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International Trade and Unemployment: A Quantitative Framework

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Abstract

Quantifying the welfare effects of trade liberalization is a core issue in international trade. Existing frameworks assume perfect labor markets and therefore ignore the effects of aggregate employment changes for welfare. We develop a quantitative trade framework which explicitly models labor market frictions. To illustrate, we assess the effects of trade and labor market reforms for 28 OECD countries. Welfare effects of trade agreements are magnified when accounting for employment changes. While employment and welfare increase in most countries, some experience higher unemployment and lower welfare. Labor market reforms in one country have small positive spillover effects on trading partners.

JEL-Code: F140, F160, F130.

Keywords: international trade, unemployment, trade costs, structural estimation, gravity equation.

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1 Introduction

The quantification of the welfare effects of trade liberalization is one of the core issues in empirical international trade. All empirical frameworks for evaluating welfare effects of trade policies so far assume perfect labor markets with full employment. For example, Arkolakis et al. (2012) have shown that an ex post analysis of the welfare effects (measured in terms of real income) of a move from autarky to the observed level of trade liberalization is possible by using only data on the observed import share in a country and an estimate of the trade elasticity. If we relax the assumption of full employment, then real income is given by the real wage bill of all employed workers, i.e., $e_j L_j w_j / P_j$, where e_j is the share of the labor force L_j which is employed times the wage w_j which is paid to a worker in terms of the price level P_j. Hence assuming a constant labor force, any change in welfare $\hat{W}_j$ can be decomposed into a change in net employment and the real wage, i.e.,

$$\hat{W}_j = \hat{e}_j \widehat{\left(\frac{w_j}{P_j} \right)}, \tag{1}$$

where hats denote changes. In Arkolakis et al. (2012), $\hat{e}_j = 1$ by assumption, and the change in real wages is given by $\hat{\lambda}_{jj}^{1/\varepsilon}$, the change in the share of domestic expenditures, $\hat{\lambda}_{jj}$, raised to some power of ε, the elasticity of imports with respect to variable trade costs. Assuming full employment allows Arkolakis et al. (2012) to conduct a very simple ex post analysis of the welfare effects of moving from autarky to the observed level of trade integration. As $\lambda_{jj} = 1$ under autarky, one can calculate the welfare gains from trade from the observed domestic expenditure share when an estimate of the trade elasticity is available. When we allow for unemployment, however, this is not feasible any longer as we do not observe the counterfactual employment level under autarky. When we are interested in an ex ante evaluation of any counterfactual trade policy besides autarky, we additionally need estimates of trade cost parameters to get an estimate of the counterfactual domestic consumption share, which typically are obtained from estimating gravity models, regardless of whether we assume perfect or imperfect labor markets.

In the following, we present a simple quantitative framework for bilateral trade flows based on Armington (1969) preferences and recently developed models of international trade with search and matching labor market frictions, specifically Felbermayr et al. (2013). This framework allows us to derive sufficient statistics for the welfare effects of trade liberalization similar to those of Arkolakis et al. (2012) but augmented by the aggregate employment change. The additional insights of incorporating labor market frictions into a quantitative trade model come at minimal cost: We only require knowledge of the elasticity of the matching function. Hence, this framework is easily applied to all topics where trade flow effects are inferred, such as free trade agreements, currency unions, borders and ethnic networks.

We apply the framework to a sample of 28 OECD countries from 1950 to 2006 in order to evaluate two scenarios. First, we calculate the effects of introducing preferential trade agreements (PTAs) starting from a counterfactual world without any PTAs. Second, we evaluate the effects of a hypothetical labor market reform in the United States. We find that, on average, introducing PTAs as observed in 2006 increases GDP about four percent more when accounting for employment effects arising from imperfect labor markets. Countries with only small increases in GDP, however, experience negative employment effects. On average, welfare effects are eight percent larger when allowing for imperfect labor markets. When we use commonly assumed values for the elasticities in our model instead of our estimates, we find that accounting for labor market frictions increases the welfare gains by more than 50 percent. In our framework, changes in trade costs or labor market policies affect labor market outcomes through changes in relative prices and income. When trade costs fall, imports of foreign varieties become cheaper, leading to a lower consumer price index in the corresponding country. When labor markets are characterized by search frictions, firms have to incur costs to post vacancies in order to find workers. The lower price level translates one-to-one into lower recruiting costs for domestic firms.[1] Firms *ceteris paribus* create more vacan-

[1]Felbermayr et al. (2011a) and Felbermayr et al. (2013) on the one hand and Helpman

cies so that more workers find a job and unemployment is reduced. Hence, standard methods neglecting labor market effects considerably underestimate the welfare gains from trade liberalization.

Our second counterfactual experiment analyzes a hypothetical improvement of labor market institutions in the United States. As expected, GDP and welfare increase in the United States but also improve for its trading partners due to positive spillover effects of the labor market reform. A unilateral labor market reform which for example increases the matching efficiency will increase the number of successful matches between workers and firms and thus rise employment, GDP, and welfare in the corresponding country. As workers spend part of their income on foreign varieties, the increase in income leads to higher import demand for all trading partners. This translates into lower unemployment in the trading partners, leading to a positive correlation between changes in unemployment rates across countries.

In Section 2 we present our quantitative framework and show how to estimate trade cost parameters and elasticities. We then derive expressions for the counterfactual trade and employment levels for welfare evaluations of trade and labor market policy changes using the estimated trade cost parameters and elasticities. As an illustration of our approach, Section 3 evaluates the effects of preferential trade agreements and labor market reforms for a sample of 28 OECD countries. Section 4 concludes.

Our paper is related to several literatures, notably the gravity literature which models bilateral trade flows. Within our framework, changes in employment and GDP directly affect bilateral trade flows which can be described by a gravity equation. It captures the key stylized facts that trade increases with market size and decreases with distance. The empirical success of the gravity equation spurred a great deal of interest in its theoretical underpinnings. Anderson (1979) and Bergstrand (1985) address the role of multilateral price effects for trade flows. A more recent contribution by Eaton and Kortum (2002) develops a quantifiable Ricardian model of international trade

and Itskhoki (2010) on the other use a similar mechanism in a one- and two-sector model, respectively.

to investigate the role of comparative advantage and geography for bilateral trade flows. Anderson and van Wincoop (2003) refine the gravity equation's theoretical foundations by including average trade barriers to capture multilateral resistance and highlight the importance of proper empirical comparative static analysis. Fieler (2011) introduces non-homothetic preferences into the Ricardian framework of Eaton and Kortum (2002) to rationalize the fact that bilateral trade is large between rich countries and small between poor countries. Waugh (2010) provides a complementary framework with asymmetric trade costs to explain the cross-country-pair differences in bilateral trade volumes and income levels. Anderson and Yotov (2010) elaborate on the incidence of bilateral trade costs in the Anderson and van Wincoop (2003) framework. These theoretical developments allow to employ the gravity equation to infer the GDP and welfare effects of counterfactual trade liberalization scenarios accounting for general equilibrium effects, which is a core issue in empirical work on international trade.

Despite this multitude of theoretical foundations for the gravity equation, to date all of them assume perfect labor markets. Crucially, this implies that changes in real welfare ignore changes in the total number of employed workers due to trade liberalization or labor market reforms. A different strand of the theoretical trade literature stresses various channels through which trade liberalization affects (un)employment. Brecher (1974), Davis (1998), and Egger et al. (2012) focus on minimum wages to analyze the interactions between trade and labor market policies. A binding minimum wage prevents downward wage adjustments when a country opens up to trade. Instead, firms adjust the number of employed workers. Others have stressed labor market frictions arising due to fair wages or efficiency wages (Amiti and Davis 2012; Davis and Harrigan 2011; Egger and Kreickemeier 2009). Fair wages or efficiency wages lead firms to pay wages above the market clearing level in order to ensure compliance of workers. When trade is liberalized, average productivity of firms increases, which leads to an increase of the fair or efficiency wage due to rent-sharing as well as an increase in unemployment. Finally, search-theoretic foundations of labor market frictions are introduced into trade models (Davidson et al. 1988, 1999; Felbermayr et al. 2011a; Helpman et al. 2010; Helpman and Itskhoki 2010; Felbermayr et al. 2013). In these models, workers search for jobs and firms for workers. Once a firm-worker match is established, they bargain over the match-specific surplus. Trade and labor markets interact via relative prices of hiring workers and goods prices which affect search and recruitment efforts. While our framework relies on a search-theoretical foundation of labor market frictions, we employ several approaches to divide the rent between workers and firms like minimum wages, efficiency wages, and bargaining.[2]

Theoretically, the effects of trade liberalization on (un)employment are ambiguous, but Dutt et al. (2009) as well as Felbermayr et al. (2011b) provide reduced-form evidence that more open economies have lower unemployment rates on average. In contrast to these reduced-form approaches, our structural quantitative framework accounts for country-specific general equilibrium effects and allows to quantify employment, GDP, and welfare effects of policies.[3]

2 A quantitative framework for trade and unemployment

2.1 Goods market

The representative consumer in country j is characterized by the utility function U_j. We assume that goods are differentiated by country of origin, i.e. we

[2]Cuñat and Melitz (2010) and Cuñat and Melitz (2012) study the effect of differences in labor market frictions on patterns of comparative advantage. However, their model does neither feature trade costs, the center piece of gravity analysis, nor does it consider unemployment.

[3]A recent literature studies the labor market effects of trade liberalization using structural dynamic models (Kambourov, 2009; Artuç et al., 2010; Coşar et al., 2011; Menezes-Filho and Muendler, 2011; Coşar, 2013; Dix-Carneiro, 2013; Helpman et al., 2013). However, all these studies focus on single countries and hence abstract from the interdependencies of trade flows between countries, a decisive feature of our model. Also, with the exception of Artuç et al. (2010) who study the United States, this literature focuses on the effects of trade liberalization in Latin American emerging economies, not developed countries.

use the simplest possible way to provide a rationale for bilateral trade between similar countries based on preferences à la Armington (1969).[4] In a companion web appendix, we demonstrate that our framework and counterfactual analysis are isomorphic to a Ricardian model of international trade along the lines of Eaton and Kortum (2002). The quantity of purchased goods from country i is given by q_{ij}, leading to the following utility function

$$U_j = \left[\sum_{i=1}^{n} \beta_i^{\frac{1-\sigma}{\sigma}} q_{ij}^{\frac{\sigma-1}{\sigma}} \right]^{\frac{\sigma}{\sigma-1}}, \tag{2}$$

where n is the number of countries, σ is the elasticity of substitution in consumption, and β_i is a positive preference parameter measuring the product appeal for goods from country i.

International trade of goods from i to j imposes iceberg trade costs $t_{ij} > 1$. Profit maximization then implies that $p_{ij} = p_i t_{ij}$, where p_i denotes the factory gate price of the good in country i.

The representative consumer maximizes Equation (2) subject to the budget constraint $\tilde{y}_j = \sum_{i=1}^{n} p_i t_{ij} q_{ij}$, where $\tilde{y}_j = y_j(1 + d_j)$, with y_j denoting nominal income in country j and d_j the share of the exogenously given trade deficit (if $d_j > 0$) or surplus (if $d_j < 0$) of country j in terms of GDP.[5] The value of aggregate sales of goods from country i to country j can then be expressed as

$$x_{ij} \;=\; p_i t_{ij} q_{ij} = \left(\frac{\beta_i p_i t_{ij}}{P_j} \right)^{1-\sigma} \tilde{y}_j, \tag{3}$$

and P_j is the standard CES price index given by $P_j = [\sum_{i=1}^{n} (\beta_i p_i t_{ij})^{1-\sigma}]^{1/(1-\sigma)}$. In general equilibrium, total sales correspond to nominal income, i.e., $y_i = \sum_{j=1}^{n} x_{ij}$. Assuming labor to be the only factor of production which produces one unit of output per worker, GDP in a world with imperfect labor markets

[4] Consequently, we deliberately abstract from distinguishing between the intensive and extensive margin of international trade as for example in Chaney (2008) or Helpman et al. (2008).

[5] We allow for trade imbalances following Dekle et al. (2007). We also conducted all counterfactual scenarios assuming balanced trade, but our results changed very little. Detailed results can be found in the companion web appendix of this paper.

is given by total production of the final output good multiplied with its price, i.e., $y_i = p_i(1-u_i)L_i$.[6]

This setup implies a gravity equation for bilateral trade flows. In general equilibrium, GDP is given by the sum of all sales, i.e.

$$y_i \;=\; \sum_{j=1}^{n} x_{ij} = \sum_{j=1}^{n} \left(\frac{\beta_i t_{ij} p_i}{P_j}\right)^{1-\sigma} \tilde{y}_j = (\beta_i p_i)^{1-\sigma} \sum_{j=1}^{n} \left(\frac{t_{ij}}{P_j}\right)^{1-\sigma} \tilde{y}_j. \qquad (4)$$

Solving for scaled prices $\beta_i p_i$ and defining $y^W \equiv \sum_j y_j$, $\tilde{y}^W \equiv \sum_j \tilde{y}_j$ and income shares $\theta_j \equiv y_j/y^W$ and $\tilde{\theta}_j \equiv \tilde{y}_j/\tilde{y}^W$, we can write bilateral trade flows as given in Equation (3) as

$$x_{ij} = \frac{y_i \tilde{y}_j}{y^W} \left(\frac{t_{ij}}{\tilde{\Pi}_i \tilde{P}_j}\right)^{1-\sigma}, \quad \text{where} \qquad (5)$$

$$\tilde{\Pi}_i \equiv \left(\sum_{j=1}^{n} \left(\frac{t_{ij}}{\tilde{P}_j}\right)^{1-\sigma} \tilde{\theta}_j\right)^{1/(1-\sigma)}, \quad \tilde{P}_j \equiv \left(\sum_{i=1}^{n} \left(\frac{t_{ij}}{\tilde{\Pi}_i}\right)^{1-\sigma} \theta_i\right)^{1/(1-\sigma)}, \qquad (6)$$

while we substituted equilibrium scaled prices into the definition of the price index to obtain the multilateral resistance terms $\tilde{P}_j$.

Note that this system of equations exactly corresponds to the system given in Equations (9)-(11) in Anderson and van Wincoop (2003) or Equations (5.32) and (5.35) in Feenstra (2004) assuming balanced trade, $d_i = 0$ for all i, even when labor markets are imperfect.[7]

The intuition for this result is that GDPs appear in Equation (5). Observed GDPs already include the actual number of employed people. Hence, it still holds that total spending equals total production. The only difference is that now total production is achieved by *employed workers*, not all workers, as is assumed with perfect labor markets. By adding a stochastic error term,

[6] For further reference, note that we measure (changes in) nominal variables like GDP in terms of the price index of the first country in our data set in our subsequent empirical analysis.

[7] If trade is balanced, then $\tilde{\Pi}_i = \Pi_i$ and $\tilde{P}_i = P_i$. When, in addition, trade costs are symmetric, i.e., $t_{ij} = t_{ji}$, then $\tilde{\Pi}_i = \tilde{P}_i$ (see Anderson and van Wincoop 2003).

Equation (5) can be written as

$$z_{ij} \equiv \frac{x_{ij}}{y_i \tilde{y}_j} = \exp\left(k - (1-\sigma)\ln t_{ij} - \ln \tilde{\Pi}_i^{1-\sigma} - \ln \tilde{P}_j^{1-\sigma} + \varepsilon_{ij}\right), \qquad (7)$$

where ε_{ij} is a random disturbance term or measurement error of exports, assumed to be identically distributed and mean-independent of the remaining terms on the right-hand side of Equation (7), and k is a constant capturing the logarithm of world GDP. Country-specific importer and exporter fixed effects can be used to control for the outward and inward multilateral resistance terms $\tilde{\Pi}_i$ and $\tilde{P}_j$, respectively, as suggested by Anderson and van Wincoop (2003) and Feenstra (2004). Hence, even with labor market frictions, we can use established methods to estimate trade costs using the gravity equation, independently of the underlying labor market model. We summarize this result in Implication 1:

Implication 1 *The estimation of trade costs is unchanged when allowing for imperfect labor markets.*

To evaluate ex ante welfare effects of changes in trade policies, we need in addition to trade cost elasticity estimates the counterfactual changes in employment and GDP. To derive these, we have to take a stance on how to model the labor market, to which we turn in the next section.

2.2 Labor market

We model the labor market using a one-shot version of the search and matching framework (SMF, see Mortensen and Pissarides, 1994 and Pissarides, 2000) which is closely related to Felbermayr et al. (2013).[8] Search-theoretic frame-

[8]See Rogerson et al. (2005) for a survey of search and matching models, including an exposition of a simplified one-shot (directed) search model. For other recent trade models using a similar static (non-directed search) approach, see for example Keuschnigg and Ribi (2009) and Helpman and Itskhoki (2010). We use the labor market setup from Felbermayr et al. (2013). However, they do not investigate its implications for the estimation of gravity equations nor do they use it for a structural quantitative analysis. They also do not present labor market setups with minimum and efficiency wages nor do they consider alternative trade models such as the Eaton and Kortum (2002) framework as we do in our companion

works fit stylized facts of labor markets in developed economies as for example the simultaneous existence of unfilled vacancies and unemployed workers.[9]

The labor market is characterized by frictions. All potential workers in country j, L_j, have to search for a job, and firms post vacancies V_j in order to find workers. The number of successful matches between an employer and a worker, M_j, is given by $M_j = m_j L_j^{\mu} V_j^{1-\mu}$, where $\mu \in (0,1)$ is the elasticity of the matching function and m_j measures the overall efficiency of the labor market.[10] Only a fraction of open vacancies will be filled, $M_j/V_j = m_j \left(V_j/L_j\right)^{-\mu} = m_j \vartheta_j^{-\mu}$, and only a fraction of all workers will find a job, $M_j/L_j = m_j \left(V_j/L_j\right)^{1-\mu} = m_j \vartheta_j^{1-\mu}$, where $\vartheta_j \equiv V_j/L_j$ denotes the degree of labor market tightness in country j. This implies that the unemployment rate is given by[11]

$$u_j = 1 - m_j \vartheta_j^{1-\mu}. \tag{8}$$

As is standard in search models, we assume that every firm employs one worker. Similar to Helpman and Itskhoki (2010), this assumption does not lead to any loss of generality as long as the firm operates under perfect competition and constant returns to scale. In addition, we assume that all firms have the same productivity and produce a homogeneous good. In order to employ a worker (i.e. to enter the market), the firm has to post a vacancy at a cost of $c_j P_j$, i.e. in units of the final output good.[12] After paying these costs, a firm finds a worker with probability $m_j \vartheta^{-\mu}$. When a match between a worker and a firm has been established, we assume that they bargain over the total match surplus. Alternatively, we consider minimum and efficiency wages in a companion web appendix as mechanisms for wage determination. All three

web appendix.

[9]They are less successful in explaining the cyclical behavior of unemployment and vacancies, see Shimer (2005). This deficiency is not crucial in our case as we purposely focus on the steady state.

[10]Note that we assume a constant returns to scale matching function in line with empirical studies, see Petrongolo and Pissarides (2001).

[11]Note that the matching efficiency has to be sufficiently low to ensure job finding rates and job filling rates between 0 and 1.

[12]This implies that not all of GDP is available for final consumption (and hence welfare) of workers.

approaches are observationally equivalent in our setting.

In the bargaining case, the match gain of the firm is given by its revenue from sales of one unit of the homogeneous product minus wage costs, $p_j - w_j$, as the firm's outside option is zero. The match surplus of a worker is given by $w_j - b_j$, where b_j is the outside option of the worker, i.e. the unemployment benefits (b_j) she receives when she is unemployed.[13]

As is standard in the literature, we use a generalized Nash bargaining solution to determine the surplus splitting rule. Hence, wages w_j are chosen to maximize $(w_j - b_j)^{\xi_j}(p_j - w_j)^{1-\xi_j}$, where the bargaining power of the worker is given by $\xi_j \in (0,1)$. The unemployment benefits are expressed as a fraction γ_j of the market wage rate. Note that both the worker and the firm neglect the fact that in general equilibrium, higher wages lead to higher unemployment benefits, i.e., they both treat the replacement rate as exogenous (see Pissarides 2000). The first order conditions of the bargaining problem yield $w_j - \gamma_j w_j = \xi_j/(1-\xi_j)(p_j - w_j)$. Solving for w_j results in the **wage curve** $w_j = \xi_j/(1 + \gamma_j \xi_j - \gamma_j)p_j$. Due to the one-shot matching, the wage curve does not depend on ϑ_j. The bargained wage increases in the value of output p_j, in the worker's bargaining power ξ_j, and in the replacement rate γ_j.[14]

Given wages w_j, profits of a firm π_j are given by $\pi_j = p_j - w_j$. As we assume one worker firms and the probability of filling an open vacancy is $m_j \vartheta^{-\mu}$, expected profits are equal to $(p_j - w_j)m_j\vartheta^{-\mu}$. Firms enter the market until these expected profits cover the entry costs $c_j P_j$. Rewriting, one finds the **job creation curve** $w_j = p_j - P_j c_j/(m_j \vartheta_j^{-\mu})$. It is increasing in the value of output and decreasing in the expected recruiting costs $P_j c_j/(m_j \vartheta_j^{-\mu})$.

As pointed out by Felbermayr et al. (2013), combining the job creation and wage curves determines the equilibrium labor market tightness as

$$\vartheta_j = \left(\frac{p_j}{P_j}\right)^{1/\mu} \left(\frac{c_j}{m_j}\Omega_j\right)^{-1/\mu}. \tag{9}$$

[13]Unemployment benefits are financed via lump-sum transfers from employed workers to the unemployed. As we assume homothetic preferences and homogenous workers, this does not show up in the economy-wide budget constraint $\tilde{y}_j$, see equation (3).

[14]The replacement rate is the percentage of the equilibrium wage a worker receives as unemployment benefits when she is unemployed.

$\Omega_j \equiv \frac{1-\gamma_j+\gamma_j\xi_j}{1-\gamma_j+\gamma_j\xi_j-\xi_j} \geq 1$ summarizes the effect of the worker's bargaining power ξ_j and the replacement rate γ_j on labor market tightness. Ω_j increases in both ξ_j and γ_j. Labor market tightness decreases and the unemployment rate increases when m_j or c_j decrease or Ω_j increases. The relative price p_j/P_j is determined by the demand and the supply of goods. It therefore provides the link between the labor and goods market.

2.3 Estimation of elasticities

We have now set the stage to derive expressions for our counterfactual welfare analysis—if we follow most of the gravity literature and merely assume plausible values for the elasticity of substitution, σ, and, in our case, the matching elasticity, μ. In the following, we demonstrate that in principle, both elasticities can be estimated within our quantitative framework, even though the main contribution of this paper is providing a structural gravity framework allowing for imperfect labor markets. Therefore, impatient (or unconvinced) readers may as well simply assume values for σ and μ and continue with Section 2.4. In addition for these readers, we present results of our counterfactual analysis for different assumed values of the elasticities in Table 4.

2.3.1 Estimating the elasticity of substitution

Bergstrand et al. (2013) show how to obtain estimates for σ within their proposed framework without relying on additional data besides the standard trade data. We show that a variant of their approach is also applicable when assuming imperfect labor markets. To estimate σ, in addition to the trade data we only need data on unemployment rates as well as civil labor force data.

First, note that we can rewrite trade flows as given in Equation (3) by observing that the variety price can be substituted by $p_i = y_i/[(1-u_i)L_i]$. This yields $x_{ij} = \left((\beta_i y_i t_{ij})/((1-u_i)L_i P_j)\right)^{1-\sigma} \tilde{y}_j$. Estimation of Equation (7) using observable determinants of bilateral trade costs generates estimates $\widehat{t_{ij}^{1-\sigma}}$. We next substitute $\widehat{t_{ij}^{1-\sigma}}$ in Equation (5) to generate $\hat{x}_{ij}$ and $\widehat{t_{mj}^{1-\sigma}}$ in its analogue to generate $\hat{x}_{mj}$. Using observed unemployment rates we end up with:

$$\frac{\hat{x}_{ij}}{\hat{x}_{mj}} = \frac{\widehat{t_{ij}^{1-\sigma}}}{\widehat{t_{mj}^{1-\sigma}}} \left(\frac{\beta_i y_i (1-u_m) L_m}{\beta_m y_m (1-u_i) L_i} \right)^{1-\sigma}. \tag{10}$$

We can solve Equation (10) for σ, where y_i, y_m, L_i, L_m, u_i, and u_m are observables. In addition, we assume that $\beta_i = \beta_m$. Then, we can calculate $n^2(n-1)$ values of σ by using all combinations i, j, and m ($m \neq i$). As a measure of central tendency, we use the average value of all estimates of $\sigma > 1$ as our summary estimate in order to ensure that trade costs do not counterfactually increase with rising distance. We use bootstrapped standard errors for σ.

2.3.2 Estimating the elasticity of the matching function

The other crucial parameter for our counterfactual analysis is the elasticity of the matching function, μ. As with the elasticity of substitution, there are a great many of plausible estimates of the matching elasticity available in the literature. Still, we demonstrate that it is also possible to obtain an estimate of μ within our structural gravity framework relying on the cross-country-pair variation in bilateral trade flows.

Using again Equations (8) and (9) and defining $\Xi_j \equiv m_j \left(\frac{c_j}{m_j} \Omega_j \right)^{\frac{\mu-1}{\mu}}$, we can write $1 - u_j = \Xi_j \left(p_j / \tilde{P}_j \right)^{(1-\mu)/\mu}$. As we observe u_j in the baseline, we may take ratios for two countries and the log of this ratio to obtain:

$$\ln\left(\frac{1-u_j}{1-u_m}\right) = \frac{1-\mu}{\mu} \left[\ln\left(\frac{p_j}{p_m}\frac{\tilde{P}_m}{\tilde{P}_j}\right) - \ln\left(\frac{c_j \Omega_j}{c_m \Omega_m}\right) \right] + \frac{1}{\mu} \ln\left(\frac{m_j}{m_m}\right). \tag{11}$$

We can solve Equation (11) for μ, where u_j, c_j and Ω_j are in principle observable. The unobservable variety prices p_j and the price indices P_j can be replaced by $(\beta_j p_j)^{1-\sigma} = (y^W/\tilde{y}^W)\theta_j \tilde{\Pi}_j^{\sigma-1} = (y^W/\tilde{y}^W)\mathfrak{t}_j$ and $\tilde{P}_j^{1-\sigma} = \sum_{i=1}^n t_{ij}^{1-\sigma}\mathfrak{t}_i$, respectively. $\mathfrak{t}_i$s can be recovered from solving the system of equations given in Equations (5) and (6) for observed trade flows using an estimate of $\widehat{t_{ij}^{1-\sigma}}$. In our application, we assume again that $\beta_j = \beta_m$. In addition, we assume identical recruiting costs, c_j, and matching efficiencies, m_j, across countries as empirical measures of recruiting costs and efficiencies which are comparable across countries are hard to come by. We also assume that the bargaining power of workers, ξ_j, is 0.5 in all countries. However, we use observed unemployment benefits across countries from OECD (2007).[15] Hence γ_j and thus Ω_j vary across countries and reflect the heterogeneity in this labor market institution across countries.

We can then calculate $n(n-1)$ such values of μ by using all combinations of j and m ($m \neq j$). As a summary estimate, we average over all estimated values of μ within the unit interval. We use bootstrapped standard errors for μ.[16]

2.4 Counterfactual analysis

While trade cost parameters can be recovered without assumptions concerning the labor market according to Implication 1, most researchers estimate gravity equations in order to evaluate counterfactual policy changes which take into account general equilibrium effects. This allows to analyze large policy changes which very likely violate the stable unit treatment assumption (SUTVA) and thus preclude interpreting gravity equation estimates as marginal effects. More importantly, a structural counterfactual analysis allows an ex ante evaluation of a potential policy change, whereas reduced form regressions are best suited for ex post evaluations of actually observed policies.

Having obtained consistent estimates of the trade cost parameters of t_{ij} as well as the elasticities μ and σ, our model structure allows us to conduct counterfactual analyses. Given these estimates, solving the system of equations given by Equation (6) for the multilateral resistance terms $\tilde{P}_j$ and $\tilde{\Pi}_i$ and using the actual observed GDPs to calculate world income shares θ_j gives us the solutions for the baseline scenario.[17] Resolving the system of equations after

[15] For further details on the data, see Section 3.

[16] We use analytical standard errors for the trade cost parameters.

[17] See Appendix A for a detailed description of the solution of the system of multilateral

having changed e.g. the trade cost vector by abolishing all observed PTAs (i.e. setting the PTA dummy variable to 0) yields the multilateral resistance terms in the counterfactual scenario, $\tilde{P}_j^c$ and $\tilde{\Pi}_i^c$. When solving for the counterfactual, one has to take into account that world income shares change endogenously as implied by the model structure.

When calculating counterfactual GDP, all approaches to date neglect changes in the total number of employed workers. For example, in the framework of Anderson and van Wincoop (2003) with perfect labor markets, calculating GDP and corresponding shares in world GDP is easy as "*quantities produced are assumed fixed*" (p. 190). However, this assumption is also very restrictive, as it implies that GDP and welfare changes are solely due to changes in (real) prices. Hence, changes in a country's GDP only translate into price changes in the perfect labor market framework. Similarly, in Eaton and Kortum (2002) the number of employed workers remains constant.

In contrast, our model also leads to *employment* adjustments. When GDP falls, unemployment will rise, which in turn will impact wages. In essence, our model allows labor market variables to affect income. Hence, assuming perfect or imperfect labor markets matters for the proper counterfactual analysis.

In the following, we derive and discuss in turn counterfactual welfare along the lines of Arkolakis et al. (2012), (un)employment, GDP, and trade flows as functions of the multilateral resistance terms in the baseline and counterfactual scenario.

2.4.1 Counterfactual welfare

We can now consider the welfare consequences of a counterfactual change in trade costs that leaves the ability to serve the own market, t_{jj}, unchanged as in Arkolakis et al. (2012). Additionally, we follow their normalization and set the wage in country j, w_j, equal to one. In our economy, (nominal) GDP is given by total production of the final output good multiplied with its price, i.e., $y_i =$

resistance terms with asymmetric trade costs and trade deficits.

$p_i(1-u_i)L_i$, whereas consumable income is given by $\breve{y}_j = (1+d_j)(1-u_j)w_j L_j$.[18] We then come up with the following sufficient statistics (see Appendix B for the derivation):

Implication 2 *Welfare effects of trade liberalization in our model with imperfect labor markets can be expressed as*

$$\hat{W}_j = \hat{e}_j \hat{\lambda}_{jj}^{\frac{1}{1-\sigma}}.$$

Hence, welfare depends on the employment change, $\hat{e}_j$, the change in the share of domestic expenditures, $\hat{\lambda}_{jj}$, and the partial elasticity of imports with respect to variable trade costs, given in our case by $1/(1-\sigma)$. Note that in the case of perfect labor markets $\hat{e}_j = 1$ and $\hat{W}_j = \hat{\lambda}_{jj}^{1/(1-\sigma)}$, which is exactly Equation (6) in Arkolakis et al. (2012).

When $\hat{\lambda}_{jj}$ is observed, assuming imperfect or perfect labor markets would lead to different welfare predictions. The difference in the welfare change is given by $\hat{e}_j$. Hence, assuming perfect labor markets neglects the effects on employment and the corresponding welfare effects. Whether welfare increases or decreases in a particular country depends on the relative magnitude of trade creation and diversion.

While Implication 2 already describes how to calculate welfare within our framework, we can equivalently express the change in welfare as a function of the multilateral resistance terms by using the equivalent variation, i.e. the amount of income the representative consumer would need to make her as well off under current prices $\tilde{P}_j$ as in the counterfactual situation with price level $\tilde{P}_j^c$. The advantage of this formulation is that it allows for trade imbalances and changes in labor market institutions. We can express the equivalent variation

[18] Total consumable income $\breve{y}_j$ consists of the income of employed workers $(1+d_j)(1-u_j)w_j L_j - B_j$, and the income of unemployed workers B_j where $B_j = u_j L_j b_j$, the total sum of unemployment benefits which is financed by a lump-sum transfer from employed workers to the unemployed.

in percent as follows:

$$EV_j \quad = \quad \frac{\check{y}_j^c \frac{\tilde{P}_j}{\tilde{P}_j^c} - \check{y}_j}{\check{y}_j} = \frac{\check{y}_j^c}{\check{y}_j} \frac{\tilde{P}_j}{\tilde{P}_j^c} - 1 = \hat{\check{y}}_j \frac{\tilde{P}_j}{\tilde{P}_j^c} - 1. \tag{12}$$

Note that $\hat{\check{y}}_j = \hat{\upsilon}_j \hat{y}_j$ where $\upsilon_j \equiv \xi_j/(1+\gamma_j\xi_j-\gamma_j)$ and $\hat{\upsilon}_j \equiv \upsilon_j^c/\upsilon_j$. Hence welfare can be calculated by using the expressions for the price indices (which can be derived from the multilateral resistance terms) and the counterfactual change in GDP. To derive the counterfactual change in GDP, it turns out to be useful to first derive an expression for the counterfactual change in (un)employment.

2.4.2 Counterfactual (un)employment

Noting that variety prices p_j are not observed, we follow Anderson and van Wincoop (2003) and use Equation (4) to solve for scaled prices as follows:

$$(\beta_j p_j)^{1-\sigma} = \frac{y_j}{\sum_{i=1}^n \left(\frac{t_{ji}}{\tilde{P}_i}\right)^{1-\sigma} \tilde{y}_i} = \frac{y^W}{\tilde{y}^W} \theta_j \tilde{\Pi}_j^{\sigma-1} = \frac{y^W}{\tilde{y}^W} \mathfrak{t}_j, \tag{13}$$

where $\mathfrak{t}_j \equiv \theta_j \tilde{\Pi}_j^{\sigma-1}$. We then use the definition of u_j given in Equation (8), replacing ϑ_j by the expression given in Equation (9) and defining $\Xi_j \equiv m_j \left(\frac{c_j}{m_j}\Omega_j\right)^{\frac{\mu-1}{\mu}}$ and $\hat{\kappa}_j \equiv \Xi_j^c/\Xi_j$, where superscript c denotes counterfactual values:

$$\frac{e_j^c}{e_j} \equiv \frac{1-u_j^c}{1-u_j} = \hat{\kappa}_j \left(\frac{p_j^c}{p_j}\right)^{\frac{1-\mu}{\mu}} \left(\frac{\tilde{P}_j}{\tilde{P}_j^c}\right)^{\frac{1-\mu}{\mu}}, \tag{14}$$

where e_j denotes the employment rate. Noting the derivation of Equation (13) and remembering that $\tilde{P}_j^{1-\sigma} = \sum_i (y^W/\tilde{y}^W) t_{ij}^{1-\sigma} \mathfrak{t}_i$ (see the definition of the price index and (13)), we can express the ratios of the prices and price indices as functions of $\mathfrak{t}_i$ to end up with counterfactual (un)employment levels summarized in the following implication:

Implication 3 *Whereas in the setting with perfect labor markets (un)employment effects are zero by assumption, the (un)employment effects* *in our gravity system with imperfections on the labor market are given by:*

$$\hat{e}_j \equiv \frac{e_j^c}{e_j} = \hat{\kappa}_j \left(\frac{\mathfrak{t}_j^c}{\mathfrak{t}_j}\right)^{\frac{1-\mu}{\mu(1-\sigma)}} \left(\frac{\sum_i t_{ij}^{1-\sigma}\mathfrak{t}_i}{\sum_i \left(t_{ij}^c\right)^{1-\sigma}\mathfrak{t}_i^c}\right)^{\frac{1-\mu}{\mu(1-\sigma)}},$$
$$\Delta u_j \equiv u_j^c - u_j = (1-u_j)(1-\hat{e}_j).$$

Implication 3 reveals that a country can directly affect its (un)employment level by changes in its labor market institutions, as reflected by changes in $\hat{\kappa}_j$.[19] In addition, all trading partners are affected by such a labor market reform due to changes in prices as reflected by $\mathfrak{t}_i$. Direct effects are scaled by changes in relative prices $p_j/\tilde{P}_j$ which are proportional to $\left(\mathfrak{t}_j/\sum_i t_{ij}^{1-\sigma}\mathfrak{t}_i\right)^{1/(1-\sigma)}$, reflecting the spillovers of labor market reforms to other countries. Changes of relative prices due to trade liberalization therefore provide the link to the labor market.

Even with imperfect labor markets we just need one additional parameter alongside σ, namely μ, the elasticity of the matching function, in order to calculate counterfactual values once we have solved for the multilateral resistance terms. Note that μ plays a crucial role for the importance of the labor market frictions. To illustrate, assume that all labor market institutions remain the same and μ approaches one. Then, the (un)employment effects vanish.[20] A lower μ, i.e., higher labor market frictions, leads to larger changes in (un)employment for given relative price changes. Additionally, all (potential) changes in labor market policies are succinctly summarized in a reduced-form fashion in $\hat{\kappa}_j$.

2.4.3 Counterfactual GDP

We next derive counterfactual (nominal) GDPs. Using the definition of GDP, $y_j = p_j(1-u_j)L_j = p_j e_j L_j$, and taking the ratio of counterfactual GDP, y_j^c, and observed GDP, y_j, we can use Implication 3 and Equation (13) to come

[19] Note that employment changes are homogeneous of degree zero in prices, implying that a normalization does not matter for the employment effects.

[20] In this case the level of unemployment is given by $u_j = 1 - m_j$.

up with the following implication:

Implication 4 *Counterfactual GDPs are given by:*

$$\begin{aligned} &\textit{imperfect labor markets:} \quad \hat{y}_j = \left(\hat{D}^W\right)^{\frac{1}{1-\sigma}} \hat{\kappa}_j \left(\frac{\mathfrak{t}_j^c}{\mathfrak{t}_j}\right)^{\frac{1}{\mu(1-\sigma)}} \left(\frac{\sum_i t_{ij}^{1-\sigma}\mathfrak{t}_i}{\sum_i \left(t_{ij}^c\right)^{1-\sigma}\mathfrak{t}_i^c}\right)^{\frac{1-\mu}{\mu(1-\sigma)}}, \\ &\textit{perfect labor markets:} \quad \hat{y}_j = \left(\hat{D}^W\right)^{\frac{1}{1-\sigma}} \left(\frac{\mathfrak{t}_j^c}{\mathfrak{t}_j}\right)^{\frac{1}{1-\sigma}}, \end{aligned}$$

with $\hat{D}^W \equiv (y^{W,c}\tilde{y}^W)/(\tilde{y}^{W,c}y^W)$ indicating the endogenous change in the world trade deficit to keep trade deficit GDP shares d_js constant. It equals one in the case of balanced trade. In order to ensure a common numéraire, we normalize $\tilde{P}_1 = \tilde{P}_1^c = 1$, i.e., GDP changes are in terms of the price level of the first importer in the data set.[21] If we assume $\mu = 1$ and balanced trade, we end up with the case of perfect labor markets employed by Anderson and van Wincoop (2003).

It is illuminating to decompose the change in GDP as follows:

$$\hat{y}_j = \left(\hat{D}^W\right)^{\frac{1}{1-\sigma}} \underbrace{\left(\frac{\mathfrak{t}_j^c}{\mathfrak{t}_j}\right)^{\frac{\mu}{\mu(1-\sigma)}}}_{\text{price change}} \underbrace{\hat{\kappa}_j \left(\frac{\mathfrak{t}_j^c}{\mathfrak{t}_j}\right)^{\frac{1-\mu}{\mu(1-\sigma)}} \left(\frac{\sum_i t_{ij}^{1-\sigma}\mathfrak{t}_i}{\sum_i \left(t_{ij}^c\right)^{1-\sigma}\mathfrak{t}_i^c}\right)^{\frac{1-\mu}{\mu(1-\sigma)}}}_{\text{employment change}}, \quad (15)$$

with the price change and the employment change as defined in Implication 3.

Let us focus on the numéraire country for a moment. As we use its price index as our numéraire, the last expression in brackets of Equation (15) is equal to one. Then, the equation simplifies to the change in the world deficit, and, when labor market institutions remain constant, i.e. $\hat{\kappa}_j = 0$, to two terms that are equal except for their exponents: the price change term rises to the power of μ and the employment change term to the power of $1-\mu$. Hence, the relative importance of price and employment changes only depends on μ. If μ

[21] As mentioned in footnote 12 in Anderson and van Wincoop (2003), the solution of the multilateral resistance terms (MRTs) adopts a particular normalization. In general, this applied normalization may vary between the baseline MRTs and the counterfactual MRTs. In order to ensure the same normalization for the baseline and counterfactual scenario, we normalize $\tilde{P}_1 = \tilde{P}_1^c = 1$.

approaches one, the labor market rigidities vanish, and the total GDP change is due to the price change, as in models assuming perfect labor markets. With any value of μ between zero and one, the share of the GDP change attributable to the price change is μ and the share due to the employment change $1-\mu$. To illustrate, let $\mu = 0.75$, then three-quarters of the change in GDP are due to the price change and one-quarter is due to the employment change. In all other countries, changes in price indices lead to a more complex relationship. A lower price index lowers recruiting costs and thus spurs employment. This effect is captured by the last bracket in Equation (15). On the other hand, lower variety prices render recruiting less attractive, which is reflected by the first term of the employment change. Hence, the overall effect is ambiguous.

Taking logs, we can attribute the share of log change in GDP divided by $\left(\hat{D}^W\right)^{\frac{1}{1-\sigma}}$, $\hat{y}_j^\star$, due to changes in prices and employment as follows:

$$1 = \frac{\ln \hat{p}_j}{\ln \hat{y}_j^\star} + \frac{\ln \hat{e}_j}{\ln \hat{y}_j^\star}. \tag{16}$$

Alongside GDP changes, we will report this decomposition in all our counterfactual exercises.

2.4.4 Counterfactual trade flows

Finally, given estimates of $t_{ij}^{1-\sigma}$, data on y_i, and a value for σ, we can calculate (scaled) baseline trade flows as $x_{ij}y^W/(y_i\tilde{y}_j) = (t_{ij}/(\tilde{\Pi}_i\tilde{P}_j))^{1-\sigma}$, where $\tilde{\Pi}_i$ and $\tilde{P}_j$ are given by Equation (6). With counterfactual GDPs given by Implication 4, we can calculate counterfactual trade flows as $x_{ij}^c y^{W,c}/(y_i^c\tilde{y}_j^c) = (t_{ij}^c/(\tilde{\Pi}_i^c\tilde{P}_j^c))^{1-\sigma}$, where $\tilde{\Pi}_i^c$ and $\tilde{P}_j^c$ are defined analogously to their counterparts in the baseline scenario given in Equation (6).[22] Due to direct effects of changes in trade costs via t_{ij} and non-trivial changes in $\tilde{\Pi}_i$ and $\tilde{P}_j$, trade may change more or less when assuming imperfect labor markets in comparison

[22] Note that $\tilde{P}_j$ and $\tilde{P}_j^c$ are homogeneous of degree one in prices while $\tilde{\Pi}_i$ and $\tilde{\Pi}_i^c$ are homogeneous of degree minus one. Hence, scaled trade flows $x_{ij}y^W/(y_i\tilde{y}_j)$ and $x_{ij}^c y^{W,c}/(y_i^c\tilde{y}_j^c)$ are homogeneous of degree zero in prices. In other words, they do not depend on the normalization chosen.

with the baseline case of perfect labor markets.

3 Preferential trade agreements and labor market frictions

We now apply our framework to evaluate the trade effects of preferential trade agreements and labor market reforms in a sample of 28 OECD countries for the years 1950 to 2006. The trade data are from Head et al. (2010). We use internationally comparable harmonized unemployment rates as well as employment and civil labor force data from OECD (2012). Internationally comparable gross average replacement rates are from OECD (2007).[23]

To obtain an estimable gravity equation as given in Equation (7), we need to parameterize trade costs. We follow the literature and proxy t_{ij} by a vector of trade barrier variables as follows:

$$t_{ij\tau}^{1-\sigma} = \exp(\delta_1 PTA_{ij\tau} + \delta_2 \ln DIST_{ij} + \delta_3 CONTIG_{ij} + \delta_4 COMLANG_{ij}), \quad (17)$$

where $PTA_{ij\tau}$ is an indicator variable of preferential trade agreement membership between country pair ij in year τ, $DIST_{ij}$ is bilateral distance, $CONTIG_{ij}$ is a dummy variable indicating whether countries i and j are contiguous, and $COMLANG_{ij}$ indicates whether the two countries share a common official language.[24] The data for the PTA's are constructed from the notifications to the World Trade Organization (WTO) and augmented and corrected by using information from PTA secretariat webpages. Table 1 contains summary statistics of the data.

[23] This OECD summary measure is defined as the average of the gross unemployment benefit replacement rates for two earnings levels, three family situations and three durations of unemployment (for details of its calculation see Martin, 1996). As Mexico does not have any unemployment insurance scheme but is characterized by a large informal employment share, its labor market institutions are markedly different to the other OECD countries in our sample. Consequently, no replacement rate data are available for Mexico. We therefore exclude it from our analysis. For all other countries, we use the simple average of replacement rates between 2005 and 2007 as data for 2006 are not available.

[24] We do not use common colonizer indicators or similar variables regularly used in the literature as these have very little variation in our OECD sample.

[Table 1 about here.]

Obviously, countries do not randomly sign PTAs. This has long been recognized in the international trade literature, see for example Trefler (1993), Magee (2003), Baier and Bergstrand (2007), and references therein. Empirical evidence shows that the exogeneity assumption of PTAs is inappropriate when attempting to quantify the effects of regional trade agreements. To avoid potential endogeneity, we follow Baier and Bergstrand (2007) and Anderson and Yotov (2011) and use a two-step estimation approach to obtain consistent estimates of trade cost coefficients. In a first step, we estimate Equation (7) including (directional) bilateral fixed effects, i.e., we estimate

$$z_{ij\tau} = \exp\left(k + \delta_1 PTA_{ij\tau} + \varphi_{i\tau} + \phi_{j\tau} + \nu_{ij} + \varepsilon_{ij}\right), \tag{18}$$

where $\varphi_{i\tau}$ and $\phi_{j\tau}$ are exporter and importer time-varying fixed effects and ν_{ij} is a time-constant (directional) bilateral fixed effect.[25] Note that $\varphi_{i\tau}$ and $\phi_{j\tau}$ control for the multilateral resistance terms $\tilde{\Pi}_i$ and $\tilde{P}_j$, and the bilateral fixed effect also captures the time-invariant geography variables. In a second step, we re-estimate Equation (7) to obtain estimates for the coefficients of the time-invariant geography variables, δ_2 to δ_4. We therefore use only exporter- and importer-time-varying fixed effects and constrain the coefficient of PTA, δ_1, to the estimate of the first step, $\hat{\delta}_1$.

Finally, we use data from the last year in our sample, 2006, to estimate the elasticity of substitution and the elasticity of the matching function.

3.1 Estimation results

We present results estimating log-linearized trade flows by OLS as well as the Poisson pseudo-maximum-likelihood (PPML) estimator for the trade flows in levels following the recommendation by Santos Silva and Tenreyro (2006) in Table 2.

[25] We report results for regressions including bilateral fixed effects, i.e.,$\nu_{ij} = \nu_{ji}$, and directional bilateral fixed effects, i.e., $\nu_{ij} \neq \nu_{ji}$.

[Table 2 about here.]

Columns (1)-(4) of Table 2 present results using bilateral fixed effects, i.e., assuming symmetric trade costs $t_{ij} = t_{ji}$ which is the same assumption made by Anderson and van Wincoop (2003). Columns (5)-(8) allow for asymmetric unobserved trade costs, i.e. $t_{ij} \neq t_{ji}$, by employing directional bilateral fixed effects. Each of these two blocks contains four specifications. Columns (1) and (5) report OLS estimates for scaled trade flows $z_{ij\tau}$ in logs. Column (2) and (6) present PPML estimates for the scaled trade flows in levels to control for heteroskedasticity and zero trade flows. Columns (3) and (7) reproduce Columns (1) and (5) for unscaled trade flows $x_{ij\tau}$. Finally, Columns (4) and (8) present PPML estimates for unscaled trade flows. The slightly larger number of observations for unscaled trade flows stems from the fact that GDP data are not available for all countries in all years where we have trade data and control variables.

Our estimates are in accordance with well-known results from the empirical trade literature. Distance is a large obstacle to trade, whereas contiguity, a common language and PTAs enhance trade. Comparing the results from Columns (1)-(4) with those of Columns (5)-(8) reveals that allowing for asymmetric trade costs does not substantially change our parameter estimates. Comparing with PPML estimates shows a clear pattern: distance coefficients are smaller in absolute values, but all other coefficients are larger (except for the coefficients of $COMLANG$ in specifications (4) and (8)). The differences are larger for estimates using scaled trade rather than unscaled trade flows. Note that in the case of specifications using unscaled trade flows, GDP effects are captured by the time-varying importer- and exporter-fixed effects. Hence, those specifications implicitly allow for non-unitary GDP coefficients.

PTAs increase trade by 30.60 percent (Column (3)) to 40.64 percent (Column (8)) when neglecting general equilibrium effects.[26] The general equilibrium effects are accounted for in the counterfactual analysis, to which we turn in Section 3.2.

[26]Effects are calculated as $(\exp(\hat{\delta}_{PTA}) - 1) \times 100$ percent.

Turning to the elasticity of substitution, our significant estimates lie between 2.349 in Columns (1), (3), and (5) and 2.535 in Columns (2) and (6). These results are very much in line with recent evidence from Feenstra et al. (2012) who report estimates for the Armington elasticity between domestic and foreign goods of around 1 and between different foreign sources of 3.1. As our model forces these two elasticities to be equal, we would expect an estimate that lies in between these two estimates.[27]

Finally, our estimates of the matching elasticity vary between 0.928 and 0.947 and are significant at any standard level of significance. With our method, we find that the elasticity of labor markets in OECD countries indicates a very low level of labor market frictions and a very high matching elasticity compared to previous estimates. For example, Yashiv (2000) estimates μ between 0.2 and 0.6 for Israel for the years between 1975 and 1989. A literature review by Petrongolo and Pissarides (2001) reports estimates between 0.12 and 0.81 across studies focussing on several countries and time periods. Hall (2005) finds $\mu = 0.24$ for the United States for the years 2000 to 2002. Rogerson and Shimer (2011) estimate $\mu = 0.58$ for the same data for the years 2000 to 2009.[28] Even though our estimates are on the high side, note that our method infers the matching elasticity from (ratios) of bilateral trade flows using their cross-country-pair variation at one point in time. All other estimates of the matching elasticity in the literature use time series data on the number of matches, vacancies, and the unemployed from a single labor market. Hence, it is not too surprising that our estimates are somewhat different from the literature. In the counterfactual analysis, to which we turn next, we therefore provide results for alternative values of the matching elasticity.

[27] See Feenstra (2010) for a detailed discussion of estimates of the elasticity of substitution in international trade.

[28] Note that the literature reports both estimates of the matching elasticity with respect to the unemployed, as we do, or with respect to vacancies. In our discussion, we transformed the estimates when necessary assuming constant returns to scale in the matching process.

3.2 Counterfactual analysis

We conduct two counterfactual experiments in our OECD sample. First, we evaluate the effects of PTAs. To this end, we compare a situation with PTAs as observed in 2006 with a counterfactual situation without any PTAs. Second, we evaluate improvements of labor market institutions in the United States and Germany.

3.2.1 Evaluating the effects of PTAs

Our first counterfactual experiment evaluates the effects of introducing PTAs as observed in 2006 compared to a counterfactual situation in which there are no PTAs. We base our counterfactual analysis on parameter estimates from Column (6) of Table 2 as they control for heteroskedasticity and impose unitary income elasticities for trade flows consistent with our framework.

The results are shown in Table 3.[29] It is organized as follows. Column (1), "PLM %GDP", gives the percentage change in nominal GDP in terms of the price index of Australia for the case of perfect labor markets. Column (2), "SMF %GDP", gives the same change within our search and matching framework. Columns (3) and (4) use Equation (16) and decompose the change in nominal GDP of Column (2) into price and employment changes. Column (5) reports the percentage change in the employment share for the case of imperfect labor markets, whereas Column (6) reports unemployment changes in percentage points. Finally, Columns (7) and (8) report the equivalent variation (EV) for the case of perfect and imperfect labor markets, respectively.

Table 3 reveals that all countries gain in terms of GDP when introducing PTAs as observed in 2006. This translates into an average gain in terms of GDP of 12.73 percent when assuming perfect labor markets. The average GDP gain increases by 4 percent to 13.28 percent when accounting for employment effects. Hidden behind these average effects is substantial heterogeneity. Some countries gain substantially more than the average, for example Canada with

[29] In the companion web appendix, we additionally provide results concerning the changes in trade flows across countries.

a gain of 20.70 percent, whereas other countries such as the United States experience a smaller increase of 9.92 percent. The decomposition of (log) GDP change into (log) price and (log) employment changes highlights that for many of our sample countries, roughly 7 percent of the increase in GDP is driven by the increase in employment. Countries with only slight increases in GDP may even see negative employment effects, as can be seen in Column (5) of Table 3. Typically, welfare effects are magnified when taking into account employment effects. For example, the standard welfare estimate for Canada is about 5 percent larger when taking into account labor markets imperfections.

To assess the fit of our model, we first compare the implied changes in both openness (measured as imports plus exports over nominal GDP) and in unemployment rates predicted by our model with actually observed data for our sample. While it is straightforward to calculate these changes for our model, we cannot, of course, observe "real-world" counterfactual openness and unemployment rates. Thus, to compare model predictions with observed data, we take a simple and admittedly very crude approach: we calculate the observed change in openness and the unemployment rate as the change between the first year for which unemployment rate data are available and 2006.[30] Note that we standardized changes for comparison reasons. As can be seen from Figure 1, our model replicates the average negative correlation between openness and unemployment. The correlation between the fitted values of the two regression lines is 0.57.

[Figure 1 about here.]

[Figure 2 about here.]

[30] The first year is 1955 for the United States and Japan, 1956 for New Zealand, Ireland, France, and Canada, 1958 for Finland, 1959 for Italy, 1960 for Denmark and Turkey, 1961 for Greece, 1962 for Germany, 1964 for Australia and Austria, 1970 for Sweden, 1972 for Norway, Spain, and the United Kingdom, 1975 for Switzerland, 1983 for Belgium and the Netherlands, 1984 for Portugal, 1989 for Korea, 1990 for Poland, 1991 for Iceland, 1992 for Hungary, 1993 for the Czech Republic, and 1994 for the Slovak Republic. Note that all countries either had no or only a few PTAs in place for the first year in which we observe the unemployment rate, but all of them had experienced a tremendous increase in PTAs by 2006.

As an additional validation of our results we compare observed unemployment rates in the first year available for our sample countries with the implied counterfactual unemployment rates without PTAs predicted by our model (see Figure 2). The correlation between the observed and predicted counterfactual unemployment rate is 0.54 which is tantamount to explaining 29 percent of the variation in the observed unemployment rate. Thus, although there is room for improving the model fit, we are the first to explain any of the observed variation in unemployment rates by changes in international trade policy changes.

As in every trade model, the resulting magnitudes of policy changes crucially depend on the exact values of the elasticities. We therefore test the sensitivity of our results to different values of the elasticity of substitution σ and the elasticity of the matching function μ. In the interest of brevity, we present only average effects in Table 4. The GDP, employment, and EV effects crucially depend on the values of σ and μ. When the elasticity of substitution increases, GDP, employment, and EV changes become smaller. This is because varieties are better substitutes, making trade less important. Hence, incepting PTAs leads to smaller predicted gains in terms of GDP, employment, and welfare. Changes in the elasticity of the matching function μ also show a clear pattern. Lower values of μ indicate higher GDP, employment, and welfare changes. A lower μ corresponds to larger labor market imperfections. When μ approaches 1 we end up in the case of perfect labor markets. The reason for this is that larger frictions on the labor market imply that firms have to post more vacancies in order to find a worker, effectively increasing recruiting costs. As trade liberalization decreases the overall price level, it also lessens a firm's recruiting costs. This reduction of recruiting costs is more important in labor markets with higher frictions, making trade liberalization more attractive. Overall, Table 4 highlights that the extent of labor market frictions plays a crucial role in assessing the quantitative impact of free trade agreements.

[Table 3 about here.]

[Table 4 about here.]

3.2.2 Evaluating the effects of labor market reforms

In our second counterfactual experiment, we evaluate the effects of a hypothetical labor market reform which improves U.S. labor market institutions. We implement this by a 3 percent increase in $\hat{\kappa}_j$ for the United States, i.e., we set $\hat{\kappa}_{U.S.}$ to 1.03. Given our estimate of the matching elasticity of $\mu = 0.928$, this change in $\hat{\kappa}_{U.S.}$ corresponds to either an increase of 2.8 percent in the overall matching efficiency m_j or a 32 percent reduction of recruiting costs in the United States. Note that within our framework we do not necessarily have to specify the explicit source of changes in labor market institutions. The results of this experiment are set out in Table 5.[31]

[Table 5 about here.]

All countries gain in terms of GDP when U.S. labor market institutions improve. This highlights the positive spillover effects, recently theorized by Egger et al. (2012) and Felbermayr et al. (2013), and documented empirically in a reduced-form setting in Felbermayr et al. (2013). Of course, when perfect labor markets are assumed, it is not possible to evaluate any change in them. Therefore, Columns (1) and (7) are uninformative. The decomposition of (log) GDP into (log) price and (log) employment changes highlights that in the United States prices fall and all increases in GDP are due to increases in employment. For the trading partners of the United States, the positive GDP effects are composed of roughly 97 percent of price changes and 3 percent changes in employment. This can also be seen when comparing the relative magnitudes of the employment changes reported in Column (5) of Table 5. Concerning welfare, obviously the United States profit the most from its improvements in labor market institutions, with an increase in welfare of 2.54 percent. However and importantly, all other countries also gain, with the highest gains for Canada at 1.21 percent.

[31] Again, detailed results on the heterogeneous trade effects can be found in the companion web appendix.

We also analyzed the recent German labor market reforms implemented between 2003 and 2005.[32] These reforms reduced unemployment benefits to increase search incentives for unemployed workers and are thought to have increased the overall matching efficiency of German labor markets.[33] For our counterfactual scenario, we reduce the matching efficiency by 5 percent and increase the replacement rate to the level prevailing in 2003. We find that unemployment in Germany would be about 4 percentage points higher and GDP more than 4 percent lower were it to undo its recent labor market reforms.

4 Conclusion

State of the art frameworks for quantitative analyses of international trade policies to evaluate the trade and welfare implications of trade liberalization all assume perfect labor markets. However, net employment effects are at the heart of the political debate on trade integration. Accordingly, recent developments in international trade theory have highlighted the link between trade liberalization and labor market outcomes.

We build on these theoretical contributions to develop a quantitative framework of bilateral trade flows which takes into account labor market frictions within a search and matching framework. Our model allows counterfactual analysis of changes in trade costs and labor market reforms on trade flows, prices, employment, and welfare.

We apply our structural model to a sample of 28 OECD countries from 1950 to 2006 to evaluate the effects of preferential trade agreements (PTAs) and labor market reforms in the United States and Germany. We find that introducing PTAs as observed in 2006 leads to greater GDP increases when accounting for aggregate employment effects. Countries with only slight increases in GDP see negative employment effects. Our second counterfactual analysis assumes an improvement of labor market institutions in the United States. Average welfare effects are substantially magnified when taking into

[32] Results can be found in the companion web appendix.

[33] Fahr and Sunde (2009) estimate this increase to be about 5 percent.

account employment effects. U.S. GDP increases roughly five times more than GDP of the other countries. While the United States profits the most from improvements of its labor market institutions with an equivalent variation of 2.54 percent, all of its trading partners also experience an increase in welfare due to positive spillover effects.

As our approach does not require any information about the labor market except for the elasticity of the matching function, it can be easily applied to any other field in which the gravity equation is employed.

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Appendix

Introduction to the Appendix

In this Appendix, we present further results and derivations.

In Section A, we derive the solution of the system of asymmetric multilateral resistance equations.

In Section B, we derive sufficient statistics for welfare with imperfect labor markets and show that in the case of imperfect labor markets, the welfare statistics presented in Arkolakis et al. (2012) are augmented by the net employment change.

A Solution of asymmetric multilateral resistance equations

Using Equation (6), we can write $\tilde{\Pi}_i^{1-\sigma} = \sum_{j=1}^n t_{ij}^{1-\sigma} \tilde{P}_j^{\sigma-1} \tilde{\theta}_j$. Defining $\mathfrak{P}_\mathfrak{j} = \tilde{\theta}_j \tilde{P}_j^{\sigma-1}$ leads to $\tilde{\Pi}_i^{1-\sigma} = \sum_{j=1}^n t_{ij}^{1-\sigma} \mathfrak{P}_j$. Similarly, $\tilde{P}_j$ can be written as $\tilde{P}_j^{1-\sigma} = \sum_{i=1}^n t_{ij}^{1-\sigma} \tilde{\Pi}_i^{\sigma-1} \theta_i$. Defining $\mathfrak{t}_i = \theta_i \tilde{\Pi}_i^{\sigma-1}$ leads to $\tilde{P}_j^{1-\sigma} = \sum_{i=1}^n t_{ij}^{1-\sigma} \mathfrak{t}_i$. Now dividing $\tilde{\Pi}_i^{1-\sigma} = \sum_{j=1}^n t_{ij}^{1-\sigma} \mathfrak{P}_j$ by $\tilde{\Pi}_i^{1-\sigma}$ and using again $\mathfrak{t}_i = \theta_i \tilde{\Pi}_i^{\sigma-1}$ leads to $\theta_i = \mathfrak{t}_i \sum_{j=1}^n t_{ij}^{1-\sigma} \mathfrak{P}_j$ which can be rearranged to $\theta_i = \mathfrak{t}_i \sum_{j=1}^n t_{ij}^{1-\sigma} \mathfrak{P}_j$. Similarly, dividing $\tilde{P}_j^{1-\sigma} = \sum_{i=1}^n t_{ij}^{1-\sigma} \mathfrak{t}_i$ by $\tilde{P}_j^{1-\sigma}$ and using again $\mathfrak{P}_j = \tilde{\theta}_j \tilde{P}_j^{\sigma-1}$ leads to $\tilde{\theta}_j = \mathfrak{P}_j \sum_{i=1}^n t_{ij}^{1-\sigma} \mathfrak{t}_i$ which can be rearranged to $\tilde{\theta}_j = \mathfrak{P}_j \sum_{i=1}^n t_{ij}^{1-\sigma} \mathfrak{t}_i$. $\theta_i = \mathfrak{t}_i \sum_{j=1}^n t_{ij}^{1-\sigma} \mathfrak{P}_j$ and $\tilde{\theta}_j = \mathfrak{P}_j \sum_{i=1}^n t_{ij}^{1-\sigma} \mathfrak{t}_i$ define a system of $2n$ equations that can be solved for the $2n$ unknowns $\mathfrak{t}_i$ and $\mathfrak{P}_j$.

B Sufficient statistics for welfare with imperfect labor markets

We follow Arkolakis et al. (2012) in the following derivations. Defining real income as $W_j \equiv \check{y}_j / P_j$ and taking logs, the total differential is given by $d \ln W_j = d \ln \check{y}_j - d \ln P_j$. As $y_j = p_j(1 - u_j)L_j$, we can write analogously

$d\ln y_j = d\ln p_j - u_j/(1-u_j)d\ln u_j = -u_j/(1-u_j)d\ln u_j$ assuming that the labor force remains constant. The second expression on the right-hand side uses the wage curve $w_j = \xi_j/(1+\gamma_j\xi_j - \gamma_j)p_j$, implying $d\ln w_j = d\ln p_j$ holding all labor market parameters constant and choice of numéraire w_j. Assuming that $d_j = 0$, i.e. that there are no trade imbalances, it holds that $d\ln \check{y}_j = d\ln y_j$.

The total differential of $\ln P_j = \ln\left\{\left[\sum_{i=1}^n (\beta_i p_i t_{ij})^{1-\sigma}\right]^{\frac{1}{1-\sigma}}\right\}$ is given by

$$d\ln P_j = \sum_{i=1}^n \left(\left(\frac{\beta_i p_i t_{ij}}{P_j}\right)^{1-\sigma} d\ln p_i + \left(\frac{\beta_i p_i t_{ij}}{P_j}\right)^{1-\sigma} d\ln t_{ij}\right).$$

Using $x_{ij} = ((\beta_i p_i t_{ij})/P_j)^{1-\sigma} y_j$ and defining $\lambda_{ij} = x_{ij}/y_j = ((\beta_i p_i t_{ij})/P_j)^{1-\sigma}$, yields

$$d\ln P_j = \sum_{i=1}^n \lambda_{ij}\left(d\ln p_i + d\ln t_{ij}\right). \tag{19}$$

Noting again that $d\ln p_i = d\ln w_i$ holds, we can also write: $d\ln P_j = \sum_{i=1}^n \lambda_{ij}(d\ln w_i + d\ln t_{ij})$. Combining terms leads to $d\ln W_j = d\ln y_j - d\ln P_j = -\frac{u_j}{1-u_j}d\ln u_j - \sum_{i=1}^n \lambda_{ij}(d\ln w_i + d\ln t_{ij})$. Taking the ratio of λ_{ij} and λ_{jj} we can write $\lambda_{ij}/\lambda_{jj} = [(\beta_i p_i t_{ij})/(\beta_j p_j t_{jj})]^{1-\sigma}$. Noting that $dt_{jj} = 0$ by assumption and that w_j is the numéraire, so that $dw_j = dp_j = 0$, the log-change of this ratio is given by $d\ln\lambda_{ij} - d\ln\lambda_{jj} = (1-\sigma)(d\ln t_{ij} + d\ln p_i)$. Combining this with Equation (19) leads to:

$$d\ln P_j = \frac{1}{1-\sigma}\left(\sum_{i=1}^n \lambda_{ij} d\ln\lambda_{ij} - d\ln\lambda_{jj}\sum_{i=1}^n \lambda_{ij}\right).$$

Noting that $y_j = \sum_{i=1}^n x_{ij}$, it follows that $\sum_{i=1}^n \lambda_{ij} = 1$ and $d\sum_{i=1}^n \lambda_{ij} = \sum_{i=1}^n d\lambda_{ij} = 0$. Hence, $\sum_{i=1}^n \lambda_{ij} d\ln\lambda_{ij} = \sum_{i=1}^n d\lambda_{ij} = 0$. Using these facts, the above expression simplifies to $d\ln P_j = -\frac{1}{1-\sigma}d\ln\lambda_{jj}$. The welfare change can than be expressed as $d\ln W_j = -\frac{u_j}{1-u_j}d\ln u_j + \frac{1}{1-\sigma}d\ln\lambda_{jj}$. Integrating between the initial and the counterfactual situation we get $\ln\hat{W}_j = \ln\hat{e}_j + \frac{1}{1-\sigma}\ln\hat{\lambda}_{jj}$, where $e_j = 1-u_j$ is the share of employed workers. Taking exponents leads to $\hat{W}_j = \hat{e}_j\hat{\lambda}_{jj}^{\frac{1}{1-\sigma}}$. Moving from any observed level of trade to autarky, i.e.,

$\lambda^c_{jj} = 1$, yields $\hat{W}_j = \hat{e}_j \left(\lambda_{jj}\right)^{-\frac{1}{1-\sigma}}$. Note, however, that in contrast to the case with perfect labor markets considered in Arkolakis et al. (2012), even this expression needs information about employment changes.

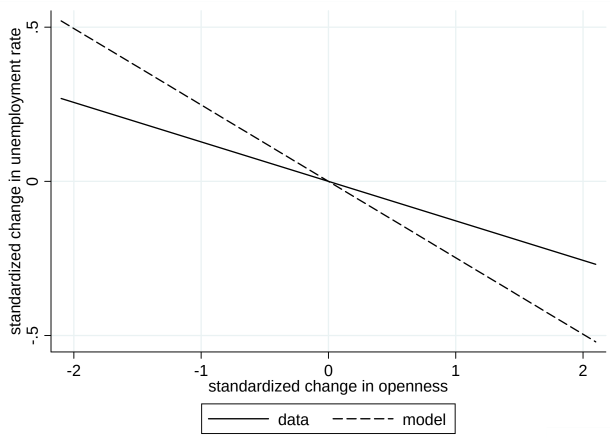

Figure 1: Implied regression lines of changes in openness and unemployment rates for both model and data.

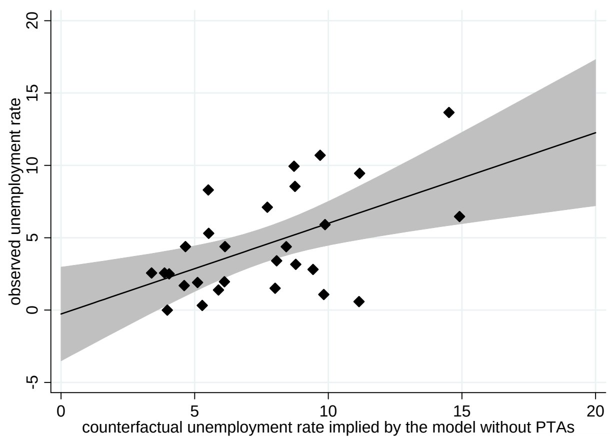

Figure 2: Regression of observed unemployment rate on the counterfactual unemployment rate implied by the model without PTAs.

Table 1: Summary statistics

	Mean	Std. Dev.	Min.	Max.	N
x_{ij} (cur. mn U.S.$)	2,048.991	8,950.166	0	348,420.6	38,313
GDP (cur. mn U.S.$)	386,072.995	1,143,571.923	126.99	13,201,819	43,372
PTA	0.237	0.425	0	1	44,688
$\ln DIST$	7.863	1.213	4.201	9.880	44,688
$CONTIG$	0.077	0.266	0	1	44,688
$COMLANG$	0.074	0.262	0	1	44,688

Notes: Summary statistics for the OECD sample from 1950 to 2006. The 28 countries included are Australia, Austria, Belgium, Canada, the Czech Republic, Denmark, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Japan, Korea, Netherlands, New Zealand, Norway, Poland, Portugal, the Slovak Republic, Spain, Sweden, Switzerland, Turkey, the United Kingdom, and the United States. Data are taken from Head et al. (2010).

Table 2: Estimation results for the OECD sample, 1950-2006

	(1) OLS $\ln z_{ij\tau}$	(2) PPML $z_{ij\tau}$	(3) OLS $\ln x_{ij\tau}$	(4) PPML $x_{ij\tau}$	(5) OLS $\ln z_{ij\tau}$	(6) PPML $z_{ij\tau}$	(7) OLS $\ln x_{ij\tau}$	(8) PPML $x_{ij\tau}$
Second stage								
$\ln DIST_{ij}$	-1.050***	-0.669***	-1.041***	-0.816***	-1.050***	-0.669***	-1.040***	-0.813***
	(0.009)	(0.027)	(0.010)	(0.010)	(0.009)	(0.027)	(0.010)	(0.010)
$CONTIG_{ij}$	0.097***	0.276***	0.116***	0.414***	0.097***	0.275***	0.115***	0.414***
	(0.019)	(0.030)	(0.019)	(0.018)	(0.019)	(0.030)	(0.019)	(0.018)
$COMLANG_{ij}$	0.386***	0.769***	0.387***	0.150***	0.386***	0.769***	0.387***	0.151***
	(0.019)	(0.049)	(0.019)	(0.017)	(0.019)	(0.049)	(0.019)	(0.017)
First stage								
$PTA_{ij\tau}$	0.274***	0.308***	0.267***	0.332***	0.274***	0.311***	0.276***	0.341***
	(0.016)	(0.019)	(0.017)	(0.019)	(0.014)	(0.016)	(0.015)	(0.013)
Estimated elasticities								
σ	2.349***	2.535***	2.349***	2.395***	2.349***	2.535***	2.350***	2.395***
	(0.303)	(0.051)	(0.024)	(0.728)	(0.352)	(0.195)	(0.255)	(0.476)
μ	0.946***	0.928***	0.947***	0.938***	0.946***	0.928***	0.947***	0.938***
	(0.003)	(0.007)	(0.001)	(0.009)	(0.005)	(0.007)	(0.003)	(0.008)
zero trade		X		X		X		X
symmetric $t_{ij\tau}$	X	X	X	X				
asymmetric $t_{ij\tau}$					X	X	X	X
N	36,945	37,741	37,493	38,313	36,945	37,741	37,493	38,313

Notes: Results for trade flows between 28 OECD countries between 1950 and 2006 estimated by ordinary least squares (OLS) and Poisson pseudo-maximum-likelihood (PPML). z_{ij} are trade flows standardized by importer and exporter GDPs. $\ln DIST$ is distance between exporting and importing country, $CONTIG$ is an indicator variable equal to 1 if the exporting and importing countries i and j share a common border, $COMLANG$ is an indicator variable equal to 1 if the exporting and importing country share a common official language, and PTA is an indicator variable equal to 1 if the exporting and importing country have signed a preferential trade agreement. All regressions control for multilateral resistance terms (MRTs) via exporter and importer fixed effects. (Robust) standard errors in parentheses, *** $p < 0.01$. Standard errors for σ and μ are bootstrapped using 200 replications.

Table 3: Comparative static effects of PTA inception controlling for trade imbalances in 2006

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	PLM	SMF	share %GDP SMF		SMF	SMF	PLM	SMF
	%GDP	%GDP	$\% \ln(\hat{p})$	$\% \ln(\hat{e})$	$\%\hat{e}$	Δu	%EV	%EV
Australia	16.45	17.40	92.75	7.25	1.17	-1.10	16.49	17.43
Austria	17.73	19.01	91.69	8.31	1.46	-1.37	20.59	22.12
Belgium	18.25	19.61	91.45	8.55	1.55	-1.40	21.92	23.57
Canada	20.70	22.16	90.60	9.40	1.90	-1.75	28.24	29.72
Czech Republic	17.29	18.50	91.95	8.05	1.38	-1.26	19.36	20.80
Denmark	16.71	17.84	92.28	7.72	1.28	-1.21	17.84	19.16
Finland	15.90	16.91	92.77	7.23	1.14	-1.04	15.72	16.90
France	15.70	16.71	92.88	7.12	1.11	-1.00	15.22	16.43
Germany	15.27	16.22	93.31	6.69	1.01	-0.90	13.77	14.91
Greece	15.62	16.60	92.92	7.08	1.10	-0.99	15.10	16.24
Hungary	16.79	17.92	92.24	7.76	1.29	-1.18	18.01	19.35
Iceland	15.36	16.26	93.17	6.83	1.04	-1.00	14.28	15.29
Ireland	16.19	17.20	92.66	7.34	1.17	-1.11	16.35	17.49
Italy	15.22	16.15	93.27	6.73	1.01	-0.94	13.83	14.94
Japan	9.25	9.28	101.03	-1.03	-0.09	0.09	-1.24	-1.26
Korea	9.39	9.44	100.71	-0.71	-0.06	0.06	-0.90	-0.89
Netherlands	16.86	18.01	92.32	7.68	1.28	-1.21	17.86	19.23
New Zealand	10.49	10.72	98.70	1.30	0.13	-0.13	1.61	1.85
Norway	16.38	17.45	92.55	7.45	1.21	-1.15	16.78	18.02
Poland	16.58	17.69	92.34	7.66	1.26	-1.07	17.53	18.83
Portugal	16.02	17.04	92.70	7.30	1.16	-1.06	16.03	17.21
Slovak Republic	17.05	18.22	92.08	7.92	1.34	-1.14	18.72	20.11
Spain	15.15	16.07	93.25	6.75	1.01	-0.92	13.86	14.93
Sweden	16.17	17.22	92.61	7.39	1.18	-1.09	16.39	17.62
Switzerland	18.50	19.89	91.31	8.69	1.59	-1.51	22.66	24.34
Turkey	15.58	16.54	93.00	7.00	1.08	-0.96	14.87	15.97
United Kingdom	13.61	14.31	94.49	5.51	0.74	-0.70	9.92	10.72
United States	9.92	10.08	99.63	0.37	0.04	-0.03	0.30	0.49
Average	12.73	13.28	96.59	3.41	0.55	-0.50	7.53	8.16

Notes: Counterfactual analysis is based on parameter estimates from column (6) of Table 2. PLM gives results assuming perfect labor markets. SMF gives results using a search and matching framework for the labor market. Averages are weighted averages using country GDP as weight.

Table 4: Average comparative static effects of PTA inception controlling for trade imbalances for various parameter values

μ	σ	PLM %GDP	SMF %GDP	SMF $\%\hat{e}$	SMF $\%\Delta u$	PLM %EV	SMF %EV
	5	4.81	16.68	11.91	-9.24	2.75	15.25
0.2	10	2.13	7.11	5.00	-4.22	1.20	6.33
	15	1.37	4.51	3.16	-2.74	0.77	3.98
	5	4.81	7.54	2.75	-2.41	2.75	5.67
0.5	10	2.13	3.32	1.20	-1.08	1.20	2.44
	15	1.37	2.13	0.77	-0.70	0.77	1.55
	5	4.81	5.69	0.90	-0.81	2.75	3.71
0.75	10	2.13	2.52	0.40	-0.36	1.20	1.61
	15	1.37	1.62	0.25	-0.23	0.77	1.03
	5	4.81	5.10	0.30	-0.27	2.75	3.07
0.9	10	2.13	2.26	0.13	-0.12	1.20	1.34
	15	1.37	1.45	0.08	-0.08	0.77	0.85
	5	4.81	4.83	0.03	-0.03	2.75	2.78
0.99	10	2.13	2.14	0.01	-0.01	1.20	1.21
	15	1.37	1.37	0.01	-0.01	0.77	0.78

Notes: Table reports average changes in nominal GDP, employment, and the equivalent variation in percent assuming either a perfect labor market (PLM) or using a search and matching framework (SMF) for the labor market controlling for trade imbalances with varying elasticity of substitution σ and elasticity of the matching function μ. The remaining parameters are set to values from column (6) of Table 2.

Table 5: Comparative static effects of $\hat{\kappa}_{U.S.} = 1.03$ controlling for trade imbalances in 2006

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	PLM	SMF	share %GDP SMF		SMF	SMF	PLM	SMF
	%GDP	%GDP	$\% \ln(\hat{p})$	$\% \ln(\hat{e})$	$\%\hat{e}$	Δu	%EV	%EV
Australia	0.00	0.79	92.75	7.25	0.06	-0.05	0.00	0.77
Austria	0.00	0.50	98.72	1.28	0.01	-0.01	0.00	0.09
Belgium	0.00	0.48	99.41	0.59	0.00	-0.00	0.00	0.04
Canada	0.00	0.96	90.76	9.24	0.09	-0.08	0.00	1.21
Czech Republic	0.00	0.52	98.14	1.86	0.01	-0.01	0.00	0.13
Denmark	0.00	0.53	97.89	2.11	0.01	-0.01	0.00	0.15
Finland	0.00	0.56	97.15	2.85	0.02	-0.01	0.00	0.21
France	0.00	0.52	98.23	1.77	0.01	-0.01	0.00	0.12
Germany	0.00	0.52	98.28	1.72	0.01	-0.01	0.00	0.12
Greece	0.00	0.55	97.34	2.66	0.01	-0.01	0.00	0.20
Hungary	0.00	0.53	97.73	2.27	0.01	-0.01	0.00	0.16
Iceland	0.00	0.62	95.59	4.41	0.03	-0.03	0.00	0.37
Ireland	0.00	0.59	96.30	3.70	0.02	-0.02	0.00	0.29
Italy	0.00	0.53	97.81	2.19	0.01	-0.01	0.00	0.16
Japan	0.00	0.55	97.53	2.47	0.01	-0.01	0.00	0.18
Korea	0.00	0.55	97.34	2.66	0.01	-0.01	0.00	0.20
Netherlands	0.00	0.51	98.48	1.52	0.01	-0.01	0.00	0.10
New Zealand	0.00	0.73	93.58	6.42	0.05	-0.04	0.00	0.64
Norway	0.00	0.56	97.17	2.83	0.02	-0.01	0.00	0.21
Poland	0.00	0.53	97.78	2.22	0.01	-0.01	0.00	0.16
Portugal	0.00	0.56	96.88	3.12	0.02	-0.02	0.00	0.24
Slovak Republic	0.00	0.53	97.83	2.17	0.01	-0.01	0.00	0.16
Spain	0.00	0.55	97.23	2.77	0.01	-0.01	0.00	0.21
Sweden	0.00	0.55	97.44	2.56	0.01	-0.01	0.00	0.19
Switzerland	0.00	0.48	99.47	0.53	0.00	-0.00	0.00	0.03
Turkey	0.00	0.56	96.99	3.01	0.02	-0.01	0.00	0.23
United Kingdom	0.00	0.62	95.71	4.29	0.03	-0.02	0.00	0.36
United States	0.00	2.55	-16.54	116.54	2.97	-2.83	0.00	2.54
Average	0.00	1.30	55.11	44.89	1.11	-1.06	0.00	1.10

Notes: Counterfactual analysis is based on parameter estimates from column (6) of Table 2. PLM gives results assuming perfect labor markets. SMF gives results using a search and matching framework for the labor market. Averages are weighted averages using country GDP as weight.

International Trade and Unemployment: A Quantitative Framework Companion Web Appendix —Only For Online Publication—

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Introduction to the companion web appendix

In this companion web appendix, we present further results and robustness checks for the paper "International Trade and Unemployment: A Quantitative Framework", mimeo.

In Section A, we present a variant of our model where wages are determined by a binding minimum wage instead of bargaining once the match between a worker and firm is established. We derive counterfactual changes in employment and show that for constant labor market institutions, calculated employment changes are identical to the ones assuming wage bargaining as in the main text.

In Section B, we assume that the wage setting process is determined within an efficiency wage framwork. Again, when labor market institutions remain unchanged, calculated changes in employment and GDP are identical to the model presented in the main text.

In Section C, we present an alternative model setup in the vein of the Ricardian model of international trade by Eaton and Kortum (2002) and show that our results from the main text hold when reinterpreting the elasticity of substitution as the technology dispersion parameter used in Eaton and Kortum (2002).

Section D presents further results on trade flow and employment changes for the evaluation of PTAs and labor market reforms in the United States as well as detailed results for labor market reforms in Germany as presented in Section 3 from the main text.

Finally, Section E presents results for the counterfactual analyses in Section 3 from the main text under the assumption of balanced trade.

A Minimum wages within the search and matching framework

In this Section, we introduce minimum wages in our search and matching framework. The binding minimum wage replaces the bargaining of workers and firms that are matched. We then show that this leads to expressions for counterfactual changes in GDP, employment, trade flows, and welfare which are isomorphic to those in the main text.

We assume balanced trade for the following derivations. Let us first consider the bounds for a binding minimum wage. If the minimum wage is above the wage that a firm and a worker agree upon, it is not binding and hence not relevant. The lower bound for a binding minimum wage, denoted by $\underline{w}_j$, is therefore given by the **wage curve** from the main text

$$\underline{w}_j = w_j = \frac{\xi_j}{1 + \gamma_j \xi_j - \gamma_j} p_j. \tag{20}$$

The upper bound for a minimum wage, denoted by $\overline{w}_j$, is given by the job's output, as firms would not be able to recover recruiting costs. Hence, $\overline{w}_j = p_j$.

A well defined equilibrium with a binding minimum wage $\tilde{w}_j$ exists if $\underline{w}_j < \tilde{w}_j < \overline{w}_j$. With a given binding minimum wage, the wage curve is no longer relevant. ϑ_j can be solved by using the **job creation curve** given in the main text

$$\tilde{w}_j = p_j - \frac{P_j c_j}{m_j \vartheta_j^{-\mu}} \Rightarrow$$
$$\vartheta_j = \left(\frac{p_j - \tilde{w}_j}{P_j}\right)^{1/\mu} \left(\frac{c_j}{m_j}\right)^{-1/\mu}, \tag{21}$$

which corresponds to Equation (9) in the main text. By replacing u_j by Equation (8) from the main text and using Equation (21), GDP in country j can be written as:

$$y_j = p_j(1 - u_j)L_j = p_j m_j \left(\frac{p_j - \tilde{w}_j}{P_j}\right)^{\frac{1-\mu}{\mu}} \left(\frac{c_j}{m_j}\right)^{\frac{\mu-1}{\mu}} L_j. \tag{22}$$

Assuming that the nominal minimum wage is indexed to prices, we can express it as a share of prices, i.e. $\tilde{w}_j = \xi_j p_j$. This allows us to express GDP solely as a function of prices and parameters. Similarly, (counterfactual) employment can be rewritten using Equation (8) in the main text and Equation (21). Then, defining $\tilde{\Xi}_j = m_j \left(\frac{c_j}{m_j}\right)^{\frac{\mu-1}{\mu}}$ and $\hat{\tilde{\kappa}}_j = \tilde{\Xi}^c_j / \tilde{\Xi}_j$, we get

$$\frac{1-u_j^c}{1-u_j} = \hat{\tilde{\kappa}}_j \left(\frac{p_j^c - \tilde{w}_j}{p_j - \tilde{w}_j}\right)^{\frac{1-\mu}{\mu}} \left(\frac{P_j}{P_j^c}\right)^{\frac{1-\mu}{\mu}} . \tag{23}$$

Using again that $\tilde{w}_j = \xi_j p_j$, the last expression simplifies to

$$\frac{1-u_j^c}{1-u_j} = \hat{\tilde{\kappa}}_j^* \left(\frac{p_j^c}{p_j}\right)^{\frac{1-\mu}{\mu}} \left(\frac{P_j}{P_j^c}\right)^{\frac{1-\mu}{\mu}} , \tag{24}$$

where $\hat{\tilde{\kappa}}_j^* = \hat{\tilde{\kappa}}_j((1-\xi_j^c)/(1-\xi_j))^{(1-\mu)/\mu}$. Equation (24) exactly corresponds to Equation (14) in the main text except for the replacement of $\hat{\kappa}_j$ by $\hat{\tilde{\kappa}}_j^*$. Hence, when assuming that labor market institutions (here: minimum wage levels) do not change, we can proceed as with bargained wages to calculate employment effects.

Note that in the case of binding minimum wages, all GDP changes are due to employment changes. Hence, counterfactual GDP changes correspond to employment changes.

Counterfactual trade flows and welfare can be calculated as in the case of bargained wages.

B Efficiency wages within the search and matching framework

In this Section, we show how efficiency wages in the spirit of Stiglitz and Shapiro (1984) can be introduced into our search and matching framework by replacing the bargaining of workers and firms with the no-shirking condition. Note that we assume balanced trade and risk neutral workers in the following.

We first derive the utility for a shirker, s, and a non-shirker, ns. The non-shirker ns earns wage w_j while exerting effort e_j. Hence, her utility in our one-shot framework is given by

$$E_j^{ns} = w_j - e_j. \tag{25}$$

A shirker s also earns wage w_j but does not exert any effort e_j. However, a share α_j of shirkers is detected by firms and gets fired, which leads to unemployment. When the worker is unemployed she earns $\gamma_j w_j$, and hence the expected utility for a shirker can be written as

$$E_j^{s} = (1-\alpha_j) w_j + \alpha_j \gamma_j w_j. \tag{26}$$

The no-shirking condition $E^{ns} \geq E^{s}$ leads to $E^{ns} = E^{s}$ in equilibrium. Hence, using Equations (25) and (26), the wage can be written as:

$$w_j = \frac{1}{\alpha_j(1-\gamma_j)} e_j. \tag{27}$$

As in the case of bargaining, wages can be solved without knowledge of ϑ_j. ϑ_j can be solved by using the **job creation curve** given in the main text:

$$\frac{1}{\alpha_j(1-\gamma_j)} e_j = p_j - \frac{P_j c_j}{m_j \vartheta_j^{-\mu}} \Rightarrow$$

$$\vartheta_j^{\mu} = \left(\frac{m_j}{P_j c_j}\right)\left(p_j - \frac{1}{\alpha_j(1-\gamma_j)} e_j\right). \tag{28}$$

Now assume that effort e_j can be expressed in terms of prices p_j as $e_j = \xi_j p_j$. Then we can simplify Equation (28) to:

$$\vartheta_j = \left(\frac{p_j}{P_j}\right)^{1/\mu} \left(\frac{c_j}{m_j} \check{\Omega}_j\right)^{-1/\mu}, \tag{29}$$

with $\check{\Omega}_j = \frac{\alpha_j(1-\gamma_j)}{\alpha_j(1-\gamma_j)-\xi_j}$, which corresponds to Equation (9).

Counterfactual employment can be calculated using the definition of u_j given in Equation (8) in the main text, replacing ϑ_j by the expression given in Equation (29) and defining $\check{\Xi}_j = m_j \left(\frac{c_j}{m_j}\check{\Omega}_j\right)^{\frac{\mu-1}{\mu}}$ and $\hat{\check{\kappa}}_j = \check{\Xi}_j^c/\check{\Xi}_j$:

$$\frac{1-u_i^c}{1-u_i} = \hat{\check{\kappa}}_j \left(\frac{p_i^c}{p_i}\right)^{\frac{1-\mu}{\mu}} \left(\frac{P_i}{P_i^c}\right)^{\frac{1-\mu}{\mu}}, \tag{30}$$

which exactly corresponds to Equation (14) in the main text except for the replacement of $\hat{\kappa}_j$ by $\hat{\check{\kappa}}_j$. Hence, when assuming that labor market institutions do not change, we can proceed as with bargained wages to calculate employment effects.

Using the definition of $\check{\Xi}_j$, GDP can be expressed as:

$$y_j = p_j e_j L_j = p_j m_j \left(\frac{p_j}{P_j}\right)^{\frac{1-\mu}{\mu}} \left(\frac{c_j}{m_j}\check{\Omega}_j\right)^{\frac{\mu-1}{\mu}} L_j = p_j \left(\frac{p_j}{P_j}\right)^{\frac{1-\mu}{\mu}} \check{\Xi}_j L_j. \tag{31}$$

Now take the ratio of counterfactual GDP, y_j^c, and observed GDP, y_j, and note that the labor force, L_j, stays constant:

$$y_j^c = \hat{\check{\kappa}}_j \frac{p_j^c \left(\frac{p_j^c}{P_j^c}\right)^{\frac{1-\mu}{\mu}}}{p_j \left(\frac{p_j}{P_j}\right)^{\frac{1-\mu}{\mu}}} = \hat{\check{\kappa}}_j \left(\frac{p_j^c}{p_j}\right)^{\frac{1}{\mu}} \left(\frac{P_j}{P_j^c}\right)^{\frac{1-\mu}{\mu}} y_j, \tag{32}$$

where $\hat{\check{\kappa}}_j = \check{\Xi}_j^c/\check{\Xi}_j$. Then, using Equation (13) from the main text and the fact that $\tilde{P}_j^{1-\sigma} = \sum_i (y^W/\tilde{y}^W) t_{ij}^{1-\sigma} \mathfrak{t}_i$, we end up with exactly the same expression as given in the result in Implication 3 in the main text except for the replacement of $\hat{\kappa}_j$ by $\hat{\check{\kappa}}_j$. Hence, we can calculate counterfactual GDP as in the case of bargained wages. Similarly, counterfactual trade flows and welfare can be calculated as in the case with bargained wages.

C A Ricardian trade model with imperfect labor markets following Eaton and Kortum (2002)

In the following, we introduce search and matching frictions in the Ricardian model of international trade by Eaton and Kortum (2002) and show that this leads to expressions for counterfactual changes in GDP, employment, trade flows, and welfare which are isomorphic to those in the main text. Note that in the following we assume balanced trade.

The representative consumer in country j is again characterized by the utility function U_j. As in Eaton and Kortum (2002), we assume a continuum of goods $k \in [0, 1]$. Consumption of individual goods is denoted by $q(k)$, leading to the following utility function

$$U_j = \left[\int_0^1 q(k)^{\frac{\sigma-1}{\sigma}} dk \right]^{\frac{\sigma}{\sigma-1}}, \tag{33}$$

where σ is the elasticity of substitution in consumption. Again, international trade of goods from i to j imposes iceberg trade costs $t_{ij} > 1$.

Countries differ in the efficiency with which they can produce goods. We denote country i's efficiency in producing good $k \in [0, 1]$ as $\mathfrak{z}_i(k)$. Denoting input costs in country i as $\mathfrak{c}_i$, the cost of producing a unit of good k in country i is then $\mathfrak{c}_i / \mathfrak{z}_i(k)$.

Taking trade barriers into account, delivering a unit of good k produced in country i to country j costs

$$p_{ij}(k) = \left(\frac{\mathfrak{c}_i}{\mathfrak{z}_i(k)} \right) t_{ij}. \tag{34}$$

Assuming perfect competition, $p_{ij}(k)$ is the price which consumers in country j would pay if they bought good k from country i. With international trade, consumers can choose from which country to buy a good. Hence, the price they actually pay for good k is $p_j(k)$, the lowest price across all sources i:

$$\underline{p}_j(k) = \min\left\{p_{ij}(k); i = 1, \cdots, n\right\}, \tag{35}$$

where n denotes the number of countries.

Let country i's efficiency in producing good k be the realization of an independently drawn Fréchet random variable with distribution $F_i(\mathfrak{z}) = e^{-T_i \mathfrak{z}^{-\theta}}$, where T_i is the location parameter (also called "state of technology" by Eaton and Kortum 2002) and θ governs the variation within the distribution and thereby also the comparative advantage within the continuum of goods.

Plugging Equation (34) in $F_i(\mathfrak{z})$ leads to $G_{ij}(p) = Pr[P_{ij} \leq p] = 1 - e^{-[T_i(\mathfrak{c}_i t_{ij})^{-\theta}]p^{\theta}}$. Noting that the distribution of prices for which a country j buys is given by $G_j(p) = Pr[P_j \leq p] = 1 - \prod_{i=1}^{n}[1 - G_{ij}(p)]$ leads to:

$$G_j(p) = 1 - e^{-\Phi_j p^{\theta}}, \tag{36}$$

where $\Phi_j = \sum_{i=1}^{n} T_i \left(\mathfrak{c}_i t_{ij}\right)^{-\theta}$.

The probability that country i provides good k at the lowest price to country j is given by (see Eaton and Kortum 2002, page 1748):

$$\pi_{ij} = \frac{T_i \left(\mathfrak{c}_i t_{ij}\right)^{-\theta}}{\Phi_j}. \tag{37}$$

With a continuum of goods between zero and one this is also the fraction of goods that country j buys from country i. Eaton and Kortum (2002) show that the price of a good that country j actually buys from any country i is also distributed $G_j(p)$, and that the exact price index is given by $P_j = \tilde{\Gamma}\Phi_j^{-1/\theta}$ with $\tilde{\Gamma} = \left[\Gamma\left(\frac{\theta+1-\sigma}{\theta}\right)\right]^{\frac{1}{1-\sigma}}$ where Γ is the Gamma function.

The fraction of goods that country j buys from country i, π_{ij}, is also the fraction of its expenditures on goods from country i, x_{ij}, due to the fact that the average expenditures per good do not vary by source. Hence,

$$x_{ij} = \frac{T_i(\mathfrak{c}_i t_{ij})^{-\theta}}{\Phi_j} y_j = \frac{T_i(\mathfrak{c}_i t_{ij})^{-\theta}}{\sum_{k=1}^{n} T_k(\mathfrak{c}_k t_{kj})^{-\theta}} y_j, \tag{38}$$

where y_j is country j's total spending.

Assuming balanced trade, exporters' total sales (including home sales) are equal to total expenditure and are simply given by:

$$y_i = \sum_{j=1}^{n} x_{ij} = T_i \mathfrak{c}_i^{-\theta} \sum_{j=1}^{n} \frac{t_{ij}^{-\theta}}{\Phi_j} y_j. \tag{39}$$

Solving for $T_i \mathfrak{c}_i^{-\theta}$ leads to:

$$T_i \mathfrak{c}_i^{-\theta} = \frac{y_i}{\sum_{j=1}^{n} \frac{t_{ij}^{-\theta}}{\Phi_j} y_j}. \tag{40}$$

Replacing $T_i \mathfrak{c}_i^{-\theta}$ in Equation (38) with this expression leads to:

$$x_{ij} = \frac{t_{ij}^{-\theta}}{\Phi_j \left(\sum_{j=1}^{n} \frac{t_{ij}^{-\theta}}{\Phi_j} y_j \right)} y_i y_j.$$

Using $P_j = \tilde{\Gamma} \Phi_j^{-\frac{1}{\theta}}$ to replace Φ_j in both terms of the denominator leads to:

$$x_{ij} = \frac{t_{ij}^{-\theta}}{\tilde{\Gamma}^{\theta} P_j^{-\theta} \left(\sum_{j=1}^{n} \frac{t_{ij}^{-\theta}}{\tilde{\Gamma}^{\theta} P_j^{-\theta}} y_j \right)} y_i y_j.$$

Define

$$\Pi_i = \left(\sum_{j=1}^{n} \left(\frac{t_{ij}}{P_j} \right)^{-\theta} \theta_j \right)^{-\frac{1}{\theta}},$$

and note that we can express P_j also as follows:

$$\begin{aligned} P_j &= \left(\tilde{\Gamma}^{-\theta} \Phi_j \right)^{-\frac{1}{\theta}} = \left(\tilde{\Gamma}^{-\theta} \sum_{i=1}^{n} T_i (\mathfrak{c}_i t_{ij})^{-\theta} \right)^{-\frac{1}{\theta}} = \left(\tilde{\Gamma}^{-\theta} \sum_{i=1}^{n} \frac{t_{ij}^{-\theta} y_i}{\sum_{l=1}^{n} \frac{t_{il}^{-\theta}}{\Phi_l} y_l} \right)^{-\frac{1}{\theta}}, \\ &= \left(\sum_{i=1}^{n} \left(\frac{t_{ij}}{\Pi_i} \right)^{-\theta} \theta_i \right)^{-\frac{1}{\theta}}, \end{aligned}$$

where $\theta_j = y_j/y^W$ with $y^W = \sum_j y_j$. Then we can write:

$$x_{ij} \;=\; \frac{y_i y_j}{y^W}\left(\frac{t_{ij}}{\Pi_i P_j}\right)^{-\theta}.$$

Replacing $-\theta$ by $1-\sigma$ we end up with exactly the same system as in the model by Anderson and van Wincoop (2003).

Hence, our approach can be applied to both worlds with the only difference that the interpretation differs and the roles of θ and σ have to be exchanged.

C.1 Counterfactual GDP in the Eaton and Kortum (2002) framework with perfect labor markets

We assume that there are no intermediates and one unit of the final good is produced with one unit of labor, hence $\mathfrak{c}_i = w_i$. Equation (40) can be written as

$$T_i w_i^{-\theta} = \frac{y_i}{\sum_{j=1}^n \frac{t_{ij}^{-\theta}}{\Phi_j} y_j} = \frac{\theta_i}{\sum_{j=1}^n \tilde{\Gamma}^{-\theta}\left(\frac{t_{ij}}{P_j}\right)^{-\theta}\theta_j} = \tilde{\Gamma}^{\theta}\theta_i \Pi_i^{\theta}.$$

Solving for w_i leads to:

$$w_i = \tilde{\Gamma}^{-1} T_i^{\frac{1}{\theta}} \theta_i^{-\frac{1}{\theta}} \Pi_i^{-1}.$$

As $y_i = w_i L_i$, the change in GDP is given by $y_i^c/y_i = w_i^c/w_i$. Hence,

$$\frac{y_i^c}{y_i} \;=\; \frac{\tilde{\Gamma} T_i^{\frac{1}{\theta}} (\theta_i^c)^{-\frac{1}{\theta}} (\Pi_i^c)^{-1}}{\tilde{\Gamma} T_i^{\frac{1}{\theta}} \theta_i^{-\frac{1}{\theta}} \Pi_i^{-1}} = \frac{(\theta_i^c)^{-\frac{1}{\theta}} (\Pi_i^c)^{-1}}{\theta_i^{-\frac{1}{\theta}} \Pi_i^{-1}} = \left(\frac{\mathfrak{k}_i^c}{\mathfrak{k}_i}\right)^{-\frac{1}{\theta}},$$

where $\mathfrak{k}_i = \theta_i \Pi_i^{\theta}$.

C.2 Counterfactuals in the Eaton and Kortum (2002) framework with imperfect labor markets

We assume that there are no intermediates and $\mathfrak{z}_i$ units of the final good k are produced using one unit of labor. For simplicity, we omit the product index k

in the following. Denoting the net price earned by the producer by $p_i = p_{ij}/t_{ij}$, the total surplus of a successful match is given by $\mathfrak{z}_i p_i - b_i$, while the firm's rent is given by $\mathfrak{z}_i p_i - w_i$ and the worker's by $w_i - b_i$. Nash bargaining leads to $w_i - b_i = \xi_i/(1-\xi_i)(\mathfrak{z}_i p_i - w_i)$. Using $b_i = \gamma_i w_i$ and combining leads to

$$w_i = \frac{\xi_i}{1-\gamma_i+\xi_i\gamma_i}\mathfrak{z}_i p_i = \frac{\xi_i}{1-\gamma_i+\xi_i\gamma_i}\mathfrak{c}_i. \tag{41}$$

Firms create vacancies until all rents are dissipated. The free entry (zero profit) condition is given by $M_i/V_i(\mathfrak{z}_i p_i - w_i) = P_i c_i$. Rewriting leads to the job creation curve

$$w_i = \mathfrak{z}_i p_i - \frac{P_i c_i}{m_i \vartheta_i^{-\mu}} = \mathfrak{c}_i - \frac{P_i c_i}{m_i \vartheta_i^{-\mu}}. \tag{42}$$

We can combine Equations (41) and (42) to write the wage paid by a firm as

$$w_i = \frac{\xi_i}{1-\gamma_i+\gamma_i\xi_i-\xi_i}\frac{P_i c_i}{m_i \vartheta^{-\mu}}. \tag{43}$$

The wage paid by a firm producing variety k is solely determined by parameters and aggregate variables and does neither depend on its variety-specific price nor on productivity. Hence, as wages are equalized across firms, Equation (42) then implies that also $\mathfrak{c}_i$ is the same across firms, irrespective of the variety they produce. Hence the job creation and wage curve are the same for all firms and we can thus determine aggregate labor market tightness ϑ_i as the locus of intersection of both curves:

$$\vartheta_i = \left(\frac{\mathfrak{c}_i}{P_i}\right)^{1/\mu}\left(\frac{c_i}{m_i}\Omega_i\right)^{-1/\mu}. \tag{44}$$

Equation (40) can be written as

$$T_i \mathfrak{c}_i^{-\theta} \quad = \quad \frac{y_i}{\sum_{j=1}^{n}\frac{t_{ij}^{-\theta}}{\Phi_j}y_j} = \frac{\theta_i}{\sum_{j=1}^{n}\tilde{\Gamma}^{-\theta}\left(\frac{t_{ij}}{P_j}\right)^{-\theta}\theta_j} = \tilde{\Gamma}^{\theta}\theta_i\Pi_i^{\theta}.$$

Solving for $\mathfrak{c}_i$ leads to:

$$\mathfrak{c}_i = \tilde{\Gamma}^{-1} T_i^{\frac{1}{\theta}} \theta_i^{-\frac{1}{\theta}} \Pi_i^{-1}. \tag{45}$$

As $y_i = \mathfrak{c}_i(1-u_i)L_i$, assuming a constant labor force the change in GDP is given by $y_i^c/y_i = (1-u_i^c)\mathfrak{c}_i^c/[(1-u_i)\mathfrak{c}_i]$ leading to

$$\begin{aligned} \frac{y_i^c}{y_i} &= \frac{(1-u_i^c)\tilde{\Gamma} T_i^{\frac{1}{\theta}} \left(\theta_i^c\right)^{-\frac{1}{\theta}} \left(\Pi_i^c\right)^{-1}}{(1-u_i)\tilde{\Gamma} T_i^{\frac{1}{\theta}} \theta_i^{-\frac{1}{\theta}} \Pi_i^{-1}} \\ &= \frac{(1-u_i^c) \left(\theta_i^c\right)^{-\frac{1}{\theta}} \left(\Pi_i^c\right)^{-1}}{(1-u_i)\theta_i^{-\frac{1}{\theta}} \Pi_i^{-1}} \\ &= \frac{(1-u_i^c)}{(1-u_i)} \left(\frac{\mathfrak{k}_i^c}{\mathfrak{k}_i}\right)^{-\frac{1}{\theta}}, \end{aligned} \tag{46}$$

where $\mathfrak{k}_i = \theta_i \Pi_i^{\theta}$.

For the change in employment (the first fraction on the right-hand side of Equation (46)) the same relationship holds as is given in the main text in Equation (14) when we remember once more that $-\theta = 1-\sigma$. Hence, we end up with

$$\frac{y_i^c}{y_i} = \hat{\kappa}_i \left(\frac{\mathfrak{k}_i^c}{\mathfrak{k}_i}\right)^{-\frac{1}{\mu\theta}} \left(\frac{\sum_i t_{ij}^{-\theta}\mathfrak{k}_i}{\sum_i \left(t_{ij}^c\right)^{-\theta} \mathfrak{k}_i^c}\right)^{-\frac{1-\mu}{\mu\theta}}, \tag{47}$$

which is the same relationship as given in Implication 3 in the main text when we remember that we assumed balanced trade and again replace $1-\sigma$ by $-\theta$.

Besides counterfactual employment, also counterfactual trade flows and welfare can be calculated as in the main text.

D Further results for counterfactual analyses

D.1 Further results for introducing PTAs as observed in 2006

This section reports additional results for the counterfactual analysis presented in Section 3.2.1 in the main text.

Tables 1 and 2 report goods trade changes for perfect and imperfect labor markets, respectively. Trade changes are heterogeneous across importers and exporters. To summarize this heterogeneity, we present quantiles of calculated trade flow changes across all destination countries for all exporters. Both tables report the minimum and maximum changes, along with the 0.025, 0.25, 0.5, 0.75, and 0.975 quantiles. Comparing numbers across columns for each row reveals the heterogeneity across importers, while comparing numbers across rows for each column highlights the heterogeneity across exporters.

In general, every country experiences both positive and negative bilateral trade flow changes. For example, the introduction of PTAs as observed in 2006 implies that the change in trade flows for the United Kingdom is larger than 11.94% for 25% of all countries importing goods from the United Kingdom. Turning to the trade flow results of our model with imperfect labor markets (Table 2), we find a similar pattern for trade flow changes. Again, changes are heterogeneous across importers and exporters and, again, small and remote countries experience larger changes. The implied trade flow changes differ from the case with perfect labor markets but are of similar magnitude.

[Table 1 about here.]

[Table 2 about here.]

[Table 3 about here.]

The employment effects of incepting PTAs from column (5) of Table 3 in the main text are illustrated graphically in Figure 1.

[Figure 1 about here.]

D.2 Further results for a labor market reform in the U.S.

Table 3 summarizes the trade effects of the hypothetical labor market reform in the U.S. presented in Section 3.2.2 in the main text. A labor market reform in the United States spurs trade changes across the whole sample. The effects of exports by the United States range between -0.98% and 0.08%. Effects across other exporters range from -0.98% for Australia to 0.77% for Belgium and Switzerland. On average, 50% of trade flow changes are larger than 0.41%. The size pattern of the spillover effects of labor market reforms in the United States clearly depend on the distance from and trade volume of the corresponding country and the United States.

The employment effects of the counterfactual U.S. labor market reform from column (5) of Table 5 are graphically illustrated in Figure 2.

[Figure 2 about here.]

D.3 Evaluating the effects of counterfactually undoing the recent German labor market reforms

In the following, we present the results of counterfactually undoing the recent labor market reforms in Germany as alluded to in the last paragraph of Section 3.2.2 in the main text.

Table 4 presents the main results, and Table 5 the corresponding trade effects. As can be seen, undoing the German labor market reforms would increase unemployment in Germany by about 4 percentage points, and welfare would be more than 3 percent lower. Most importantly, we see that abolishing German labor market reforms would have negative spillover effects in all trading partners of Germany. Whereas the net effect on unemployment rates in the trading partners is negligible given our parameter estimates, welfare effects are not: Austria's welfare would be about 0.9 percent lower without German labor market reforms. This is also reflected in the trade effects reported in Table 5. Austria's exports would change between 0.5 and 1.2 percent across its importing partners. Again, trade effects are heterogeneous across countries.

[Table 4 about here.]

[Table 5 about here.]

E Results with balanced trade

The following Tables present the results for the same counterfactual experiments as presented in Section 3.2 in the main text but we assume balanced trade throughout, i.e. $\tilde{y}_j = y_j$ and $\tilde{\theta}_j = \theta_j$. Results basically remain the same, both qualitatively and quantitatively. Note that imposing balanced trade also affects the estimates for σ and μ, whereas the estimated trade cost coefficients do not change by construction (see Table 2).

[Table 6 about here.]

E.1 Introducing PTAs as observed in 2006

Table 7 presents the results from incepting PTAs as observed in 2006 starting from a counterfactual situation without any PTAs assuming balanced trade. Tables 8 and 9 present the changes in trade flows for both perfect and imperfect labor markets, similar to Tables 1 and 2.

[Table 7 about here.]

[Table 8 about here.]

[Table 9 about here.]

E.2 Different parameter values for elasticities

Table 10 presents the robustness checks for different parameter values for the elasticity of substitution and the matching elasticity assuming balanced trade.

[Table 10 about here.]

E.3 Evaluating the effects of a labor market reform in the U.S.

Tables 11 and 12 present the results from the counterfactual labor market reform in the U.S. assuming balanced trade.

[Table 11 about here.]

[Table 12 about here.]

E.4 Evaluating the effects of counterfactually undoing the recent German labor market reforms

Tables 13 and 14 present the results of counterfactually undoing the recent labor market reforms in Germany assuming balanced trade.

[Table 13 about here.]

[Table 14 about here.]

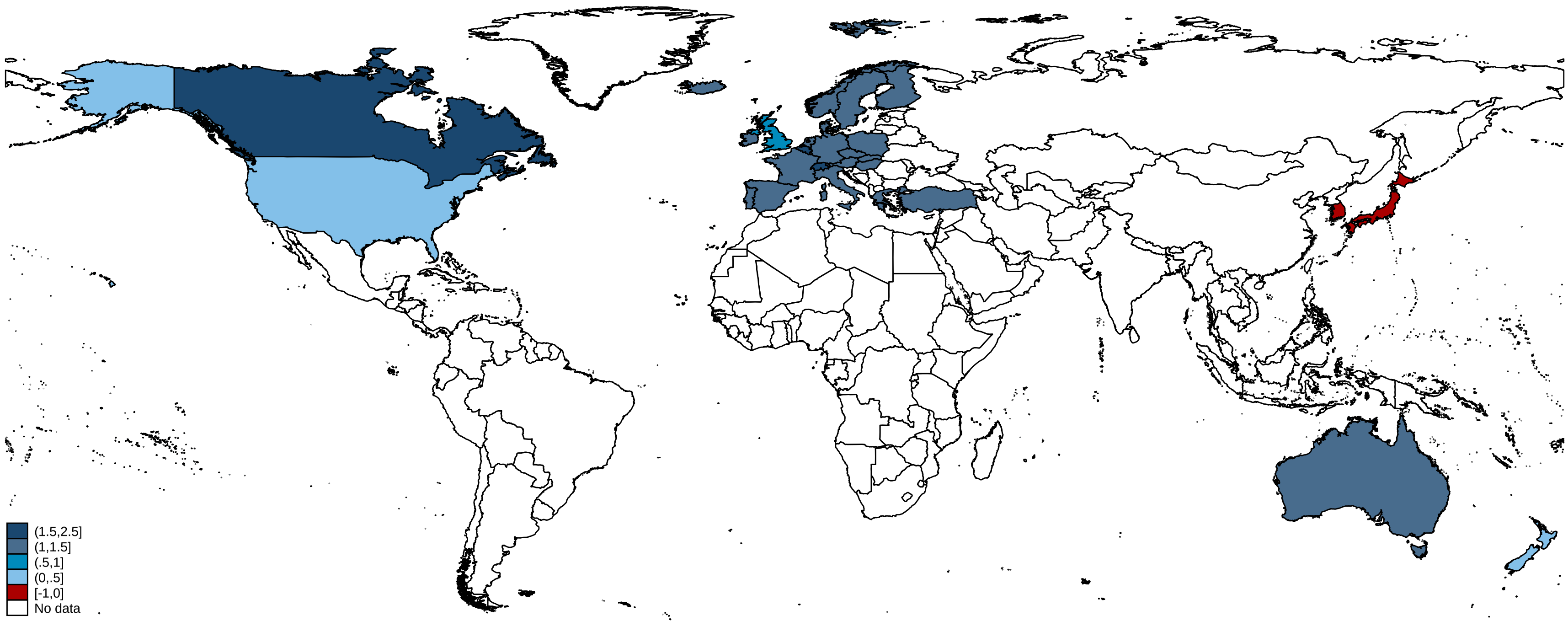

Figure 1: Employment effects of incepting PTAs as observed in 2006.

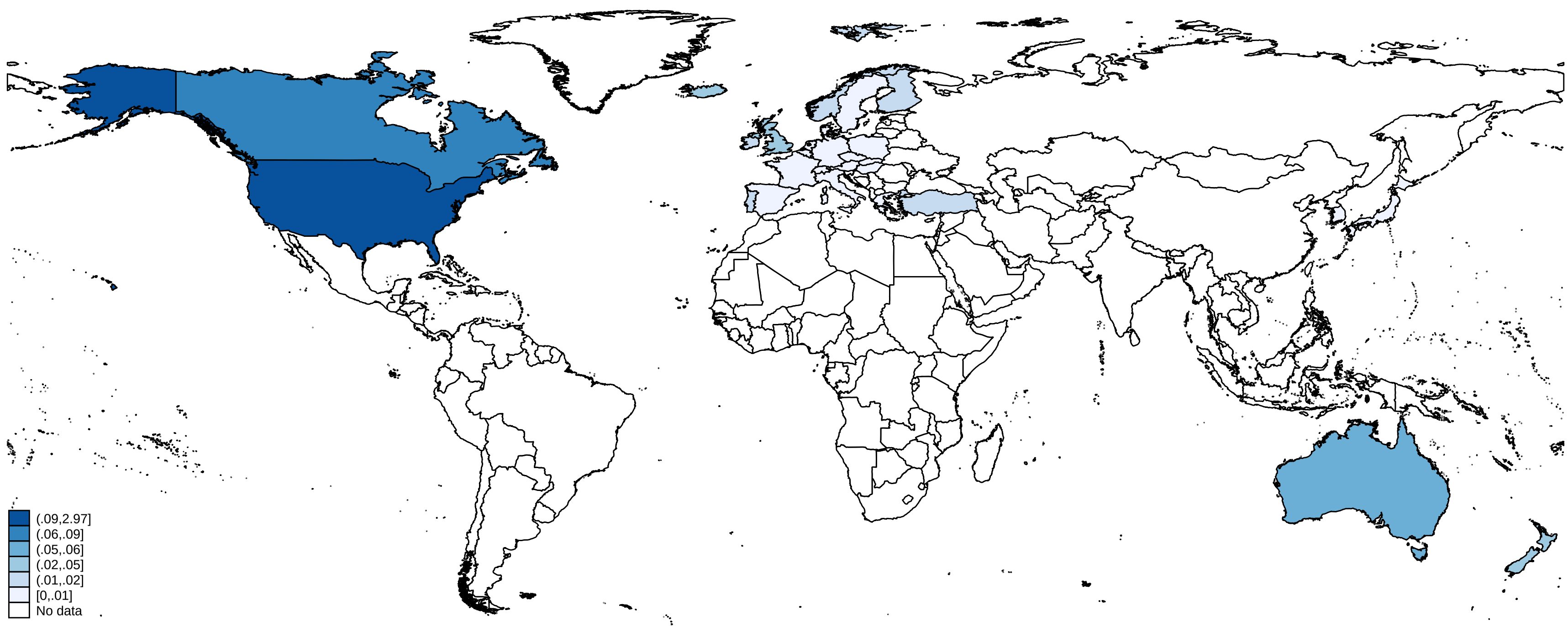

Figure 2: Employment effects of a hypothetical labor market reform in the United States ($\hat{\kappa}_{US} = 1.03$).

Table 1: Heterogeneity of comparative static trade effects of PTA inception with perfect labor markets and controlling for trade imbalances in 2006

	Changes in exports in percent by importer quantiles						
Exporting country	Min.	0.025	0.25	0.5	0.75	0.975	Max.
Australia	-30.19	-29.69	-24.57	-23.39	-21.97	20.12	20.37
Austria	-32.09	-30.93	-3.37	0.47	2.42	6.46	7.02
Belgium	-32.84	-31.70	-4.21	-0.65	1.29	5.27	5.83
Canada	-33.64	-33.57	-31.02	-30.04	-28.74	4.98	9.92
Czech Republic	-31.44	-30.27	-2.45	1.44	3.41	7.48	8.05
Denmark	-30.58	-29.40	-1.23	2.70	4.70	8.82	9.40
Finland	-29.34	-28.14	0.53	4.46	6.57	10.76	11.35
France	-29.03	-27.82	0.98	4.93	6.93	11.25	11.84
Germany	-28.36	-27.14	1.94	5.92	7.89	12.27	12.90
Greece	-28.91	-27.70	1.15	5.11	7.06	11.44	12.03
Hungary	-30.69	-29.51	-1.38	2.54	4.54	8.65	9.23
Iceland	-28.49	-27.28	2.46	5.79	7.85	22.56	24.66
Ireland	-29.78	-28.58	-0.08	3.82	5.91	10.08	10.66
Italy	-28.27	-27.05	2.06	6.05	8.02	12.44	13.04
Japan	-17.92	-17.34	-11.32	-9.96	-8.41	4.63	4.83
Korea	-18.20	-17.52	-11.49	-10.00	0.20	24.21	24.32
Netherlands	-30.80	-29.63	-1.54	2.37	4.36	8.47	9.05
New Zealand	-20.24	-19.67	-13.83	-12.48	-10.85	16.41	19.42
Norway	-30.08	-28.89	0.18	3.44	5.67	19.84	21.89
Poland	-30.37	-29.19	-0.93	2.94	5.01	9.14	9.72
Portugal	-29.53	-28.33	0.27	4.19	6.29	10.47	11.06
Slovak Republic	-31.08	-29.91	-1.94	1.97	3.95	8.04	8.61
Spain	-28.17	-26.95	2.21	6.20	8.18	12.60	13.20
Sweden	-29.75	-28.56	-0.05	3.86	5.95	10.12	10.70
Switzerland	-33.20	-32.07	-3.32	-0.46	0.95	14.50	16.45
Turkey	-28.84	-27.63	1.97	5.28	7.33	21.98	24.06
United Kingdom	-25.67	-24.41	5.76	9.90	11.94	13.58	13.61
United States	-15.89	-15.80	-12.57	-11.10	-9.54	19.13	21.00
Average	-28.33	-27.31	-3.78	-0.52	1.68	12.35	13.36

Notes: Counterfactual analysis based on parameter estimates from column (6) of Table 2 in the main text. Table depicts changes in normalized exports, i.e. exports divided by source and origin GDPs.

Table 2: Heterogeneity of comparative static trade effects of PTA inception with imperfect labor markets and controlling for trade imbalances in 2006

	Changes in exports in percent by importer quantiles						
Exporting country	Min.	0.025	0.25	0.5	0.75	0.975	Max.
Australia	-29.96	-29.51	-24.58	-23.37	-21.98	20.31	20.56
Austria	-32.05	-30.91	-3.69	0.19	2.15	6.21	6.79
Belgium	-32.82	-31.69	-4.54	-0.95	0.99	5.00	5.58
Canada	-33.61	-33.54	-30.97	-29.83	-28.67	5.28	10.21
Czech Republic	-31.39	-30.23	-2.75	1.17	3.15	7.25	7.84
Denmark	-30.52	-29.35	-1.52	2.45	4.45	8.61	9.20
Finland	-29.26	-28.08	0.26	4.20	6.34	10.57	11.17
France	-28.98	-27.79	0.66	4.61	6.67	11.00	11.61
Germany	-28.32	-27.12	1.59	5.59	7.57	12.02	12.65
Greece	-28.83	-27.64	0.87	4.84	6.81	11.24	11.85
Hungary	-30.63	-29.47	-1.68	2.29	4.29	8.43	9.02
Iceland	-28.37	-27.16	2.25	5.63	7.69	22.69	24.83
Ireland	-29.66	-28.47	-0.30	3.62	5.75	9.95	10.56
Italy	-28.21	-27.01	1.75	5.75	7.73	12.21	12.82
Japan	-17.61	-17.08	-11.28	-9.86	-8.33	4.96	5.19
Korea	-17.90	-17.28	-11.47	-9.96	0.38	24.35	24.47
Netherlands	-30.76	-29.60	-1.86	2.10	4.09	8.23	8.82
New Zealand	-20.03	-19.51	-13.88	-12.50	-10.91	16.62	19.63
Norway	-30.00	-28.82	-0.09	3.22	5.48	19.89	21.98
Poland	-30.31	-29.14	-1.23	2.65	4.76	8.93	9.52
Portugal	-29.44	-28.26	0.01	3.94	6.08	10.29	10.89
Slovak Republic	-31.03	-29.87	-2.24	1.71	3.69	7.81	8.40
Spain	-28.09	-26.88	1.92	5.93	7.92	12.40	13.02
Sweden	-29.68	-28.50	-0.33	3.58	5.71	9.92	10.52
Switzerland	-33.18	-32.06	-3.64	-0.73	0.69	14.45	16.44
Turkey	-28.74	-27.55	1.71	5.07	7.12	22.04	24.17
United Kingdom	-25.55	-24.30	5.52	9.67	11.73	13.34	13.37
United States	-15.99	-15.90	-12.64	-11.14	-9.63	19.34	21.20
Average	-28.25	-27.24	-4.01	-0.72	1.49	12.26	13.30

Notes: Counterfactual analysis based on parameter estimates from column (6) of Table 2 in the main text. Table depicts changes in normalized exports, i.e. exports divided by source and origin GDPs.

Table 3: Heterogeneity of comparative static trade effects of $\hat{\kappa}_{U.S.} = 1.03$ controlling for trade imbalances with imperfect labor markets in 2006

	Changes in exports in percent by importer quantiles						
Exporting country	Min.	0.025	0.25	0.5	0.75	0.975	Max.
Australia	-0.98	-0.91	-0.10	-0.06	-0.01	0.08	0.08
Austria	-0.34	-0.27	0.50	0.58	0.62	0.72	0.72
Belgium	-0.30	-0.23	0.55	0.63	0.66	0.76	0.77
Canada	-0.97	-0.97	-0.49	-0.45	-0.40	-0.31	-0.31
Czech Republic	-0.39	-0.32	0.46	0.54	0.58	0.68	0.68
Denmark	-0.41	-0.34	0.44	0.52	0.57	0.66	0.66
Finland	-0.47	-0.40	0.38	0.46	0.51	0.60	0.60
France	-0.38	-0.31	0.47	0.55	0.58	0.69	0.69
Germany	-0.37	-0.30	0.47	0.55	0.59	0.69	0.69
Greece	-0.44	-0.37	0.40	0.48	0.53	0.62	0.62
Hungary	-0.42	-0.35	0.43	0.51	0.56	0.65	0.65
Iceland	-0.61	-0.54	0.27	0.32	0.36	0.45	0.45
Ireland	-0.54	-0.47	0.34	0.39	0.44	0.52	0.52
Italy	-0.41	-0.34	0.44	0.52	0.57	0.66	0.66
Japan	-0.44	-0.38	0.40	0.48	0.53	0.62	0.62
Korea	-0.46	-0.39	0.39	0.47	0.52	0.61	0.61
Netherlands	-0.36	-0.29	0.48	0.56	0.60	0.70	0.70
New Zealand	-0.85	-0.78	0.03	0.07	0.12	0.20	0.21
Norway	-0.46	-0.39	0.38	0.46	0.51	0.60	0.60
Poland	-0.41	-0.34	0.43	0.51	0.56	0.65	0.65
Portugal	-0.48	-0.41	0.36	0.44	0.49	0.58	0.58
Slovak Republic	-0.41	-0.34	0.44	0.52	0.57	0.65	0.66
Spain	-0.45	-0.38	0.39	0.47	0.52	0.61	0.61
Sweden	-0.44	-0.37	0.40	0.48	0.53	0.62	0.62
Switzerland	-0.29	-0.22	0.55	0.63	0.67	0.76	0.77
Turkey	-0.47	-0.41	0.37	0.45	0.50	0.59	0.59
United Kingdom	-0.60	-0.53	0.28	0.33	0.37	0.46	0.46
United States	-0.98	-0.91	-0.10	-0.06	-0.01	0.07	0.08
Average	-0.50	-0.44	0.33	0.41	0.45	0.54	0.54

Notes: Counterfactual analysis based on parameter estimates from column (6) of Table 2 in the main text. Table depicts changes in normalized exports, i.e. exports divided by source and origin GDPs.

Table 4: Comparative static effects of undoing recent German labor market reforms controlling for trade imbalances in 2006

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	PLM	SMF	share %GDP SMF		SMF	SMF	PLM	SMF
	%GDP	%GDP	$\% \ln(\hat{p})$	$\% \ln(\hat{e})$	$\%\hat{e}$	Δu	%EV	%EV
Australia	0.00	-0.02	92.75	7.25	-0.00	0.00	0.00	-0.03
Austria	0.00	-0.35	82.14	17.86	-0.06	0.06	0.00	-0.89
Belgium	0.00	-0.29	82.44	17.56	-0.05	0.05	0.00	-0.72
Canada	0.00	-0.01	98.28	1.72	-0.00	0.00	0.00	-0.01
Czech Republic	0.00	-0.22	82.44	17.56	-0.04	0.04	0.00	-0.56
Denmark	0.00	-0.22	82.59	17.41	-0.04	0.04	0.00	-0.55
Finland	0.00	-0.09	84.05	15.95	-0.02	0.02	0.00	-0.23
France	0.00	-0.13	83.00	17.00	-0.02	0.02	0.00	-0.34
Germany	0.00	-4.58	-37.14	100.89	-4.63	4.16	0.00	-3.13
Greece	0.00	-0.08	83.99	16.01	-0.01	0.01	0.00	-0.21
Hungary	0.00	-0.12	83.20	16.80	-0.02	0.02	0.00	-0.30
Iceland	0.00	-0.08	84.47	15.53	-0.01	0.01	0.00	-0.20
Ireland	0.00	-0.05	85.86	14.14	-0.01	0.01	0.00	-0.12
Italy	0.00	-0.09	83.56	16.44	-0.02	0.02	0.00	-0.24
Japan	0.00	-0.03	92.24	7.76	-0.00	0.00	0.00	-0.04
Korea	0.00	-0.03	91.42	8.58	-0.00	0.00	0.00	-0.05
Netherlands	0.00	-0.21	82.72	17.28	-0.04	0.04	0.00	-0.53
New Zealand	0.00	-0.02	92.76	7.24	-0.00	0.00	0.00	-0.03
Norway	0.00	-0.12	83.57	16.43	-0.02	0.02	0.00	-0.29
Poland	0.00	-0.20	82.61	17.39	-0.04	0.03	0.00	-0.49
Portugal	0.00	-0.07	84.47	15.53	-0.01	0.01	0.00	-0.17
Slovak Republic	0.00	-0.12	83.13	16.87	-0.02	0.02	0.00	-0.31
Spain	0.00	-0.08	84.19	15.81	-0.01	0.01	0.00	-0.19
Sweden	0.00	-0.12	83.49	16.51	-0.02	0.02	0.00	-0.30
Switzerland	0.00	-0.24	82.24	17.76	-0.04	0.04	0.00	-0.60
Turkey	0.00	-0.09	84.07	15.93	-0.02	0.01	0.00	-0.21
United Kingdom	0.00	-0.09	84.21	15.79	-0.02	0.01	0.00	-0.22
United States	0.00	-0.03	91.18	8.82	-0.00	0.00	0.00	-0.05
Average	0.00	-0.43	78.53	18.52	-0.39	0.35	0.00	-0.39

Notes: Counterfactual analysis based on parameter estimates from column (6) of Table 2. PLM gives results assuming perfect labor markets. SMF gives results using a search and matching framework for the labor market. Averages are weighted averages using country GDP as weight.

Table 5: Heterogeneity of comparative static trade effects of undoing recent German labor market reforms controlling for trade imbalances with imperfect labor markets in 2006

	Changes in exports in percent by importer quantiles						
Exporting country	Min.	0.025	0.25	0.5	0.75	0.975	Max.
Australia	-0.25	-0.25	-0.08	-0.02	0.18	0.56	0.59
Austria	0.49	0.49	0.62	0.71	0.81	1.15	1.17
Belgium	0.34	0.34	0.47	0.56	0.66	1.14	1.19
Canada	-0.25	-0.25	-0.10	-0.05	0.16	0.54	0.57
Czech Republic	0.18	0.19	0.32	0.41	0.51	1.01	1.04
Denmark	0.18	0.19	0.31	0.40	0.50	1.00	1.03
Finland	-0.10	-0.09	0.03	0.13	0.34	0.72	0.75
France	-0.01	-0.00	0.12	0.21	0.42	0.81	0.84
Germany	-0.02	-0.02	0.11	0.20	0.41	0.80	0.83
Greece	-0.12	-0.12	0.01	0.11	0.31	0.70	0.72
Hungary	-0.04	-0.04	0.09	0.18	0.40	0.78	0.81
Iceland	-0.12	-0.12	0.01	0.11	0.31	0.70	0.73
Ireland	-0.20	-0.19	-0.02	0.03	0.24	0.62	0.65
Italy	-0.10	-0.10	0.03	0.12	0.34	0.72	0.75
Japan	-0.24	-0.24	-0.07	-0.01	0.19	0.58	0.61
Korea	-0.24	-0.23	-0.07	-0.01	0.20	0.58	0.61
Netherlands	0.17	0.17	0.30	0.39	0.49	0.99	1.02
New Zealand	-0.25	-0.25	-0.08	-0.02	0.18	0.56	0.59
Norway	-0.05	-0.04	0.08	0.17	0.39	0.77	0.80
Poland	0.13	0.14	0.26	0.35	0.45	0.95	0.98
Portugal	-0.15	-0.15	-0.02	0.08	0.28	0.67	0.70
Slovak Republic	-0.03	-0.03	0.10	0.19	0.40	0.79	0.82
Spain	-0.14	-0.14	-0.01	0.09	0.30	0.68	0.71
Sweden	-0.04	-0.03	0.09	0.18	0.40	0.78	0.81
Switzerland	0.22	0.23	0.35	0.44	0.55	1.04	1.07
Turkey	-0.12	-0.11	0.01	0.11	0.32	0.70	0.73
United Kingdom	-0.11	-0.10	0.02	0.12	0.33	0.71	0.74
United States	-0.24	-0.24	-0.07	-0.01	0.19	0.57	0.60
Average	-0.04	-0.04	0.10	0.18	0.37	0.77	0.80

Notes: Counterfactual analysis based on parameter estimates from column (6) of Table 2 in the main text. Table depicts changes in normalized exports, i.e. exports divided by source and origin GDPs.

Table 6: Estimation results for OECD sample, 1950-2006, assuming balanced trade

	(1) OLS $\ln z_{ij\tau}$	(2) PPML $z_{ij\tau}$	(3) OLS $\ln x_{ij\tau}$	(4) PPML $x_{ij\tau}$	(5) OLS $\ln z_{ij\tau}$	(6) PPML $z_{ij\tau}$	(7) OLS $\ln x_{ij\tau}$	(8) PPML $x_{ij\tau}$
Second stage								
$\ln DIST_{ij}$	-1.050***	-0.669***	-1.041***	-0.816***	-1.050***	-0.669***	-1.040***	-0.813***
	(0.009)	(0.027)	(0.010)	(0.010)	(0.009)	(0.027)	(0.010)	(0.010)
$CONTIG_{ij}$	0.097***	0.276***	0.116***	0.414***	0.097***	0.275***	0.115***	0.414***
	(0.019)	(0.030)	(0.019)	(0.018)	(0.019)	(0.030)	(0.019)	(0.018)
$COMLANG_{ij}$	0.386***	0.769***	0.387***	0.150***	0.386***	0.769***	0.387***	0.151***
	(0.019)	(0.049)	(0.019)	(0.017)	(0.019)	(0.049)	(0.019)	(0.017)
First stage								
$PTA_{ij\tau}$	0.274***	0.308***	0.267***	0.332***	0.274***	0.311***	0.276***	0.341***
	(0.016)	(0.019)	(0.017)	(0.019)	(0.014)	(0.016)	(0.015)	(0.013)
Estimated elasticities								
σ	2.361***	2.506***	2.371***	2.383***	2.362***	2.507***	2.373***	2.383***
	(0.174)	(0.045)	(0.606)	(0.560)	(0.019)	(0.048)	(0.491)	(0.449)
μ	0.947***	0.928***	0.946***	0.939***	0.947***	0.928***	0.945***	0.939***
	(0.003)	(0.007)	(0.009)	(0.006)	(0.001)	(0.007)	(0.006)	(0.005)
zero trade		X		X		X		X
symmetric $t_{ij\tau}$	X	X	X	X				
asymmetric $t_{ij\tau}$					X	X	X	X
N	36,945	37,741	37,493	38,313	36,945	37,741	37,493	38,313

Notes: Results for trade flows between 28 OECD countries between 1950 and 2006 estimated by ordinary least squares (OLS) and Poisson pseudo-maximum-likelihood (PPML). z_{ij} are trade flows standardized by importer and exporter GDPs. $\ln DIST$ is distance between exporting and importing country, $CONTIG$ is an indicator variable equal to 1 if the exporting and importing countries i and j share a common border, $COMLANG$ is an indicator variable equal to 1 if the exporting and importing country share a common official language, and PTA is an indicator variable equal to 1 if the exporting and importing country have signed a preferential trade agreement. All regressions control for multilateral resistance terms (MRTs) via exporter and importer fixed effects. (Robust) standard errors in parentheses, *** $p < 0.01$. Standard errors for σ and μ are bootstrapped using 200 replications.

Table 7: Comparative static effects of PTA inception assuming balanced trade in 2006

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	PLM	SMF	share %GDP SMF		SMF	SMF	PLM	SMF
	%GDP	%GDP	$\% \ln(\hat{p})$	$\% \ln(\hat{e})$	$\%\hat{e}$	Δu	%EV	%EV
Australia	16.69	17.64	92.78	7.22	1.18	-1.11	16.69	17.64
Austria	18.31	19.61	91.78	8.22	1.48	-1.39	21.05	22.60
Belgium	18.79	20.17	91.53	8.47	1.57	-1.42	22.37	24.04
Canada	21.05	22.53	90.63	9.37	1.92	-1.77	28.68	30.16
Czech Republic	17.82	19.06	92.04	7.96	1.40	-1.28	19.74	21.19
Denmark	17.25	18.40	92.37	7.63	1.30	-1.23	18.19	19.54
Finland	16.44	17.48	92.87	7.13	1.16	-1.05	16.04	17.24
France	16.26	17.30	92.97	7.03	1.13	-1.02	15.56	16.79
Germany	15.65	16.61	93.39	6.61	1.02	-0.91	13.94	15.10
Greece	16.22	17.23	93.01	6.99	1.12	-1.01	15.45	16.62
Hungary	17.30	18.46	92.33	7.67	1.31	-1.19	18.34	19.70
Iceland	15.88	16.80	93.27	6.73	1.05	-1.01	14.54	15.56
Ireland	16.63	17.65	92.77	7.23	1.18	-1.12	16.52	17.67
Italy	15.69	16.64	93.37	6.63	1.03	-0.95	14.05	15.17
Japan	9.59	9.62	101.02	-1.02	-0.09	0.09	-1.27	-1.29
Korea	9.74	9.79	100.70	-0.70	-0.07	0.06	-0.92	-0.91
Netherlands	17.20	18.36	92.39	7.61	1.29	-1.22	18.06	19.44
New Zealand	10.79	11.02	98.71	1.29	0.13	-0.13	1.63	1.88
Norway	16.80	17.88	92.64	7.36	1.22	-1.16	16.99	18.23
Poland	17.14	18.28	92.43	7.57	1.28	-1.09	17.90	19.23
Portugal	16.55	17.59	92.80	7.20	1.17	-1.07	16.33	17.52
Slovak Republic	17.57	18.77	92.18	7.82	1.35	-1.16	19.06	20.47
Spain	15.73	16.67	93.35	6.65	1.03	-0.93	14.15	15.24
Sweden	16.70	17.77	92.70	7.30	1.20	-1.10	16.71	17.96
Switzerland	19.06	20.48	91.40	8.60	1.61	-1.53	23.11	24.81
Turkey	16.11	17.09	93.10	6.90	1.10	-0.97	15.15	16.27
United Kingdom	14.21	14.93	94.57	5.43	0.76	-0.71	10.20	11.02
United States	10.26	10.43	99.60	0.40	0.04	-0.04	0.35	0.54
Average	13.14	13.70	96.61	3.39	0.56	-0.51	7.68	8.32

Notes: Counterfactual analysis based on parameter estimates from column (6) of Table 2. PLM gives results assuming perfect labor markets. SMF gives results using a search and matching framework for the labor market. Averages are weighted averages using country GDP as weight.

Table 8: Heterogeneity of comparative static trade effects of PTA inception with perfect labor markets assuming balanced trade in 2006

	Changes in exports in percent by importer quantiles						
Exporting country	Min.	0.025	0.25	0.5	0.75	0.975	Max.
Australia	-29.91	-29.39	-24.14	-22.93	-21.50	20.63	20.88
Austria	-32.29	-31.15	-3.53	0.33	2.32	6.34	6.92
Belgium	-32.98	-31.85	-4.26	-0.68	1.28	5.27	5.84
Canada	-33.36	-33.29	-30.74	-29.71	-28.40	5.31	10.25
Czech Republic	-31.59	-30.44	-2.53	1.37	3.37	7.44	8.03
Denmark	-30.75	-29.59	-1.33	2.61	4.64	8.76	9.35
Finland	-29.55	-28.36	0.39	4.27	6.47	10.66	11.26
France	-29.27	-28.08	0.78	4.68	6.78	11.10	11.70
Germany	-28.33	-27.12	2.13	6.08	8.13	12.56	13.19
Greece	-29.21	-28.01	0.87	4.77	6.80	11.19	11.80
Hungary	-30.83	-29.67	-1.45	2.50	4.52	8.64	9.23
Iceland	-28.68	-27.47	2.32	5.69	7.78	22.41	24.49
Ireland	-29.82	-28.64	-0.00	3.87	6.05	10.23	10.83
Italy	-28.39	-27.18	2.04	5.99	8.04	12.48	13.09
Japan	-17.98	-17.37	-11.23	-9.95	-8.27	4.67	4.89
Korea	-18.25	-17.56	-11.42	-9.90	0.20	24.38	24.49
Netherlands	-30.68	-29.51	-1.23	2.72	4.75	8.88	9.47
New Zealand	-20.18	-19.59	-13.61	-12.24	-10.61	16.46	19.44
Norway	-30.08	-28.90	0.31	3.61	5.87	20.00	22.03
Poland	-30.59	-29.42	-1.11	2.72	4.88	9.01	9.61
Portugal	-29.71	-28.52	0.16	4.03	6.22	10.40	11.01
Slovak Republic	-31.23	-30.07	-2.01	1.91	3.92	8.02	8.61
Spain	-28.45	-27.24	1.95	5.89	7.95	12.38	12.99
Sweden	-29.93	-28.75	-0.16	3.71	5.89	10.06	10.66
Switzerland	-33.36	-32.24	-3.42	-0.52	0.91	14.38	16.31
Turkey	-29.03	-27.84	1.81	5.16	7.24	21.80	23.87
United Kingdom	-26.03	-24.79	5.39	9.47	11.59	13.17	13.19
United States	-15.79	-15.71	-12.48	-10.97	-9.45	19.02	20.88
Average	-28.44	-27.42	-3.80	-0.55	1.69	12.35	13.37

Notes: Counterfactual analysis based on parameter estimates from column (6) of Table 2. Table depicts changes in normalized exports, i.e. exports divided by source and origin GDPs.

Table 9: Heterogeneity of comparative static effects of PTA inception with imperfect labor markets and assuming balanced trade in 2006

	Changes in exports in percent by importer quantiles						
Exporting country	Min.	0.025	0.25	0.5	0.75	0.975	Max.
Australia	-29.68	-29.21	-24.15	-22.91	-21.51	20.83	21.08
Austria	-32.25	-31.12	-3.84	0.06	2.04	6.10	6.70
Belgium	-32.96	-31.84	-4.59	-0.98	0.98	5.00	5.59
Canada	-33.33	-33.27	-30.68	-29.62	-28.34	5.61	10.54
Czech Republic	-31.54	-30.40	-2.84	1.11	3.11	7.22	7.82
Denmark	-30.69	-29.54	-1.63	2.36	4.39	8.55	9.16
Finland	-29.47	-28.29	0.11	4.01	6.24	10.47	11.09
France	-29.22	-28.04	0.46	4.37	6.52	10.85	11.47
Germany	-28.29	-27.09	1.78	5.74	7.81	12.30	12.94
Greece	-29.13	-27.95	0.59	4.51	6.55	11.00	11.62
Hungary	-30.77	-29.62	-1.74	2.25	4.27	8.42	9.03
Iceland	-28.55	-27.36	2.11	5.53	7.62	22.53	24.65
Ireland	-29.70	-28.53	-0.22	3.66	5.89	10.10	10.72
Italy	-28.33	-27.13	1.73	5.69	7.75	12.25	12.88
Japan	-17.65	-17.10	-11.17	-9.80	-8.18	5.02	5.26
Korea	-17.94	-17.31	-11.39	-9.84	0.40	24.53	24.65
Netherlands	-30.64	-29.49	-1.56	2.44	4.47	8.63	9.24
New Zealand	-19.97	-19.43	-13.67	-12.26	-10.66	16.68	19.65
Norway	-30.00	-28.83	0.03	3.38	5.68	20.04	22.12
Poland	-30.53	-29.37	-1.40	2.44	4.64	8.80	9.41
Portugal	-29.62	-28.45	-0.11	3.78	6.01	10.23	10.85
Slovak Republic	-31.17	-30.03	-2.31	1.65	3.67	7.79	8.40
Spain	-28.37	-27.18	1.67	5.62	7.69	12.18	12.82
Sweden	-29.86	-28.69	-0.44	3.43	5.65	9.86	10.48
Switzerland	-33.33	-32.22	-3.73	-0.79	0.65	14.33	16.30
Turkey	-28.94	-27.75	1.55	4.95	7.03	21.86	23.97
United Kingdom	-25.92	-24.68	5.15	9.24	11.38	12.93	12.94
United States	-15.89	-15.81	-12.55	-11.02	-9.54	19.23	21.08
Average	-28.35	-27.35	-4.03	-0.75	1.51	12.26	13.30

Notes: Counterfactual analysis based on parameter estimates from column (6) of Table 2. Table depicts changes in normalized exports, i.e. exports divided by source and origin GDPs.

Table 10: Average comparative static effects of PTA inception assuming balanced trade for various parameter values

μ	σ	PLM %GDP	SMF %GDP	SMF $\%\hat{e}$	SMF $\%\Delta u$	PLM %EV	SMF %EV
	5	4.86	16.76	11.90	-9.23	2.75	15.23
0.2	10	2.15	7.13	5.00	-4.22	1.20	6.33
	15	1.38	4.53	3.16	-2.74	0.77	3.98
	5	4.86	7.60	2.75	-2.41	2.75	5.66
0.5	10	2.15	3.35	1.20	-1.08	1.20	2.44
	15	1.38	2.15	0.77	-0.70	0.77	1.55
	5	4.86	5.75	0.90	-0.81	2.75	3.71
0.75	10	2.15	2.55	0.40	-0.36	1.20	1.61
	15	1.38	1.64	0.25	-0.23	0.77	1.03
	5	4.86	5.15	0.30	-0.27	2.75	3.07
0.9	10	2.15	2.28	0.13	-0.12	1.20	1.34
	15	1.38	1.47	0.08	-0.08	0.77	0.85
	5	4.86	4.89	0.03	-0.03	2.75	2.78
0.99	10	2.15	2.16	0.01	-0.01	1.20	1.21
	15	1.38	1.39	0.01	-0.01	0.77	0.78

Notes: Table reports average changes in nominal GDP, employment, and the equivalent variation in percent assuming either a perfect labor market (PLM) or using a search and matching framework (SMF) for the labor market with varying elasticity of substitution σ and elasticity of the matching function μ.

Table 11: Comparative static effects of $\hat{\kappa}_{U.S.} = 1.03$ assuming balanced trade in 2006

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	PLM	SMF	share %GDP SMF		SMF	SMF	PLM	SMF
	%GDP	%GDP	$\% \ln(\hat{p})$	$\% \ln(\hat{e})$	$\%\hat{e}$	Δu	%EV	%EV
Australia	0.00	0.79	92.78	7.22	0.06	-0.05	0.00	0.79
Austria	0.00	0.51	98.69	1.31	0.01	-0.01	0.00	0.09
Belgium	0.00	0.49	99.36	0.64	0.00	-0.00	0.00	0.04
Canada	0.00	0.96	90.80	9.20	0.09	-0.08	0.00	1.23
Czech Republic	0.00	0.52	98.12	1.88	0.01	-0.01	0.00	0.14
Denmark	0.00	0.53	97.88	2.12	0.01	-0.01	0.00	0.16
Finland	0.00	0.56	97.15	2.85	0.02	-0.01	0.00	0.22
France	0.00	0.52	98.20	1.80	0.01	-0.01	0.00	0.13
Germany	0.00	0.52	98.25	1.75	0.01	-0.01	0.00	0.13
Greece	0.00	0.55	97.32	2.68	0.01	-0.01	0.00	0.20
Hungary	0.00	0.54	97.71	2.29	0.01	-0.01	0.00	0.17
Iceland	0.00	0.62	95.60	4.40	0.03	-0.03	0.00	0.38
Ireland	0.00	0.59	96.29	3.71	0.02	-0.02	0.00	0.30
Italy	0.00	0.53	97.79	2.21	0.01	-0.01	0.00	0.16
Japan	0.00	0.54	97.50	2.50	0.01	-0.01	0.00	0.19
Korea	0.00	0.55	97.32	2.68	0.01	-0.01	0.00	0.20
Netherlands	0.00	0.51	98.45	1.55	0.01	-0.01	0.00	0.11
New Zealand	0.00	0.73	93.60	6.40	0.05	-0.04	0.00	0.65
Norway	0.00	0.56	97.17	2.83	0.02	-0.02	0.00	0.22
Poland	0.00	0.54	97.76	2.24	0.01	-0.01	0.00	0.17
Portugal	0.00	0.57	96.87	3.13	0.02	-0.02	0.00	0.25
Slovak Republic	0.00	0.53	97.81	2.19	0.01	-0.01	0.00	0.16
Spain	0.00	0.55	97.22	2.78	0.02	-0.01	0.00	0.21
Sweden	0.00	0.55	97.43	2.57	0.01	-0.01	0.00	0.19
Switzerland	0.00	0.48	99.41	0.59	0.00	-0.00	0.00	0.04
Turkey	0.00	0.56	96.98	3.02	0.02	-0.02	0.00	0.24
United Kingdom	0.00	0.62	95.73	4.27	0.03	-0.02	0.00	0.36
United States	0.00	2.54	-16.66	116.66	2.97	-2.83	0.00	2.54
Average	0.00	1.30	55.06	44.94	1.11	-1.06	0.00	1.10

Notes: Counterfactual analysis based on parameter estimates from column (6) of Table 2. PLM gives results assuming perfect labor markets. SMF gives results using a search and matching framework for the labor market. Averages are weighted averages using country GDP as weight.

Table 12: Heterogeneity of comparative static trade effects of $\hat{\kappa}_{U.S.} = 1.03$ with imperfect labor markets and assuming balanced trade in 2006

	Changes in exports in percent by importer quantiles						
Exporting country	Min.	0.025	0.25	0.5	0.75	0.975	Max.
Australia	-0.98	-0.91	-0.10	-0.05	-0.01	0.08	0.08
Austria	-0.36	-0.29	0.48	0.56	0.60	0.71	0.71
Belgium	-0.31	-0.24	0.53	0.60	0.65	0.74	0.75
Canada	-0.98	-0.98	-0.49	-0.45	-0.40	-0.31	-0.31
Czech Republic	-0.40	-0.33	0.44	0.52	0.56	0.67	0.67
Denmark	-0.41	-0.35	0.43	0.50	0.56	0.65	0.65
Finland	-0.47	-0.40	0.37	0.45	0.50	0.59	0.59
France	-0.39	-0.32	0.45	0.53	0.57	0.67	0.67
Germany	-0.39	-0.32	0.45	0.53	0.57	0.68	0.68
Greece	-0.46	-0.39	0.38	0.47	0.52	0.61	0.61
Hungary	-0.43	-0.36	0.41	0.49	0.55	0.64	0.64
Iceland	-0.61	-0.54	0.27	0.31	0.36	0.45	0.45
Ireland	-0.55	-0.48	0.33	0.38	0.43	0.52	0.52
Italy	-0.42	-0.35	0.42	0.50	0.55	0.64	0.64
Japan	-0.44	-0.37	0.40	0.47	0.53	0.62	0.62
Korea	-0.46	-0.39	0.38	0.47	0.51	0.61	0.61
Netherlands	-0.37	-0.30	0.47	0.54	0.59	0.69	0.69
New Zealand	-0.85	-0.78	0.03	0.07	0.12	0.21	0.21
Norway	-0.47	-0.40	0.37	0.45	0.50	0.59	0.59
Poland	-0.42	-0.35	0.42	0.49	0.55	0.64	0.64
Portugal	-0.50	-0.43	0.35	0.43	0.48	0.57	0.57
Slovak Republic	-0.42	-0.35	0.42	0.50	0.55	0.64	0.65
Spain	-0.47	-0.40	0.37	0.46	0.51	0.60	0.60
Sweden	-0.45	-0.38	0.39	0.47	0.52	0.62	0.62
Switzerland	-0.31	-0.24	0.53	0.61	0.65	0.75	0.75
Turkey	-0.49	-0.42	0.35	0.44	0.49	0.58	0.58
United Kingdom	-0.60	-0.53	0.28	0.32	0.37	0.46	0.46
United States	-0.98	-0.91	-0.10	-0.06	-0.01	0.08	0.08
Average	-0.51	-0.45	0.32	0.39	0.44	0.54	0.54

Notes: Counterfactual analysis based on parameter estimates from column (6) of Table 2. Table depicts changes in normalized exports, i.e. exports divided by source and origin GDPs.

Table 13: Comparative static effects of undoing recent German labor market reforms assuming balanced trade in 2006

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	PLM	SMF	share %GDP SMF		SMF	SMF	PLM	SMF
	%GDP	%GDP	$\% \ln(\hat{p})$	$\% \ln(\hat{e})$	$\%\hat{e}$	Δu	%EV	%EV
Australia	0.00	-0.03	92.78	7.22	-0.00	0.00	0.00	-0.03
Austria	0.00	-0.39	82.93	17.07	-0.07	0.06	0.00	-0.91
Belgium	0.00	-0.31	83.13	16.87	-0.05	0.05	0.00	-0.73
Canada	0.00	-0.02	99.31	0.69	-0.00	0.00	0.00	-0.00
Czech Republic	0.00	-0.25	83.41	16.59	-0.04	0.04	0.00	-0.57
Denmark	0.00	-0.24	83.44	16.56	-0.04	0.04	0.00	-0.56
Finland	0.00	-0.11	85.05	14.95	-0.02	0.02	0.00	-0.23
France	0.00	-0.16	84.19	15.81	-0.02	0.02	0.00	-0.34
Germany	0.00	-4.58	-37.40	101.08	-4.63	4.15	0.00	-3.11
Greece	0.00	-0.10	85.33	14.67	-0.02	0.01	0.00	-0.21
Hungary	0.00	-0.14	84.42	15.58	-0.02	0.02	0.00	-0.31
Iceland	0.00	-0.10	85.40	14.60	-0.01	0.01	0.00	-0.20
Ireland	0.00	-0.07	87.07	12.93	-0.01	0.01	0.00	-0.12
Italy	0.00	-0.12	84.98	15.02	-0.02	0.02	0.00	-0.24
Japan	0.00	-0.03	91.78	8.22	-0.00	0.00	0.00	-0.04
Korea	0.00	-0.04	91.06	8.94	-0.00	0.00	0.00	-0.05
Netherlands	0.00	-0.23	83.49	16.51	-0.04	0.04	0.00	-0.54
New Zealand	0.00	-0.03	92.76	7.24	-0.00	0.00	0.00	-0.03
Norway	0.00	-0.14	84.54	15.46	-0.02	0.02	0.00	-0.29
Poland	0.00	-0.22	83.58	16.42	-0.04	0.03	0.00	-0.50
Portugal	0.00	-0.09	85.83	14.17	-0.01	0.01	0.00	-0.18
Slovak Republic	0.00	-0.15	84.35	15.65	-0.02	0.02	0.00	-0.32
Spain	0.00	-0.10	85.59	14.41	-0.01	0.01	0.00	-0.19
Sweden	0.00	-0.14	84.46	15.54	-0.02	0.02	0.00	-0.30
Switzerland	0.00	-0.27	83.31	16.69	-0.04	0.04	0.00	-0.62
Turkey	0.00	-0.11	85.25	14.75	-0.02	0.01	0.00	-0.22
United Kingdom	0.00	-0.11	85.21	14.79	-0.02	0.01	0.00	-0.22
United States	0.00	-0.04	91.25	8.75	-0.00	0.00	0.00	-0.04
Average	0.00	-0.44	78.90	18.15	-0.39	0.35	0.00	-0.39

Notes: Counterfactual analysis based on parameter estimates from column (6) of Table 2. PLM gives results assuming perfect labor markets. SMF gives results using a search and matching framework for the labor market. Averages are weighted averages using country GDP as weight.

Table 14: Heterogeneity of comparative static trade effects of undoing recent German labor market reforms assuming balanced trade with imperfect labor markets in 2006

	Changes in exports in percent by importer quantiles						
Exporting country	Min.	0.025	0.25	0.5	0.75	0.975	Max.
Australia	-0.26	-0.26	-0.10	-0.05	0.15	0.53	0.56
Austria	0.53	0.54	0.65	0.74	0.84	1.18	1.20
Belgium	0.37	0.37	0.49	0.58	0.68	1.15	1.20
Canada	-0.26	-0.26	-0.13	-0.08	0.13	0.50	0.53
Czech Republic	0.22	0.23	0.34	0.43	0.53	1.02	1.05
Denmark	0.21	0.22	0.33	0.42	0.52	1.01	1.04
Finland	-0.08	-0.08	0.04	0.13	0.33	0.71	0.74
France	0.02	0.02	0.14	0.23	0.43	0.81	0.84
Germany	0.01	0.01	0.12	0.21	0.42	0.80	0.83
Greece	-0.10	-0.10	0.02	0.11	0.31	0.69	0.72
Hungary	-0.01	-0.01	0.10	0.19	0.40	0.78	0.81
Iceland	-0.11	-0.10	0.01	0.11	0.31	0.69	0.71
Ireland	-0.18	-0.18	-0.02	0.03	0.23	0.61	0.64
Italy	-0.08	-0.07	0.04	0.13	0.34	0.72	0.75
Japan	-0.26	-0.25	-0.10	-0.04	0.16	0.54	0.57
Korea	-0.25	-0.24	-0.09	-0.04	0.17	0.54	0.57
Netherlands	0.19	0.20	0.31	0.40	0.50	0.99	1.02
New Zealand	-0.26	-0.26	-0.10	-0.05	0.15	0.53	0.56
Norway	-0.03	-0.02	0.09	0.18	0.39	0.77	0.79
Poland	0.16	0.17	0.28	0.37	0.47	0.96	0.99
Portugal	-0.13	-0.13	-0.01	0.08	0.28	0.66	0.69
Slovak Republic	-0.00	0.00	0.11	0.20	0.41	0.79	0.82
Spain	-0.12	-0.12	-0.00	0.09	0.30	0.67	0.70
Sweden	-0.02	-0.02	0.10	0.19	0.40	0.77	0.80
Switzerland	0.27	0.27	0.39	0.47	0.57	1.06	1.09
Turkey	-0.10	-0.09	0.02	0.12	0.32	0.70	0.73
United Kingdom	-0.09	-0.09	0.02	0.12	0.32	0.70	0.73
United States	-0.25	-0.25	-0.09	-0.04	0.17	0.54	0.57
Average	-0.02	-0.02	0.11	0.19	0.37	0.77	0.79

Notes: Counterfactual analysis based on parameter estimates from column (6) of Table 2 in the main text. Table depicts changes in normalized exports, i.e. exports divided by source and origin GDPs.