Gravity with Unemployment*

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Abstract

The gravity equation is the workhorse of international trade flow studies and has been the basis for numerous evaluations of the trade and welfare impact of trade liberalization. However, its theoretical foundations have neglected labor market frictions. We extend a standard structural gravity model by modeling these frictions within a search and matching framework. Our framework allows counterfactual analysis of changes in trade costs and labor market reforms on trade flows, prices, employment, and welfare. We demonstrate that standard gravity models which neglect adjustments on the labor market typically underestimate welfare effects of trade liberalization by deriving a sufficient statistic for welfare. We apply our methodology to evaluate the trade effect of endogenous preferential trade agreements (PTA) for a sample of OECD countries and reconsider the border puzzle. On average our estimates imply that welfare effects of PTAs are doubled when taking into account employment effects. However, some countries experience higher unemployment and lower welfare after trade liberalization.

Keywords: International trade; gravity equation; trade costs; unemployment; structural estimation
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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. The workhorse model for evaluating trade policies is the gravity equation which relates bilateral trade flows between two countries to their respective market sizes and the geographic distance between them. Its empirical success in explaining trade flows has spurred the development of its theoretical underpinnings. Anderson (1979) and Bergstrand (1985) addressed the role of "multilateral price" effects on trade flows, while more recent contributions by Eaton and Kortum (2002) and Anderson and van Wincoop (2003) refined the theoretical foundations for the gravity equation to emphasize the importance of accounting properly for the endogeneity of prices. As for example emphasized by Anderson and van Wincoop (2003), in order to calculate the effects of a counterfactual situation taking into account general equilibrium effects, one needs to take care of changes of income. To do so, one needs to calculate prices in the counterfactual equilibrium. In the framework of Anderson and van Wincoop (2003) assuming perfect labor markets, this 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. All these models assume that labor markets are perfectly competitive, so that wages adjust fully in order to restore labor market equilibrium after a policy change.

We propose the first structural gravity model in international trade accounting for employment effects. We derive a simple, structural framework that allows for *price and quantity* adjustments. In essence, our model allows labor market variables to affect income. We show that the gravity equation derived from our model does not differ from the standard gravity equation derived under the assumption of perfect labor markets. The secret of the power of our approach lies in the counterfactual analysis.

We therefore contribute to the vast literature on structural gravity estimation by augmenting a standard Armington (1969) type model by labor market frictions along the lines of the standard Pissarides (2000) search and matching model and its one-shot simplification discussed in Rogerson et al. (2005). We derive an estimable structural gravity equation from our model and show how to calculate counterfactual trade flow, GDP, employment, and welfare changes. We also derive a simple sufficient statistic for welfare, relating welfare changes to employment changes, changes in the share of spending on domestic goods and the (partial) import trade elasticity similar to Arkolakis et al. (2012).

We apply our developed structural model to two different data-sets. First, we use a sample of 28 OECD countries from 1950 to 2006 in order to evaluate the effects of preferential trade agreements (PTAs) and a hypothetical labor market reform in the US. We find that introducing PTAs as observed in 2006 leads to a doubling of the average GDP effect when accounting for employment effects. Countries with only slight increases in GDP even see negative employment effects. These negative employment effects translate into a magnification of the negative welfare effects predicted for those countries. Our second counterfactual analysis assumes an improvement of labor market institutions in the US. Again, average welfare effects are doubled when taking into account employment effects. US GDP increases roughly ten times more than GDP of the other countries. While the US profits the most from its improvements in labor market institutions with welfare increasing by 4.38%, all trading partners also experience an increase in welfare due to positive spill-over effects.

We next use our methodology to reconsider the McCallum (1995) border puzzle accounting for employment effects. McCallum (1995) showed that trade between US states and Canadian provinces is reduced by a factor of 22 in comparison to trade within a country. When comparing the GDP changes between the perfect and imperfect labor markets, we see that on average, GDP changes are more than twice as large. On average, US states gain far less than Canadian provinces. Finally, turning to the welfare implications, we calculate a doubling in the equivalent variation when comparing the perfect with the imperfect labor market scenario, similar to the effect found for GDP.

As our two applications show, the developed approach can easily be applied. It has only minimal requirements on the information needed on the labor market side as it only needs an estimate of the elasticity of the matching function. Hence, our suggested framework opens up for applications in all fields where the gravity equation has been applied successfully previously.

The remainder of the paper is structured as follows: Section 2 presents the structural gravity model accounting for employment effects. It also includes a discussion of how to calculate counterfactual employment, GDP, trade flow, and welfare changes. Section 3 discusses the parameter estimation. Section 4 evaluates the effects of preferential trade agreements and labor market reforms for a sample of 28 OECD countries. Section 5 revisits the McCallum (1995) border puzzle. Section 6 presents robustness checks, and Section 7 concludes.

2 A gravity model with imperfect labor markets

In order to derive the gravity model with imperfect labor markets, we first describe the goods and labor market, and then derive the gravity equation given the assumptions about the goods and factor market. Afterwards we discuss the comparative static analysis.

2.1 Goods market

The representative consumer in country j is characterized by the utility function U_j. We assume goods that are differentiated by country of origin following Armington (1969). Consumption of goods from country i are given by c_{ij}, leading to the following utility function

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

where n is the number of countries, σ is the elasticity of substitution in consumption and β_i is a positive distribution parameter.

International trade of goods from i to j imposes iceberg trade costs $t_{ij} > 1$ for all $i \neq j$, and $t_{ij} = 1$ for $i = j$ such that all goods from i sell at the same price p_i domestically. Profit maximization then implies that $p_{ij} = p_i t_{ij}$.

Therefore, the representative consumer maximizes (1) subject to the budget constraint

$$\tilde{y}_j = \sum_{i=1}^{n} p_i t_{ij} c_{ij}, \tag{2}$$

where $\tilde{y}_j = y_j(1 + d_j)$, with y_j denoting nominal income in country j and d_j the share of trade deficit or surplus of country j in terms of GDP. The according demand for each variety is given by

$$c_{ij} = \frac{\beta_i^{1-\sigma} (p_i t_{ij})^{-\sigma}}{P_j^{1-\sigma}} \tilde{y}_j, \tag{3}$$

where the CES price index is defined by

$$P_j = \left[\sum_{i=1}^{n} (\beta_i p_i t_{ij})^{1-\sigma} \right]^{1/(1-\sigma)} . \tag{4}$$

The value of aggregate exports from i to j can then be expressed as

$$x_{ij} \;=\; p_i t_{ij} c_{ij} = \left(\frac{\beta_i p_i t_{ij}}{P_j} \right)^{1-\sigma} \tilde{y}_j . \tag{5}$$

In general equilibrium the total amount of exports corresponds to nominal income, i.e.

$$y_i \;=\; \sum_{j=1}^{n} x_{ij} . \tag{6}$$

Assuming labor to be the only factor of production, GDP in a world with imperfect labor markets is given by:

$$y_i \;=\; w_i (1 - u_i) L_i . \tag{7}$$

We next describe the labor market, which determines wages w_i and the unemployment rate u_i.

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)).[1] Search-theoretic frameworks fit stylized facts of labor markets in developed economies as e.g. the simultaneous existence of unfilled vacancies and unemployed workers.[2]

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 at a unit cost of $c_j P_j$ (measured in terms of the final output good) 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.[3] 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[4]

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

After a match has been established, the firm and the worker bargain over the match surplus. The worker's surplus from the match is the difference between the wage the worker earns

[1] See Rogerson et al. (2005) for a survey of search and matching models including an exposition of the simplified one-shot version. For recent trade models using a similar static approach see Keuschnigg and Ribi (2009) and Helpman and Itskhoki (2010).

[2] 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.

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

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

while being employed and the unemployment benefits she receives when she is unemployed. The unemployment benefits are expressed as a fraction γ_j of the ongoing wage rate.

Denote by J_j^o the value of expected profit from an occupied job and J_j^v the value of expected profit from a vacant job. J_j^v is given by $-P_j c_j + M_j/V_j(J_j^o - J_j^v)$, i.e. by the sum of negative of the cost of posting a vacancy and the probability of filling the vacancy multiplied with the surplus of filling it. J_j^o is given by $J_j^o = p_j - w_j$, i.e. by the difference of marginal revenues and marginal costs of an employed worker. Firms post vacancies until all profit opportunities are exploited, hence $J_j^v = 0$ in equilibrium. This implies that $p_j - w_j = P_j c_j V_j/M_j$. Hence, the worker's wage has to be strictly smaller than the value of output of the firm.

Rewriting, one finds the **job creation curve**

$$w_j = p_j - \frac{P_j c_j}{m_j \vartheta_j^{-\mu}}. \tag{9}$$

It is increasing in the value of output and decreasing in the expected costs of filling a vacancy $P_j c_j/(m_j \vartheta_j^{-\mu})$.

We use a generalized Nash bargaining solution to determine the surplus splitting rule:

$$\max_{w_j} \quad (w_j - \gamma_j w_j)^{\xi_j} (J_j^o - J_j^v)^{1-\xi_j} \tag{10}$$

$$\Rightarrow \max_{w_j} \quad (w_j - \gamma_j w_j)^{\xi_j} (p_j - w_j)^{1-\xi_j}, \tag{11}$$

where the bargaining power of the worker is given by $\xi_j \in (0,1)$. 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. 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**

$$w_j = \frac{\xi_j}{1 + \gamma_j \xi_j - \gamma_j} p_j. \tag{12}$$

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.

Combining the job creation and wage curves determines the equilibrium labor market tightness as

$$\vartheta_j = \left(\frac{p_j}{P_j}\right)^{1/\mu} \left(\frac{c_j}{m_j}\Omega_j\right)^{-1/\mu}, \tag{13}$$

where $\Omega_j := \frac{1-\gamma_j+\gamma_j\xi_j}{1-\gamma_j+\gamma_j\xi_j-\xi_j} \geq 1$ summarizes the effective bargaining power of workers. Ω_j is increasing in the worker's bargaining power ξ_j and in the replacement rate γ_j. Labor market tightness decreases and the unemployment rate increases when m_j or c_j decrease or Ω_j increases. An increase of p_j/P_j increases the marginal revenue of an additional worker relative to the cost of posting the vacancy. Hence, firms will create more vacancies, thereby increasing labor market tightness and lowering unemployment.

The relative price p_j/P_j is determined via goods demand and supply. It therefor provides the link between the labor and goods market. Specifically, changes in trade costs will affect the relative price, therefore influence labor market outcomes. This can best be seen by using equation (12) to replace wages w_j and equations (8) and (13) to replace u_j in equation (7)

$$y_j = \frac{\xi_j}{1+\gamma_j\xi_j-\gamma_j} p_j m_j \left(\frac{p_j}{P_j}\right)^{\frac{1-\mu}{\mu}} \left(\frac{c_j}{m_j}\Omega_j\right)^{\frac{\mu-1}{\mu}} L_j. \tag{14}$$

Given trade costs t_{ij}, labor endowments L_j and the parameters, we can use equations (4), (5), (6) and (14) to solve for the p_j's and subsequently for relative prices p_j/P_j, wages w_j, trade flows x_{ij}, GDPs y_j and the unemployment rate u_j.

2.3 Derivation of the gravity equation

In order to derive the gravity equation in our setting we first use equation (6) that summarizes the general equilibrium nature of our model and implies market clearing, i.e.

$$y_i = \sum_{j=1}^{n} x_{ij} = \sum_{j=1}^{n} \left(\frac{\beta_i t_{ij} p_i}{P_j}\right)^{1-\sigma} \tilde{y}_j = (\beta_i p_i)^{1-\sigma} \sum_{j=1}^{n} \left(\frac{t_{ij}}{P_j}\right)^{1-\sigma} \tilde{y}_j. \tag{15}$$

Solving for scaled prices $\beta_i p_i$ and defining $y^W = \sum_j y_j$, $\tilde{y}^W = \sum_j \tilde{y}_j$ and income shares $\theta_j \equiv y_j/y^W$ and $\tilde{\theta}_j \equiv \tilde{y}_j/\tilde{y}^W$, we can write

$$x_{ij} = \frac{y_i \tilde{y}_j}{y^W} \left(\frac{t_{ij}}{\Pi_i P_j}\right)^{1-\sigma}, \tag{16}$$

where

$$\Pi_i \equiv \left(\sum_{j=1}^{n} \left(\frac{t_{ij}}{P_j}\right)^{1-\sigma} \tilde{\theta}_j\right)^{1/(1-\sigma)}. \tag{17}$$

Substituting equilibrium scaled prices into equation (4), we obtain

$$P_j \equiv \left(\sum_{i=1}^{n} \left(\frac{t_{ij}}{\Pi_i}\right)^{1-\sigma} \theta_i\right)^{1/(1-\sigma)}. \tag{18}$$

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. If trade costs are symmetric, i.e. $t_{ij} = t_{ji}$, and trade is balanced $\Pi_i = P_i$ (see AvW). This is what Anderson and van Wincoop (2003) assumed throughout. Bergstrand et al. (2012) relaxed this assumption and we follow their approach here.

The intuition for this results is that in equation (16) GDPs appear. Observed GDPs already take care of the actual number of employed peoples. Hence, it still holds that total spending is 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. We summarize this result in the following implication:

Implication 1 *The gravity system is unchanged when allowing for imperfect labor markets.*

An immediate consequence of Proposition 1 is that parameter estimates of the gravity equation are not affected by allowing for imperfect labor markets. But then the question arises whether imperfections on the labor market matter at all for the evaluation of trade policies? The answer is yes, they do matter in the counterfactual analysis, to which we turn next.

2.4 Comparative statics

As pointed out in Proposition 1, the gravity equation derived from our model does not differ from the standard gravity equation (see for an overview Feenstra (2004)). The secret of the power of our approach lies in the counterfactual analysis.

As Anderson and van Wincoop (2003) emphasize in Appendix B, in order to calculate the counterfactual situation without borders, one needs to take into account that income and spending shares θ_i and $\tilde{\theta}_i$ change. In doing so, one needs to calculate prices in the borderless equilibrium. In the framework of Anderson and van Wincoop (2003) assuming perfect labor markets, this 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, whereas a change in a country's GDP only translates into price changes in the perfect labor market framework, our model leads to *price and quantity* 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, in the proper counterfactual analysis assuming perfect or imperfect labor markets matters.

We derive and discuss in turn counterfactual (un)employment, GDP, and trade flows. Afterwards we discuss how to calculate welfare and derive a sufficient statistics for welfare along the lines of Arkolakis et al. (2012).

2.4.1 Counterfactual employment

Noting that the p's are not observed, we follow Anderson and van Wincoop (2003) and use equation (15) to solve for scaled prices as follows:

$$(\beta_j p_j)^{1-\sigma} = \frac{y_j}{\sum_{i=1}^{n} \left(\frac{t_{ji}}{P_i}\right)^{1-\sigma} \tilde{y}_i} = \frac{y^W}{\tilde{y}^W} \theta_j \Pi_j^{\sigma-1} = \frac{y^W}{\tilde{y}^W} \mathfrak{t}_j, \tag{19}$$

where $\mathfrak{t}_j \equiv \theta_j \Pi_j^{\sigma-1}$. We then use the definition of u_i given in equation equation (8), replacing ϑ by the expression given in equation (13) and $\Xi_j = m_j \left(\frac{c_j}{m_j}\Omega_j\right)^{\frac{\mu-1}{\mu}}$ and $\hat{\kappa}_j = \Xi_j^c / \Xi_j$, we may write:

$$\frac{1-u_i^c}{1-u_i} = \hat{\kappa}_j \left(\frac{p_i^c}{p_i}\right)^{\frac{1-\mu}{\mu}} \left(\frac{P_i}{P_i^c}\right)^{\frac{1-\mu}{\mu}}. \tag{20}$$

Noting from the derivation of equation (19) and the fact that $P_j^{1-\sigma} = \sum_i t_{ij}^{1-\sigma} \mathfrak{t}_i$ (see Appendix A) that we can express the ratios of the prices and price indices as functions of $\mathfrak{t}_i$, we end up with

$$\hat{e}_j \equiv \frac{1-u_i^c}{1-u_i} = \hat{\kappa}_j \left(\frac{\mathfrak{t}_j^c}{\mathfrak{t}_j}\right)^{\frac{1-\mu}{\mu(1-\sigma)}} \left(\frac{\sum_i t_{ij}^{1-\sigma} \mathfrak{t}_i}{\sum_i t_{ij,c}^{1-\sigma} \mathfrak{t}_{i,c}}\right)^{\frac{1-\mu}{\mu(1-\sigma)}}. \tag{21}$$

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

In contrast to the setting assuming perfect labor markets, our framework allows for employment effects. We summarize in the following implication:

Implication 2 *Whereas in the setting with perfect labor markets employment effects are zero by assumption, the employment effects in our gravity system with imperfections on the labor market are given by:*

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

2.4.2 Counterfactual GDP

We next derive counterfactual GDPs. Defining $\Xi_j = m_j \left(\frac{c_j}{m_j}\Omega_j\right)^{\frac{\mu-1}{\mu}}$, we can write equation (14) as:

$$y_j = \frac{\xi_j}{1+\gamma_j\xi_j-\gamma_j} p_j \left(\frac{p_j}{P_j}\right)^{\frac{1-\mu}{\mu}} \Xi_j L_j. \tag{22}$$

Now take the ratio of counterfactual GDP, y_j^c and observed GDP y_j, while noting that all parameters and constants, like ξ_j, γ_j, Ξ_j and L_j, stay constant:

$$\frac{y_j^c}{y_j} = \hat{\kappa}_j \frac{p_j^c \left(\frac{p_j^c}{P_j^c}\right)^{\frac{1-\mu}{\mu}}}{p_j \left(\frac{p_j}{P_j}\right)^{\frac{1-\mu}{\mu}}} = \hat{\kappa}_j \left(\frac{p_j^c}{p_j}\right)^{\frac{1}{\mu}} \left(\frac{P_j}{P_j^c}\right)^{\frac{1-\mu}{\mu}}, \tag{23}$$

where $\hat{\kappa}_j = \Xi_j^c/\Xi_j$.

Using again (19) and the fact that $P_j^{1-\sigma} = \sum_i t_{ij}^{1-\sigma}\mathfrak{t}_i$ (see Appendix A), we can write

$$\hat{y}_j \equiv \frac{y_j^c}{y_j} = \left(\hat{D}^W\right)^{\frac{1}{1-\sigma}} \hat{\kappa}_j \left(\frac{\mathfrak{t}_j^c}{\mathfrak{t}_j}\right)^{\frac{1}{\mu(1-\sigma)}} \left(\frac{\sum_i t_{ij}^{1-\sigma}\mathfrak{t}_i}{\sum_i \left(t_{ij}^c\right)^{1-\sigma}\mathfrak{t}_i^c}\right)^{\frac{1-\mu}{\mu(1-\sigma)}}. \tag{24}$$

with $\hat{D}^W \equiv \left(\frac{y^{W,c}\tilde{y}^W}{\tilde{y}^{W,c}y^W}\right)^{\frac{1}{1-\sigma}}$ indicating the endogenous change in the world trade deficit to keep trade deficit GDP shares d_j's constant. It equals one in the case of balanced trade. Hence, given y_j, t_{ij} and t_{ij}^c, we can solve counterfactual GDPs, y_j^c, as soon as we have $\mathfrak{t}_j$, $\mathfrak{t}_j^c$, σ and μ. 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 GDPs. In order to ensure a common numéraire, we normalize $P_1 = P_1^c = 1$, i.e. GDP changes are in terms of the price level of the first importer in the data-set.[5]

If we assume balanced trade and if $\mu = 1$, we end up in the case of perfect labor markets employed by AvW, i.e.

$$\frac{y_j^c}{y_j} = \left(\frac{\mathfrak{t}_j^c}{\mathfrak{t}_j}\right)^{\frac{1}{1-\sigma}}. \tag{25}$$

We summarize our findings in the following implication:

[5] As mentioned in footnote 12 in AvW, the solution of the multilateral resistance terms 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 $P_i = P_{i,c} = 1$.

Implication 3 *Counterfactual GDPs are given by:*

$$\text{imperfect labor markets:} \quad y_j^c = \left(\hat{D}^W\right)^{\frac{1}{1-\sigma}} \hat{\kappa}_j \left(\frac{\mathfrak{t}_j^c}{\mathfrak{t}_j}\right)^{\frac{1}{\mu(1-\sigma)}} \left(\frac{\sum_i t_{ij}^{1-\sigma}\mathfrak{t}_i}{\sum_i \left(t_{ij}^c\right)^{1-\sigma}\mathfrak{t}_i^c}\right)^{\frac{1-\mu}{\mu(1-\sigma)}} y_j.$$

$$\text{perfect labor markets:} \quad y_j^c = \left(\hat{D}^W\right)^{\frac{1}{1-\sigma}} \left(\frac{\mathfrak{t}_j^c}{\mathfrak{t}_j}\right)^{\frac{1}{1-\sigma}} y_j.$$

We can now go a step further and disentangle the change in GDP in changes due to real price changes and changes due to employment changes as follows:

$$\begin{aligned}
\hat{y}_j &= \left(\hat{D}^W\right)^{\frac{1}{1-\sigma}} \hat{\kappa}_j \hat{p}_j \hat{e}_j \\
&= \left(\hat{D}^W\right)^{\frac{1}{1-\sigma}} \hat{\kappa}_j \left(\frac{\mathfrak{t}_j^c}{\mathfrak{t}_j}\right)^{\frac{1}{\mu(1-\sigma)}} \left(\frac{\sum_i t_{ij}^{1-\sigma}\mathfrak{t}_i}{\sum_i t_{ij,c}^{1-\sigma}\mathfrak{t}_i^c}\right)^{\frac{1-\mu}{\mu(1-\sigma)}} \\
&= \left(\hat{D}^W\right)^{\frac{1}{1-\sigma}} \hat{\kappa}_j \underbrace{\left(\frac{\mathfrak{t}_j^c}{\mathfrak{t}_j}\right)^{\frac{\mu}{\mu(1-\sigma)}}}_{\text{price change}} \underbrace{\left(\frac{\mathfrak{t}_j^c}{\mathfrak{t}_j}\right)^{\frac{1-\mu}{\mu(1-\sigma)}} \left(\frac{\sum_i t_{ij}^{1-\sigma}\mathfrak{t}_i}{\sum_i t_{ij,c}^{1-\sigma}\mathfrak{t}_{i,c}}\right)^{\frac{1-\mu}{\mu(1-\sigma)}}}_{\text{employment change}},
\end{aligned} \tag{26}$$

with $\hat{p}_j$ denoting the price change. 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 institutions, prices and employment as follows:

$$1 = \frac{\ln \hat{\kappa}_j}{\ln \hat{y}_j^\star} + \frac{\ln \hat{p}_j}{\ln \hat{y}_j^\star} + \frac{\ln \hat{e}_j}{\ln \hat{y}_j^\star}. \tag{27}$$

Let us focus on country 1 for a moment. As we use its price index P_1 as our numéraire, the last expression in brackets of equation (26) is equal to one for country 1. Then, the equation simplifies to the change in κ_j (which is solely driven by changes in exogenous parameters) and to two terms which are equal except their exponents: The price change term is risen 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 approaches zero, 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 $1-\mu$. Hence, with $\mu = 0.5$, half of the change in GDP is due to the price change and the other half due to the employment change.

2.4.3 Counterfactual trade flows

With estimates of t_{ij}, data on y_i and a value for σ, we can calculate (scaled) baseline trade flows as:

$$\frac{x_{ij}y^W}{y_i\tilde{y}_j} = \left(\frac{t_{ij}}{\Pi_i P_j}\right)^{1-\sigma}, \tag{28}$$

where Π_i and P_j are given by equations (17) and (18), respectively.

With counterfactual GDPs given by (24), we can calculate counterfactual trade flows as

$$\frac{x_{ij}^c y^{W,c}}{y_i^c\tilde{y}_j^c} = \left(\frac{t_{ij}^c}{\Pi_i^c P_j^c}\right)^{1-\sigma}, \tag{29}$$

where

$$\Pi_i^c = \left(\sum_{j=1}^{n} \left(\frac{t_{ij}^c}{P_j^c} \right)^{1-\sigma} \tilde{\theta}_j^c \right)^{1/(1-\sigma)}, \tag{30}$$

$$P_j^c = \left(\sum_{i=1}^{n} \left(\frac{t_{ij}^c}{\Pi_i^c} \right)^{1-\sigma} \theta_i^c \right)^{1/(1-\sigma)}, \tag{31}$$

and $\theta_j^c = y_j^c / \sum_i y_i^c$ and $\tilde{\theta}_j^c = \tilde{y}_j^c / \sum_i \tilde{y}_i^c$.

Note that P_j and P_j^c are homogeneous of degree one in prices while Π_i and Π_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.

Due to direct effects of trade costs changes via t_{ij} and non-trivial changes in Π_i and P_j it is theoretically ambiguous whether trade will change more or less assuming imperfect labor markets in comparison with the baseline case with perfect labor markets. This will also become obvious when we present our results for trade flow changes of the empirical examples in Section 5.2.

2.4.4 Calculating welfare effects

The equivalent variation in percent can in our framework be expressed as follows:

$$EV_i = \frac{\tilde{y}_i^{\star,c} \frac{P_i}{P_i^c} - \tilde{y}_i^{\star}}{\tilde{y}_i^{\star}} = \frac{\tilde{y}_i^{\star,c}}{\tilde{y}_i^{\star}} \frac{P_i}{P_i^c} - 1 = \hat{\tilde{y}}_i^{\star} \frac{P_i}{P_i^c} - 1. \tag{32}$$

We next derive a similar sufficient statistics for the welfare effects of trade liberalization as Arkolakis et al. (2012). We therefore consider a foreign shock that leaves the ability to serve the own market, τ_{jj}, unchanged as in Arkolakis et al. (2012). Additionally, we follow their normalization and set labor in country j, w_j equal to one and assume balanced trade. We then come up with the following sufficient statistics (see Appendix B for the derivation):

Implication 4 *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).

Assuming that $\hat{\lambda}_{jj}$ 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 welfare effects thereof. Recent empirical findings suggest that trade liberalization lowers unemployment (see Dutt et al. (2009) and Felbermayr et al. (2011)). Hence, falling trade costs will increase welfare due to to a decreasing share of domestic expenditures and increasing employment. The sufficient statistics of Arkolakis et al. (2012) neglects the employment effect and therefore likely underestimates the welfare effects of trade liberalization.

3 Parameter estimation

Having laid out our structural model and described how to obtain counterfactual GDPs, trade flows, employment levels and welfare, we next describe our estimation strategy for the gravity variables and the key parameters needed for the counterfactual analysis, the elasticity of substitution, σ, and the elasticity of the matching function, μ.

3.1 Estimating the gravity variables

We start by writing (16) in stochastic form as follows

$$z_{ij} \equiv \frac{x_{ij}}{y_i y_j} = \exp\left(k - (1-\sigma)\ln t_{ij} - \ln \Pi_i^{1-\sigma} - \ln P_j^{1-\sigma} + \varepsilon_{ij}\right), \tag{33}$$

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 of the right-hand side of equation (33).

We employ country-specific importer and exporter fixed-effects to control for the outward and inward MRT terms Π_i and P_j, respectively, as was already suggested by Anderson and van Wincoop (2003) and Feenstra (2004).[6] We then solve for the multilateral resistance terms based on the fixed effects trade friction parameter estimates.

Additionally to estimating equation (16) log-linear, we also use the approach suggested by Santos Silva and Tenreyro (2006) and estimate the multiplicative version of the model using PPML.

3.2 Estimating σ

There are many possible ways to estimate σ. However, Bergstrand et al. (2012) show how to obtain estimates for σ within their proposed framework with a production structure without relying on additional data. We show here that their approach which only relies on trade flows and observed baseline variables is still applicable, even when assuming imperfect labor markets. We therefore follow this approach in order to obtain an estimate for σ.

First, note that we can rewrite trade flows as given in equation (5) by using equation (12) as follows:

$$x_{ij} = \left(\frac{\beta_i(1-\gamma_i+\xi_i)w_i t_{ij}}{\xi_i P_j}\right)^{1-\sigma} y_j. \tag{34}$$

Estimation of equation (16) using observable determinants of bilateral trade costs generates estimates $\widehat{t_{ij}^{1-\sigma}}$.[7] We next substitute $\widehat{t_{ij}^{1-\sigma}}$ in equation (16) to generate $\hat{x}_{ij}$, $\widehat{t_{mj}^{1-\sigma}}$ in its analogue to generate $\hat{x}_{mj}$. Using observations on unemployment rates and observing that $w_i = y_i/[(1-u_i)L_i]$, we end up with

$$x_{ij} = \left(\frac{\beta_i(1-\gamma_i+\xi_i)y_i t_{ij}}{\xi_i(1-u_i)L_i P_j}\right)^{1-\sigma} y_j. \tag{35}$$

[6] Egger and Larch (2012) show that even in the US-Canada example of Anderson and van Wincoop (2003), a disadvantage of the structural approach as compared to fixed effects estimation is that correlation between trade friction variables in the model and unobserved country/region-specific determinants leads to inconsistent parameter estimates and, hence, to inconsistent estimates of the impact of trade frictions such as international borders on bilateral trade. They show that the AvW model produces biased parameter estimates according to a Hausman test.

[7] For instance, in the AvW context, $\widehat{t_{ij}^{1-\sigma}}$ would be determined by the exponentiated value of $[\widehat{(1-\sigma)\rho}]\ln d_{ij} + [\widehat{(1-\sigma)\ln b_{US,CA}}]Border_{ij}$.

Taking ratios of predicted trade flows $\hat{x}_{ij}$ and $\hat{x}_{mj}$, we end up with:

$$\frac{\hat{x}_{ij}}{\hat{x}_{mj}} = \frac{\widehat{t_{ij}^{1-\sigma}}}{\widehat{t_{mj}^{1-\sigma}}} \left(\frac{\beta_i(1-\gamma_i+\xi_i)y_i\xi_m(1-u_m)L_m}{\beta_m(1-\gamma_m+\xi_m)y_m\xi_i(1-u_i)L_i} \right)^{1-\sigma}. \tag{36}$$

Now we are left with an equation with only observables and parameters. Hence, we can solve for σ:

$$\sigma = 1 - \ln\left(\frac{\hat{x}_{ij}\widehat{t_{mj}^{1-\sigma}}}{\hat{x}_{mj}\widehat{t_{ij}^{1-\sigma}}} \right) / \ln\left(\frac{\beta_i(1-\gamma_i+\xi_i)\xi_m y_i(1-u_m)L_m}{\beta_m(1-\gamma_m+\xi_m)\xi_i y_m(1-u_i)L_i} \right). \tag{37}$$

where y_i, y_m, L_i, L_m, u_i and u_m are observables.[8] We can then calculate $n^2(n-1)$ such values of σ by using all combinations i, j, and m $(m \neq i)$. As a measure of central tendency, we use the median value of σ as our (summary) estimate, since the distribution of σ estimates is skewed to the right in that context (and the mean is slightly higher than the median). Standard errors for σ are obtained via bootstrapping.[9]

Assuming that labor market parameters and β's are equal, this simplifies to:

$$\frac{\hat{x}_{ij}}{\hat{x}_{mj}} = \frac{\widehat{t_{ij}^{1-\sigma}}}{\widehat{t_{mj}^{1-\sigma}}} \left(\frac{y_i(1-u_m)L_m}{y_m(1-u_i)L_i} \right)^{1-\sigma}. \tag{38}$$

3.3 Estimating μ

The other crucial parameter for our counterfactual analysis is the elasticity of the matching function, μ.

A first attempt to solve μ is to assume that labor market variables, such as m_j, c_j and Ω_j are identical across countries.

Then

$$1 - u_j = \Xi_j \left(\frac{p_j}{P_j} \right)^{\frac{1-\mu}{\mu}} = \Xi \left(\frac{p_j}{P_j} \right)^{\frac{1-\mu}{\mu}}. \tag{39}$$

Noting that we observe u_j in the baseline, we may take ratios for two countries and the log of this ratio to obtain:

$$\begin{aligned} \ln\left(\frac{1-u_j}{1-u_m}\right) &= \frac{1-\mu}{\mu}\ln\left(\frac{p_j}{p_m}\frac{P_m}{P_j}\right) \\ \Rightarrow \mu &= \frac{1}{1+\ln\left(\frac{1-u_j}{1-u_m}\right)/\ln\left(\frac{p_j}{p_m}\frac{P_m}{P_j}\right)}. \end{aligned} \tag{40}$$

Using $(\beta_j p_j)^{1-\sigma} = \theta_j \Pi_j^{\sigma-1} = \mathfrak{t}_j$ and $P_j^{1-\sigma} = \sum_{i=1}^n t_{ij}^{1-\sigma}\mathfrak{t}_i$, we can reformulate as follows:

$$\mu = \frac{1}{1+(1-\sigma)\ln\left(\frac{1-u_j}{1-u_m}\right)/\ln\left(\frac{\mathfrak{t}_j}{\mathfrak{t}_m}\frac{\sum_{i=1}^n t_{im}^{1-\sigma}\mathfrak{t}_i}{\sum_{i=1}^n t_{ij}^{1-\sigma}\mathfrak{t}_i}\right)} \tag{41}$$

We then calculate $n^2(n-1)$ such values of μ by using all combinations j, m, and $m(m \neq j)$. From those values we can then calculate $n^2(n-1)$ μ's.

[8] Alternatively, we can use the predicted Ys from the model. We show in our empirical results that the correlation coefficient between observed and predicted Ys is 0.992.

[9] Standard errors for all other parameters are the analytical standard errors of the corresponding models. However, the bootstrapped standard errors of those parameters are very similar to the analytical ones.

4 Preferential trade agreements and labor market frictions

We now turn 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.[10] The trade data are taken from Head et al. (2010), available from the CEPII website.[11]

In order to obtain an estimable gravity equation as given in (33), we have to parametrize trade costs. We follow the literature and proxy t_{ij} by a vector of trade barrier variables in the following way

$$t_{ij\tau}^{1-\sigma} = \exp(\beta_1 PTA_{ij\tau} + \beta_2 \ln DIST_{ij} + \beta_3 CONTIG_{ij} + \beta_4 COMLANG_{ij}), \qquad (42)$$

where $PTA_{ij\tau}$ is an indicator variable of preferential trade agreement membership, $DIST_{ij}$ is bilateral distance, $CONTIG_{ij}$ is a dummy variable indicating whether countries i and j are contiguous, and $COMLANG_{ij}$ indicates whether two countries share a common official language.[12] The data for the PTA's are constructed from the notifications to the World Trade Organization (WTO) and were augmented and corrected by using information from PTA secretariat webpages. The remaining geography variables are taken from the CEPII geography data-set. Table 1 gives summary statistics of the data.

[Table 1 about here.]

As is well known in the literature, countries do not randomly sign PTAs. Recently, Baier and Bergstrand (2004), Baier and Bergstrand (2007), Baier and Bergstrand (2009), Magee (2003), Egger et al. (2008), Egger et al. (2011b), Anderson and Yotov (2011) allowed for PTAs to be endogenous to trade in an econometric sense and showed that the exogeneity assumption is harmful for quantifying the effects of regional trade agreements. In order to avoid the 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 (33) including (directional) bilateral fixed effects, i.e. we estimate

$$z_{ij\tau} = \exp\left(k + \beta_1 PTA_{ij\tau} + \varphi_{i\tau} + \phi_{j\tau} + \nu_{ij} + \varepsilon_{ij}\right), \qquad (43)$$

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 effects.[13] Note that $\varphi_{i\tau}$ and $\phi_{j\tau}$ control for the multilateral resistance terms Π_i and P_j, and the bilateral fixed effects also capture the time-invariant geography variables. In a second step we re-estimate equation (33) in order to obtain estimates for the coefficients of the time-invariant geography variables, β_2 to β_4. We therefore only use exporter- and importer-time varying fixed effects and constrain the coefficient of PTA, β_1, to the estimate of the first step, $\hat{\beta}_1$. We follow Wei (1996) and Anderson and van Wincoop (2003) and set the internal distance in a country i, $DIST_{ii}$, to one quarter of the distance to the closest neighboring country.

[10] The 28 countries are Australia, Austria, Belgium, Canada, Switzerland, Czech Republic, Germany, Denmark, Spain, Finland, France, United Kingdom, Greece, Hungary, Ireland, Iceland, Italy, Japan, Korea, Netherlands, Norway, New Zealand, Poland, Portugal, Slovak Republic, Sweden, Turkey, and United States.

[11] `http://www.cepii.fr/anglaisgraph/bdd/gravity.htm`.

[12] We do not use common colonizer indicators or similar variables regularly used in the literature as these have hardly any variation in the employed OECD sample.

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

4.1 Estimation results

Concerning the estimation, 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). Results are shown in Table 2.

[Table 2 about here.]

Columns (1)-(4) present results using bilateral fixed effects, i.e. assuming symmetric trade costs $t_{ij} = t_{ji}$. Columns (5)-(8) allow for asymmetric trade costs, i.e. $t_{ij} \neq t_{ji}$, by employing directional bilateral fixed effects. Each of these two blocks presents four specifications. Columns (1) and (5) report OLS estimates for logged scaled trade flows $z_{ij\mathcal{T}}$. 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 $x_{ij\mathcal{T}}$. 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 reproduce well-known results from the empirical trade literature. Distance is a large obstacle to trade, whereas contiguity, a common language and PTAs spur trade. Comparing the results from columns (1)-(4) with those of columns (5)-(8) reveals that allowing for asymmetric trade costs does not change our parameter estimates substantially. Comparing with PPML estimates shows a clear pattern. While distance coefficients are smaller in absolute values with PPML, all other coefficients are larger. 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 14.68% (column (1)) to 29.56% (column (6)) when neglecting general equilibrium effects. The general equilibrium effects will be taken into account in the comparative static results, to which we turn next.

4.2 Comparative static results

We perform two counterfactual experiments in our OECD sample. First, we evaluate the effects of PTAs. Therefore we take PTAs as observed in 2006 and contrast it with a counterfactual situation without any PTAs. Second, we evaluate a hypothetical improvement of labor market institutions in the US. In all scenarios we assume that trade is balanced multilaterally.

4.2.1 Introducing PTAs as observed in 2006

Our first counterfactual experiment evaluates the effects of introducing PTAs as observed in 2006 from a counterfactual situation with no PTAs in place. We base our counterfactual analysis on parameter estimates from column (6) of Table 2. Additionally, we have to chose a value for the elasticity of substitution σ and the elasticity of the matching function μ. We use standard values for both and set $\sigma = 5$ as in Anderson and van Wincoop (2003) and $\mu = 0.5$, as proposed in Petrongolo and Pissarides (2001). We provide robustness results with respect to these parameter values in the Appendix.

[Table 3 about here.]

The results can be found in Tables 3, 4, and 5. Table 3 is organized as follows: The first column (1) labeled "AvW %GDP" gives the percentage change in nominal GDP in terms of the price index of Australia for the baseline case of perfect labor markets. Column (2) labeled "SMF %GDP" gives the same change for our gravity model using a search and matching framework. Columns (3) and (4) use equation (26) and decompose the change in nominal GDP of column (2) due to the price and employment changes. Column (5) reports the percentage change in the employement share for the case of imperfect labor markets. Finally, columns (6) and (7) 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 0.18% when assuming perfect labor markets. The average GDP effect more than doubles when accounting for employment effects. Hidden these average effects is a substantial heterogeneity. While some countries gain in the double digits like Switzerland, countries like the US experience a modest increase of 0.05%. The decomposition of (log) GDP in (log) price and (log) employment changes highlights that countries where GDP increases are primarily driven by employment effects. Countries with only slight increases in GDP even see negative employment effects. This reflects that employment effects reported in column (5) of Table 3 are negative for those countries. We graphically illustrate the employment effects in Figure 1. These negative employment effects translate into a magnification of the negative welfare effects predicted for those countries, see columns (6) and (7). On average, welfare effects are doubled when taking into account employment effects.

[Figure 1 about here.]

Tables 4 and 5 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 moments of calculated trade flow changes across all destination countries for all exporters. Both tables report the minimum and maximum changes, alongside with the 2.5%, 25%, 50%, 75% and 97.5% quantiles. Comparing numbers across columns for each row reveals the heterogeneity amongst importers, while comparing numbers across rows for each column highlights the heterogeneity across exporters.

In general, we see that for every country there are both positive and negative bilateral trade flow changes. By and large, median trade flow changes tend to be larger for small (e.g., Austria and Switzerland) and remote (e.g., Korea and Japan) countries. For example, the introduction of PTAs as observed in 2005 implies that the change in trade flows for the US is larger than 0.06% for 25% of all countries importing goods from the US. Turning to the trade flow results of our model with imperfect labor markets given in Table 5, we find a similar pattern for trade flow changes. Again, changes are heterogeneous both across importers and exporters and again small and remote countries experience larger changes. Even the implied trade flow changes differ from the case with perfect labor markets, albeit similar in magnitude.

[Table 4 about here.]

[Table 5 about here.]

4.2.2 Evaluating the effects of a labor market reform in the US

Our second counterfactual experiment evaluates the effects of a labor market reform in the US which improves their labor market institutions. We implement this reform by a 5% increase in κ for the US, i.e. changing κ from 1 to 1.05 for the US. Note that with our framework we do not have to be explicit about the specific changes in labor market institutions.

[Table 6 about here.]

The results can be found in Tables 6 and 7. Table 6 is organized as Table 3.

Table 6 reveals that all countries gain in terms of GDP when improving US labor market institutions. This highlights the positive spill-over effects, recently suggested theoretically by Egger et al. (2011a) and Felbermayr et al. (2009). Trivially an evaluation of any change of labor market institutions can not be analyzed when assuming perfect labor markets. Therefore, columns (1) and (6) are uninformative in this setting. US GDP increases roughly ten times more than GDP of the other countries, a finding in-line with empirical findings of Felbermayr et al. (2009). The decomposition of (log) GDP in (log) price and (log) employment changes highlights that on the US prices fall and all GDP increases are brought about by employment increases. In the trading partner countries of the US the positive GDP effects are on average composed of two third price changes and one third employment changes. This is also reflected in the relative magnitudes of the employment changes reported in column (5) of Table 6. We graphically illustrate the employment effects in Figure 2. Concerning welfare, obviously US profits the most from its improvements in labor market institutions with an EV of 4.38%. However, importantly all other countries also gain, with the highest gains for Canada with 1.49%.

[Figure 2 about here.]

Table 7 summarizes the trade effects. A labor market reform in the US spurs trade changes across th whole sample. Effects of exports of the US range between -1.71% and 0.19%. Effects across other exporters range between -1.43% for Australia to 1.48% for Switzerland. On average, 50% of trade flow changes are larger than 0.76%. The size pattern of the spill-over effects of labor market reforms in the US clearly depend on the distance and trade volumes between the corresponding countries and the US.

[Table 7 about here.]

5 The US-Canadian border puzzle and labor market frictions

We next use our methodology to reconsider the McCallum (1995) border puzzle accounting for employment effects. McCallum (1995) showed that trade between US states and Canadian provinces is reduced by a factor of 22 in comparison to trade within a country. This has spawned a vast literature on estimating border effects, which is too numerous to be discussed here.[14] Most notably, Anderson and van Wincoop (2003) made much progress in solving McCallum's border puzzle by showing that accounting for multilateral resistance terms reduces this effect to a factor of 1/5 to 1/2.

While the subtleties of the price effects have now been widely acknowledged, the literature so far has abstracted from employment effects. We therefore turn to the classical

[14] For an in-depth review of this literature see Anderson and van Wincoop (2004).

data-set used by McCallum (1995) and Anderson and van Wincoop (2003) to reconsider the border effect and quantify the employment effects of counterfactually abolishing the US-Canadian border.

For reasons of comparison we use data for the same 30 US states and 10 Canadian provinces alongside an aggregate of OECD countries labeled ROW for the year 1993[15] as in Anderson and van Wincoop (2003). We also follow there specification of the trade costs function, which is given by

$$t_{ij}^{1-\sigma} = \exp(\beta_1 \ln DIST_{ij} + \beta_2 BORDER_{ij}), \tag{44}$$

where $DIST_{ij}$ is again bilateral distance and $BORDER_{ij}$ is a dummy variable indicates whether a trade flow crosses the US-Canadian border.

5.1 Estimation results

We present results of our estimates for 6 different specifications in Table 8. Column (1) reproduces the parameter estimates of Table 6, column (viii) using fixed effects to control for the multilateral resistance terms. Column (2) estimates the gravity model as given in equation (16) multiplicatively using PPML on the same 1,511 observations as in column (1). This controls for the heteroskedasticity, a typical feature of trade flow data. This reduces the estimated coefficient for $BORDER$ from -1.551 in column (1) to -0.981. Assuming $\sigma = 5$, this implies a partial equilibrium tariff equivalent of the US-Canadian border of 47.37% and 27.79%, respectively.[16] Hence, accounting for heteroskedasticity by estimating the gravity equation in multiplicative form more than halfs the estimate of the partial border effect.

In column (3) we include the 49 zero trade flows, leading to a total of 1,560 observations. Compared to column (2), estimates hardly change. The coefficient of the border dummy even slightly decreases. In column (4) we include internal trade flows for states and provinces. As internal trade flows are not readily available, we follow Anderson and Yotov (2012) and calculate them as $y_i - \sum_{j\neq i}^{n} x_{ij}$. Using fixed effects, we end up with somewhat larger distance and border effects as compared to column (1). Column (5) reproduces results with the PPML. Now, distance coefficients get much larger and the border effect much smaller. Finally, column (6) includes both, zero trade flows and internal trade, leaving estimates virtually unchanged compared to column (5). Our preferred specification (6) implies a partial equilibrium tariff equivalent of the border barrier of 22.26%.

5.2 Comparative static results

[Table 8 about here.]

[Table 9 about here.]

Our counterfactual experiment abolishes the US-Canadian border. We base our counterfactual analysis on parameter estimates from column (1) of Table 8. Further, following Anderson and van Wincoop (2003), we add one aggregate region consisting of 20 OECD countries labeled ROW and assume balanced trade.[17] Additionally, we have to chose a value for the elasticity of substitution σ and the elasticity of the matching function μ. We

[15] For a detailed description of the data-set see Anderson and van Wincoop (2003).

[16] This is calculated as $\exp(BORDER/(1-\sigma))$.

[17] We differ from the optimization routine used in Anderson and van Wincoop (2003) by solving the system of multilateral resistance terms for all regions including ROW.

use standard values for both and set $\sigma = 5$ as in Anderson and van Wincoop (2003) and $\mu = 0.75$, as proposed in Hall (2005). We provide robustness results with respect to these parameter values in the Appendix.

The results can be found in Tables 9, 10, and 11. Table 9 is organized as follows: The first column (1) labeled "AvW %GDP" gives the percentage change in nominal GDP in terms of the price index of Alabama for the baseline case of perfect labor markets. Column (2) labeled "SMF %GDP" gives the same change for our gravity model using a search and matching framework. Columns (3) and (4) use equation (26) and decompose the change in nominal GDP of column (2) due to the price and employment changes. Column (5) reports the percentage change in the employement share for the case of imperfect labor markets. We graphically illustrate the employment effects in Figure 3. Finally, columns (6) and (7) report the equivalent variation (EV) for the case of perfect and imperfect labor markets, respectively.

Table 9 reveals that all states and provinces gain both in terms of GDP and equivalent variation. This result holds irrespective of whether we consider perfect or imperfect labor markets. When comparing the GDP changes between the perfect and imperfect labor markets, we see that on average, GDP changes are more than twice as large. On average US states gain far less than Canadian provinces, in line with standard predictions of new trade theory models of larger gains for smaller regions/countries. This result is even magnified when considering search and matching labor market frictions. The decomposition of (log) GDP in (log) price and (log) employment changes highlights that in the US GDP changes are predominantly brought about by price changes, whereas the change in GDP of Canadian provinces is predominantly brought about by employment changes. This reflects the fact that the reduction in trade costs due to the abolition of the US-Canadian border leads to a bigger change in the domestic price index in the smaller country. This leads to a relatively larger reduction in real vacancy posting costs in Canada, explaining the larger importance of employment changes. In line with this fact, are the larger employment changes stated in column (5). Finally, turning to the welfare implications, we calculate a doubling in the equivalent variation when comparing the perfect with the imperfect labor market scenario, similar to the effect found for GDP.

[Figure 3 about here.]

[Table 10 about here.]

[Table 11 about here.]

Tables 10 and 11 reports goods trade changes for perfect and imperfect labor markets, respectively. Trade changes are heterogeneous across importers and exporters. To summarize this heterogeneity, we present moments of calculated trade flow changes across all destination countries for all exporters. Both tables report the minimum and maximum changes, alongside with the 2.5%, 25%, 50%, 75% and 97.5% quantiles. Comparing numbers across columns for each row reveals the heterogeneity amongst importers, while comparing numbers across rows for each column highlights the heterogeneity across exporters. In general, we see that for every region there are both postive and negative bilateral trade flow changes. By and large, trade flow changes are larger for exporting Canadian provinces.

Interestingly, this pattern is reversed for the largest quantiles. For example, the abolition of the border implies that the change in trade flows for the state of New York is larger than 80.50% for 25% of all regions importing goods from New York. Turning to our model with imperfect labor markets, we find a similar pattern for trade flow changes. Again, changes are heterogeneous both across importers and exporters and again Canadian provinces experience larger changes. Even the implied trade flow changes differ from the case with perfect labor markets, albeit similar in magnitude.

6 Robustness checks

In order to check the sensitivity of our results, we perform two sets of robustness checks. First, we allow for trade imbalances following Dekle et al. (2007). Second, as we have to set the unobserved parameters for the elasticity of substitution and of the matching function, σ and μ, we provide results for different values of those parameters.

6.1 Controlling for trade imbalances

Our framework can easily accommodate trade imbalances following Dekle et al. (2007). With trade balance, $\tilde{y}_j = y_j$ and $\tilde{\theta}_j = \theta_j$. However, as soon as we allow for trade imbalances, GDP and total spending differ.[18] In Tables 12, 13 and 14 we reevaluate the effects of preferential trade agreements when allowing for trade imbalances. By and large our results are hardly effected by trade imbalances. The biggest difference is in the decomposition of the GDP change. The price change share is smaller when accounting for trade imbalances. Aggregate average welfare effects are literally the same.

In Tables 15 and 16 we recalculate the effects of the hypothetical US labor market reform. Average GDP, employment and welfare effects are literally unchanged.

We also report results from counterfactually erasing the US-Canadian border taking into account trade imbalances in Tables 17, 18, and 19. Whereas GDP changes are somewhat larger for Canada and slightly smaller for the US when controlling for trade imbalances, welfare effects remain very similar.

[Table 12 about here.]

[Table 13 about here.]

[Table 14 about here.]

[Table 15 about here.]

[Table 16 about here.]

[Table 17 about here.]

[Table 18 about here.]

[Table 19 about here.]

[18] We set the trade imbalance for the aggregate of OECD countries (ROW) equal to 0.

6.2 Different parameter values for counterfactual analysis

We check the sensitivity of our results to variations in the elasticity of substitution, σ, as well as the elasticity of the matching function μ. For expositional brevity, we only present average effects in Tables 20 and 21. Clearly, our GDP, employment and EV effects depend on the values of σ and μ. When the elasticity of substitution increases, GDP, employment and EV changes get smaller. This is due to the fact that varieties are higher substitutes, making trade less important. Hence, abolishing the US-Canadian border 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. Lower μ corresponds to larger labor market imperfections. When μ approaches 1 we end up in the case of perfect labor markets.

[Table 20 about here.]

[Table 21 about here.]

7 Conclusion

The gravity equation is the workhorse of international trade flow studies and has been the basis for numerous evaluations of the trade and welfare impact of trade liberalization. However, its theoretical foundations have neglected labor market frictions.

We extend a standard structural gravity model by modeling these frictions within a search and matching framework. Our framework allows counterfactual analysis of changes in trade costs and labor market reforms on trade flows, prices, employment, and welfare.

We apply our developed structural model to two different data-sets. First, we use a sample of 28 OECD countries from 1950 to 2006 in order to evaluate the effects of preferential trade agreements (PTAs) and a hypothetical labor market reform in the US. We find that introducing PTAs as observed in 2006 leads to a doubling of the average GDP effect when accounting for employment effects. Countries with only slight increases in GDP even see negative employment effects. These negative employment effects translate into a magnification of the negative welfare effects predicted for those countries. Our second counterfactual analysis assumes an improvement of labor market institutions in the US. Again, average welfare effects are doubled when taking into account employment effects. US GDP increases roughly ten times more than GDP of the other countries. While the US profits the most from its improvements in labor market institutions with an EV of 4.38%, all trading partners also experience an increase in welfare due to positive spill-over effects.

We next use our methodology to reconsider the McCallum (1995) border puzzle accounting for employment effects. McCallum (1995) showed that trade between US states and Canadian provinces is reduced by a factor of 22 in comparison to trade within a country. When comparing the GDP changes between the perfect and imperfect labor markets, we see that on average, GDP changes are more than twice as large. On average US states gain far less than Canadian provinces. Finally, turning to the welfare implications, we calculate a doubling in the equivalent variation when comparing the perfect with the imperfect labor market scenario, similar to the effect found for GDP.

As our developed approach does not need any information of the labor market besides the elasticity of the matching function, it can easily be applied in all fields where the gravity equation has been applied successfully previously.

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A Derivation of asymmetric multilateral resistance equations

Using equation (17), we can write

$$\Pi_i^{1-\sigma} = \sum_{j=1}^{n} t_{ij}^{1-\sigma} P_j^{\sigma-1} \tilde{\theta}_j. \tag{45}$$

Define $\mathfrak{P}_\mathrm{j} = \tilde{\theta}_j P_j^{\sigma-1}$, wich leads to

$$\Pi_i^{1-\sigma} = \sum_{j=1}^{n} t_{ij}^{1-\sigma} \mathfrak{P}_j. \tag{46}$$

Similarly, equation (18) can be written as

$$P_j^{1-\sigma} = \sum_{i=1}^{n} t_{ij}^{1-\sigma} \Pi_i^{\sigma-1} \theta_i. \tag{47}$$

Define $\mathfrak{k}_i = \theta_i \Pi_i^{\sigma-1}$ leads to

$$P_j^{1-\sigma} = \sum_{i=1}^{n} t_{ij}^{1-\sigma} \mathfrak{k}_i. \tag{48}$$

Now divide equation (46) by $\Pi_i^{1-\sigma}$

$$1 = \Pi_i^{\sigma-1} \sum_{j=1}^{n} t_{ij}^{1-\sigma} \mathfrak{P}_j. \tag{49}$$

Using again $\mathfrak{k}_i = \theta_i \Pi_i^{\sigma-1}$ leads to

$$1 = \frac{\mathfrak{k}_i}{\theta_i} \sum_{j=1}^{n} t_{ij}^{1-\sigma} \mathfrak{P}_j. \tag{50}$$

And therefor to

$$\theta_i - \mathfrak{k}_i \sum_{j=1}^{n} t_{ij}^{1-\sigma} \mathfrak{P}_j = 0. \tag{51}$$

Similarly, divide equation (48) by $P_j^{1-\sigma}$

$$1 = P_j^{\sigma-1} \sum_{i=1}^{n} t_{ij}^{1-\sigma} \mathfrak{k}_i. \tag{52}$$

Using again $\mathfrak{P}_j = \tilde{\theta}_j P_j^{\sigma-1}$ leads to:

$$1 = \frac{\mathfrak{P}_j}{\tilde{\theta}_j} \sum_{i=1}^{n} t_{ij}^{1-\sigma} \mathfrak{k}_i. \tag{53}$$

And therefore to:

$$\tilde{\theta}_j - \mathfrak{P}_j \sum_{i=1}^{n} t_{ij}^{1-\sigma} \mathfrak{k}_i = 0. \tag{54}$$

Equations (51) and (54) lead to a system of $2n$ equations that can be solved for the $2n$ unknowns $\mathfrak{k}_i$ and $\mathfrak{P}_j$.

B Sufficient statistics for welfare in the trade model with imperfect labor markets

Defining real income as $W_j \equiv \tilde{y}_j / P_j$ and taking the log-derivative leads to

$$d \ln W_j = d \ln \tilde{y}_j - d \ln P_j. \tag{55}$$

y_j is given by $y_j = w_j(1-u_j)L_j$. Hence, the log-derivative of y_j can be written as

$$d \ln y_j \quad = \quad d \ln w_j - \frac{u_j}{1-u_j} d \ln u_j = -\frac{u_j}{1-u_j} d \ln u_j,$$

where the second expression on the right-hand side follows by choice of numéraire. Noting that $\tilde{y}_j = y_j(1+d_j)$ and taking d_j as constant, it holds that $d \ln \tilde{y}_j = d \ln y_j$.

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

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

Using $x_{ij} = \left(\frac{\beta_i p_i t_{ij}}{P_j}\right)^{1-\sigma} \tilde{y}_j$ and defining $\lambda_{ij} = x_{ij}/\tilde{y}_j = \left(\frac{\beta_i p_i t_{ij}}{P_j}\right)^{1-\sigma}$, we can simplify to

$$d \ln P_j = \sum_{i=1}^{n} \lambda_{ij} \left(d \ln p_i + d \ln t_{ij} \right). \tag{56}$$

Noting that $p_i = \frac{1-\gamma_i+\xi_i}{\xi_i} w_i$, it also holds that $d \ln p_i = d \ln w_i$. Hence, we can also write: $d \ln P_j = \sum_{i=1}^{n} \lambda_{ij} \left(d \ln w_i + d \ln t_{ij} \right)$. Combining terms leads to

$$d \ln W_j = d \ln y_j - d \ln P_j = -\frac{u_j}{1-u_j} d \ln u_j - \sum_{i=1}^{n} \lambda_{ij} \left(d \ln w_i + d \ln t_{ij} \right). \tag{57}$$

Taking the ratio of λ_{ij} and λ_{jj} we can write

$$\frac{\lambda_{ij}}{\lambda_{jj}} = \left(\frac{\beta_i p_i t_{ij}}{\beta_j p_j t_{jj}} \right)^{1-\sigma}.$$

Noting that $dt_{jj} = 0$ by assumption and that w_j is the numeraire, so that $dw_j = dp_j = 0$, the log-change of this ratio is given by:

$$d \ln \lambda_{ij} - d \ln \lambda_{jj} = (1-\sigma) \left(d \ln t_{ij} + d \ln p_i \right).$$

Combining this with equation (56) leads to:

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

Noting that $\tilde{y}_j = \sum_{i=1}^{n} x_{ij}$, 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:

$$d \ln P_j \quad = \quad -\frac{1}{1-\sigma} d \ln \lambda_{jj}.$$

The welfare change can than be expressed as follows

$$d \ln W_j \quad = \quad -\frac{u_j}{1-u_j} d \ln u_j + \frac{1}{1-\sigma} d \ln \lambda_{jj}.$$

Integrating between an initial situation and a counterfactual situation we end up with

$$\ln \hat{W}_j \quad = \ln \hat{e_j} + \tfrac{1}{1-\sigma} \ln \hat{\lambda}_{jj}.$$

Taking exponents leads to

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

where $e_j = 1 - u_j$ is the share of employed people. When we move from any observed level of trade to autarky, $\lambda_{jj}^c = 1$, which simplifies the expression to

$$\hat{W}_j \quad = \quad \hat{e}_j \left(\lambda_{jj}\right)^{-\frac{1}{1-\sigma}}.$$

Note, however, that unequal to the case with perfect labor markets considered in Arkolakis et al. (2012), even this expression needs information about counterfactual GDP or at least, with balanced trade, employment levels.

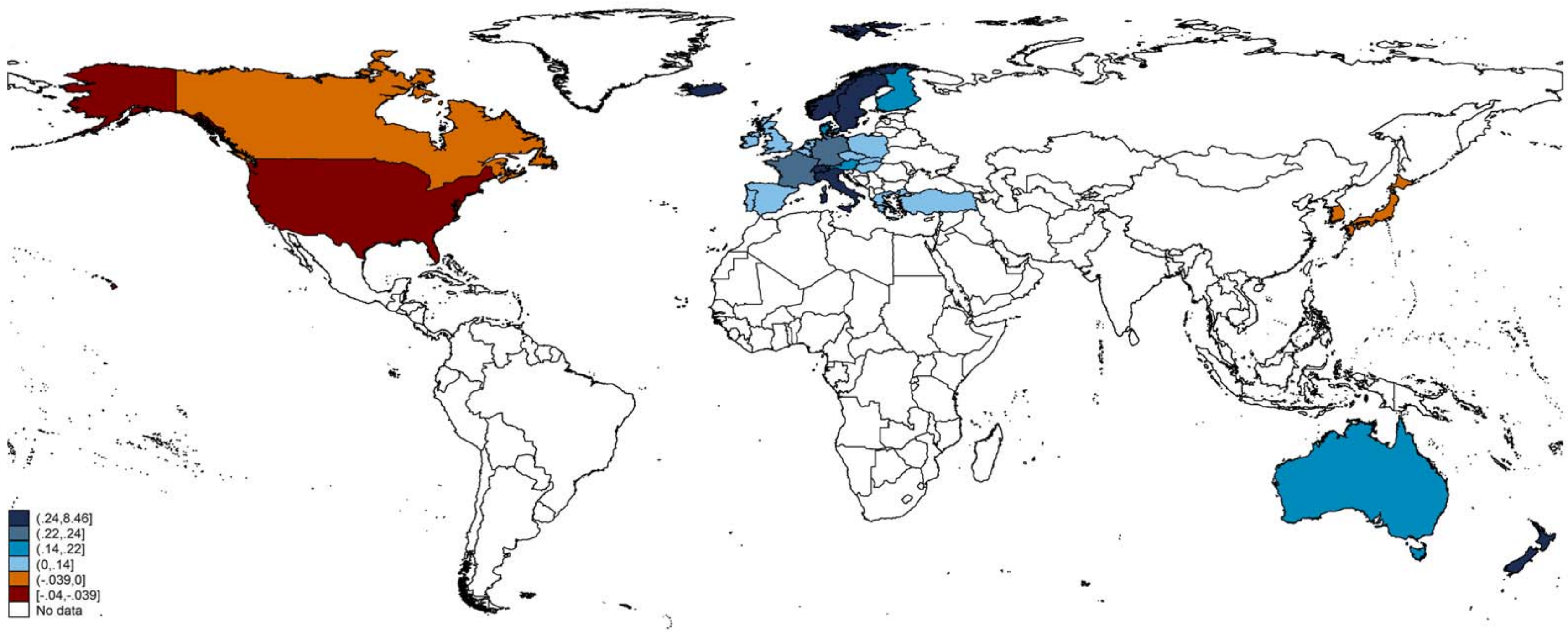

Figure 1: Employment effects of counterfactually incepting PTAs as observed in 2006.

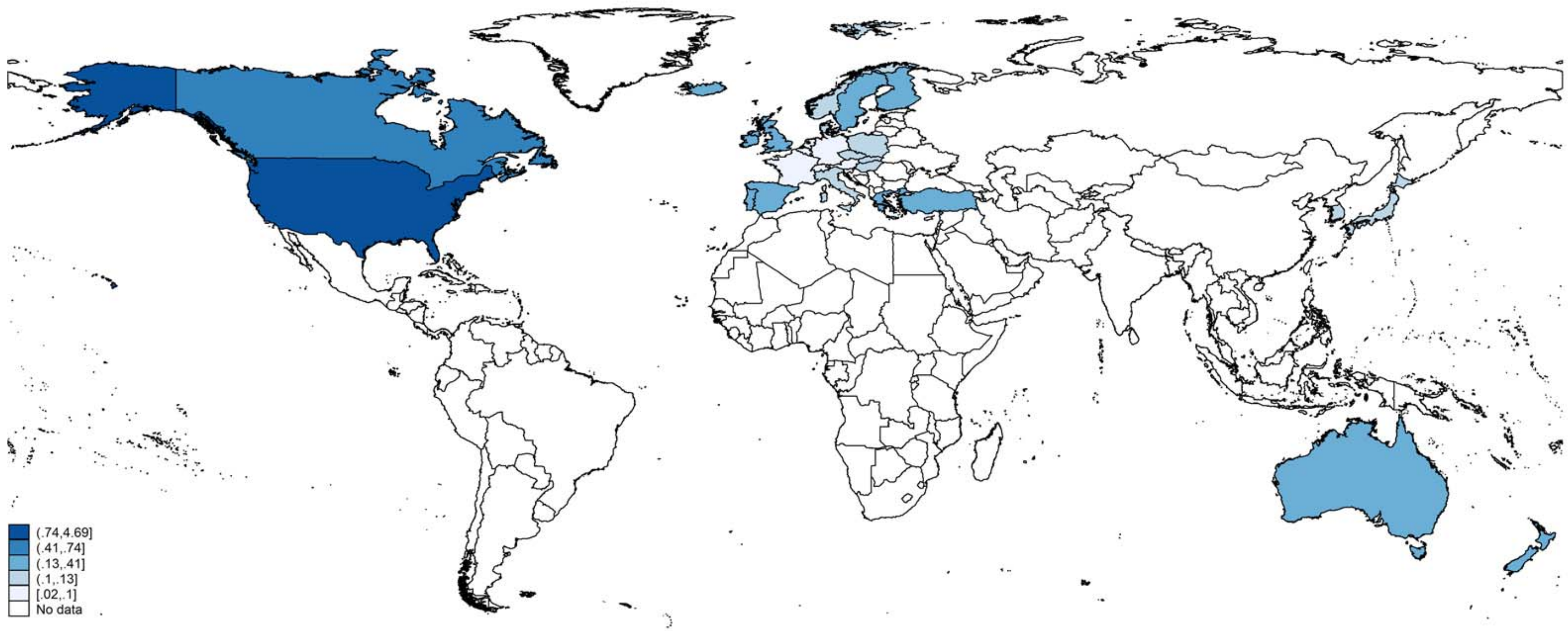

Figure 2: Employment effects of a hypothetical labor market reform in the US ($\hat{\kappa}_{US} = 1.05$).

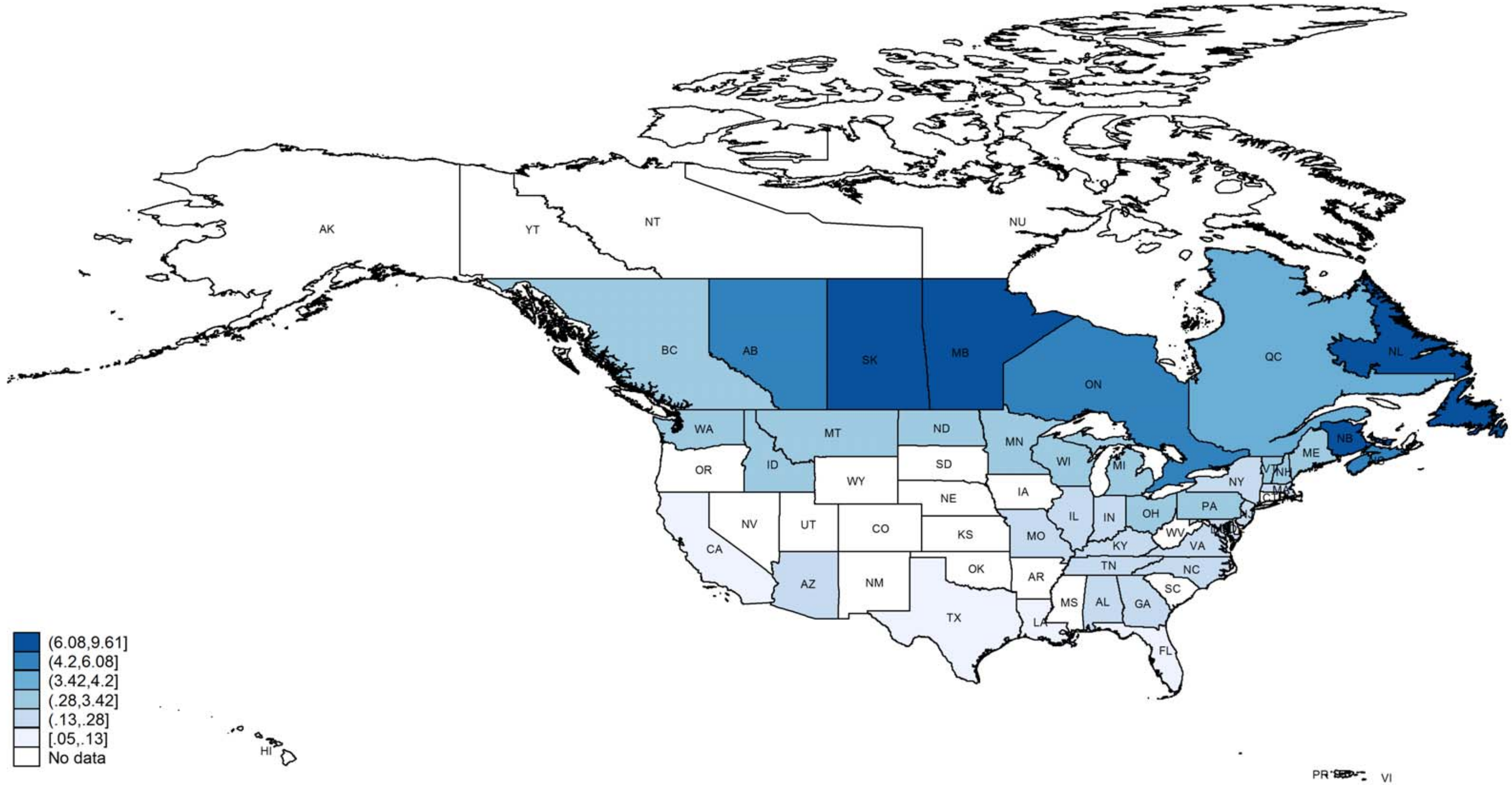

Figure 3: Employment effects of counterfactually abolishing the US-Canadian border.

Table 1: Summary statistics

	Mean	Std. Dev.	Min.	Max.	N
x_{ij} (cur. mn US$)	2,048.991	8,950.167	0	348,420.6	38,313
GDP (cur. mn US$)	372,673.061	1,125,265.893	126.99	13,201,819	46,574
PTA	0.094	0.291	0	1	47,937
$\ln(DIST)$	7.819	1.231	3.008	9.880	47,937
$CONTIG$	0.078	0.269	0	1	47,937
$COMLANG$	0.083	0.276	0	1	47,937

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

Table 2: Estimation results for gravity model 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								
$\ln DIST_{ij}$	-1.086***	-0.680***	-1.074***	-0.913***	-1.086***	-0.679***	-1.074***	-0.912***
	(0.010)	(0.027)	(0.010)	(0.011)	(0.010)	(0.027)	(0.010)	(0.011)
$CONTIG_{ij}$	0.103***	0.307***	0.120***	0.413***	0.103***	0.306***	0.121***	0.413***
	(0.019)	(0.030)	(0.020)	(0.019)	(0.019)	(0.030)	(0.019)	(0.019)
$COMLANG_{ij}$	0.376***	0.762***	0.376***	0.124***	0.376***	0.762***	0.377***	0.123***
	(0.019)	(0.049)	(0.019)	(0.175)	(0.019)	(0.049)	(0.019)	(0.017)
First stage								
$PTA_{ij\tau}$	0.137***	0.241***	0.143***	0.164***	0.135***	0.259***	0.141***	0.167***
	(0.020)	(0.028)	(0.023)	(0.022)	(0.0178)	(0.023)	(0.021)	(0.019)
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 a gravity model of normalized 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, *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

Table 3: OECD sample, Comparative static effects of PTA inception in 2006

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
	AvW	SMF	share %GDP SMF		SMF	AvW	SMF
	%GDP	%GDP	$\% \ln(\hat{p})$	$\% \ln(\hat{e})$	$\%\hat{e}$	%EV	%EV
Australia	0.15	0.29	50.00	50.00	0.14	0.15	0.29
Austria	0.13	0.32	47.28	52.72	0.17	0.10	0.34
Belgium	0.10	0.20	61.25	38.75	0.08	0.04	0.15
Canada	0.08	0.07	129.38	-29.38	-0.02	-0.02	-0.04
Switzerland	4.50	11.55	25.66	74.34	8.46	10.19	17.64
Czech Republic	0.12	0.24	55.33	44.67	0.11	0.07	0.21
Germany	0.15	0.41	42.83	57.17	0.23	0.15	0.46
Denmark	0.14	0.33	47.09	52.91	0.17	0.13	0.35
Spain	0.11	0.21	58.87	41.13	0.09	0.06	0.18
Finland	0.16	0.39	43.44	56.56	0.22	0.17	0.44
France	0.16	0.42	42.12	57.88	0.24	0.16	0.49
United Kingdom	0.12	0.22	57.72	42.28	0.09	0.07	0.19
Greece	0.11	0.22	57.94	42.06	0.09	0.06	0.18
Hungary	0.12	0.25	54.16	45.84	0.11	0.08	0.23
Ireland	0.11	0.19	62.85	37.15	0.07	0.05	0.14
Iceland	2.83	7.17	26.04	73.96	5.26	6.28	10.79
Italy	0.16	0.43	41.82	58.18	0.25	0.16	0.50
Japan	0.07	0.06	148.86	-48.86	-0.03	-0.04	-0.06
Korea	0.07	0.05	165.85	-65.85	-0.03	-0.05	-0.07
Netherlands	0.11	0.22	57.25	42.75	0.10	0.06	0.19
Norway	3.33	8.50	25.88	74.12	6.23	7.43	12.86
New Zealand	0.82	1.97	28.69	71.31	1.40	1.66	2.83
Poland	0.12	0.26	53.09	46.91	0.12	0.08	0.24
Portugal	0.11	0.22	58.47	41.53	0.09	0.06	0.18
Slovak Republic	0.12	0.25	54.16	45.84	0.11	0.08	0.23
Sweden	0.19	0.50	39.53	60.47	0.30	0.24	0.60
Turkey	0.12	0.23	56.23	43.77	0.10	0.07	0.20
United States	0.06	0.05	179.23	-79.23	-0.04	-0.05	-0.07
Average	0.18	0.37	114.50	-14.50	0.21	0.21	0.42

Notes: AvW gives results assuming perfect labor markets. SMF are results for the gravity model using a search and matching framework for the labor market.

Table 4: Heterogeneity of comparative static effects in percent of PTA inception, OECD sample with perfect labor markets in 2006

	Heterogeneity of goods trade changes in %						
	Min.	2.50%	25%	50%	75%	97.5%	Max.
Australia	-19.61	-18.79	-0.60	-0.41	-0.37	20.30	24.63
Austria	-3.74	-3.20	-0.46	-0.29	-0.12	12.59	13.06
Belgium	-3.59	-3.06	-0.32	-0.14	0.02	12.76	13.22
Canada	-19.29	-18.47	-0.22	-0.03	0.00	0.25	0.25
Switzerland	-22.24	-21.78	-10.29	4.26	4.40	4.47	4.48
Czech Republic	-3.66	-3.13	-0.39	-0.22	-0.04	12.67	13.14
Germany	-3.84	-3.31	-0.52	-0.40	-0.23	12.46	12.93
Denmark	-3.79	-3.26	-0.51	-0.35	-0.18	12.52	12.99
Spain	-3.64	-3.10	-0.37	-0.19	-0.02	12.70	13.17
Finland	-3.89	-3.35	-0.56	-0.45	-0.27	12.41	12.88
France	-3.85	-3.32	-0.53	-0.41	-0.24	12.45	12.92
United Kingdom	-3.66	-3.13	-0.39	-0.22	-0.04	12.67	13.14
Greece	-3.65	-3.11	-0.38	-0.20	-0.03	12.69	13.16
Hungary	-3.68	-3.14	-0.41	-0.23	-0.06	12.65	13.12
Ireland	-3.63	-3.09	-0.35	-0.18	-0.01	12.72	13.19
Iceland	-15.73	-15.23	-7.35	12.99	13.14	13.22	13.22
Italy	-3.86	-3.33	-0.54	-0.42	-0.25	12.44	12.91
Japan	-19.26	-18.44	-0.18	0.00	0.04	0.29	0.29
Korea	-19.25	-18.43	-0.17	0.02	0.05	0.30	0.31
Netherlands	-3.65	-3.11	-0.37	-0.20	-0.03	12.69	13.16
Norway	-17.72	-17.24	-8.97	10.31	10.46	10.54	10.54
New Zealand	-22.24	-21.45	-3.85	-3.67	-3.63	19.73	24.63
Poland	-3.70	-3.16	-0.42	-0.25	-0.08	12.63	13.10
Portugal	-3.65	-3.11	-0.38	-0.20	-0.03	12.69	13.16
Slovak Republic	-3.68	-3.14	-0.41	-0.23	-0.06	12.65	13.12
Sweden	-4.03	-3.47	-0.72	-0.60	-0.43	12.24	12.71
Turkey	-3.67	-3.13	-0.40	-0.22	-0.05	12.66	13.13
United States	-19.24	-18.42	-0.16	0.03	0.06	0.30	0.31
Average	-8.77	-8.18	-1.44	0.65	0.79	11.02	11.67

Table 5: Heterogeneity of comparative static effects in percent of PTA inception, OECD sample with imperfect labor markets in 2006

	Heterogeneity of goods trade changes in %						
	Min.	2.50%	25%	50%	75%	97.5%	Max.
Australia	-19.56	-18.76	-0.71	-0.39	-0.32	20.42	24.76
Austria	-3.82	-3.32	-0.62	-0.43	-0.18	12.38	12.86
Belgium	-3.58	-3.08	-0.39	-0.20	0.06	12.66	13.14
Canada	-19.21	-18.40	-0.31	0.03	0.09	0.43	0.43
Switzerland	-22.20	-21.74	-10.37	4.18	4.39	4.46	4.47
Czech Republic	-3.65	-3.16	-0.46	-0.26	-0.01	12.57	13.06
Germany	-3.97	-3.48	-0.77	-0.59	-0.35	12.20	12.68
Denmark	-3.82	-3.33	-0.62	-0.44	-0.19	12.38	12.86
Spain	-3.61	-3.11	-0.41	-0.23	0.04	12.63	13.11
Finland	-3.95	-3.45	-0.75	-0.57	-0.32	12.23	12.71
France	-4.01	-3.51	-0.81	-0.63	-0.38	12.16	12.64
United Kingdom	-3.62	-3.12	-0.43	-0.24	0.02	12.61	13.10
Greece	-3.62	-3.12	-0.43	-0.24	0.02	12.62	13.10
Hungary	-3.67	-3.17	-0.48	-0.28	-0.03	12.55	13.03
Ireland	-3.56	-3.06	-0.37	-0.18	0.08	12.68	13.16
Iceland	-15.72	-15.22	-7.41	12.86	13.08	13.16	13.16
Italy	-4.02	-3.52	-0.82	-0.64	-0.39	12.15	12.63
Japan	-19.19	-18.39	-0.29	0.05	0.11	0.45	0.45
Korea	-19.18	-18.38	-0.27	0.06	0.13	0.46	0.47
Netherlands	-3.63	-3.13	-0.44	-0.25	0.02	12.61	13.09
Norway	-17.77	-17.28	-9.07	10.11	10.33	10.41	10.41
New Zealand	-22.20	-21.42	-3.97	-3.65	-3.59	19.85	24.76
Poland	-3.69	-3.19	-0.50	-0.30	-0.05	12.53	13.01
Portugal	-3.61	-3.11	-0.42	-0.23	0.03	12.62	13.11
Slovak Republic	-3.67	-3.17	-0.48	-0.28	-0.03	12.55	13.03
Sweden	-4.15	-3.63	-0.96	-0.78	-0.53	11.99	12.47
Turkey	-3.64	-3.14	-0.45	-0.25	0.00	12.59	13.07
United States	-19.17	-18.37	-0.27	0.07	0.13	0.46	0.47
Average	-8.77	-8.21	-1.55	0.58	0.79	10.96	11.62

Table 6: OECD sample, Comparative static effects of a 5% increase of κ in US in 2006

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
	AvW	SMF	share %GDP SMF		SMF	AvW	SMF
	%GDP	%GDP	$\% \ln(\hat{p})$	$\% \ln(\hat{e})$	$\%\hat{e}$	%EV	%EV
Australia	0.00	0.82	50.00	50.00	0.41	0.00	0.82
Austria	0.00	0.37	79.86	20.14	0.08	0.00	0.15
Belgium	0.00	0.33	87.91	12.09	0.04	0.00	0.08
Canada	0.00	1.26	41.29	58.71	0.74	0.00	1.49
Switzerland	0.00	0.30	93.67	6.33	0.02	0.00	0.04
Czech Republic	0.00	0.42	74.08	25.92	0.11	0.00	0.22
Germany	0.00	0.40	76.60	23.40	0.09	0.00	0.19
Denmark	0.00	0.44	72.09	27.91	0.12	0.00	0.24
Spain	0.00	0.48	67.38	32.62	0.16	0.00	0.32
Finland	0.00	0.50	66.42	33.58	0.17	0.00	0.33
France	0.00	0.40	75.68	24.32	0.10	0.00	0.20
United Kingdom	0.00	0.61	58.61	41.39	0.25	0.00	0.51
Greece	0.00	0.48	67.88	32.12	0.15	0.00	0.31
Hungary	0.00	0.45	70.48	29.52	0.13	0.00	0.27
Ireland	0.00	0.58	60.36	39.64	0.23	0.00	0.46
Iceland	0.00	0.59	59.67	40.33	0.24	0.00	0.48
Italy	0.00	0.43	72.16	27.84	0.12	0.00	0.24
Japan	0.00	0.44	72.05	27.95	0.12	0.00	0.24
Korea	0.00	0.45	70.58	29.42	0.13	0.00	0.26
Netherlands	0.00	0.39	77.69	22.31	0.09	0.00	0.17
Norway	0.00	0.45	70.42	29.58	0.13	0.00	0.27
New Zealand	0.00	0.82	49.99	50.01	0.41	0.00	0.82
Poland	0.00	0.44	71.11	28.89	0.13	0.00	0.26
Portugal	0.00	0.52	64.29	35.71	0.19	0.00	0.37
Slovak Republic	0.00	0.44	71.26	28.74	0.13	0.00	0.25
Sweden	0.00	0.47	68.46	31.54	0.15	0.00	0.30
Turkey	0.00	0.51	65.26	34.74	0.18	0.00	0.35
United States	0.00	4.31	-8.72	108.72	4.69	0.00	4.38
Average	0.00	1.91	40.40	59.60	1.84	0.00	1.84

Notes: AvW gives results assuming perfect labor markets. SMF are results for the gravity model using a search and matching framework for the labor market.

Table 7: Heterogeneity of comparative static effects in percent of a 5% increase of κ in US, OECD sample with imperfect labor markets in 2006

	Heterogeneity of goods trade changes in %						
	Min.	2.50%	25%	50%	75%	97.5%	Max.
Australia	-1.43	-1.33	0.04	0.17	0.23	0.47	0.48
Austria	-0.55	-0.44	0.84	1.07	1.10	1.37	1.38
Belgium	-0.45	-0.35	0.94	1.17	1.20	1.45	1.48
Canada	-1.71	-1.66	-0.83	-0.70	-0.64	-0.41	-0.40
Switzerland	-0.40	-0.29	0.99	1.22	1.25	1.46	1.48
Czech Republic	-0.63	-0.53	0.75	0.98	1.01	1.28	1.29
Germany	-0.59	-0.49	0.79	1.02	1.06	1.32	1.33
Denmark	-0.67	-0.57	0.72	0.95	1.00	1.24	1.25
Spain	-0.76	-0.66	0.62	0.85	0.91	1.15	1.16
Finland	-0.79	-0.68	0.60	0.83	0.88	1.12	1.13
France	-0.61	-0.50	0.78	1.01	1.04	1.31	1.32
United Kingdom	-1.01	-0.91	0.46	0.60	0.65	0.89	0.90
Greece	-0.75	-0.65	0.63	0.86	0.92	1.16	1.17
Hungary	-0.70	-0.60	0.69	0.91	0.97	1.21	1.22
Ireland	-0.95	-0.85	0.52	0.66	0.71	0.95	0.96
Iceland	-0.98	-0.87	0.50	0.63	0.69	0.93	0.94
Italy	-0.67	-0.56	0.72	0.95	1.01	1.25	1.26
Japan	-0.67	-0.57	0.72	0.94	1.00	1.24	1.25
Korea	-0.70	-0.59	0.69	0.92	0.98	1.21	1.22
Netherlands	-0.58	-0.47	0.81	1.04	1.07	1.34	1.35
Norway	-0.70	-0.60	0.68	0.91	0.97	1.21	1.22
New Zealand	-1.43	-1.33	0.04	0.17	0.23	0.47	0.48
Poland	-0.69	-0.58	0.70	0.93	0.99	1.23	1.24
Portugal	-0.84	-0.74	0.55	0.77	0.83	1.07	1.08
Slovak Republic	-0.68	-0.58	0.70	0.93	0.99	1.23	1.24
Sweden	-0.74	-0.64	0.64	0.87	0.93	1.17	1.18
Turkey	-0.81	-0.71	0.57	0.80	0.86	1.10	1.10
United States	-1.71	-1.56	-0.25	-0.11	-0.06	0.18	0.19
Average	-0.83	-0.73	0.56	0.76	0.81	1.06	1.07

Table 8: Estimation results for gravity model of US-CAN trade in the Anderson and van Wincoop (2003) sample

	(1) OLS $\ln z_{ij}$	(2) PPML z_{ij}	(3) PPML z_{ij}	(4) OLS $\ln z_{ij}$	(5) PPML z_{ij}	(6) PPML z_{ij}
$\ln DIST$	-1.252***	-1.328***	-1.353***	-1.411***	-1.934***	-1.942***
	(0.0368)	(0.0420)	(0.0430)	(0.0292)	(0.0418)	(0.0409)
$BORDER$	-1.551***	-0.981***	-0.962***	-1.562***	-0.807***	-0.804***
	(0.0589)	(0.0823)	(0.0835)	(0.0603)	(0.122)	(0.121)
internal trade				X	X	X
zero trade			X			X
MRTs	X	X	X	X	X	X
N	1511	1511	1560	1551	1551	1600
R^2	0.664	0.898	0.897	0.744	0.999	0.999
$\ln \mathcal{L}$	-1841	-0.002	-0.002	-1957	-0.014	-0.014

Notes: Results for a gravity model of normalized trade flows between 30 US states and 10 Canadian provinces in 1993 estimated by ordinary least squares (OLS) and Poisson pseudo-maximum-likelihood (PPML) on the sample used in Anderson and van Wincoop (2003). z_{ij} are trade flows standardized by importer and exporter GDPs. $BORDER$ is an indicator variable equal to 1 if a trade flow between regions i and j crosses the US-CAN border. Intra-trade indicates whether inter-state/inter-provicincial trade is included. All regressions control for multilateral resistance terms (MRTs) via exporter and importer fixed effects. (Robust) standard errors in parentheses, *** $p<0.01$, ** $p<0.05$, * $p<0.1$.

Table 9: US-CAN sample, Comparative static effects of erasing the US-CAN border

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
	AvW	SMF	share %GDP SMF		SMF	AvW	SMF
	%GDP	%GDP	$\% \ln(\hat{p})$	$\% \ln(\hat{e})$	$\%\hat{e}$	%EV	%EV
ROW	1.75	2.42	75.00	25.00	0.60	1.75	2.42
Alabama	1.16	1.42	88.97	11.03	0.16	0.43	0.62
Arizona	1.28	1.63	84.59	15.41	0.25	0.70	1.00
California	1.04	1.19	95.39	4.61	0.05	0.15	0.22
Florida	1.11	1.31	91.63	8.37	0.11	0.30	0.44
Georgia	1.16	1.40	89.31	10.69	0.15	0.41	0.60
Idaho	1.88	2.63	73.39	26.61	0.69	2.04	2.80
Illinois	1.17	1.43	88.64	11.36	0.16	0.45	0.65
Indiana	1.29	1.63	84.45	15.55	0.25	0.71	1.01
Kentucky	1.31	1.67	83.87	16.13	0.27	0.76	1.07
Louisiana	1.13	1.36	90.32	9.68	0.13	0.36	0.52
Maine	2.85	4.25	66.47	33.53	1.40	4.25	5.74
Maryland	1.17	1.43	88.73	11.27	0.16	0.45	0.64
Massachusetts	1.28	1.61	84.87	15.13	0.24	0.69	0.97
Michigan	1.68	2.29	76.08	23.92	0.54	1.58	2.19
Minnesota	1.46	1.94	79.86	20.14	0.39	1.10	1.56
Missouri	1.20	1.49	87.35	12.65	0.19	0.52	0.75
Montana	2.34	3.40	69.29	30.71	1.03	3.07	4.19
New Hampshire	1.94	2.72	72.77	27.23	0.73	2.17	2.97
New Jersey	1.32	1.68	83.65	16.35	0.27	0.78	1.10
New York	1.33	1.70	83.39	16.61	0.28	0.80	1.12
North Carolina	1.25	1.57	85.72	14.28	0.22	0.63	0.89
North Dakota	2.11	3.04	70.96	29.04	0.87	2.55	3.54
Ohio	1.37	1.78	82.11	17.89	0.32	0.90	1.27
Pennsylvania	1.38	1.79	81.91	18.09	0.32	0.92	1.29
Tennessee	1.23	1.53	86.44	13.56	0.21	0.58	0.83
Texas	1.10	1.31	91.66	8.34	0.11	0.29	0.44
Vermont	2.75	4.05	67.03	32.97	1.32	4.00	5.37
Virginia	1.27	1.59	85.20	14.80	0.23	0.67	0.94
Washington	1.90	2.65	73.27	26.73	0.70	2.07	2.83
Wisconsin	1.44	1.89	80.45	19.55	0.37	1.05	1.48
Alberta	8.87	14.20	58.59	41.41	5.65	18.46	24.60
British Columbia	5.67	8.91	60.59	39.41	3.42	10.79	14.41
Manitoba	14.54	23.59	57.25	42.75	9.47	32.81	43.63
New Brunswick	11.65	18.74	57.78	42.22	7.52	25.37	33.65
Newfoundland	14.76	23.92	57.23	42.77	9.61	33.38	44.34
Nova Scotia	8.68	13.89	58.67	41.33	5.52	17.99	23.98
Ontario	9.49	15.22	58.37	41.63	6.08	20.00	26.61
Prince Edward Island	12.98	20.92	57.51	42.49	8.41	28.76	38.11
Quebec	6.77	10.74	59.68	40.32	4.20	13.39	17.88
Saskatchewan	13.50	21.84	57.42	42.58	8.78	30.10	40.00
Total average	1.86	2.58	82.93	17.07	0.66	2.05	2.79
US average	1.28	1.60	86.49	13.51	0.24	0.68	0.96
CAN average	8.72	13.95	58.88	41.12	5.54	18.18	24.21

Notes: AvW gives results for the Anderson and van Wincoop (2003) estimates assuming perfect labor markets. SMF are results for the gravity model using a search and matching framework for the labor market.

Table 10: Heterogeneity of comparative static effects in percent of erasing the US-CAN border, US-CAN sample with perfect labor markets

	Heterogeneity of goods trade changes in %						
	Min.	2.50%	25%	50%	75%	97.5%	Max.
ROW	-11.51	-11.27	-5.04	-4.23	68.98	255.21	264.38
Alabama	-8.90	-8.65	-2.42	-1.50	73.97	265.70	275.14
Arizona	-9.43	-9.19	-3.00	-1.98	72.95	263.54	272.93
California	-8.33	-8.09	-1.82	-0.89	74.89	267.97	277.47
Florida	-8.63	-8.39	-2.14	-1.21	74.48	266.76	276.22
Georgia	-8.86	-8.62	-2.39	-1.46	74.04	265.84	275.28
Idaho	-12.07	-11.83	-5.63	-4.83	67.92	252.98	262.09
Illinois	-8.93	-8.68	-2.46	-1.53	73.91	265.57	275.01
Indiana	-9.46	-9.22	-3.03	-2.02	72.89	263.42	272.80
Kentucky	-9.55	-9.31	-3.13	-2.11	72.72	263.06	272.44
Louisiana	-8.75	-8.51	-2.27	-1.34	74.25	266.28	275.74
Maine	-15.69	-14.85	-10.01	-9.24	60.14	236.62	245.31
Maryland	-8.93	-8.69	-2.46	-1.54	73.90	265.55	274.99
Massachusetts	-9.42	-9.17	-2.98	-1.96	72.98	263.62	273.00
Michigan	-11.17	-10.93	-4.67	-3.86	69.63	256.58	265.78
Minnesota	-10.24	-9.99	-3.67	-2.85	71.42	260.33	269.63
Missouri	-9.07	-8.83	-2.61	-1.68	73.64	265.00	274.43
Montana	-14.00	-13.77	-7.71	-6.92	64.23	245.22	254.13
New Hampshire	-12.31	-12.08	-5.89	-5.10	67.46	252.00	261.09
New Jersey	-9.60	-9.35	-3.17	-2.16	72.64	262.89	272.26
New York	-9.64	-9.40	-3.22	-2.20	72.56	262.73	272.09
North Carolina	-9.29	-9.05	-2.85	-1.87	73.21	264.10	273.50
North Dakota	-13.03	-12.79	-6.66	-5.87	66.09	249.13	258.14
Ohio	-9.84	-9.60	-3.43	-2.42	72.17	261.92	271.26
Pennsylvania	-9.88	-9.64	-3.48	-2.47	72.10	261.75	271.09
Tennessee	-9.19	-8.95	-2.74	-1.82	73.41	264.52	273.93
Texas	-8.62	-8.38	-2.13	-1.20	74.50	266.80	276.27
Vermont	-15.69	-14.62	-9.52	-8.76	61.00	238.42	247.15
Virginia	-9.37	-9.13	-2.93	-1.91	73.07	263.81	273.20
Washington	-12.12	-11.88	-5.69	-4.89	67.82	252.77	261.88
Wisconsin	-10.13	-9.89	-3.61	-2.74	71.61	260.74	270.05
Alberta	-63.50	-63.32	198.33	219.30	222.01	224.73	225.24
British Columbia	-57.64	-57.43	246.23	270.57	273.71	276.87	277.47
Manitoba	-71.68	-70.88	131.42	147.69	149.79	151.90	152.30
New Brunswick	-67.82	-67.66	163.03	181.53	183.91	186.31	186.76
Newfoundland	-71.68	-71.02	129.22	145.33	147.42	149.50	149.90
Nova Scotia	-63.17	-63.00	200.97	222.13	224.86	227.61	228.13
Ontario	-64.53	-64.36	189.91	210.30	212.93	215.57	216.07
Prince Edward Island	-69.67	-69.52	147.89	165.32	167.57	169.83	170.26
Quebec	-59.77	-59.58	228.80	251.92	254.91	257.90	258.47
Saskatchewan	-70.36	-70.21	142.27	159.30	161.50	163.71	164.13
Total average	-23.94	-23.65	40.37	45.83	102.52	245.73	252.86
US average	-10.34	-10.05	-3.92	-3.01	71.19	259.85	269.14
CAN average	-65.98	-65.70	177.81	197.34	199.86	202.39	202.87

Table 11: Heterogeneity of comparative static effects in percent of erasing the US-CAN border, US-CAN sample with imperfect labor markets

	Heterogeneity of goods trade changes in %						
	Min.	2.50%	25%	50%	75%	97.5%	Max.
ROW	-11.91	-11.63	-5.07	-4.19	67.86	251.64	260.99
Alabama	-9.10	-8.81	-2.27	-1.23	73.21	262.86	272.51
Arizona	-9.70	-9.42	-2.92	-1.79	72.07	260.46	270.04
California	-8.44	-8.16	-1.57	-0.52	74.27	265.46	275.18
Florida	-8.80	-8.52	-1.95	-0.91	73.78	264.05	273.73
Georgia	-9.06	-8.77	-2.23	-1.19	73.29	263.02	272.68
Idaho	-12.50	-12.22	-5.70	-4.83	66.74	249.29	258.58
Illinois	-9.14	-8.85	-2.31	-1.27	73.14	262.70	272.35
Indiana	-9.72	-9.44	-2.94	-1.81	72.02	260.36	269.95
Kentucky	-9.82	-9.54	-3.04	-1.91	71.84	259.99	269.56
Louisiana	-8.94	-8.66	-2.10	-1.06	73.51	263.48	273.15
Maine	-16.25	-15.40	-10.31	-9.48	58.60	232.23	241.07
Maryland	-9.13	-8.84	-2.30	-1.26	73.16	262.75	272.39
Massachusetts	-9.66	-9.37	-2.87	-1.74	72.15	260.63	270.22
Michigan	-11.56	-11.29	-4.69	-3.81	68.52	253.03	262.41
Minnesota	-10.58	-10.30	-3.64	-2.75	70.39	256.93	266.42
Missouri	-9.30	-9.02	-2.49	-1.45	72.83	262.05	271.67
Montana	-14.55	-14.29	-7.92	-7.07	62.82	241.08	250.15
New Hampshire	-12.75	-12.47	-5.97	-5.10	66.26	248.30	257.56
New Jersey	-9.85	-9.57	-3.08	-1.95	71.78	259.84	269.41
New York	-9.90	-9.62	-3.13	-2.00	71.69	259.67	269.23
North Carolina	-9.53	-9.25	-2.73	-1.64	72.39	261.14	270.74
North Dakota	-13.59	-13.33	-6.89	-6.02	64.64	244.91	254.08
Ohio	-10.12	-9.85	-3.37	-2.25	71.26	258.76	268.30
Pennsylvania	-10.16	-9.88	-3.41	-2.29	71.19	258.61	268.15
Tennessee	-9.43	-9.14	-2.62	-1.59	72.59	261.55	271.16
Texas	-8.80	-8.51	-1.95	-0.90	73.79	264.06	273.74
Vermont	-16.25	-15.14	-9.75	-8.91	59.58	234.30	243.19
Virginia	-9.61	-9.32	-2.82	-1.69	72.25	260.83	270.42
Washington	-12.54	-12.27	-5.75	-4.88	66.65	249.11	258.40
Wisconsin	-10.45	-10.18	-3.57	-2.61	70.63	257.44	266.95
Alberta	-64.25	-64.09	193.96	215.80	218.73	221.74	222.36
British Columbia	-58.39	-58.21	242.13	267.55	270.95	274.46	275.18
Manitoba	-72.23	-71.46	128.31	145.28	147.55	149.89	150.37
New Brunswick	-68.44	-68.30	159.51	178.79	181.38	184.04	184.59
Newfoundland	-72.23	-71.58	126.34	143.15	145.41	147.73	148.20
Nova Scotia	-63.93	-63.77	196.56	218.59	221.54	224.59	225.21
Ontario	-65.25	-65.10	185.70	206.92	209.77	212.70	213.30
Prince Edward Island	-70.23	-70.10	144.79	162.98	165.42	167.93	168.45
Quebec	-60.55	-60.37	224.40	248.50	251.73	255.06	255.75
Saskatchewan	-70.94	-70.81	138.96	156.72	159.10	161.55	162.05
Total average	-24.33	-24.02	39.50	45.22	101.13	242.69	250.00
US average	-10.64	-10.31	-3.88	-2.86	70.23	256.63	266.11
CAN average	-66.64	-66.38	174.07	194.43	197.16	199.97	200.55

Table 12: OECD sample, Comparative static effects of PTA inception controlling for trade imbalances in 2006

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
	AvW	SMF	share %GDP SMF		SMF	AvW	SMF
	%GDP	%GDP	$\% \ln(\hat{p})$	$\% \ln(\hat{e})$	$\%\hat{e}$	%EV	%EV
Australia	0.16	0.29	50.00	50.00	0.15	0.16	0.30
Austria	0.12	0.31	45.27	54.73	0.17	0.10	0.34
Belgium	0.09	0.18	58.74	41.26	0.08	0.04	0.16
Canada	0.08	0.07	124.69	-24.69	-0.02	-0.02	-0.04
Switzerland	4.47	11.51	25.50	74.50	8.46	10.19	17.63
Czech Republic	0.10	0.21	53.28	46.72	0.10	0.06	0.20
Germany	0.14	0.39	41.01	58.99	0.23	0.15	0.46
Denmark	0.12	0.29	44.77	55.23	0.16	0.12	0.32
Spain	0.10	0.19	57.11	42.89	0.08	0.05	0.17
Finland	0.14	0.34	40.77	59.23	0.20	0.16	0.41
France	0.14	0.40	40.38	59.62	0.24	0.16	0.49
United Kingdom	0.10	0.20	56.28	43.72	0.09	0.06	0.18
Greece	0.10	0.20	56.19	43.81	0.09	0.06	0.17
Hungary	0.10	0.22	52.19	47.81	0.11	0.07	0.22
Ireland	0.10	0.17	61.53	38.47	0.07	0.05	0.13
Iceland	2.80	7.13	25.70	74.30	5.25	6.27	10.78
Italy	0.14	0.41	40.06	59.94	0.25	0.16	0.50
Japan	0.07	0.06	141.47	-41.47	-0.03	-0.04	-0.05
Korea	0.06	0.05	155.45	-55.45	-0.03	-0.04	-0.06
Netherlands	0.10	0.20	55.22	44.78	0.09	0.06	0.18
Norway	3.35	8.54	25.85	74.15	6.27	7.48	12.93
New Zealand	0.82	1.97	28.81	71.19	1.40	1.66	2.82
Poland	0.11	0.23	51.07	48.93	0.11	0.08	0.23
Portugal	0.10	0.19	56.81	43.19	0.09	0.06	0.17
Slovak Republic	0.10	0.22	52.16	47.84	0.11	0.07	0.22
Sweden	0.16	0.43	36.66	63.34	0.28	0.22	0.55
Turkey	0.10	0.21	54.59	45.41	0.10	0.07	0.19
United States	0.06	0.05	165.48	-65.48	-0.03	-0.05	-0.07
Average	0.17	0.36	107.38	-7.38	0.21	0.21	0.42

Notes: AvW gives results assuming perfect labor markets. SMF are results for the gravity model using a search and matching framework for the labor market.

Table 13: Heterogeneity of comparative static effects in percent of PTA inception, OECD sample with perfect labor markets and controlling for trade imbalances in 2006

	Heterogeneity of goods trade changes in %						
	Min.	2.50%	25%	50%	75%	97.5%	Max.
Australia	-19.69	-18.88	-0.66	-0.47	-0.42	20.29	24.63
Austria	-3.67	-3.14	-0.42	-0.27	-0.08	12.53	13.00
Belgium	-3.53	-3.00	-0.28	-0.13	0.07	12.70	13.16
Canada	-19.37	-18.55	-0.27	-0.08	-0.05	0.24	0.24
Switzerland	-22.13	-21.67	-10.28	4.34	4.49	4.55	4.56
Czech Republic	-3.58	-3.05	-0.33	-0.18	0.01	12.63	13.10
Germany	-3.76	-3.24	-0.50	-0.37	-0.18	12.42	12.88
Denmark	-3.68	-3.15	-0.42	-0.28	-0.09	12.52	12.99
Spain	-3.56	-3.04	-0.32	-0.17	0.03	12.65	13.12
Finland	-3.75	-3.22	-0.48	-0.35	-0.16	12.44	12.90
France	-3.78	-3.26	-0.52	-0.39	-0.20	12.40	12.86
United Kingdom	-3.59	-3.06	-0.34	-0.20	0.00	12.62	13.09
Greece	-3.57	-3.04	-0.32	-0.18	0.02	12.64	13.11
Hungary	-3.60	-3.07	-0.35	-0.20	0.00	12.61	13.08
Ireland	-3.56	-3.03	-0.31	-0.17	0.04	12.66	13.13
Iceland	-15.58	-15.08	-7.28	13.13	13.29	13.35	13.36
Italy	-3.79	-3.26	-0.52	-0.39	-0.20	12.39	12.86
Japan	-19.34	-18.52	-0.23	-0.04	-0.01	0.27	0.28
Korea	-19.32	-18.50	-0.22	-0.03	0.01	0.29	0.29
Netherlands	-3.57	-3.04	-0.32	-0.18	0.02	12.65	13.11
Norway	-17.80	-17.32	-9.15	10.14	10.30	10.36	10.37
New Zealand	-22.31	-21.52	-3.90	-3.71	-3.67	19.71	24.62
Poland	-3.61	-3.08	-0.36	-0.20	-0.01	12.60	13.07
Portugal	-3.58	-3.05	-0.33	-0.18	0.02	12.64	13.10
Slovak Republic	-3.60	-3.07	-0.35	-0.19	0.00	12.62	13.08
Sweden	-3.86	-3.31	-0.60	-0.47	-0.28	12.30	12.77
Turkey	-3.59	-3.06	-0.34	-0.19	0.00	12.62	13.09
United States	-19.32	-18.50	-0.21	-0.02	0.01	0.28	0.28
Average	-8.72	-8.13	-1.42	0.66	0.82	11.00	11.65

Table 14: Heterogeneity of comparative static effects in percent of PTA inception, OECD sample with imperfect labor markets and controlling for trade imbalances in 2006

	Heterogeneity of goods trade changes in %						
	Min.	2.50%	25%	50%	75%	97.5%	Max.
Australia	-19.65	-18.85	-0.79	-0.46	-0.39	20.41	24.75
Austria	-3.75	-3.27	-0.60	-0.42	-0.14	12.32	12.80
Belgium	-3.51	-3.02	-0.38	-0.18	0.11	12.60	13.08
Canada	-19.29	-18.49	-0.38	-0.03	0.03	0.41	0.41
Switzerland	-22.09	-21.63	-10.35	4.26	4.47	4.55	4.56
Czech Republic	-3.56	-3.07	-0.43	-0.23	0.06	12.54	13.02
Germany	-3.89	-3.41	-0.74	-0.57	-0.29	12.15	12.63
Denmark	-3.69	-3.20	-0.53	-0.36	-0.07	12.39	12.87
Spain	-3.52	-3.03	-0.39	-0.19	0.10	12.59	13.07
Finland	-3.78	-3.29	-0.63	-0.45	-0.17	12.29	12.77
France	-3.93	-3.45	-0.78	-0.61	-0.33	12.11	12.59
United Kingdom	-3.54	-3.05	-0.41	-0.21	0.08	12.57	13.05
Greece	-3.53	-3.04	-0.40	-0.20	0.09	12.58	13.06
Hungary	-3.58	-3.09	-0.45	-0.24	0.04	12.52	13.00
Ireland	-3.49	-3.00	-0.36	-0.16	0.12	12.63	13.11
Iceland	-15.56	-15.06	-7.33	13.00	13.23	13.31	13.32
Italy	-3.94	-3.46	-0.79	-0.62	-0.34	12.10	12.57
Japan	-19.27	-18.47	-0.35	-0.01	0.06	0.43	0.43
Korea	-19.26	-18.46	-0.34	0.01	0.07	0.44	0.45
Netherlands	-3.54	-3.05	-0.41	-0.21	0.08	12.57	13.05
Norway	-17.82	-17.34	-9.23	9.97	10.20	10.28	10.28
New Zealand	-22.28	-21.51	-4.03	-3.71	-3.65	19.83	24.74
Poland	-3.59	-3.10	-0.46	-0.25	0.03	12.51	12.99
Portugal	-3.53	-3.04	-0.40	-0.20	0.09	12.58	13.06
Slovak Republic	-3.58	-3.09	-0.45	-0.24	0.04	12.53	13.00
Sweden	-3.94	-3.43	-0.79	-0.62	-0.34	12.10	12.58
Turkey	-3.55	-3.06	-0.42	-0.22	0.07	12.55	13.03
United States	-19.25	-18.45	-0.33	0.01	0.08	0.44	0.44
Average	-8.71	-8.16	-1.53	0.60	0.83	10.94	11.60

Table 15: OECD sample, Comparative static effects of a 5% increase of κ in US controlling for trade imbalances in 2006

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
	AvW	SMF	share %GDP SMF		SMF	AvW	SMF
	%GDP	%GDP	$\% \ln(\hat{p})$	$\% \ln(\hat{e})$	$\%\hat{e}$	%EV	%EV
Australia	0.00	0.83	50.00	50.00	0.41	0.00	0.82
Austria	0.00	0.37	80.14	19.86	0.07	0.00	0.14
Belgium	0.00	0.33	88.45	11.55	0.04	0.00	0.07
Canada	0.00	1.27	41.23	58.77	0.74	0.00	1.48
Switzerland	0.00	0.30	94.69	5.31	0.02	0.00	0.03
Czech Republic	0.00	0.42	74.24	25.76	0.11	0.00	0.21
Germany	0.00	0.40	76.82	23.18	0.09	0.00	0.18
Denmark	0.00	0.44	72.19	27.81	0.12	0.00	0.24
Spain	0.00	0.48	67.49	32.51	0.15	0.00	0.31
Finland	0.00	0.50	66.47	33.53	0.16	0.00	0.33
France	0.00	0.40	75.91	24.09	0.09	0.00	0.19
United Kingdom	0.00	0.61	58.60	41.40	0.25	0.00	0.50
Greece	0.00	0.48	68.02	31.98	0.15	0.00	0.30
Hungary	0.00	0.45	70.60	29.40	0.13	0.00	0.26
Ireland	0.00	0.58	60.41	39.59	0.23	0.00	0.45
Iceland	0.00	0.59	59.68	40.32	0.24	0.00	0.47
Italy	0.00	0.43	72.32	27.68	0.12	0.00	0.23
Japan	0.00	0.44	72.31	27.69	0.12	0.00	0.24
Korea	0.00	0.45	70.83	29.17	0.13	0.00	0.26
Netherlands	0.00	0.39	77.86	22.14	0.08	0.00	0.17
Norway	0.00	0.45	70.51	29.49	0.13	0.00	0.26
New Zealand	0.00	0.83	49.97	50.03	0.41	0.00	0.82
Poland	0.00	0.45	71.23	28.77	0.13	0.00	0.25
Portugal	0.00	0.52	64.36	35.64	0.18	0.00	0.36
Slovak Republic	0.00	0.44	71.40	28.60	0.12	0.00	0.25
Sweden	0.00	0.47	68.52	31.48	0.15	0.00	0.29
Turkey	0.00	0.51	65.34	34.66	0.17	0.00	0.35
United States	0.00	4.31	-8.77	108.77	4.69	0.00	4.38
Average	0.00	1.91	40.50	59.50	1.84	0.00	1.84

Notes: AvW gives results assuming perfect labor markets. SMF are results for the gravity model using a search and matching framework for the labor market.

Table 16: Heterogeneity of comparative static effects in percent of a 5% increase of κ in US controlling for trade imbalances, OECD sample with imperfect labor markets in 2006

	Heterogeneity of goods trade changes in %						
	Min.	2.50%	25%	50%	75%	97.5%	Max.
Australia	-1.42	-1.32	0.04	0.17	0.23	0.46	0.47
Austria	-0.52	-0.42	0.86	1.09	1.13	1.38	1.39
Belgium	-0.42	-0.32	0.96	1.19	1.23	1.46	1.49
Canada	-1.70	-1.65	-0.83	-0.69	-0.63	-0.41	-0.40
Switzerland	-0.36	-0.26	1.03	1.25	1.29	1.48	1.50
Czech Republic	-0.61	-0.51	0.77	1.00	1.04	1.29	1.30
Germany	-0.57	-0.47	0.81	1.04	1.08	1.33	1.34
Denmark	-0.65	-0.55	0.73	0.96	1.02	1.25	1.25
Spain	-0.73	-0.63	0.64	0.87	0.93	1.16	1.17
Finland	-0.77	-0.67	0.61	0.83	0.89	1.12	1.13
France	-0.58	-0.48	0.80	1.03	1.07	1.32	1.33
United Kingdom	-1.00	-0.90	0.46	0.60	0.66	0.89	0.90
Greece	-0.72	-0.62	0.66	0.88	0.94	1.17	1.18
Hungary	-0.67	-0.57	0.70	0.93	0.99	1.22	1.23
Ireland	-0.93	-0.83	0.53	0.67	0.73	0.96	0.97
Iceland	-0.96	-0.86	0.50	0.64	0.70	0.93	0.94
Italy	-0.64	-0.54	0.74	0.97	1.03	1.26	1.27
Japan	-0.66	-0.56	0.72	0.95	1.00	1.23	1.24
Korea	-0.69	-0.58	0.69	0.92	0.98	1.21	1.22
Netherlands	-0.56	-0.45	0.83	1.05	1.09	1.34	1.35
Norway	-0.68	-0.58	0.70	0.92	0.98	1.21	1.22
New Zealand	-1.42	-1.32	0.04	0.17	0.23	0.46	0.47
Poland	-0.67	-0.56	0.71	0.94	1.00	1.23	1.24
Portugal	-0.81	-0.71	0.57	0.79	0.85	1.08	1.09
Slovak Republic	-0.66	-0.56	0.72	0.95	1.01	1.24	1.24
Sweden	-0.73	-0.62	0.65	0.88	0.94	1.17	1.18
Turkey	-0.79	-0.69	0.59	0.81	0.87	1.10	1.11
United States	-1.71	-1.56	-0.26	-0.12	-0.06	0.16	0.17
Average	-0.81	-0.71	0.57	0.77	0.83	1.06	1.07

Table 17: US-CAN sample, Comparative static effects of erasing the US-CAN border controlling for trade imbalances

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
	AvW	SMF	share %GDP SMF		SMF	AvW	SMF
	%GDP	%GDP	$\% \ln(\hat{p})$	$\% \ln(\hat{e})$	$\%\hat{e}$	%EV	%EV
ROW	1.74	2.39	75.00	25.00	0.60	1.75	2.41
Alabama	1.15	1.40	88.84	11.16	0.16	0.43	0.63
Arizona	1.26	1.60	84.57	15.43	0.25	0.69	1.00
California	1.08	1.25	95.52	4.48	0.06	0.15	0.23
Florida	1.05	1.25	91.36	8.64	0.11	0.30	0.44
Georgia	1.15	1.40	89.26	10.74	0.15	0.42	0.60
Idaho	1.86	2.60	73.43	26.57	0.69	2.03	2.78
Illinois	1.20	1.46	88.82	11.18	0.16	0.45	0.66
Indiana	1.32	1.67	84.72	15.28	0.26	0.72	1.03
Kentucky	1.34	1.70	84.11	15.89	0.27	0.77	1.09
Louisiana	1.11	1.34	90.18	9.82	0.13	0.36	0.53
Maine	2.81	4.19	66.12	33.88	1.41	4.25	5.75
Maryland	1.18	1.43	88.82	11.18	0.16	0.45	0.64
Massachusetts	1.18	1.51	83.93	16.07	0.24	0.69	0.98
Michigan	1.60	2.20	75.77	24.23	0.53	1.54	2.14
Minnesota	1.46	1.94	79.98	20.02	0.39	1.10	1.56
Missouri	1.21	1.49	87.46	12.54	0.19	0.52	0.75
Montana	2.26	3.30	69.08	30.92	1.01	3.01	4.11
New Hampshire	1.83	2.60	71.80	28.20	0.73	2.16	2.96
New Jersey	1.36	1.73	84.06	15.94	0.28	0.79	1.11
New York	1.18	1.54	81.92	18.08	0.28	0.80	1.12
North Carolina	1.28	1.59	85.90	14.10	0.23	0.64	0.90
North Dakota	2.11	3.04	71.11	28.89	0.87	2.55	3.54
Ohio	1.40	1.81	82.47	17.53	0.32	0.90	1.27
Pennsylvania	1.38	1.79	82.07	17.93	0.32	0.92	1.29
Tennessee	1.25	1.55	86.53	13.47	0.21	0.59	0.84
Texas	1.07	1.28	91.48	8.52	0.11	0.30	0.44
Vermont	2.58	3.86	66.05	33.95	1.30	3.94	5.30
Virginia	1.24	1.56	85.15	14.85	0.23	0.66	0.93
Washington	1.57	2.31	69.94	30.06	0.69	2.05	2.81
Wisconsin	1.45	1.91	80.62	19.38	0.37	1.05	1.49
Alberta	12.16	17.66	65.99	34.01	5.69	18.61	24.79
British Columbia	5.33	8.56	59.14	40.86	3.42	10.78	14.39
Manitoba	15.57	24.60	59.33	40.67	9.37	32.38	43.06
New Brunswick	13.48	20.59	61.84	38.16	7.41	24.96	33.10
Newfoundland	15.48	24.52	59.06	40.94	9.40	32.56	43.25
Nova Scotia	10.10	15.32	62.82	37.18	5.45	17.73	23.63
Ontario	12.69	18.57	65.39	34.61	6.08	20.00	26.62
Prince Edward Island	14.18	22.04	60.41	39.59	8.21	28.01	37.12
Quebec	9.99	14.04	68.86	31.14	4.18	13.33	17.81
Saskatchewan	15.40	23.85	60.82	39.18	8.75	29.99	39.86
Total average	2.02	2.74	83.17	16.83	0.66	2.05	2.78
US average	1.25	1.58	86.27	13.73	0.24	0.68	0.96
CAN average	11.25	16.58	64.82	35.18	5.53	18.14	24.15

Notes: AvW gives results for the Anderson and van Wincoop (2003) estimates assuming perfect labor markets. SMF are results for the gravity model using a search and matching framework for the labor market.

Table 18: Heterogeneity of comparative static effects in percent of erasing the US-CAN border, US-CAN sample with perfect labor markets and controlling for trade imbalances

	Heterogeneity of goods trade changes in %						
	Min.	2.50%	25%	50%	75%	97.5%	Max.
ROW	-11.48	-11.33	-4.94	-3.95	75.60	276.00	291.37
Alabama	-8.86	-8.70	-2.20	-1.23	80.80	287.14	302.97
Arizona	-9.38	-9.23	-2.76	-1.68	79.76	284.91	300.65
California	-8.57	-8.42	-1.89	-0.92	81.07	288.35	304.23
Florida	-8.44	-8.28	-1.74	-0.77	81.64	288.93	304.84
Georgia	-8.88	-8.73	-2.22	-1.25	80.76	287.04	302.87
Idaho	-12.00	-11.85	-5.50	-4.52	74.56	273.78	289.07
Illinois	-9.09	-8.94	-2.44	-1.48	80.35	286.16	301.95
Indiana	-9.66	-9.51	-3.06	-1.98	79.21	283.72	299.41
Kentucky	-9.73	-9.58	-3.13	-2.06	79.07	283.43	299.11
Louisiana	-8.69	-8.54	-2.02	-1.05	81.13	287.84	303.70
Maine	-15.71	-14.72	-9.79	-8.85	66.65	256.83	271.42
Maryland	-9.00	-8.85	-2.35	-1.38	80.52	286.54	302.34
Massachusetts	-9.02	-8.87	-2.37	-1.29	80.48	286.44	302.25
Michigan	-10.88	-10.73	-4.30	-3.30	76.79	278.54	294.02
Minnesota	-10.29	-10.13	-3.66	-2.66	77.97	281.08	296.66
Missouri	-9.14	-8.99	-2.50	-1.53	80.24	285.95	301.73
Montana	-13.71	-13.57	-7.34	-6.37	71.18	266.53	281.52
New Hampshire	-11.88	-11.73	-5.37	-4.38	74.81	274.31	289.62
New Jersey	-9.84	-9.68	-3.24	-2.17	78.86	282.99	298.65
New York	-9.01	-8.86	-2.33	-1.27	80.50	286.49	302.30
North Carolina	-9.45	-9.30	-2.83	-1.82	79.63	284.63	300.36
North Dakota	-13.09	-12.94	-6.67	-5.70	72.41	269.18	284.28
Ohio	-10.02	-9.86	-3.44	-2.36	78.51	282.23	297.86
Pennsylvania	-9.93	-9.78	-3.35	-2.27	78.68	282.59	298.23
Tennessee	-9.33	-9.17	-2.70	-1.73	79.87	285.15	300.90
Texas	-8.54	-8.38	-1.85	-0.88	81.44	288.51	304.40
Vermont	-15.07	-13.93	-8.79	-7.84	68.49	260.77	275.52
Virginia	-9.29	-9.14	-2.66	-1.58	79.94	285.30	301.06
Washington	-10.76	-10.61	-4.17	-3.17	77.03	279.06	294.56
Wisconsin	-10.23	-10.08	-3.67	-2.60	78.08	281.31	296.90
Alberta	-66.90	-66.75	156.67	175.16	178.03	180.28	181.11
British Columbia	-54.68	-54.48	251.41	276.72	280.65	283.73	284.87
Manitoba	-71.51	-70.39	120.95	136.86	139.33	141.27	141.99
New Brunswick	-68.78	-68.64	142.08	159.52	162.23	164.35	165.14
Newfoundland	-71.14	-70.14	121.84	137.83	140.31	142.25	142.97
Nova Scotia	-63.69	-63.53	181.54	201.82	204.97	207.43	208.35
Ontario	-67.68	-67.54	150.65	168.70	171.50	173.70	174.52
Prince Edward Island	-69.72	-69.59	134.78	151.69	154.32	156.37	157.14
Quebec	-63.50	-63.34	183.04	203.43	206.59	209.07	210.00
Saskatchewan	-71.29	-71.17	122.61	138.64	141.13	143.08	143.81
Total average	-24.09	-23.85	35.37	40.64	102.32	256.42	268.41
US average	-10.25	-10.04	-3.68	-2.67	78.01	281.19	296.78
CAN average	-66.89	-66.56	156.56	175.04	177.91	180.15	180.99

Table 19: Heterogeneity of comparative static effects in percent of erasing the US-CAN border, US-CAN sample with imperfect labor markets and controlling for trade imbalances

	Heterogeneity of goods trade changes in %						
	Min.	2.50%	25%	50%	75%	97.5%	Max.
ROW	-11.90	-11.71	-4.97	-3.90	74.48	272.18	286.96
Alabama	-9.09	-8.89	-2.02	-0.97	80.05	284.06	299.31
Arizona	-9.68	-9.49	-2.66	-1.48	78.87	281.56	296.72
California	-8.79	-8.59	-1.70	-0.64	80.27	285.33	300.63
Florida	-8.62	-8.43	-1.52	-0.46	80.97	286.03	301.37
Georgia	-9.11	-8.92	-2.04	-0.99	80.00	283.97	299.22
Idaho	-12.46	-12.27	-5.58	-4.51	73.36	269.81	284.50
Illinois	-9.34	-9.15	-2.29	-1.24	79.55	282.99	298.21
Indiana	-9.96	-9.77	-2.96	-1.79	78.32	280.37	295.48
Kentucky	-10.03	-9.84	-3.04	-1.86	78.18	280.07	295.17
Louisiana	-8.91	-8.72	-1.83	-0.77	80.40	284.81	300.10
Maine	-16.27	-15.27	-10.06	-9.05	65.13	252.24	266.23
Maryland	-9.22	-9.03	-2.17	-1.12	79.77	283.47	298.70
Massachusetts	-9.27	-9.08	-2.22	-1.04	79.68	283.27	298.50
Michigan	-11.28	-11.09	-4.30	-3.22	75.70	274.80	289.69
Minnesota	-10.66	-10.47	-3.63	-2.55	76.93	277.42	292.41
Missouri	-9.40	-9.21	-2.36	-1.31	79.42	282.72	297.92
Montana	-14.27	-14.09	-7.53	-6.49	69.77	262.14	276.53
New Hampshire	-12.31	-12.13	-5.42	-4.35	73.66	270.43	285.14
New Jersey	-10.13	-9.94	-3.14	-1.97	77.98	279.66	294.74
New York	-9.27	-9.07	-2.21	-1.03	79.69	283.30	298.53
North Carolina	-9.72	-9.53	-2.70	-1.61	78.79	281.39	296.54
North Dakota	-13.68	-13.49	-6.89	-5.84	70.96	264.67	279.16
Ohio	-10.33	-10.14	-3.36	-2.19	77.58	278.80	293.85
Pennsylvania	-10.23	-10.04	-3.26	-2.09	77.77	279.21	294.27
Tennessee	-9.60	-9.41	-2.57	-1.52	79.03	281.90	297.07
Texas	-8.74	-8.54	-1.64	-0.59	80.74	285.54	300.85
Vermont	-15.62	-14.43	-8.98	-7.96	67.11	256.46	270.62
Virginia	-9.55	-9.36	-2.52	-1.34	79.13	282.10	297.28
Washington	-11.21	-11.02	-4.23	-3.15	75.84	275.09	289.99
Wisconsin	-10.58	-10.39	-3.63	-2.46	77.08	277.74	292.75
Alberta	-67.54	-67.41	153.10	172.43	175.50	178.08	179.09
British Columbia	-55.49	-55.32	247.03	273.52	277.73	281.27	282.66
Manitoba	-72.06	-70.98	117.87	134.51	137.15	139.37	140.24
New Brunswick	-69.38	-69.26	138.79	157.02	159.91	162.35	163.30
Newfoundland	-71.71	-70.74	118.86	135.57	138.23	140.46	141.33
Nova Scotia	-64.43	-64.30	177.32	198.49	201.86	204.69	205.80
Ontario	-68.30	-68.18	147.15	166.02	169.02	171.54	172.53
Prince Edward Island	-70.29	-70.17	131.69	149.38	152.19	154.55	155.47
Quebec	-64.17	-64.03	179.37	200.70	204.08	206.93	208.05
Saskatchewan	-71.84	-71.73	119.57	136.34	139.00	141.24	142.12
Total average	-24.50	-24.24	34.57	40.11	101.00	253.27	264.85
US average	-10.58	-10.33	-3.62	-2.52	77.06	277.71	292.72
CAN average	-67.52	-67.21	153.08	172.40	175.47	178.05	179.06

Table 20: US-CAN sample, Comparative static effects of erasing the US-CAN border for various parameter values

μ	σ	average %GDP			average %$\hat{e}$			average %EV		
		total	US	CAN	total	US	CAN	total	US	CAN
	5	11.82	6.63	71.26	9.42	4.34	67.58	12.28	5.46	91.00
0.2	10	4.73	2.27	33.14	3.79	1.52	30.01	4.84	1.90	38.91
	15	2.94	1.32	21.69	2.36	0.89	19.41	2.99	1.11	24.87
	5	4.08	2.32	24.37	2.05	0.79	16.64	4.32	1.58	36.25
0.5	10	1.73	0.90	11.39	0.88	0.31	7.53	1.81	0.62	15.68
	15	1.10	0.55	7.44	0.56	0.19	4.88	1.14	0.39	10.02
	5	2.58	1.60	13.95	0.66	0.24	5.54	2.79	0.96	24.21
0.75	10	1.11	0.65	6.51	0.29	0.10	2.52	1.19	0.39	10.48
	15	0.71	0.41	4.25	0.19	0.06	1.63	0.75	0.25	6.69
	5	2.10	1.38	10.47	0.22	0.08	1.84	2.29	0.77	20.19
0.9	10	0.91	0.57	4.88	0.10	0.03	0.84	0.98	0.32	8.74
	15	0.58	0.36	3.18	0.06	0.02	0.54	0.63	0.20	5.58
	5	1.88	1.28	8.88	0.02	0.01	0.17	2.07	0.69	18.36
0.99	10	0.82	0.54	4.13	0.01	0.00	0.08	0.89	0.29	7.95
	15	0.52	0.34	2.70	0.01	0.00	0.05	0.57	0.18	5.07

Notes: Table reports average changes in nominal GDP, employment, and the equivalent variation for the gravity model using a search and matching framework for the labor market with varying elasticity of substitution σ and the elasticity of the matching function μ.

Table 21: US-CAN sample, Comparative static effects of erasing the US-CAN border controlling for trade imbalances for various parameter values

μ	σ	average %GDP			average $\%\hat{e}$			average %EV		
		total	US	CAN	total	US	CAN	total	US	CAN
0.2	5	12.14	6.69	75.02	9.50	4.42	67.53	12.37	5.57	90.93
	10	4.82	2.25	34.77	3.80	1.52	30.19	4.85	1.90	39.15
	15	2.99	1.30	22.73	2.36	0.88	19.57	2.99	1.10	25.08
0.5	5	4.26	2.31	27.19	2.05	0.79	16.61	4.32	1.59	36.18
	10	1.80	0.88	12.68	0.88	0.31	7.58	1.81	0.62	15.77
	15	1.14	0.54	8.27	0.56	0.19	4.92	1.14	0.38	10.10
0.75	5	2.74	1.58	16.58	0.66	0.24	5.53	2.78	0.96	24.15
	10	1.18	0.63	7.72	0.29	0.10	2.53	1.18	0.39	10.54
	15	0.75	0.39	5.03	0.18	0.06	1.64	0.75	0.24	6.75
0.9	5	2.26	1.36	13.03	0.22	0.08	1.84	2.29	0.77	20.14
	10	0.98	0.55	6.06	0.10	0.03	0.84	0.98	0.32	8.79
	15	0.62	0.35	3.95	0.06	0.02	0.55	0.62	0.20	5.63
0.99	5	2.04	1.26	11.41	0.02	0.01	0.17	2.07	0.69	18.32
	10	0.89	0.52	5.30	0.01	0.00	0.08	0.89	0.29	8.00
	15	0.57	0.33	3.46	0.01	0.00	0.05	0.57	0.18	5.12

Notes: Table reports average changes in nominal GDP, employment, and the equivalent variation for the gravity model using a search and matching framework for the labor market with varying elasticity of substitution σ and the elasticity of the matching function μ.