparative advantage. Finally, column (8) includes the ratio of capital intensities $(K^*/L^*) / (K/L) = k^*/k$ and the interaction term $u^* \times k^*/k$. The strategy parallels the one applied in Table 2; results are similarly inconclusive. Based on the overall evidence, it seems safe to disregard the possibility that cross-country labor market spillovers are importantly shaped by comparative advantage forces.

4.5 Additional Robustness Checks

Sensitivity checks on model specification. We have conducted a number of robustness checks. Tables 5 and 6 in Appendix A7 provide the details. For example, in our model with the spatial lag of unemployment on the right-hand-side we use the log of unemployment $\ln u$ as the dependent variable, to account for the fact that unemployment rates are non-negative numbers. Using levels instead, we find qualitatively similar results. Sticking to our standard specification, we also experiment with contemporaneous rather than lagged instruments for endogenous variables and find that results do not change much. Including an EU dummy in order to capture similar institutional regulations and the specific synchronization of business cycles among EU members turns out to have little effects on our results. In the model that includes spatial lags of foreign institutions, specifying unemployment in logs or including a EU dummy does not alter results. In both models, we also work with three-year averages rather than with yearly data, in order to mean out business cycle effects not captured by our control variables. Identification is more difficult, but results are generally robust.

Alternative normalization strategies. Another set of robustness checks refers to the choice of normalization of weights. We 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 (14). First, the coefficient of the distance variable in the computation of the weights is set 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. To facilitate comparison with our benchmark regressions, we compute standardized beta coefficients. The conclusion is that, qualitatively, these modifications have little effect on the estimates. We also modify the weights such that they close down the direct size effect: $\alpha_1 = \alpha_2 = 0$. We find that taking out country size from the construction of the bilateral weights slightly reduces the estimated effects. Finally, we use the alternative normalization by $\max_i (\omega_{ijt})$, for each year t and country j. Alternatively, weights are normalized such that they 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.

5 Conclusions

How do institutional labor market reforms affect countries at home and abroad? Are trading partners affected positively or negatively from a labor market reform leading to higher unemployment at home? We propose an asymmetric two-country single-sector trade model of the Armington type with search frictions on the labor market to address this question. We use this very simple and analytically tractable framework to generate testable empirical predictions concerning international spillover effects of labor market institutions. We show how country size, geography and real wage rigidities shape those spillovers.

In the employed model, labor market institutions that are prone to increase unemployment in Home also yield higher unemployment in Foreign. The relative strength of this positive link is greater the larger Home's labor force is relative to Foreign's. Further, the spillover effects are stronger if trade costs are smaller. In contrast, a higher degree of real wage flexibility turns out to weaken the spillover effects.

These results operate through a terms of trade effect. When Home's unemployment rate increases, the relative supply of its good falls while–with homothetic preferences–relative demand remains unchanged. So, Home's terms of trade improve and Foreign's deteriorate. The latter effect lowers incentives of firms in Foreign to create vacancies and the equilibrium unemployment rate there goes up. One can also view the mechanism as an income effect: when Home's income falls (due to higher unemployment), so must its spending on foreign goods. This hurts Foreign.

In order to measure the empirical importance of spillovers, 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. Carefully controlling for business cycle comovements by including domestic and foreign output gaps, an array of exogenous shocks and time dummies, we find that more severe foreign labor market frictions increase unemployment also in the domestic economy. 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. Larger economies can spillover more of the effects, while flexible wages imply lower unemployment movements. On average, our results suggest that the effect of foreign institutions on domestic unemployment is about 10% of the effect of domestic institutions.

Hence, our empirical results confirm the qualitative predictions of our theoretical model that country size, geography, as well as real wage rigidities condition the spillovers as suggested by our theory. From a policy perspective we may conclude that, in contrast to Davis (1998), workers in all countries should be concerned when labor market reforms threaten job perspectives.

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Appendix

A1 Slopes of relative demand and relative supply

$$
\begin{aligned}
RS(\pi, .) &= \lambda B^{-\frac{(1-\mu)}{\mu}} \left[\frac{1+(\pi/\tau)^{\sigma-1}}{1+(\pi\tau)^{1-\sigma}}\right]^{\frac{1-\mu}{\mu(\sigma-1)}}, \qquad \text{(A1)}\\
&= \lambda B^{-\frac{(1-\mu)}{\mu}} G(\pi)^{\frac{1-\mu}{\mu(\sigma-1)}},
\end{aligned}
$$

where $G(\pi) := \left[1+(\pi/\tau)^{\sigma-1}\right] / \left[1+(\pi\tau)^{1-\sigma}\right]$. The elasticity of relative supply with respect to π is

$$
\frac{RS_\pi \pi}{RS} = \frac{1-\mu}{\mu(\sigma-1)} \frac{G_\pi \pi}{G} > 0, \qquad \text{(A2)}
$$

where the sign follows from $\sigma > 1$ and

$$
\frac{G_\pi \pi}{G} = (\sigma-1)\left(\frac{(\pi/\tau)^{\sigma-1}}{1+(\pi/\tau)^{\sigma-1}} + \frac{(\pi\tau)^{1-\sigma}}{1+(\pi\tau)^{1-\sigma}}\right) > 0. \qquad \text{(A3)}
$$

Hence, the relative supply is increasing in π.

$$
\begin{aligned}
RD(\pi, .) &= \pi^{1-2\sigma} \frac{1+(\pi/\tau)^{\sigma-1}}{1+(\pi\tau)^{1-\sigma}}\\
&= \pi^{1-2\sigma} G(\pi).
\end{aligned}
$$

The elasticity of relative demand with respect to π is

$$
\begin{aligned}
\frac{RD_\pi \pi}{RD} &= 1-2\sigma + (\sigma-1)\left(\frac{(\pi/\tau)^{\sigma-1}}{1+(\pi/\tau)^{\sigma-1}} + \frac{(\pi\tau)^{1-\sigma}}{1+(\pi\tau)^{1-\sigma}}\right)\\
&= -(\sigma-1) + (\sigma-1)\left(\frac{(\pi/\tau)^{\sigma-1}}{1+(\pi/\tau)^{\sigma-1}} + \frac{(\pi\tau)^{1-\sigma}}{1+(\pi\tau)^{1-\sigma}}\right) - \sigma\\
&= -(\sigma-1)\left(1 - \frac{(\pi/\tau)^{\sigma-1}}{1+(\pi/\tau)^{\sigma-1}} - \frac{(\pi\tau)^{1-\sigma}}{1+(\pi\tau)^{1-\sigma}}\right) - \sigma < 0,
\end{aligned}
$$

since

$$1-\frac{(\pi/\tau)^{\sigma-1}}{1+(\pi/\tau)^{\sigma-1}}-\frac{(\pi\tau)^{1-\sigma}}{1+(\pi\tau)^{1-\sigma}}=\frac{1-\tau^{-2(\sigma-1)}}{\left(1+(\pi/\tau)^{\sigma-1}\right)\left(1+(\pi\tau)^{1-\sigma}\right)}\geq 0.$$

Note that the above expression is exactly zero when $\tau=1$ in which case we have

$$\left.\frac{RD_{\pi}\pi}{RD}\right|_{\tau=1}=-\sigma,$$

which is standard in the CES demand system.

A2 Proof of Proposition 1: Trade liberalization and unemployment

A2.1 The effect of trade costs on terms of trade

In the following, we use the goods market equilibrium condition $RS(\pi)=RD(\pi)$ and rewrite it as

$$\mathcal{L}\equiv\lambda B^{\frac{\mu-1}{\mu}}\mathcal{K}^{\frac{1-\mu}{\mu(\sigma-1)}}\pi^{\sigma}\mathcal{J}=1, \tag{A4}$$

where $\mathcal{K}\equiv\left[\frac{1+(\pi/\tau)^{\sigma-1}}{1+(\pi\tau)^{1-\sigma}}\right]$ and $\mathcal{J}\equiv\frac{\tau^{1-\sigma}+\pi^{\sigma-1}}{1+\tau^{1-\sigma}\pi^{\sigma-1}}$. Using the implicit function theorem, we derive the elasticity of terms of trade π with respect to trade costs τ

$$\frac{\partial\pi}{\partial\tau}\frac{\tau}{\pi}=-\frac{\frac{\partial\mathcal{L}}{\partial\tau}}{\frac{\partial\mathcal{L}}{\partial\pi}}\frac{\tau}{\pi}=-\frac{(\tau/\mathcal{L})\,\partial\mathcal{L}/\partial\tau}{\frac{1-\mu}{\mu(\sigma-1)}\varepsilon_{\mathcal{K},\pi}+\sigma+\varepsilon_{\mathcal{J},\pi}}.$$

One can show that

$$\frac{\partial\mathcal{L}}{\partial\tau}=\left(\frac{1-\mu}{\mu(\sigma-1)}\right)\frac{\mathcal{L}}{\mathcal{K}}\left(\frac{(1-\sigma)\pi^{\sigma-1}\tau^{-\sigma}\left(1+(\pi\tau)^{1-\sigma}\right)-\left(1+(\pi/\tau)^{\sigma-1}\right)(1-\sigma)\tau^{-\sigma}\pi^{1-\sigma}}{\left(1+(\pi\tau)^{1-\sigma}\right)^{2}}\right)$$
$$+\frac{\mathcal{L}}{\mathcal{J}}\frac{(1-\sigma)\,\tau^{-\sigma}\left(1+\tau^{1-\sigma}\pi^{\sigma-1}\right)-\left(\tau^{1-\sigma}+\pi^{\sigma-1}\right)(1-\sigma)\,\tau^{-\sigma}\pi^{\sigma-1}}{\left(1+\tau^{1-\sigma}\pi^{\sigma-1}\right)^{2}}.$$

$$\frac{\partial \mathcal{L}}{\partial \tau} = \left(\frac{1-\mu}{\mu(\sigma-1)}\right)(1-\sigma)\tau^{-\sigma}\frac{\mathcal{L}}{\mathcal{K}}\left(\frac{\pi^{\sigma-1}\left(1+(\pi\tau)^{1-\sigma}\right)-\left(1+(\pi/\tau)^{\sigma-1}\right)\pi^{1-\sigma}}{\left(1+(\pi\tau)^{1-\sigma}\right)^2}\right)$$
$$+(1-\sigma)\tau^{-\sigma}\frac{\mathcal{L}}{\mathcal{J}}\frac{\left(1+\tau^{1-\sigma}\pi^{\sigma-1}\right)-\left(\tau^{1-\sigma}+\pi^{\sigma-1}\right)\pi^{\sigma-1}}{\left(1+\tau^{1-\sigma}\pi^{\sigma-1}\right)^2}.$$

$$\left.\frac{\partial \mathcal{L}}{\partial \tau}\right|_{\pi=1} = \left(\frac{1-\mu}{\mu(\sigma-1)}\right)(1-\sigma)\tau^{-\sigma}\frac{\mathcal{L}}{\mathcal{K}}\left(\frac{1+\tau^{1-\sigma}-1-\tau^{1-\sigma}}{(1+\tau^{1-\sigma})^2}\right)$$
$$+(1-\sigma)\tau^{-\sigma}\frac{\mathcal{L}}{\mathcal{J}}\left(\frac{1+\tau^{1-\sigma}-\tau^{1-\sigma}-1}{(1+\tau^{1-\sigma})^2}\right)=0,$$

which implies that $\partial\pi/\partial\tau = 0$.

In the more general case where $\pi \neq 1$ it holds that $\tau G_\tau/G \gtrless 0$ if $\pi \lesseqgtr 1$. Then, relative demand shifts by $\tau G_\tau/G$, while relative supply shifts by $(1-\mu)/(\mu(\sigma-1))(\tau G_\tau/G)$. If countries are asymmetric so that $\pi > 1$ in the initial equilibrium (e.g., because Home is smaller than Foreign, $\lambda < 1$) and if $\sigma > 1/\mu$, it follows that relative demand increases more than relative supply due to a decrease of τ. In order to establish a new equilibrium, π has to increase, as relative demand is decreasing and relative supply increasing in π. This leads to a higher tightness and lower unemployment at Home, reinforcing the direct increasing effect on labor market tightness of a fall in τ. The terms of trade worsen for Foreign, mitigating the direct positive effect of lower trade costs on unemployment.

A2.2 The effects of trade liberalization on unemployment

Using equation (7), the effect of trade liberalization can be determined as:

$$\varepsilon_{\theta_H,\tau} = \frac{\partial\theta_H}{\partial\tau}\frac{\tau}{\theta_H} = \frac{1}{\mu}\frac{(\pi/\tau)^{\sigma-1}}{1+(\pi/\tau)^{\sigma-1}}\left[\varepsilon_{\pi,\tau}-1\right].$$

As just shown, under symmetry $\varepsilon_{\pi,\tau} = 0$, so that the equation simplifies to:

$$\varepsilon_{\theta_H,\tau} = -\frac{1}{\mu}\frac{(\pi/\tau)^{\sigma-1}}{1+(\pi/\tau)^{\sigma-1}} < 0.$$

Similarly, using equation (8), the effect of trade liberalization can be determined as:

$$\varepsilon_{\theta_F,\tau} = \frac{\partial \theta_F}{\partial \tau}\frac{\tau}{\theta_F} = -\frac{1}{\mu}\frac{(\pi\tau)^{1-\sigma}}{1+(\pi\tau)^{1-\sigma}}\left[\varepsilon_{\pi,\tau}+1\right].$$

Using again $\varepsilon_{\pi,\tau} = 0$ holding under symmetry, we end up with:

$$\varepsilon_{\theta_F,\tau} = -\frac{1}{\mu}\frac{(\pi\tau)^{1-\sigma}}{1+(\pi\tau)^{1-\sigma}} < 0.$$

A3 Proof of Proposition 2: Institutional spillovers

A3.1 The effect of institutions on terms of trade

Using (A4) and the implicit function theorem, we derive

$$\varepsilon_{\pi,B} = \frac{(1-\mu)/\mu}{\frac{1-\mu}{\mu(\sigma-1)}\varepsilon_{\mathcal{K},\pi}+\sigma+\varepsilon_{\mathcal{J},\pi}} > 0,$$

where $\varepsilon_{\pi,B} \equiv \frac{\partial \pi}{\partial B}\frac{B}{\pi}$, $\varepsilon_{\mathcal{K},\pi} \equiv \frac{\partial \mathcal{K}}{\partial \pi}\frac{\pi}{\mathcal{K}}$, $\varepsilon_{\mathcal{J},\pi} \equiv \frac{\partial \mathcal{J}}{\partial \pi}\frac{\pi}{\mathcal{J}}$, with

$$\begin{aligned}
\varepsilon_{\mathcal{K},\pi} &= \pi\frac{(\sigma-1)\,\pi^{\sigma-2}\tau^{1-\sigma}(1+(\pi\tau)^{1-\sigma})+(\sigma-1)\pi^{-\sigma}\tau^{1-\sigma}(1+(\pi/\tau)^{\sigma-1})}{\left[1+(\pi\tau)^{1-\sigma}\right]}\frac{1}{1+(\pi/\tau)^{\sigma-1}} \\
&= (\sigma-1)\,\tau^{1-\sigma}\frac{\pi^{\sigma-1}+2\tau^{1-\sigma}+\pi^{1-\sigma}}{\left[1+(\pi\tau)^{1-\sigma}\right]\left[1+(\pi/\tau)^{\sigma-1}\right]} > 0.
\end{aligned}$$

$$\varepsilon_{\mathcal{J},\pi} = (\sigma-1)\frac{\left[1-\tau^{-2(\sigma-1)}\right]\pi^{\sigma-1}}{(1+\tau^{1-\sigma}\pi^{\sigma-1})\,(\tau^{1-\sigma}+\pi^{\sigma-1})} > 0$$

Hence, more severe labor market frictions in Home lead to a terms-of-trade increase in Home and decrease the terms-of-trade of Foreign.

A3.2 The effect of institutions on unemployment

The labor market effects of Home's institutions (in terms of elasticities) are given by:

$$
\begin{aligned}
\varepsilon_{\theta_H,B} &= -\frac{1}{\mu} + \varepsilon_{\theta_H,\pi}\varepsilon_{\pi,B} < 0, \\
\varepsilon_{\theta_F,B} &= \varepsilon_{\theta_F,\pi}\varepsilon_{\pi,B} < 0,
\end{aligned}
$$

with

$$
\begin{aligned}
\varepsilon_{\theta_H,\pi} &= \frac{1}{\mu}\frac{(\pi/\tau)^{\sigma-1}}{1+(\pi/\tau)^{\sigma-1}} > 0, \\
\varepsilon_{\theta_F,\pi} &= -\frac{1}{\mu}\frac{(\pi\tau)^{1-\sigma}}{1+(\pi\tau)^{1-\sigma}} < 0.
\end{aligned}
$$

Given that $\varepsilon_{\pi,B} > 0$ it is straight forward to see that $\varepsilon_{\theta_F,B} < 0$, i.e. a worsening of labor market institutions in Home increases unemployment in Foreign. For Home we have two counteracting effects, but it can be shown that the positive spillover effect cannot dominate the negative direct effect so that $\varepsilon_{\theta_H,B} < 0$. To see this more clearly, first substitute out the elasticities:

$$
\begin{aligned}
\frac{\partial\theta_H}{\partial B}\frac{B}{\theta_H} &= -\frac{1}{\mu} + \frac{1}{\mu}\frac{(\pi/\tau)^{\sigma-1}}{1+(\pi/\tau)^{\sigma-1}}\frac{(1-\mu)/\mu}{\frac{1-\mu}{\mu(\sigma-1)}\varepsilon_{\mathcal{K},\pi} + \sigma + \varepsilon_{\mathcal{J},\pi}} \\
&= -\frac{1}{\mu} + \frac{1}{\mu}\frac{1}{\frac{1+(\pi/\tau)^{\sigma-1}}{(\pi/\tau)^{\sigma-1}}}\frac{(1-\mu)/\mu}{\frac{1-\mu}{\mu(\sigma-1)}\varepsilon_{\mathcal{K},\pi} + \sigma + \varepsilon_{\mathcal{J},\pi}}.
\end{aligned}
$$

Now we show that the first term in denominator of the last term $\frac{1-\mu}{\mu(\sigma-1)}\varepsilon_{\mathcal{K},\pi}$ multiplied by $\frac{1+(\pi/\tau)^{\sigma-1}}{(\pi/\tau)^{\sigma-1}}$ is already larger than the last numerator ($(1-\mu)/\mu$). Since the remaining two terms are larger than zero, the whole term has to be smaller than one and thus the indirect effect cannot dominate. So let's pick the first term in the numerator $\frac{1-\mu}{\mu(\sigma-1)}\varepsilon_{\mathcal{K},\pi}$ and multiply with $\frac{1+(\pi/\tau)^{\sigma-1}}{(\pi/\tau)^{\sigma-1}}$:

$$
\frac{1-\mu}{\mu(\sigma-1)}\varepsilon_{\mathcal{K},\pi}\frac{1+(\pi/\tau)^{\sigma-1}}{(\pi/\tau)^{\sigma-1}}.
$$

Substituting out $\varepsilon_{\mathcal{K},\pi}$ this becomes:

$$
\frac{1-\mu}{\mu(\sigma-1)}\frac{1+(\pi\tau)^{1-\sigma}}{1+(\pi/\tau)^{\sigma-1}}\pi\frac{(\sigma-1)\pi^{\sigma-2}\tau^{1-\sigma}(1+(\pi\tau)^{1-\sigma}) + (\sigma-1)\pi^{-\sigma}\tau^{1-\sigma}(1+(\pi/\tau)^{\sigma-1})}{(1+(\pi\tau)^{1-\sigma})^2}\frac{1+(\pi/\tau)^{\sigma-1}}{(\pi/\tau)^{\sigma-1}}.
$$

Canceling $(\sigma-1), 1+(\pi/\tau)^{\sigma-1}, 1+(\pi\tau)^{1-\sigma}$ and multiplying by π yields

$$\frac{1-\mu}{\mu}\frac{\pi^{\sigma-1}\tau^{1-\sigma}(1+(\pi\tau)^{1-\sigma})+\pi^{1-\sigma}\tau^{1-\sigma}(1+(\pi/\tau)^{\sigma-1})}{(1+(\pi\tau)^{1-\sigma})\,(\pi/\tau)^{\sigma-1}}.$$

Canceling $\tau^{1-\sigma}$ yields

$$\begin{aligned}
&\frac{1-\mu}{\mu}\frac{\pi^{\sigma-1}(1+(\pi\tau)^{1-\sigma})+\pi^{1-\sigma}(1+(\pi/\tau)^{\sigma-1})}{(1+(\pi\tau)^{1-\sigma})\pi^{\sigma-1}}\\
=\;&\frac{1-\mu}{\mu}\left(1+\frac{\pi^{1-\sigma}(1+(\pi/\tau)^{\sigma-1})}{(1+(\pi\tau)^{1-\sigma})\pi^{\sigma-1}}\right)>\frac{1-\mu}{\mu}.
\end{aligned}$$

The term in brackets is obviously larger than 1 since all terms in the fraction are positive. Thus, the denominator in the first equation (including the premultiplier) is necessarily smaller than one.

A4 Proof of Proposition 3: Institutional spillovers and country size

A4.1 The effect of terms of trade on the elasticity $\varepsilon_{\pi,B}$

First we show that $\partial\varepsilon_{\mathcal{K},\pi}/\partial\pi|_{\pi=1}=\partial\varepsilon_{\mathcal{J},\pi}/\partial\pi|_{\pi=1}=0$ so that $\partial\varepsilon_{\pi,B}/\partial\pi|_{\pi=1}=0$, too, i.e., evaluated for symmetric countries, the elasticity $\varepsilon_{\pi,B}$ does not change with changes in π. This is convenient because we can concentrate on $\varepsilon_{\theta_H,\pi}$ and $\varepsilon_{\theta F,\pi}$. For convenience repeat the elasticities:

$$\begin{aligned}
\varepsilon_{\mathcal{K},\pi} &= (\sigma-1)\,\tau^{1-\sigma}\frac{\pi^{\sigma-1}+2\tau^{1-\sigma}+\pi^{1-\sigma}}{\left[1+(\pi\tau)^{1-\sigma}\right]\left[1+(\pi/\tau)^{\sigma-1}\right]},\\
\varepsilon_{\mathcal{J},\pi} &= (\sigma-1)\,\frac{\left[1-\tau^{-2(\sigma-1)}\right]\pi^{\sigma-1}}{(1+\tau^{1-\sigma}\pi^{\sigma-1})\,(\tau^{1-\sigma}+\pi^{\sigma-1})}.
\end{aligned}$$

Show that $\partial\varepsilon_{\mathcal{K},\pi}/\partial\pi|_{\pi=1}=0$

$$
\begin{aligned}
\partial\varepsilon_{\mathcal{K},\pi}/\partial\pi &= (\sigma-1)\,\tau^{1-\sigma}\Bigg[\frac{(\sigma-1)\left(\pi^{\sigma-2}-\pi^{-\sigma}\right)\left[1+(\pi\tau)^{1-\sigma}\right]\left[1+(\pi/\tau)^{\sigma-1}\right]}{\left[1+(\pi\tau)^{1-\sigma}\right]^{2}\left[1+(\pi/\tau)^{\sigma-1}\right]^{2}} \\
&\quad-\frac{(\sigma-1)\left(\pi^{\sigma-1}+2\tau^{1-\sigma}+\pi^{1-\sigma}\right)\left[\left[-\pi^{-\sigma}\tau^{1-\sigma}\right]\left[1+(\pi/\tau)^{\sigma-1}\right]\right]}{\left[1+(\pi\tau)^{1-\sigma}\right]^{2}\left[1+(\pi/\tau)^{\sigma-1}\right]^{2}} \\
&\quad-\frac{(\sigma-1)\left(\pi^{\sigma-1}+2\tau^{1-\sigma}+\pi^{1-\sigma}\right)\left[\left[1+(\pi\tau)^{1-\sigma}\right]\pi^{\sigma-2}\tau^{1-\sigma}\right]}{\left[1+(\pi\tau)^{1-\sigma}\right]^{2}\left[1+(\pi/\tau)^{\sigma-1}\right]^{2}}\Bigg] \\
&= (\sigma-1)\,\tau^{1-\sigma}\Bigg[(\sigma-1)\,\frac{\left(\pi^{\sigma-2}-\pi^{-\sigma}\right)\left[1+(\pi\tau)^{1-\sigma}\right]\left[1+(\pi/\tau)^{\sigma-1}\right]}{\left[1+(\pi\tau)^{1-\sigma}\right]^{2}\left[1+(\pi/\tau)^{\sigma-1}\right]^{2}} \\
&\quad-(\sigma-1)\,\frac{\left(\pi^{\sigma-1}+2\tau^{1-\sigma}+\pi^{1-\sigma}\right)\tau^{1-\sigma}\left[-\pi^{-\sigma}\left[1+(\pi/\tau)^{\sigma-1}\right]+\left[1+(\pi\tau)^{1-\sigma}\right]\pi^{\sigma-2}\right]}{\left[1+(\pi\tau)^{1-\sigma}\right]^{2}\left[1+(\pi/\tau)^{\sigma-1}\right]^{2}}\Bigg], \\
\partial\varepsilon_{\mathcal{K},\pi}/\partial\pi|_{\pi=1} &= (\sigma-1)^{2}\,\tau^{1-\sigma}\frac{(1-1)\left[1+\tau^{1-\sigma}\right]^{2}-\left(1+2\tau^{1-\sigma}+1\right)\tau^{1-\sigma}\left[-1-\tau^{1-\sigma}+1+\tau^{1-\sigma}\right]}{\left[1+(\tau)^{1-\sigma}\right]^{2}\left[1+(1/\tau)^{\sigma-1}\right]^{2}}, \\
\partial\varepsilon_{\mathcal{K},\pi}/\partial\pi|_{\pi=1} &= 0.
\end{aligned}
$$

Show that $\partial\varepsilon_{\mathcal{J},\pi}/\partial\pi|_{\pi=1}=0$

$$
\begin{aligned}
\partial\varepsilon_{\mathcal{J},\pi}/\partial\pi &= (\sigma-1)\,\frac{(\sigma-1)\left[1-\tau^{-2(\sigma-1)}\right]\pi^{\sigma-2}\left(1+\tau^{1-\sigma}\pi^{\sigma-1}\right)\left(\tau^{1-\sigma}+\pi^{\sigma-1}\right)}{\left(1+\tau^{1-\sigma}\pi^{\sigma-1}\right)^{2}\left(\tau^{1-\sigma}+\pi^{\sigma-1}\right)^{2}} \\
&\quad-(\sigma-1)\Bigg[\frac{\left[1-\tau^{-2(\sigma-1)}\right]\pi^{\sigma-1}\left[(\sigma-1)\,\pi^{\sigma-2}\tau^{1-\sigma}\left(\tau^{1-\sigma}+\pi^{\sigma-1}\right)\right]}{\left(1+\tau^{1-\sigma}\pi^{\sigma-1}\right)^{2}\left(\tau^{1-\sigma}+\pi^{\sigma-1}\right)^{2}} \\
&\quad+\frac{\left[1-\tau^{-2(\sigma-1)}\right]\pi^{\sigma-1}\,(\sigma-1)\,\pi^{\sigma-2}\left(1+\tau^{1-\sigma}\pi^{\sigma-1}\right)}{\left(1+\tau^{1-\sigma}\pi^{\sigma-1}\right)^{2}\left(\tau^{1-\sigma}+\pi^{\sigma-1}\right)^{2}}\Bigg] \\
&= (\sigma-1)^{2}\left[1-\tau^{-2(\sigma-1)}\right]\frac{\pi^{\sigma-2}\left(1+\tau^{1-\sigma}\pi^{\sigma-1}\right)\left(\tau^{1-\sigma}+\pi^{\sigma-1}\right)}{\left(1+\tau^{1-\sigma}\pi^{\sigma-1}\right)^{2}\left(\tau^{1-\sigma}+\pi^{\sigma-1}\right)^{2}} \\
&\quad-(\sigma-1)^{2}\left[1-\tau^{-2(\sigma-1)}\right]\frac{\pi^{2\sigma-3}\left[\tau^{1-\sigma}\left(\tau^{1-\sigma}+\pi^{\sigma-1}\right)+\left(1+\tau^{1-\sigma}\pi^{\sigma-1}\right)\right]}{\left(1+\tau^{1-\sigma}\pi^{\sigma-1}\right)^{2}\left(\tau^{1-\sigma}+\pi^{\sigma-1}\right)^{2}}. \\
\partial\varepsilon_{\mathcal{J},\pi}/\partial\pi|_{\pi=1} &= (\sigma-1)^{2}\left[1-\tau^{-2(\sigma-1)}\right]\frac{\left(1+\tau^{1-\sigma}\right)\left(1+\tau^{1-\sigma}\right)-\left[\tau^{1-\sigma}\left(1+\tau^{1-\sigma}\right)+\left(1+\tau^{1-\sigma}\right)\right]}{\left(1+\tau^{1-\sigma}\right)^{2}\left(1+\tau^{1-\sigma}\right)^{2}} \\
&= (\sigma-1)^{2}\left[1-\tau^{-2(\sigma-1)}\right]\frac{1+2\tau^{1-\sigma}+\tau^{2(1-\sigma)}-2\tau^{1-\sigma}-\tau^{2(1-\sigma)}-1}{\left(1+\tau^{1-\sigma}\right)^{2}\left(1+\tau^{1-\sigma}\right)^{2}}=0.
\end{aligned}
$$

A4.2 The effect of country size on terms of trade

Employing again the implicate function theorem

$$\varepsilon_{\pi,\lambda} = -\frac{\frac{\partial \mathcal{L}}{\partial \lambda}}{\frac{\partial \mathcal{L}}{\partial \pi}}\frac{\lambda}{\pi} = -\frac{\mathcal{L}}{\frac{1-\mu}{\mu(\sigma-1)}\varepsilon_{\mathcal{K},\pi} + \sigma + \varepsilon_{\mathcal{J},\pi}} < 0.$$

A4.3 The effect of country size on unemployment spillovers

The effect of country size on unemployment spillovers is given by

$$\begin{aligned}
\frac{\partial \varepsilon_{\theta_H,B}}{\partial \lambda} &= \frac{\partial \varepsilon_{\theta_H,\pi}}{\partial \lambda}\varepsilon_{\pi,B} + \frac{\partial \varepsilon_{\pi,B}}{\partial \lambda}\varepsilon_{\theta_H,\pi}, \\
\frac{\partial \varepsilon_{\theta_F,B}}{\partial \lambda} &= \frac{\partial \varepsilon_{\theta_F,\pi}}{\partial \lambda}\varepsilon_{\pi,B} + \frac{\partial \varepsilon_{\pi,B}}{\partial \lambda}\varepsilon_{\theta_F,\pi},
\end{aligned}$$

which at $\pi = 1$ simplifies to:

$$\begin{aligned}
\left.\frac{\partial \varepsilon_{\theta_H,B}}{\partial \lambda}\right|_{\pi=1} &= \frac{\partial \varepsilon_{\theta_H,\pi}}{\partial \lambda}\varepsilon_{\pi,B}, \\
\left.\frac{\partial \varepsilon_{\theta_F,B}}{\partial \lambda}\right|_{\pi=1} &= \frac{\partial \varepsilon_{\theta_F,\pi}}{\partial \lambda}\varepsilon_{\pi,B},
\end{aligned}$$

because $\left.\frac{\partial \varepsilon_{\pi,B}}{\partial \lambda}\right|_{\pi=1} = 0$: λ does not have a direct effect on $\varepsilon_{\pi,B}$ and we have shown above that it does not have an indirect effect either because $\partial \varepsilon_{\pi,B}/\partial \pi|_{\pi=1} = 0$.

The change in the elasticicities $\varepsilon_{\theta_H,B}$ and $\varepsilon_{\theta_H,B}$ is easy to determine:

$$\begin{aligned}
\frac{\partial \varepsilon_{\theta_H,\pi}}{\partial \lambda} &= \frac{1}{\mu}\frac{(\sigma-1)\,\pi^{\sigma-2}\tau^{1-\sigma}\left(1+(\pi/\tau)^{\sigma-1}\right) - (\sigma-1)\,\pi^{\sigma-2}\tau^{1-\sigma}\,(\pi/\tau)^{\sigma-1}}{\left(1+(\pi/\tau)^{\sigma-1}\right)^2}\frac{\partial \pi}{\partial \lambda} \\
&= \frac{1}{\mu}\frac{(\sigma-1)\,\pi^{\sigma-1}\tau^{1-\sigma}}{\lambda\left(1+(\pi/\tau)^{\sigma-1}\right)^2}\varepsilon_{\pi,\lambda} < 0. \qquad \text{(A5)}
\end{aligned}$$

$$\begin{aligned}
\frac{\partial \varepsilon_{\theta_F,\pi}}{\partial \lambda} &= -\frac{1}{\mu}\frac{(1-\sigma)\,\pi^{-\sigma}\tau^{1-\sigma}\left(1+(\pi\tau)^{1-\sigma}\right) - (1-\sigma)\,\pi^{-\sigma}\tau^{1-\sigma}\,(\pi\tau)^{1-\sigma}}{\left(1+(\pi\tau)^{1-\sigma}\right)^2}\frac{\partial \pi}{\partial \lambda} \\
&= \frac{1}{\mu}\frac{(\sigma-1)\,\pi^{1-\sigma}\tau^{1-\sigma}}{\lambda\left(1+(\pi\tau)^{1-\sigma}\right)^2}\varepsilon_{\pi,\lambda} < 0. \qquad \text{(A6)}
\end{aligned}$$

and so

$$\begin{aligned}
\frac{\partial \varepsilon_{\theta_H,B}}{\partial \lambda} &< 0, \\
\frac{\partial \varepsilon_{\theta_F,B}}{\partial \lambda} &< 0.
\end{aligned}$$

A5 Proof of Proposition 4: Institutional spillovers and geography

A5.1 The effects of trade costs on the terms-of-trade-effect of institutions (the elasticity $\varepsilon_{\pi,B}$)

Here we show the effect of trade costs on $\varepsilon_{\pi,B}$.

$$\frac{\partial \varepsilon_{\pi,B}}{\partial \tau} = -\frac{1-\mu}{\mu} \frac{1}{\left(\frac{1-\mu}{\mu(1-\sigma)}\varepsilon_{K,\pi} + \sigma + \varepsilon_{J,\pi}\right)^2} \left(\frac{1-\mu}{\mu(\sigma-1)} \frac{\partial \varepsilon_{\mathcal{K},\pi}}{\partial \tau} + \frac{\partial \varepsilon_{\mathcal{J},\pi}}{\partial \tau}\right).$$

Thus, the direction of the change in the elasticity is determined by $\partial \varepsilon_{\mathcal{K},\pi}/\partial \tau$ and $\partial \varepsilon_{\mathcal{J},\pi}/\partial \tau$.

$$\begin{aligned}
\varepsilon_{\mathcal{K},\pi} &= (\sigma-1) \frac{\tau^{1-\sigma}\pi^{\sigma-1} + 2\tau^{2(1-\sigma)} + \tau^{1-\sigma}\pi^{1-\sigma}}{\left[1+(\pi\tau)^{1-\sigma}\right]\left[1+(\pi/\tau)^{\sigma-1}\right]}. \\
\varepsilon_{\mathcal{K},\pi}\big|_{\pi=1} &= 2(\sigma-1)\frac{\tau^{1-\sigma}}{1+\tau^{1-\sigma}}. \\
\frac{\partial\ \varepsilon_{\mathcal{K},\pi}\big|_{\pi=1}}{\partial \tau} &= -2(\sigma-1)^2 \frac{\tau^{-\sigma}}{(1+\tau^{1-\sigma})^2} < 0.
\end{aligned}$$

$$\begin{aligned}
\varepsilon_{\mathcal{J},\pi}\big|_{\pi=1} &= (\sigma-1)\frac{1-\tau^{-2(\sigma-1)}}{(1+\tau^{1-\sigma})^2} = (\sigma-1)\frac{\left(1-\tau^{(1-\sigma)}\right)\left(1+\tau^{(1-\sigma)}\right)}{(1+\tau^{1-\sigma})^2} \\
&= (\sigma-1)\frac{1-\tau^{(1-\sigma)}}{1+\tau^{1-\sigma}} > 0. \\
\partial \varepsilon_{\mathcal{J},\pi}/\partial \tau &= 2(\sigma-1)^2 \frac{\tau^{-\sigma}}{(1+\tau^{1-\sigma})^2} > 0.
\end{aligned}$$

Thus $\partial \varepsilon_{\pi,B}/\partial \tau\big|_{\pi=1} < 0$ if $(\sigma-1) > \frac{1-\mu}{\mu} \Longleftrightarrow \mu > 1/\sigma$.

A5.2 The effect of trade costs on unemployment spillovers

$$\begin{aligned}\frac{\partial \varepsilon_{\theta_H,B}}{\partial \tau} &= \frac{\partial \varepsilon_{\theta_H,\pi}}{\partial \tau}\varepsilon_{\pi,B} + \frac{\partial \varepsilon_{\pi,B}}{\partial \tau}\varepsilon_{\theta_H,\pi}, \\ \frac{\partial \varepsilon_{\theta_F,B}}{\partial \tau} &= \frac{\partial \varepsilon_{\theta_F,\pi}}{\partial \tau}\varepsilon_{\pi,B} + \frac{\partial \varepsilon_{\pi,B}}{\partial \tau}\varepsilon_{\theta_F,\pi}.\end{aligned}$$

$$\begin{aligned}\frac{\partial \varepsilon_{\theta_F,\pi}}{\partial \tau} &= -\frac{1}{\mu}\frac{(1-\sigma)\,\pi^{1-\sigma}\tau^{-\sigma}\left(1+(\pi\tau)^{1-\sigma}\right)-(1-\sigma)\,\pi^{1-\sigma}\tau^{-\sigma}\,(\pi\tau)^{1-\sigma}}{\left(1+(\pi\tau)^{1-\sigma}\right)^2} \\ &= \frac{1}{\mu}\frac{(\sigma-1)\,\pi^{1-\sigma}\tau^{-\sigma}}{\left(1+(\pi\tau)^{1-\sigma}\right)^2} > 0.\end{aligned}$$

$$\frac{\partial \varepsilon_{\theta_H,\pi}}{\partial \tau} = -\frac{1}{\mu}\frac{(\sigma-1)\,\pi^{\sigma-1}\tau^{-\sigma}}{\left(1+(\pi/\tau)^{\sigma-1}\right)^2} < 0.$$

And so

$$\begin{aligned}\left.\frac{\partial \varepsilon_{\theta_H,B}}{\partial \tau}\right|_{\pi=1} &< 0 \text{ if } \mu > 1/\sigma \\ \left.\frac{\partial \varepsilon_{\theta_F,B}}{\partial \tau}\right|_{\pi=1} &> 0 \text{ if } \mu > 1/\sigma\end{aligned}$$

since $\varepsilon_{\pi,B} > 0$, $\partial\varepsilon_{\pi,B}/\partial\tau|_{\pi=1} < 0$, $\varepsilon_{\theta_H,\pi} > 0$ and $\varepsilon_{\theta_F,\pi} < 0$.

A6 Proof of Proposition 5: Institutional spillovers and real wage rigidity

Treating real wages as fixed (rather than as bargained), the job creation condition (4) pins down labor market tightness $\theta_j^{\mu} = (p_j - w_j)\,m_j/\,(P_j c_j)$ and hence, according to $S_j = m_j L_j \theta_j^{1-\mu}$, supply of goods. Let $v_j \equiv w_j/P_j$ be the exogenously fixed real wage. Then, we have

$$S_j = m_j L_j \left(\frac{p_j}{P_j} - v_j\right)^{\frac{1-\mu}{\mu}} \left(\frac{c_j}{m_j}\right)^{-\frac{1-\mu}{\mu}}, \text{ for } j \in \{H, F\}. \tag{A7}$$

The relative supply condition (9) now becomes

$$\widetilde{RS} = \lambda \tilde{B}^{-\frac{1-\mu}{\mu}} \left(\frac{\left[1 + (\pi/\tau)^{\sigma-1}\right]^{1/(\sigma-1)} - v_H}{\left[1 + (\pi\tau)^{1-\sigma}\right]^{1/(\sigma-1)} - v_F} \right)^{\frac{1-\mu}{\mu}}, \tag{A8}$$

where $\tilde{B} \equiv (c_H/c_F)(m_F/m_H)^{1/(1-\mu)}$.

This expression collapses to (9) if v_j is set by Nash-bargaining and substituted out.

Now, starting from the same equilibrium,[1] we consider the effects of a marginal change $dB > 0$ and $d\tilde{B} > 0$ in the flexible and the rigid cases, respectively. In both situations, RS decreases by the same proportion; expressed in elasticities, the decrease is identical across the two cases and equal to $-(1-\mu)/\mu$. However, the effect on π is smaller in the rigid case than in the flexible one, due to the higher slope of the RS locus. The change in relative employment (relative supply) is, in turn, stronger.

Suppose that π increases (due to an increase in frictions). For example, writing Foreign's tightness as

$$\theta_F = \left(\left[1 + (\pi\tau)^{1-\sigma}\right]^{1/(\sigma-1)} - v_F \right)^{\frac{1}{\mu}} \left(\frac{c_F}{m_F} \right)^{-\frac{1}{\mu}}.$$

Under flexible wages the increase in the terms of trade will lead to a lower wage in Foreign, thus dampening the negative effect of the terms of trade movement on unemployment. If wages are rigid, this dampening effect does not take place and thus the reaction in unemployment has to be stronger the more rigid wages are.

[1] This amounts to assuming that the rigid and the flexible economies have the same initial unemployment rates, i.e., v is initially equal to the real wage in the flexible bargaining case.

The elasticity of $\widetilde{RS}$ with respect to π is given by

$$\begin{aligned}
\frac{\pi \widetilde{RS}_\pi}{\widetilde{RS}} &= \frac{1-\mu}{\mu}\left[\frac{\left[1+\left(\frac{\pi}{\tau}\right)^{\sigma-1}\right]^{\frac{2-\sigma}{\sigma-1}}\left(\frac{\pi}{\tau}\right)^{\sigma-1}\left(\left[1+(\pi\tau)^{1-\sigma}\right]^{\frac{1}{\sigma-1}}-v_F\right)}{\left(\left[1+\left(\frac{\pi}{\tau}\right)^{\sigma-1}\right]^{\frac{1}{\sigma-1}}-v_H\right)\left(\left[1+(\pi\tau)^{1-\sigma}\right]^{\frac{1}{\sigma-1}}-v_F\right)}\right. \\
&\quad \left. + \frac{\left(\left[1+\left(\frac{\pi}{\tau}\right)^{\sigma-1}\right]^{\frac{1}{\sigma-1}}-v_H\right)\left[1+(\pi\tau)^{1-\sigma}\right]^{\frac{1}{\sigma-1}-1}(\pi\tau)^{1-\sigma}}{\left(\left[1+\left(\frac{\pi}{\tau}\right)^{\sigma-1}\right]^{\frac{1}{\sigma-1}}-v_H\right)\left(\left[1+(\pi\tau)^{1-\sigma}\right]^{\frac{1}{\sigma-1}}-v_F\right)}\right] \\
&= \frac{1-\mu}{\mu}\left[\frac{\left[1+(\pi/\tau)^{\sigma-1}\right]^{\frac{1}{\sigma-1}-1}(\pi/\tau)^{\sigma-1}}{\left(\left[1+(\pi/\tau)^{\sigma-1}\right]^{\frac{1}{\sigma-1}}-v_H\right)} + \frac{\left[1+(\pi\tau)^{1-\sigma}\right]^{\frac{1}{\sigma-1}-1}(\pi\tau)^{1-\sigma}}{\left(\left[1+(\pi\tau)^{1-\sigma}\right]^{\frac{1}{\sigma-1}}-v_F\right)}\right] \\
&= \frac{1-\mu}{\mu}\left[\frac{(\pi/\tau)^{\sigma-1}}{\left(\frac{\left[1+(\pi/\tau)^{\sigma-1}\right]^{\frac{1}{\sigma-1}}-v_H}{\left[1+(\pi/\tau)^{\sigma-1}\right]^{\frac{1}{\sigma-1}-1}}\right)} + \frac{(\pi\tau)^{1-\sigma}}{\left(\frac{\left[1+(\pi\tau)^{1-\sigma}\right]^{\frac{1}{\sigma-1}}-v_F}{\left[1+(\pi\tau)^{1-\sigma}\right]^{\frac{1}{\sigma-1}-1}}\right)}\right] \\
&> \frac{1-\mu}{\mu}\left(\frac{(\pi/\tau)^{\sigma-1}}{1+(\pi/\tau)^{\sigma-1}} + \frac{(\pi\tau)^{1-\sigma}}{1+(\pi\tau)^{1-\sigma}}\right) = \frac{RS_\pi \pi}{RS}.
\end{aligned}$$

Hence,

$$\frac{\pi \widetilde{RS}_\pi}{\widetilde{RS}} > \frac{RS_\pi \pi}{RS}.$$

A7 Details on Robustness Checks

Table 5: Robustness Checks: 3-year averages, semi-log specification and different IV strategy

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Dep.var. $\ln u$	$\ln u$	$\ln u$	u	u	u	u	$\ln u$	$\ln u$	u	
	OLS	OLS	IV	IV	OLS	OLS	IV	OLS	OLS	OLS
Instruments / Proxy		b^*_{t-1}, pmr^*_{t-1}	b^*_t, pmr^*_t	u^*_{t-1}		b^*_{t-1}, pmr^*_{t-1}				
Sample	yearly	3yr-avg	yearly	yearly	yearly	yearly	yearly	yearly	3yr-avg	yearly
$\ln u^*, u^*$	0.018	0.040^c	0.022^c	0.080^a	0.075^a	0.086^a	0.087^a			
	(0.013)	(0.021)	(0.013)	(0.028)	(0.027)	(0.030)	(0.032)			
b^*							0.002^a	0.002^c	0.009^a	
							(0.001)	(0.001)	(0.003)	
b	0.017^a	0.018^a	0.018^a	0.085^a	0.099^a	0.078^a	0.095^a	0.018^a	0.010^b	0.079^a
	(0.003)	(0.006)	(0.003)	(0.018)	(0.020)	(0.020)	(0.019)	(0.003)	(0.005)	(0.020)
PMR	0.184^a	0.215^a	0.198^a	0.875^a	0.939^a	0.843^a	0.920^a	0.182^a	0.187^a	0.821^a
	(0.037)	(0.076)	(0.033)	(0.196)	(0.215)	(0.210)	(0.203)	(0.036)	(0.064)	(0.206)
Union density	-0.003	0.004	-0.003	-0.004	-0.003	-0.005	-0.004	-0.003	0.000	-0.005
	(0.003)	(0.005)	(0.003)	(0.022)	(0.023)	(0.023)	(0.022)	(0.003)	(0.004)	(0.023)
High corporatism	-0.129^b	-0.382^a	-0.150^a	-1.619^a	-1.865^a	-1.527^a	-1.781^a		-0.124^b	-1.525^a
	(0.057)	(0.086)	(0.056)	(0.390)	(0.427)	(0.415)	(0.390)	(0.057)		(0.415)
EPL	-0.012	-0.167^c	0.007	-0.413	-0.300	-0.458	-0.326	-0.020	-0.173^c	-0.461
	(0.054)	(0.089)	(0.049)	(0.342)	(0.375)	(0.366)	(0.351)	(0.056)	(0.100)	(0.371)
$EU dummy$					0.724^c	0.438			0.732^c	
					(0.383)	(0.355)			(0.383)	
GAP	-0.091^a	-0.089^a	-0.090^a	-0.621^a	-0.609^a	-0.639^a	-0.617^a	-0.091^a	-0.094^a	-0.641^a
	(0.009)	(0.011)	(0.008)	(0.041)	(0.042)	(0.043)	(0.039)	(0.009)	(0.011)	(0.043)
GAP^*	-0.008	0.012	-0.002	0.021	0.015	0.034	0.073	-0.008	-0.008	-0.015
	(0.015)	(0.033)	(0.014)	(0.070)	(0.067)	(0.073)	(0.070)	(0.015)	(0.034)	(0.070)
2nd stage statistics										
RMSE	0.210	0.242	0.188	1.046	1.095	1.123	1.008	0.210	0.241	1.124
adj. R^2	0.893	0.818	0.896	0.931	0.935	0.932	0.936	0.893	0.818	0.931
F	72.41	31.47			158.7	150.0		73.06	959.2	149.7
1st stage statistics (p-values)										
partial R^2		0.633	0.972			0.753				
χ^2-overidentification		0.019	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, TOT, 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).

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 $\sum_i \omega_i$	
	$\delta = 0.75, \alpha_i = 1.00$		$\delta = 1.50, \alpha_i = 1.00$		$\delta = 1.00, \alpha_i = 0.00$		$\delta = 1.00, \alpha_i = 1.00$		$\delta = 1.00, \alpha_i = 1.00$	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
	IV	OLS	IV	OLS	IV	OLS	IV	OLS	IV	OLS
u^*	0.096^b		0.065^a		0.582^a		0.011^b		0.026^b	
	(0.042)		(0.021)		(0.178)		(0.005)		(0.011)	
b^*		0.011^b		0.006^a		0.052^a		0.001^b		0.003^b
		(0.005)		(0.002)		(0.019)		(0.000)		(0.001)
b	0.098^a	0.085^a	0.098^a	0.087^a	0.098^a	0.089^a	0.101^a	0.088^a	0.100^a	0.087^a
	(0.019)	(0.020)	(0.019)	(0.019)	(0.018)	(0.019)	(0.019)	(0.019)	(0.019)	(0.020)
PMR	0.939^a	0.864^a		0.837^a	0.799^a	0.774^a	0.917^a	0.839^a	0.910^a	0.844^a
	(0.206)	(0.211)		(0.204)	(0.190)	(0.199)	(0.200)	(0.208)	(0.201)	(0.210)
Union density	-0.002	-0.003	-0.007	-0.006	0.001	-0.002	-0.007	-0.007	-0.005	-0.005
	(0.022)	(0.023)	(0.022)	(0.023)	(0.021)	(0.023)	(0.022)	(0.023)	(0.022)	(0.023)
High corporatism	-1.860^a	-1.635^a	-1.800^a	-1.608^a	-1.774^a	-1.594^a	-1.833^a	-1.619^a	-1.849^a	-1.638^a
	(0.394)	(0.420)	(0.395)	(0.421)	(0.381)	(0.411)	(0.392)	(0.419)	(0.393)	(0.419)
EPL	-0.271	-0.392	-0.349	-0.431	-0.283	-0.374	-0.282	-0.387	-0.257	-0.369
	(0.349)	(0.367)	(0.350)	(0.373)	(0.330)	(0.355)	(0.353)	(0.372)	(0.352)	(0.369)
GAP	-0.608^a	-0.620^a	-0.614^a	-0.624^a	-0.610^a	-0.614^a	-0.611^a	-0.622^a	-0.611^a	-0.622^a
	(0.039)	(0.044)	(0.039)	(0.044)	(0.038)	(0.044)	(0.039)	(0.044)	(0.039)	(0.044)
GAP^*	0.028	-0.070	0.063	-0.004	0.924^a	0.596^b	0.015	0.004	0.007	0.000
	(0.096)	(0.097)	(0.045)	(0.045)	(0.298)	(0.269)	(0.011)	(0.011)	(0.008)	(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		0.015		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, TOT, 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).