Comparative Advantage and the Welfare Impact of European Integration*

Andrei A. Levchenko
University of Michigan
and NBER

Jing Zhang
University of Michigan

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Abstract

This paper investigates the welfare gains from European trade integration, and the role of comparative advantage in determining the magnitude of those gains. We use a multi-sector Ricardian model implemented on 79 countries, and compare welfare in the 2000s to a counterfactual scenario in which East European countries are closed to trade. For West European countries, the mean welfare gain from trade integration with Eastern Europe is 0.16%, ranging from zero for Portugal to 0.4% for Austria. For East European countries, gains from trade are 9.23% at the mean, ranging from 2.85% for Russia to 20% for Estonia. For Eastern Europe, comparative advantage is a key determinant of the variation in the welfare gains: countries whose comparative advantage is most similar to Western Europe tend to gain less, while countries with technology most different from Western Europe gain the most.

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1 Introduction

The fall of the Iron Curtain 20 years ago led to one of the largest episodes of abrupt trade integration in postwar history. It brought some 375 million people of the former communist bloc out of the politically imposed isolation and into the world trading system. Indeed, trade integration has been rapid. Figure 1(a) plots total inflation-adjusted exports of the East European countries between 1962 and 2007, expressed as an index number relative to 1990. The nearly 8-fold expansion in East European exports between 1990 and 2007 far outpaces the growth of overall world trade. For geographical, historical, and political reasons, Western Europe is the region most affected by the integration of ex-communist countries. Figure 1(b) plots the share of Eastern Europe in total West European imports from the rest of the world. After remaining stable at about 10% from the early 1960s to the early 1990s, it reached 24% by 2007.

Such episodes of rapid trade integration of large regions are relatively rare, and provide an important "laboratory" for a quantitative study of the welfare gains from trade. This paper provides a comprehensive quantitative assessment of the welfare gains from the post-Cold War European trade integration. The analysis extends the quantitative framework recently developed by Levchenko and Zhang (2011). We build a multisector Ricardian-Heckscher-Ohlin model that incorporates a number of realistic features, such as multiple factors of production, an explicit non-traded sector, the full specification of input-output linkages between the sectors, and both inter- and intra-industry trade. We use the model to estimate sector-level productivities – comparative advantage – for 19 manufacturing sectors and a sample of 79 countries that includes 17 West European and 14 East European countries, as well as virtually all important economies in the rest of the world.

The key advantage of our multi-sector framework is that unlike quantitative assessments based on one-sector models (e.g. Eaton and Kortum 2002, Alvarez and Lucas 2007, Arkolakis, Costinot and Rodríguez-Clare 2012), we can examine the role of an often neglected determinant of welfare gains from trade: the Ricardian comparative advantage. Standard theories tell us that while trade integration should be beneficial to the countries involved, *how much* countries gain depends on the nature of comparative advantage. Generally, countries that are very different from each other will tend to gain more from trade opening than similar countries. Though qualitatively this idea is well-understood, quantitatively we still do not have a clear understanding of the role that Ricardian comparative advantage plays in general, and for welfare gains from European integration in particular.

We first use our sectoral productivity estimates to document that there is indeed a great deal of variation in relative technology among the different countries in our sample. Correlations of sectoral productivities range from 0.16 between Russia and the Netherlands, to virtually 1 between

Finland and Poland. Among the West European countries, average (GDP-weighted) correlations in sectoral technology with the Eastern bloc countries as a group range from 0.285 and 0.417 for the Netherlands and Ireland to 0.928 and 0.926 for Switzerland and Finland. Similarly, for Eastern Europe, average GDP-weighted correlations with Western Europe range from 0.533 and 0.537 for Estonia and Kazakhstan to 0.921 and 0.916 for Poland and Slovenia.

We then quantify the welfare gains from the trade integration of Eastern Europe, by comparing welfare in each West and East European country to a counterfactual scenario in which Eastern Europe is closed to trade. For each East European country, this comparison reveals the total gains from trade relative to autarky. The mean gain for Eastern Europe is 9.23%, ranging from 2.85% for Russia to 20% for Estonia. Ricardian comparative advantage plays an important role in explaining the variation in welfare gains in Eastern Europe. Controlling for country size and average trade costs, East European countries that are similar in relative technology to Western Europe – the wealthier Central European countries – tend to gain less. The most technologically different countries – Estonia and Kazakhstan – gain the most. The impact of similarity in comparative advantage is significant in magnitude: a one-standard deviation change in similarity to Western Europe increases the welfare gains for an East European country by 2.4%, all else equal.

For Western Europe, the mean gain from East European trade integration is 0.16%, ranging from zero for Portugal to 0.4% for Austria. Technological similarity to Eastern Europe does not help account – in the least-squares sense – for the variation in the gains to Western Europe. Trade costs with the East European countries are the predominant determinant of the variation in gains.

Not surprisingly, West European gains are much smaller, since for each West European country, this comparison represents the gains from the ability to trade with Eastern Europe, given that it trades with the rest of the world as well. Even at the peak, imports from Eastern Europe take up only a quarter of total West European imports from outside the region. Probing further, the main reason for the negligible role of comparative advantage is that the rest of the world has very similar sectoral productivity to the East European countries as a group. The simple correlation of average sectoral productivities in Eastern Europe with average sectoral productivities in the other countries serving the West European market – the Americas, Asia and the Pacific, the Middle East, and Sub-Saharan Africa – is in excess of 0.9. Thus, from the perspective of Western Europe, taken as a group Eastern Europe looks much like the rest of the world economy with which it trades. This is not to say that individual East European countries are not very different from the rest of the world – they are. But on the whole, Eastern Europe is a collection of diverse economies that looks quite similar to the world as a whole in terms of comparative advantage.

As a result, when Western Europe opens to trade with the East European countries, its imports from all other regions decrease somewhat and total West European imports expand by a modest 5%. Opening to trade with Eastern Europe also has a negligible effect on the sectoral structure in the West: value added shares of individual sectors never change by more than a fraction of a percentage point. This implies that Western Europe's gains come largely from within-industry specialization. Thus, part of the reason for small welfare gains in Western Europe is that without East European trade Western Europe easily substitutes towards other source countries, and its industrial structure remains largely unchanged.

We place our analysis in a broader context by evaluating the impact of other policy experiments in the European economy, benchmarking the main results and informing the policy priorities. Our first exercise compares deeper trade integration within Western Europe and the EU to broader but shallower trade integration with countries farther afield. For the West European countries the welfare gains from greater intra-West European integration are on average 16 times larger than the gains from integration with Eastern Europe.[1] In addition, more than two-thirds of the West European gains from East European trade are due to the EU accession countries. Both of these results suggest that deeper integration brings much greater welfare gains than shallower integration with more distant economies.

Next, we compare the welfare benefits of different types of integration. Western Europe gains far less from the observed productivity growth in Eastern Europe than from trade integration *per se*. This suggests that the West derives negligible welfare benefits from technology transfer to Eastern Europe, and that the majority of those benefits accrue to the East European countries. Finally, we examine the impact of barriers to factor reallocation. Our results reveal an important role for the cross-sectoral reallocation of labor and capital in Eastern Europe. When factors of production cannot reallocate across sectors, East European gains from trade integration are reduced by 14%. Equally important as the impact on aggregate gains, trade opening without sectoral reallocation can have dramatic distributional effects. The policy implications are twofold. In order to reap the full gains from trade, opening must be accompanied by policies that promote smooth functioning of both labor and capital markets. And, since wages and returns to capital can fall dramatically in some import-competing sectors, it is essential to supplement trade opening with appropriate social safety net programs, especially in cases where trade liberalization is expected to lead to large cross-sectoral reallocations of resources.

This paper relates to the broad line of research that studies regional economic integration using quantitative models (see Baldwin and Venables 1995, for a survey). With respect to its focus on Europe, our analysis is most closely related to Computable General Equilibrium (CGE) assessments of the welfare impact of East European trade integration (e.g., Baldwin, Francois and Portes 1997, Brown, Deardorff, Djankov and Stern 1997, Hertel, Brockmeier and Swaminathan

[1]Indeed, the welfare gains from the observed fall in trade costs within Western Europe from the 1960s to the 2000s are equivalent to more than half of the total West European gains from trade relative to complete autarky in the 2000s. Put simply, for a West European country the majority of the total benefits from international trade come from trading with other West European countries.

1997, Baourakis, Lakatos and Xepapadeas 2008), and to the quantitative industry equilibrium studies of West European integration under imperfect competition (e.g. Smith and Venables 1988, Ottaviano, Taglioni and di Mauro 2009, Corcos, Del Gatto, Mion and Ottaviano 2011).

Our main contribution to this literature is to focus on a neglected determinant of the gains from trade: Ricardian comparative advantage. We thus build on the CGE approach by incorporating the multi-sector Eaton and Kortum (2002) structure explicitly into a global general equilibrium framework. Our results are more complementary to the industry equilibrium investigations of Smith and Venables (1988), Ottaviano et al. (2009), and Corcos et al. (2011). While we ignore the pro-competitive effects of liberalization on firm scale, markups, and firm selection, we explicitly model cross-industry Ricardian specialization. Methodologically, our work builds on recent quantitative welfare assessments of trade integration and technological change in multi-sector Ricardian models (Shikher 2011, Caliendo and Parro 2010, Costinot, Donaldson and Komunjer 2011, Hsieh and Ossa 2011, Levchenko and Zhang 2011, di Giovanni, Levchenko and Zhang 2011). This paper is the first to apply this type of analysis to the trade integration of Eastern Europe.

Before moving on to the description of the model and the results, we outline some limitations of our analysis. Though our estimates of capital stocks and productivity are taken from the data, our counterfactuals ignore any endogenous responses of factor endowments and technology to trade opening. For instance, our analysis abstracts from endogenous cross-border movements of capital in response to trade opening, and any resulting impacts on factor prices. Similarly, we do not model the possibility that trade opening was itself responsible for technology transfer from West to East, and thus in the absence of trade productivity would be lower in Eastern Europe.[2] In addition, because the model has no aggregate uncertainty, it also cannot be used to study the welfare benefits of improved international risk sharing.

The rest of the paper is organized as follows. Section 2 lays out the theoretical framework, and describes the estimation procedure and the data. Section 3 examines the welfare implications of East European integration, paying special attention to the role of comparative advantage. Section 4 performs a number of other policy experiments and discusses the policy implications of the results. Section 5 concludes.

[2]The *cross-border* impact of technology transfer is quantitatively negligible, as we show in section 4.2. Technology transfer accompanying trade opening may have a large impact on the country receiving the technology, but not on its trading partners.

2 Theoretical Framework

2.1 The Environment

The world is comprised of N countries, indexed by n and i. In the numerical implementation below, there are 17 West European countries, 14 East European countries, and 48 non-European countries. There are J tradeable sectors, plus one nontradeable sector $J+1$. Utility over these sectors in country n is given by

$$U_n = \left(\sum_{j=1}^{J} \omega_j^{\frac{1}{\eta}} \left(Y_n^j\right)^{\frac{\eta-1}{\eta}} \right)^{\frac{\eta}{\eta-1}\xi_n} \left(Y_n^{J+1}\right)^{1-\xi_n}, \tag{1}$$

where ξ_n denotes the Cobb-Douglas weight for the tradeable sector composite good, η is the elasticity of substitution between the tradeable sectors, ω_j is the taste parameter for tradeable sector j, Y_n^{J+1} is the nontradeable-sector composite good, and Y_n^j is the composite good in tradeable sector j.

Each sector j aggregates a continuum of varieties $q \in [0,1]$ unique to each sector using a CES production function:

$$Q_n^j = \left[\int_0^1 Q_n^j(q)^{\frac{\varepsilon-1}{\varepsilon}} dq \right]^{\frac{\varepsilon}{\varepsilon-1}},$$

where ε denotes the elasticity of substitution across varieties q, Q_n^j is the total output of sector j in country n, and $Q_n^j(q)$ is the amount of variety q that is used in production in sector j and country n. Producing one unit of good q in sector j in country n requires $\frac{1}{z_n^j(q)}$ input bundles.

Production uses labor (L), capital (K), and intermediate inputs from other sectors. The cost of an input bundle is:

$$c_n^j = \left(w_n^{\alpha_j} r_n^{1-\alpha_j} \right)^{\beta_j} \left(\prod_{k=1}^{J+1} \left(p_n^k\right)^{\gamma_{k,j}} \right)^{1-\beta_j},$$

where w_n is the wage, r_n is the return to capital, and p_n^k is the price of intermediate input from sector k. The value-added based labor intensity is given by α_j, and the share of value added in total output by β_j. Both vary by sector. The shares of inputs from other sectors, $\gamma_{k,j}$ vary by output industry j as well as input industry k.

Following Eaton and Kortum (2002, henceforth EK), productivity $z_n^j(q)$ for each $q \in [0,1]$ in each sector j is random, and drawn from the Fréchet distribution with cdf:

$$F_n^j(z) = e^{-T_n^j z^{-\theta}}.$$

In this distribution, the absolute advantage term T_n^j varies by both country and sector, with higher values of T_n^j implying higher average productivity draws in sector j in country n. The parameter θ captures dispersion, with larger values of θ implying smaller dispersion in draws.

Following Chor (2010), we adopt a broad interpretation of the sectoral productivity parameter T_n^j. Countries differ in a variety of ways, for instance in the quality of contract enforcement and property rights, financial development, and labor market institutions, among others. Recent empirical and theoretical literature has shown that all of these are sources of comparative advantage in international trade. Our paper adopts a reduced-form approach, under which institutions, financial development, and other country characteristics manifest themselves in the productivity parameters T_n^j. For instance, countries with worse contracting institutions will have lower T_n^js in the more institutionally intensive sectors. Chor (2010) provides empirical evidence that sector-level trade patterns can indeed be modelled this way. We follow this approach by necessity, since it would be impractical to explicitly incorporate all of these various sources of comparative advantage into a quantitative framework of this scale.

The production cost of one unit of good q in sector j and country n is thus equal to $c_n^j/z_n^j(q)$. Each country can produce each good in each sector, and international trade is subject to iceberg costs: $d_{ni}^j > 1$ units of good q produced in sector j in country i must be shipped to country n in order for one unit to be available for consumption there. The trade costs need not be symmetric – d_{ni}^j need not equal d_{in}^j – and will vary by sector. We normalize $d_{nn}^j = 1 \; \forall \; n$ and j.

All the product and factor markets are perfectly competitive, and thus the price at which country i supplies tradeable good q in sector j to country n is:

$$p_{ni}^j(q) = \left(\frac{c_i^j}{z_i^j(q)} \right) d_{ni}^j.$$

Buyers of each good q in tradeable sector j in country n will only buy from the cheapest source country, and thus the price actually paid for this good in country n will be:

$$p_n^j(q) = \min_{i=1,\ldots,N} \left\{ p_{ni}^j(q) \right\}.$$

2.2 Characterization of Equilibrium

The **competitive equilibrium** of this model world economy consists of a set of prices, allocation rules, and trade shares such that (i) given the prices, all firms' inputs satisfy the first-order conditions, and their output is given by the production function; (ii) given the prices, the consumers' demand satisfies the first-order conditions; (iii) the prices ensure the market clearing conditions for labor, capital, tradeable goods and nontradeable goods; (iv) trade shares ensure balanced trade for each country.

The set of prices includes the wage rate w_n, the rental rate r_n, the sectoral prices $\{p_n^j\}_{j=1}^{J+1}$, and the aggregate price P_n in each country n. The allocation rules include the capital and labor allocation across sectors $\{K_n^j, L_n^j\}_{j=1}^{J+1}$, final consumption demand $\{Y_n^j\}_{j=1}^{J+1}$, and total demand $\{Q_n^j\}_{j=1}^{J+1}$ (both final and intermediate goods) for each sector. The trade shares include the expenditure share π_{ni}^j in country n on goods coming from country i in sector j.

2.2.1 Demand and Prices

It can be easily shown that the price of sector j's output will be given by:

$$p_n^j = \left[\int_0^1 p_n^j(q)^{1-\varepsilon} dq \right]^{\frac{1}{1-\varepsilon}}.$$

Following the standard EK approach, it is helpful to define

$$\Phi_n^j = \sum_{i=1}^{N} T_i^j \left(c_i^j d_{ni}^j \right)^{-\theta}.$$

This value summarizes, for country n, the access to production technologies in sector j. Its value will be higher if in sector j, country n's trading partners have high productivity (T_i^j) or low cost (c_i^j). It will also be higher if the trade costs that country n faces in this sector are low. Standard steps lead to the familiar result that the price of good j in country n is simply

$$p_n^j = \Gamma \left(\Phi_n^j \right)^{-\frac{1}{\theta}}, \tag{2}$$

where $\Gamma = \left[\mathbf{\Gamma} \left(\frac{\theta+1-\varepsilon}{\theta} \right) \right]^{\frac{1}{1-\varepsilon}}$, with $\mathbf{\Gamma}$ the Gamma function. The consumption price index in country n is then:

$$P_n = B_n \left(\sum_{j=1}^{J} \omega_j (p_n^j)^{1-\eta} \right)^{\frac{1}{1-\eta}\xi_n} (p_n^{J+1})^{1-\xi_n}, \tag{3}$$

where $B_n = \xi_n^{-\xi_n} (1-\xi_n)^{-(1-\xi_n)}$.

Both capital and labor are mobile across sectors and immobile across countries, and trade is balanced. The budget constraint (or the resource constraint) of the consumer is thus given by

$$\sum_{j=1}^{J+1} p_n^j Y_n^j = w_n L_n + r_n K_n, \tag{4}$$

where K_n and L_n are the endowments of capital and labor in country n.

Given the set of prices $\{w_n, r_n, P_n, \{p_n^j\}_{j=1}^{J+1}\}_{n=1}^{N}$, we first characterize the optimal allocations from final demand. Consumers maximize utility (1) subject to the budget constraint (4). The first order conditions associated with this optimization problem imply the following final demand:

$$p_n^j Y_n^j = \xi_n (w_n L_n + r_n K_n) \frac{\omega_j (p_n^j)^{1-\eta}}{\sum_{k=1}^J \omega_k (p_n^k)^{1-\eta}}, \text{ for all } j = \{1, .., J\} \tag{5}$$

and

$$p_n^{J+1} Y_n^{J+1} = (1 - \xi_n)(w_n L_n + r_n K_n).$$

2.2.2 Production Allocation and Market Clearing

Let Q_n^j denote the total sectoral demand in country n and sector j. Q_n^j is used for both final consumption and as intermediate inputs in domestic production of all sectors. Denote by $X_n^j = p_n^j Q_n^j$ the total *spending* on the sector j goods in country n, and by X_{ni}^j country n's total spending on sector j goods coming from country i, i.e. n's imports of j from country i. The EK structure in each sector j delivers the standard result that the probability of importing good q from country i, π_{ni}^j is equal to the share of total spending on goods coming from country i, X_{ni}^j / X_n^j, and is given by:

$$\frac{X_{ni}^j}{X_n^j} = \pi_{ni}^j = \frac{T_i^j \left(c_i^j d_{ni}^j \right)^{-\theta}}{\Phi_n^j}. \tag{6}$$

The market clearing condition expenditures on sector j in country n is:

$$p_n^j Q_n^j = p_n^j Y_n^j + \sum_{k=1}^J (1 - \beta_k) \gamma_{j,k} \left(\sum_{i=1}^N \pi_{in}^k p_i^k Q_i^k \right) + (1 - \beta_{J+1}) \gamma_{j,J+1} p_n^{J+1} Q_n^{J+1}.$$

Total expenditure in sector $j = 1, ..., J+1$ of country n, $p_n^j Q_n^j$, is the sum of (i) domestic final consumption expenditure $p_n^j Y_n^j$; (ii) expenditure on sector j goods as intermediate inputs in all the traded sectors $\sum_{k=1}^J (1 - \beta_k) \gamma_{j,k} (\sum_{i=1}^N \pi_{in}^k p_i^k Q_i^k)$, and (iii) expenditure on the j's sector intermediate inputs in the domestic non-traded sector $(1 - \beta_{J+1}) \gamma_{j,J+1} p_n^{J+1} Q_n^{J+1}$. These market clearing conditions summarize two important features of the world economy captured by our model: complex international production linkages, as much of world trade is in intermediate inputs, and a good crosses borders multiple times before being consumed (Hummels, Ishii and Yi 2001); and two-way input linkages between the tradeable and the nontradeable sectors.

In each tradeable sector j, some goods q are imported from abroad and some goods q are exported to the rest of the world. Country n's exports in sector j are given by $EX_n^j = \sum_{i=1}^N \mathbb{I}_{i \neq n} \pi_{in}^j p_i^j Q_i^j$, and its imports in sector j are given by $IM_n^j = \sum_{i=1}^N \mathbb{I}_{i \neq n} \pi_{ni}^j p_n^j Q_n^j$, where $\mathbb{I}_{i \neq n}$ is the indicator function. The total exports of country n are then $EX_n = \sum_{j=1}^J EX_n^j$, and total imports are $IM_n = \sum_{j=1}^J IM_n^j$. Trade balance requires that for any country n, $EX_n - IM_n = 0$.

Given the total production revenue in tradeable sector j in country n, $\sum_{i=1}^N \pi_{in}^j p_i^j Q_i^j$, the optimal sectoral factor allocations must satisfy

$$\sum_{i=1}^{N} \pi_{in}^{j} p_i^j Q_i^j = \frac{w_n L_n^j}{\alpha_j \beta_j} = \frac{r_n K_n^j}{(1-\alpha_j)\beta_j}.$$

For the nontradeable sector $J+1$, the optimal factor allocations in country n are simply given by

$$p_n^{J+1} Q_n^{J+1} = \frac{w_n L_n^{J+1}}{\alpha_{J+1}\beta_{J+1}} = \frac{r_n K_n^{J+1}}{(1-\alpha_{J+1})\beta_{J+1}}.$$

Finally, the feasibility conditions for factors are given by, for any n,

$$\sum_{j=1}^{J+1} L_n^j = L_n \text{ and } \sum_{j=1}^{J+1} K_n^j = K_n.$$

The model has two principal uses. The first is to estimate the sector-level technology parameters T_n^j for a large set of countries. The technology parameters in the tradeable sectors relative to a reference country (the U.S.) are estimated using data on sectoral output and bilateral trade. The procedure relies on fitting a structural gravity equation implied by the model. Intuitively, if controlling for the typical gravity determinants of trade, a country spends relatively more on domestically produced goods in a particular sector, it is revealed to have either a high relative productivity or a low relative unit cost in that sector. The procedure then uses data on factor and intermediate input prices to net out the role of factor costs, yielding an estimate of relative productivity. This step also produces estimates of bilateral, sector-level trade costs d_{ni}^j. The next step is to estimate the technology parameters in the tradeable sectors for the U.S.. This procedure requires directly measuring TFP at the sectoral level using data on real output and inputs, and then correcting measured TFP for selection due to trade. Third, we calibrate the nontradeable technology for all countries using the first-order condition of the model and the relative prices of nontradeables observed in the data. The detailed procedures for all three steps are described in Levchenko and Zhang (2011) and reproduced in Appendix A.

The second use of the quantitative model is to perform welfare analysis. Given the estimated sectoral productivities, factor endowments, trade costs, and model parameters, we solve the system of equations defining the equilibrium under the baseline values, as well as under counterfactual scenarios, and compare welfare. The algorithm for solving the model is described in Levchenko and Zhang (2011).

2.3 Data and Calibration

Estimation of sectoral productivity parameters T_n^j and trade costs d_{ni}^j requires data on total output by sector, as well as sectoral data on bilateral trade. To maximize coverage of the European countries as well as data quality, sectoral output data for the 27 European Union countries plus FYR Macedonia were taken from EUROSTAT. For the other 52 countries in the sample, information on output was obtained from the 2009 UNIDO Industrial Statistics Database. The two output data sources were merged at the roughly 2-digit ISIC Revision 3 level of disaggregation, yielding 19 manufacturing sectors. Bilateral trade data were collected from the UN COMTRADE database, and concorded to the same sectoral classification. Productivity and trade cost estimation in this model requires an assumption on the dispersion parameter θ. We pick the value of $\theta = 8.28$, which is the preferred estimate of EK, and in addition assume that it does not vary across sectors.[3]

In order to implement the model numerically, we must in addition calibrate the following sets of parameters: (i) preference parameters ω_j, ξ_n, and η; (ii) production function parameters ε, α_j, β_j, $\gamma_{k,j}$ for all sectors j and k; (iii) country factor endowments L_n and K_n.

The share of expenditure on traded goods, ξ_n in each country is sourced from Yi and Zhang (2010), who compile this information for 30 developed and developing countries. For countries unavailable in the Yi and Zhang data, values of ξ_n are imputed based on fitting a simple linear relationship to log PPP-adjusted per capita GDP from the Penn World Tables. The fit of this simple bivariate linear relationship is quite good, with the R^2 of 0.55. The taste parameters for tradeable sectors ω_j were estimated by combining the model structure above with data on final consumption expenditure shares in the U.S. sourced from the U.S. Input-Output matrix, as described in Appendix A. The elasticity of substitution between broad sectors within the tradeable bundle, η, is set to 2. Since these are very large product categories, it is sensible that this elasticity would be relatively low. It is higher, however, than the elasticity of substitution between tradeable and nontradeable goods, which is set to 1 by the Cobb-Douglas assumption.

The production function parameters α_j and β_j are estimated using the output, value added, and wage bill data from EUROSTAT and UNIDO. To compute α_j for each sector, we calculate

[3]There are no reliable estimates of how θ varies across sectors, and thus we do not model this variation. Shikher (2004, 2005, 2011), Burstein and Vogel (2009), and Eaton, Kortum, Neiman and Romalis (2010), among others, follow the same approach of assuming the same θ across sectors. Caliendo and Parro (2010) use tariff data and triple differencing to estimate sector-level θ. However, their approach may impose too much structure and/or be dominated by measurement error: at times the values of θ they estimate are negative. In addition, in each sector the restriction that $\theta > \varepsilon - 1$ must be satisfied, and it is not clear whether Caliendo and Parro (2010)'s estimated sectoral θ's meet this restriction in every case. Our approach is thus conservative by being agnostic on this variation across sectors. It is also important to assess how the results below are affected by the value of this parameter. One may be especially concerned about how the results change under lower values of θ. Lower θ implies greater within-sector heterogeneity in the random productivity draws. Thus, trade flows become less sensitive to the costs of the input bundles (c_i^j), and the gains from intra-sectoral trade become larger relative to the gains from inter-sectoral trade. In Levchenko and Zhang (2011), we estimated the sectoral productivities for a sample of 75 countries assuming instead a value of $\theta = 4$, which has been advocated by Simonovska and Waugh (2010) and is at or near the bottom of the range that has been used in the literature. Overall, the results are remarkably similar. The correlation between estimated T_i^j's under $\theta = 4$ and under $\theta = 8.28$ is above 0.95, and there is actually somewhat greater variability in T_i^j's under $\theta = 4$.

the share of the total wage bill in value added, and take a simple median across countries (taking the mean yields essentially the same results). To compute β_j, compute the ratio of value added to total output for each country and sector, and take the median across countries.

The intermediate input coefficients $\gamma_{k,j}$ are obtained from the Direct Requirements Table for the United States. We use the 1997 Benchmark Detailed Make and Use Tables (covering approximately 500 distinct sectors), as well as a concordance to the ISIC Revision 3 classification to build a Direct Requirements Table at the 2-digit ISIC level. The Direct Requirements Table gives the value of the intermediate input in row k required to produce one dollar of final output in column j. Thus, it is the direct counterpart of the input coefficients $\gamma_{k,j}$. Note that we assume these to be the same in all countries.[4] In addition, we use the U.S. I-O matrix to obtain α_{J+1} and β_{J+1} in the nontradeable sector.[5] The elasticity of substitution between varieties within each tradeable sector, ε, is set to 4.

The total labor force in each country, L_n, and the total capital stock, K_n, are computed based on the Penn World Tables 6.3. Following the standard approach in the literature (see, e.g. Hall and Jones 1999, Bernanke and Gürkaynak 2001, Caselli 2005), the total labor force is calculated from data on the total GDP per capita and per worker.[6] The total capital stock is calculated using the perpetual inventory method that assumes a depreciation rate of 6%: $K_{n,t} = (1-0.06)K_{n,t-1}+I_{n,t}$, where $I_{n,t}$ is total investment in country n in period t. For most countries, investment data start in 1950, and the initial value of K_n is set equal to $I_{n,0}/(\gamma + 0.06)$, where γ is the average growth rate of investment in the first 10 years for which data are available.

All of the variables that vary over time are averaged for the period 2000-2007 (the latest available year), which is the time period on which we carry out the analysis. Appendix Table A1 lists the countries used in the analysis, separating them into Western Europe, Eastern Europe, and the rest of the world.[7] Appendix Table A2 lists the sectors along with the key parameter values for each sector: α_j, β_j, the share of nontradeable inputs in total inputs $\gamma_{J+1,j}$, and the taste parameter ω_j.

[4]di Giovanni and Levchenko (2010) provide suggestive evidence that at such a coarse level of aggregation, Input-Output matrices are indeed similar across countries. To check robustness of the results, Levchenko and Zhang (2011) collected country-specific I-O matrices from the GTAP database. Productivities computed based on country-specific I-O matrices were very similar to the baseline values, with the median correlation of 0.98, and all but 3 out of 75 countries with a correlation of 0.93 or above, and the minimum correlation of 0.65.

[5]The U.S. I-O matrix provides an alternative way of computing α_j and β_j. These parameters calculated based on the U.S. I-O table are very similar to those obtained from UNIDO, with the correlation coefficients between them above 0.85 in each case. The U.S. I-O table implies greater variability in α_j's and β_j's across sectors than does UNIDO.

[6]Using the variable name conventions in the Penn World Tables, $L_n = 1000 * pop * rgdpch/rgdpwok$.

[7]Due to lack of required data, a number of East European countries are missing. The missing countries include all but two of the countries comprising former Yugoslavia (Bosnia and Herzegovina, Croatia, Montenegro, and Serbia), the trans-Caucasus countries (Armenia, Azerbaijan, Georgia), Albania, Belarus, and Moldova. These countries together account for 14% of total Eastern bloc population and 10% of its GDP, but less than 6% of its exports.

3 The Welfare Impact of European Integration

3.1 Basic Patterns

Table 1 reports the matrix of correlations of T_n^j in the tradeable sectors $j = 1, ..., J$ between all pairs of East and West European countries. In order to focus on differences in comparative rather than absolute advantage, we compute the correlations on the vectors of T_n^j demeaned by each country's geometric average T_n^j. It is clear that the differences in sectoral similarities between country pairs are pronounced. In Eastern Europe, countries most similar to the West are Poland, Slovenia, and Slovakia, while Estonia and Kazakhstan are most different from the West. Among the West European countries, Finland and Switzerland have the most similar comparative advantage to Eastern Europe, while the Netherlands and Ireland are the most different. Figure 2 presents these correlations graphically, using a contour plot with darker shades representing higher correlations. We next explore the impact of such pronounced differences in technological similarity on the magnitude of the welfare gains from European integration.

3.2 Model Fit

Our model matches quite closely the relative incomes of countries as well as bilateral and overall trade flows observed in the data. Table 2 compares the wages, returns to capital, and the trade shares in the baseline model solution and in the data. The top panel shows that mean and median wages implied by the model are very close to the data. The correlation coefficient between model-implied wages and those in the data is above 0.99. The second panel performs the same comparison for the return to capital. Since it is difficult to observe the return to capital in the data, we follow the approach adopted in the estimation of T_n^j's, and impute r_n from an aggregate factor market clearing condition: $r_n/w_n = (1-\alpha) L_n / (\alpha K_n)$, where α is the aggregate share of labor in GDP, assumed to be 2/3. Once again, the average levels of r_n are very similar in the model and the data, and the correlation between the two is 0.95.

Next, we compare the trade shares implied by the model to those in the data. The third panel of Table 2 reports the spending on domestically produced goods as a share of overall spending, π_{nn}^j. These values reflect the overall trade openness, with lower values implying higher international trade as a share of absorption. Though we under-predict overall trade slightly (model π_{nn}^j's tend to be higher), the averages are quite similar, and the correlation between the model and data values is 0.92. Finally, the bottom panel compares the international trade flows in the model and the data. The averages are very close, and the correlation between the model and data values is 0.91.

Figure 3 presents the comparison of trade flows graphically, by depicting the model-implied trade values against the data, along with a 45-degree line. Red/solid dots indicate π_{ni}^j's that involve Eastern Europe, that is, trade flows in which an East European country is either an exporter or an importer. All in all the fit of the model to trade flows is quite good. Eastern Europe is unexceptional when it comes to the fit of the model, with East European trade flows clustered together with the rest of the observations.

3.3 Welfare Analysis

This section evaluates the welfare gains from trade integration of Eastern Europe. To do so, we first compute welfare in the baseline model under the actual trade costs d^j_{ni} estimated on data for the 2000s. We next compute the welfare in a counterfactual scenario in which all East European countries are in autarky.[8] Table 3 reports, for each West and East European country, the percentage welfare gain from European integration (that is, the proportional difference in welfare between the benchmark model for 2000s and the counterfactual model in which all East European countries are in autarky).

All throughout, welfare is defined as the indirect utility function. Straightforward steps using the CES functional form can be used to show that indirect utility in each country n is equal to total income divided by the price level. Since the model is competitive, total income equals the total returns to factors of production. Expressed in per capita terms welfare is thus:

$$\frac{w_n + r_n k_n}{P_n},$$

where $k_n = K_n/L_n$ is capital per worker, and the consumption price level P_n comes from equation (3).

The gains to Western Europe are not large: the mean welfare increase is 0.16%, and the range is between essentially zero for Portugal and 0.4% for Austria. This result is not surprising. First, in the 2000s imports from Eastern Europe are only about 22% of overall West European imports from outside Western Europe, and only 8% of total West European imports (including from within the region). In addition, our counterfactual takes into account the fact that in the absence of Eastern Europe, the total West European imports would not fall by 8%: Western Europe will increase imports from all other regions to partially substitute for East European imports. In fact, as we discuss in detail in Section 3.4, in the complete absence of Eastern Europe, total West European imports would only fall by 4.7%.

For Eastern Europe, gains are much greater, since in this case we are comparing complete

[8] In the counterfactual, each individual East European country is in autarky, that is, it does not trade with other Eastern bloc countries. Assuming complete autarky in this counterfactual may over-estimate the gains, since there was some trade among the Eastern bloc countries, as well as between those countries and the rest of the world. Our model is not suited to evaluate the welfare gains from trade among the communist bloc countries, since those were command economies in which all international exchange was centrally planned rather than driven by market forces.

autarky to trade. The median change in welfare is 9.23%, ranging from 2.85% for Russia to nearly 20% for Estonia. Not surprisingly, larger and farther away countries (Russia, Ukraine) tend to gain much less than smaller ones, such as the Baltic countries, FYR Macedonia, and Bulgaria. Note that the gains are from trade with all of the world, not just with Western Europe.

How much does comparative advantage affect the magnitude of these gains? To account for the variation in the gains from East European trade, we regress the total welfare change on the average d_{ni}^{j}, the correlation between the T's, as well as total GDP to control for the well-known role of country size. Note that we do not seek any kind of causal interpretation of these regressions. Rather, we only want to see which variables correlate with the variation in the welfare gains, and can "explain" it in the least-squares sense. Table 4 reports the results, for three ways of weighting d_{ni}^{j}'s and correlations of T's: equal-weighted, GDP-weighted, and population-weighted. That is, when the regression is carried out on the sample of West European countries, we compute, for each country, the (weighted) average of its trade cost to each East European country, and the (weighted) average of its technological similarity to each East European country. When the regression is run on the sample of East European countries, these averages are computed across West European countries. All the left-hand side variables and the regressors are in logs throughout.[9]

Panel A reports the results for the 17 West European countries. The R^2's of these regressions are between 0.65 and 0.7, indicating that the three regressors account for the bulk of the cross-country variation in welfare gains. Trade costs and country size are significant at the 1% level in all specifications. By contrast, sectoral similarity has the "right" sign but the coefficient is close to zero and insignificant.

Panel B reports the results for the 14 East European countries. The same three variables do a better job in absorbing the variation in the welfare gains for Eastern Europe: the R^2's are above 0.88 in all three specifications. Here, by contrast, technological similarity to Western Europe matters a great deal. Even in such a small sample, the coefficients on similarity are significant at the 1% level, with robust t-statistics of about 3.5. The coefficients are also large in magnitude. A one-standard deviation change in GDP-weighted technological similarity increases welfare gains from trade integration by 2.43 percentage points. On the other hand, trade costs don't seem to matter much in accounting for the gains from trade in Eastern Europe, in spite of the fact that the variation in trade costs is very similar in the West and East European samples.

Figure 4 presents the contrast between Western and Eastern Europe graphically. It plots the partial correlations between the welfare gain from East European integration and the GDP-weighted technological similarity (left side), and the GDP-weighted d_{ni}^{j} (right side), after netting out the other variables in Table 4. The top panel reports the results for Western Europe, the

[9]None of the average correlations or welfare gains are negative, so taking logs does not lead to dropped observations. Estimating these relationships in levels delivers similar results.

bottom panel for Eastern Europe. As shown by the regression estimates, for Western Europe trade costs explain the variation in welfare gains remarkably well, while there is virtually no relationship with technological similarity. For Eastern Europe, trade costs don't do as well, but there is a pronounced negative relationship between similarity and the welfare gains.

This difference in outcomes between Western and Eastern Europe is due to the difference in relative importance of the two groups in each other's total trade. Seventy two percent of Eastern Europe's imports come from Western Europe in the period we consider. Thus, technological similarity with Western Europe is an important determinant of the gains from trade relative to autarky. However, East European countries remain relatively small trade partners for Western Europe, accounting for about 22% of its imports from the rest of the world on average in the 2000s. Thus, for Western Europe, East European trade and technological similarity has to be evaluated in the context of its broader international trade relationships. That is, for Western Europe what should matter is not so much its similarity to Eastern Europe *per se*, but the relative similarity of Eastern Europe to the average country with which Western Europe already trades (see di Giovanni et al. 2011, for a closely related result).

To that end, we compute the average productivity of East European countries in a sector, and correlate it to the average productivity of all the other trade partners of Western Europe (the Americas, Asia, the Pacific, Middle East and North Africa, and Sub-Saharan Africa). It turns out that from the perspective of Western Europe, Eastern Europe looks very much like the rest of the world with which it trades. The correlation between the average sectoral productivity in Eastern Europe and in the rest of the world is a remarkable 0.91. Figure 5 presents this result graphically, with average productivities expressed as a fraction of the world frontier. (This regularity holds for population- and GDP-weighted averages as well.) Of course, individual East European countries often have a comparative advantage that is very different from the rest of the world. But Eastern Europe contains many diverse countries, and as a group they look much like the rest of the world economy in terms of their relative technology.

Thus, the gains to Western Europe from East European trade come not primarily from trading with technologically different countries, but from the expansion of markets. As a result, trade costs explain very well the variation in the gains from trade for Western Europe, while technological similarity to Eastern Europe does not matter much.

3.4 Global Trade Volumes

We next explore how East European integration changes the pattern of global trade. By construction, when Eastern Europe opens to trade, exports from Eastern Europe to all other countries rise. But what happens to exports from other regions, in particular to Western Europe? As

Eastern Europe takes up a substantial share of West European imports, do imports to Western Europe from other regions fall, and if yes, by how much?

Before describing the comparison between the counterfactual and the benchmark, we check how well the model reproduces the cross-regional trade shares. To do so, we compute, in both the data and the benchmark model, the shares of total extra-regional imports going to each region. That is, we take the total imports from the rest of the world to, say, Western Europe, and compute the share of those imports captured by Eastern Europe, as well as every other region. The regions we consider are non-Europe OECD countries (which for us are the United States, Canada, Japan, Australia, and New Zealand); Latin America and the Caribbean; Middle East and North Africa; East and South Asia; and Sub-Saharan Africa. Figure 6 presents the scatterplot of those shares in the data (on the x-axis) against the model, along with a 45-degree line. All in all, the model matches the cross-regional import shares remarkably well. The correlation between model and data shares is 0.98, and the Spearman rank correlation is 0.98 as well.

Next, Table 5 presents the matrix of percentage changes in cross-regional trade volumes from the counterfactual to the benchmark. The table omits Eastern Europe from both the rows and the columns of the table because in the counterfactual Eastern Europe is in autarky, and thus percentage changes between the counterfactual and the benchmark are infinity. Of particular interest is the top row, that shows imports into Western Europe. As Eastern Europe opens to trade, imports from all other regions fall, by between -1.45% from non-Europe OECD and -4.09% from the Middle East/North Africa region. As a result, total West European imports – inclusive of Eastern Europe – increase by only 4.7%. This modest change is an illustration of why the gains to Western Europe from the opening up of Eastern Europe are so modest: if Eastern Europe weren't there, the Western countries would substitute imports from other world regions for East European imports. The pattern looks similar elsewhere in the world. Total imports rise, but by less than in Western Europe. Imports from regions other than Eastern Europe fall modestly.

3.5 Changes in Sectoral Structure

A closely related question is what happens to industrial structure in Western Europe as a result of European integration. In this subsection, we compare sectoral structure implied by the baseline model to the counterfactual sectoral structure that would have prevailed had Eastern Europe not been integrated.

Figure 7(a) presents the absolute changes in shares of value added in each sector and each country as Eastern Europe opens to trade. The most striking result is just how little change in sectoral structure takes place. Aside from the non-tradeable sector, in which shares usually decrease and sometimes by as much as 0.0025 (or a quarter of a percentage point), one hardly observes changes in value added shares in excess of 0.0005, or 0.05 percentage points. By and large, industrial structure remains the same as Western Europe opens to trade with Eastern Europe. This lack of effect is in part because, as mentioned above, Eastern Europe represents only 22% of all West European imports from outside the region, and in part because Eastern Europe has similar technology to the rest of Western Europe's trading partners. Thus, trade liberalization of Eastern Europe does not represent a significant change in West European comparative advantage vis-à-vis the rest of the world with which it trades.

This lack of change in Western sectoral structure is in sharp contrast with Eastern Europe, depicted in Figure 7(b). Note the difference in scale of the y-axis: while for Western Europe, changes in the tradeable sector range from -0.0005 to 0.0015, with the non-tradeable share falling by less than 0.0025 in all cases, for Eastern Europe the changes in tradeable sector shares range from about -0.005 to 0.02, and as much as -0.05 in the non-tradeable sector. This is a difference in sectoral share changes of an order of magnitude. Not surprisingly, welfare changes in Eastern Europe are much greater.

4 Benchmarking the Gains and Policy Implications

Are the gains from East European integration produced by our model large or small? Comparing the main welfare results to alternative policy experiments will shed light on where integration of Eastern Europe falls in the ranking of different changes that occurred, or might occur, in the European economy. These differences in impact will then inform the policy priorities, by highlighting economic changes that have relatively large or small welfare payoffs. This section develops a number of alternative counterfactuals, with an eye on comparing the welfare impact of these alternative changes to the welfare impact of the integration of Eastern Europe.

4.1 West European Integration

The obvious comparison for East European integration is the earlier integration within Western Europe. Unlike the fall of the Iron Curtain that brought about an abrupt integration of Eastern Europe, West European integration has been a much more gradual and continuous process. Starting with the Treaty establishing the European Coal and Steel Community among the original 6 members that went into effect in 1952, integration both broadened by expanding the EU to 15 West European members, and deepened over time. The major treaties are the Treaty of Rome (went into effect 1958), Single European Act (1987), the Treaty on European Union (also known as the Maastricht Treaty, 1993), and up to the Treaty of Lisbon (signed 2007). In between these major milestones, there were more minor treaties as well. Thus, the basic difficulty in simulating the welfare impact of West European integration is that there is no single year, or even decade, during which integration occurred.

To take the broadest view of this process, we simulate a counterfactual scenario in which trade costs d_{ni}^j between West European trade partners are rolled back to their 1960s values. Our estimates for the 1960s show that trade costs within Western Europe are 45% higher in the 1960s compared to today, and this is the change in trade costs that we simulate. This exercise in effect attributes all of the fall in iceberg trade costs within Western Europe from the 1960s to the 2000s to policy measures relating to West European integration, and thus may over-estimate the total impact of policy measures. On the other hand, a great deal of policy barriers to cross-border trade in particular were dismantled prior to 1962 (the earliest year in our data) among the original 6 members. The fact that we start in the 1960s may thus under-estimate the total sweep of the EU's impact. A fall in trade costs of this magnitude appears to be in a reasonable ballpark for assessing the impact of deep economic integration on trade flows.

The first column of Table 6 presents the results. Precisely, we report the change in West European welfare due to a reduction in intra-West-European trade costs by 45%, the end point of this reduction being today's trade costs. This counterfactual assumes that Eastern Europe stays in autarky throughout, in order to mimic, albeit in a very rough way, historical developments. Western Europe was well on its way towards deep integration within the region when Eastern Europe was integrated. The mean welfare gains to Western Europe from observed within-region integration are 2.53%. These gains are on average 16 times larger than the gains from opening to Eastern Europe. This finding is not surprising, since West European trade partners are far more important for a typical West European country than East European partners.

To probe further, column 2 of Table 6 presents the West European countries' gains from trade relative to complete autarky.[10] The model implies that the mean gains from trade in Western Europe are 4.54%. Strikingly, just a 45% reduction in trade costs with only fellow West European countries accounts for more than half of the total gains from trade for Western Europe. These results speak to the policy tradeoff between the benefits of continued "deep" integration within Western Europe, and the "shallow" but broad integration with other regions, such as Eastern Europe and beyond. West European economies are relatively large, productive, and close to each other. Thus, quantitatively the gains from reductions in trade barriers within that group of countries are an order of magnitude larger than even the gains from integration of large economic blocs such as Eastern Europe, China, or India.[11] These results point to a potentially much greater benefit of deeper, rather than broader, integration.

[10] In this calculation, gains are computed with respect to the baseline scenario, that is, each West European country goes from trading with no one to trading with everyone including Eastern Europe.

[11] Elsewhere (di Giovanni et al. 2011) we computed the worldwide gains from the trade integration of China. For West European countries, the mean gains from trade with China are 0.09%, with the maximum gain of 0.162%.

The gains from trade relative to autarky in Western Europe can also be compared to the gains for Eastern Europe in Table 3. East European gains from trade are two times larger than Western Europe's gains. Not surprisingly, since East European countries tend to be both smaller in size and less productive, they derive greater benefits from international exchange. From a policy perspective, this suggests that further trade integration in Eastern Europe, especially with its West European neighbors, is likely to have an even larger welfare impact than reductions in West European trade barriers. Thus, policies that improve the links between the two groups of countries, such as investment in infrastructure, are likely to have a larger payoff in Eastern Europe compared to the West.

4.2 East European Integration and Productivity Growth

Another facet of the tradeoff between deeper and broader integration relates to the differing degrees of integration of East European countries with the West. Does Western Europe gain more from deeper integration with the Central European countries currently in the European Union, or from a more arms-length trade relationship with non-EU countries? The answer is not clear ex ante: non-EU countries such as Russia, Ukraine, and Kazakhstan are both larger in size, and more technologically different, than the EU-25 countries of Central Europe. Columns 3 and 4 of Table 6 report the gains from integration of EU-member East European countries, and the gains from integration of non-EU East European countries respectively. Of the total mean gains from East European integration, 0.156%, two-thirds (0.107%) are due to integration of the EU East European countries. The remaining one-third (0.049%) is due to non-EU Eastern Europe.[12] Once again, these results are suggestive that economic policies should aim at deeper integration of current EU member countries, rather than broader integration of countries farther afield.

The previous exercises compare our main results to the impact of other types of reductions in trade costs, whether within Western Europe, or for different sets of East European countries. Next, we benchmark the results against another drastic change that took place in the East European economy, namely economic growth. Has Western Europe benefited more from a fall in trade costs with Eastern Europe *per se*, or from the dramatic productivity growth (and the somewhat less dramatic capital accumulation) that took place in Eastern Europe since the fall of the Iron Curtain? To answer this question, we simulate the welfare benefit to Western Europe from the productivity growth and capital accumulation that actually occurred in the East European countries from the 1990s to the 2000s. Over this period, these economies grew dramatically, with

[12]The EU East European countries are Czech Republic, Estonia, Hungary, Latvia, Lithuania, Poland, Slovak Republic, and Slovenia. All of these joined the EU in 2004, in the middle of our sample of years. Bulgaria and Romania joined in 2007, the last year of our sample, and thus we put them in the non-EU group. Adding them to the EU group will make the difference between the welfare impact of EU and non-EU integration even more pronounced.

productivity rising 33% over a decade (2.9% growth per annum).[13] Note that, as is well known in the trade literature, a trading partner's productivity growth need not improve a country's welfare (see, e.g. Hicks 1953, Samuelson 2004). In addition, quantitative assessments in other contexts have found that the overwhelming majority of welfare benefits from productivity growth accrue to the growing country itself rather than to other countries through trade (Hsieh and Ossa 2011, di Giovanni et al. 2011).

Column 5 of Table 6 reports the welfare gains to Western Europe from the observed growth in Eastern Europe from the 1990s to the 2000s. These gains are virtually nil: 0.028% (i.e. 0.00028), with a maximum of 0.067%. Thus, it appears that the modest welfare gains to Western Europe from trade integration with the East are still larger than the gains from productivity growth in those countries, even though that productivity growth has been dramatic. This finding suggests that policies favoring eastward technology transfer and foreign direct investment do not have a large aggregate welfare payoff for the West, even relative to reductions in trade costs with East European countries. Of course, those policies will have a much greater positive welfare impact on the East European countries themselves.

4.3 Importance of Factor Reallocation

The preceding counterfactuals assumed that the factors of production reallocate optimally in response to each change in trade costs, and thus labor and capital markets clear within each country. A frequently expressed concern with greater integration – be it with Eastern Europe or other regions – is that reallocation of production factors within a country is difficult. Barriers to factor reallocation will both reduce the magnitude of the gains from trade, and create winners and losers even when aggregate gains are positive. To the extent that factor reallocation is required for reaping the benefits of trade, policies that impede that reallocation, such as rigid labor market institutions, may also reduce the gains from trade.

To assess the importance of factor reallocation quantitatively, we compute the welfare gains from East European integration under the assumption that capital and labor in each sector are fixed. That is, when Eastern Europe opens to trade, factors cannot move from one sector to another in response.[14] Table 7 reports the welfare changes in that experiment. As expected, the welfare gains from East European integration are smaller for every country if factors are not mobile across sectors. For Western Europe, the difference is not large in absolute terms: the mean gains are 0.142% instead of 0.156% in the main analysis. For Eastern Europe, however, the

[13] To be precise, we compare welfare in Western Europe under the 2000s baseline to a counterfactual scenario in which Eastern Europe's trade costs are the same as in the baseline, but East European productivities and capital-labor ratios are as they were in the 1990s. Thus, the counterfactual scenario is a world in which trade integration with Eastern Europe took place, but there was no growth in those countries from the 1990s to today.

[14] In this exercise, capital and labor can still reallocate between varieties within each sector.

welfare gains without sectoral reallocation are significantly smaller in both absolute and relative terms. The mean gain from trade drops to 7.94%, which is 14% less than the 9.23% welfare gain when factors are mobile. The pronounced difference between the two groups of countries in the impact of factor reallocation on welfare gains is not surprising in light of the results in section 3.5. As Figure 7 makes clear, East European integration induced only small changes in sectoral structure in Western Europe, whereas in Eastern Europe sectoral composition changed much more dramatically. From a policy perspective, we conclude that efforts to promote smooth functioning of the labor and capital markets are especially important in trade liberalization episodes that are expected to produce large cross-sectoral reallocations.

A distinct but related question is how large are the distributional consequences of trade opening. Understanding the magnitudes of the distributional effects is important in designing the social safety net programs to cushion the negative consequences of trade opening for import-competing sectors. To address this question exhaustively, one would require a model with explicit frictions in the mobility of factors across sectors. The exercise here represents an extreme case in which factors are not allowed to move at all between sectors. In addition, we do not take an explicit stand on who owns the capital in each sector, and thus we can only compute changes in wages and returns to capital in each sector, rather than in individuals' overall incomes. Nonetheless, analyzing the factor price changes can give us a rough sense of the distributional impact of trade opening when factors are immobile across sectors.

Figure 8 presents, for each sector, the distribution of percentage changes in sector-specific real wage (top panel) and real return to capital (bottom panel) when Eastern Europe opens to trade. The solid dots represent Western Europe, and hollow dots Eastern Europe. Two conclusions emerge. First, the variation in real factor returns across sectors dwarfs the magnitude of the aggregate impact. For Western Europe, as we saw above the mean welfare change is 0.142%. By contrast, the changes in real wage and the real return to capital range across sectors from about -1% to 1% in every country, and as much as from -5% to 5% in smaller countries such as Iceland and Ireland. Second, the cross-sectoral dispersion in wage and return to capital changes is far larger in Eastern Europe. It is not uncommon to observe 50% reductions, or 100% increases in the real returns to factors in individual industries.

These results further inform policy priorities. The finding that the distributional impacts of trade liberalization can be an order of magnitude higher than the aggregate gains points to the primary importance of social safety net programs. In Western Europe, the absolute welfare changes even in the most import-competing sectors are small, rarely more than 1%. Thus, East European integration is unlikely to have led to a large amount of dislocation in the West. By contrast, East European workers and capital owners in particular sectors can experience very large swings (from halving to doubling of real wages or capital returns). Thus, social safety nets are especially needed in those countries as they open to trade. Finally, we stress that smooth and efficient factor markets will limit the within-country divergence in factor prices across sectors due to trade liberalization, and thus lead to less reliance on the social safety net.

5 Conclusion

Ever since the original formulation of the Ricardian model in the nineteenth century, it has been understood that the magnitude of the relative differences in technology – "the strength of comparative advantage" – matters for the size of the gains from trade. Broadly speaking, stronger comparative advantage leads to larger gains from trade. However, the importance of this effect has not been assessed quantitatively.

This paper uses the trade integration of Eastern Europe after the fall of the Iron Curtain as a laboratory for evaluating the role of comparative advantage in the gains from trade. We estimate sector-level productivities for 19 sectors in 79 countries, and document that differences in relative technology do indeed vary a great deal among the Western and East European country pairs. Using a multi-sector, multi-factor quantitative model of trade and these sectoral productivity estimates, we evaluate the gains from European integration for each country.

The variation in gains to West European countries is mainly accounted for by trade costs, with technological similarity playing little or no role. By contrast, the dispersion in gains to Eastern Europe is well explained by technological similarity to Western Europe. This difference is due to the asymmetry in the relative importance of the two country groups as trade partners. The large majority of East European trade is with Western Europe. For Western Europe, however, Eastern Europe is still a minor trade partner. Furthermore, a comparison of sectoral productivities reveals that as a group, Eastern Europe has a similar comparative advantage as the rest of Western Europe's trade partners. Thus, the gains to Western Europe come mainly from expansion of markets, rather than from technological differences with Eastern Europe.

Placing the East European trade opening episode within a broader context of West European integration allows us to draw out a number of policy implications. Deeper within-Europe integration appears to confer greater welfare benefits than shallower but broader trade integration. Technology transfer from Western to Eastern Europe will benefit East European countries, but have virtually no positive welfare impact on the West. Eastern Europe has likely experienced large distributional effects due to trade opening. Thus, it is imperative that trade integration is accompanied by policies that promote optimal reallocation of factors of production, and ensure a minimum safety net for those displaced by import competition.

Appendix A Procedure for Estimating T_n^j, d_{ni}^j, and ω_j

This appendix reproduces from Levchenko and Zhang (2011) the details of the procedure for estimating technology, trade costs, and taste parameters required to implement the model. Interested readers should consult that paper for further details on estimation steps and data sources.

A.1 Tradeable Sector Relative Technology

We now focus on the tradeable sectors. Following the standard EK approach, first divide trade shares by their domestic counterpart:

$$\frac{\pi_{ni}^j}{\pi_{nn}^j} = \frac{X_{ni}^j}{X_{nn}^j} = \frac{T_i^j \left(c_i^j d_{ni}^j\right)^{-\theta}}{T_n^j \left(c_n^j\right)^{-\theta}},$$

which in logs becomes:

$$\ln\left(\frac{X_{ni}^j}{X_{nn}^j}\right) = \ln\left(T_i^j (c_i^j)^{-\theta}\right) - \ln\left(T_n^j (c_n^j)^{-\theta}\right) - \theta \ln d_{ni}^j.$$

Let the (log) iceberg costs be given by the following expression:

$$\ln d_{ni}^j = d_k^j + b_{ni}^j + CU_{ni}^j + RTA_{ni}^j + ex_i^j + \nu_{ni}^j,$$

where d_k^j is an indicator variable for a distance interval. Following EK, we set the distance intervals, in miles, to [0, 350], [350, 750], [750, 1500], [1500, 3000], [3000, 6000], [6000, maximum). Additional variables are whether the two countries share a common border (b_{ni}^j), belong to a currency union (CU_{ni}^j), or to a regional trade agreement (RTA_{ni}^j). Following the arguments in Waugh (2010), we include an exporter fixed effect ex_i^j. Finally, there is an error term ν_{ni}^j. Note that all the variables have a sector superscript j: we allow all the trade cost proxy variables to affect true iceberg trade costs d_{ni}^j differentially across sectors. There is a range of evidence that trade volumes at sector level vary in their sensitivity to distance or common border (see, among many others, Do and Levchenko 2007, Berthelon and Freund 2008).

This leads to the following final estimating equation:

$$\ln\left(\frac{X_{ni}^j}{X_{nn}^j}\right) = \underbrace{\ln\left(T_i^j (c_i^j)^{-\theta}\right) - \theta ex_i^j}_{\text{Exporter Fixed Effect}} \underbrace{- \ln\left(T_n^j \left(c_n^j\right)^{-\theta}\right)}_{\text{Importer Fixed Effect}}$$
$$\underbrace{-\theta d_k^j - \theta b_{ni}^j - \theta CU_{ni}^j - \theta RTA_{ni}^j}_{\text{Bilateral Observables}} \underbrace{-\theta \nu_{ni}^j}_{\text{Error Term}}.$$

This equation is estimated for each tradeable sector $j = 1, ...J$. Estimating this relationship will thus yield, for each country, an estimate of its technology-cum-unit-cost term in each sector j, $T_n^j(c_n^j)^{-\theta}$, which is obtained by exponentiating the importer fixed effect. The available degrees of freedom imply that these estimates are of each country's $T_n^j(c_n^j)^{-\theta}$ relative to a reference country, which in our estimation is the United States. We denote this estimated value by S_n^j:

$$S_n^j = \frac{T_n^j}{T_{us}^j}\left(\frac{c_n^j}{c_{us}^j}\right)^{-\theta},$$

where the subscript us denotes the United States. It is immediate from this expression that estimation delivers a convolution of technology parameters T_n^j and cost parameters c_n^j. Both will of course affect trade volumes, but we would like to extract technology T_n^j from these estimates. In order to do that, we follow the approach of Shikher (2004). In particular, for each country n, the share of total spending going to home-produced goods is given by

$$\frac{X_{nn}^j}{X_n^j} = T_n^j\left(\frac{\Gamma c_n^j}{p_n^j}\right)^{-\theta}.$$

Dividing by its U.S. counterpart yields:

$$\frac{X_{nn}^j/X_n^j}{X_{us,us}^j/X_{us}^j} = \frac{T_n^j}{T_{us}^j}\left(\frac{c_n^j}{c_{us}^j}\frac{p_{us}^j}{p_n^j}\right)^{-\theta} = S_n^j\left(\frac{p_{us}^j}{p_n^j}\right)^{-\theta},$$

and thus the ratio of price levels in sector j relative to the U.S. becomes:

$$\frac{p_n^j}{p_{us}^j} = \left(\frac{X_{nn}^j/X_n^j}{X_{us,us}^j/X_{us}^j}\frac{1}{S_n^j}\right)^{\frac{1}{\theta}}. \tag{A.1}$$

The entire right-hand side of this expression is either observable or estimated. Thus, we can impute the price levels relative to the U.S. in each country and each tradeable sector.

The cost of the input bundles relative to the U.S. can be written as:

$$\frac{c_n^j}{c_{us}^j} = \left(\frac{w_n}{w_{us}}\right)^{\alpha_j\beta_j}\left(\frac{r_n}{r_{us}}\right)^{(1-\alpha_j)\beta_j}\left(\prod_{k=1}^{J}\left(\frac{p_n^k}{p_{us}^k}\right)^{\gamma_{k,j}}\right)^{1-\beta_j}\left(\frac{p_n^{J+1}}{p_{us}^{J+1}}\right)^{\gamma_{J+1,j}(1-\beta_j)}.$$

Using information on relative wages, returns to capital, price in each tradeable sector from (A.1), and the nontradeable sector price relative to the U.S., we can thus impute the costs of the input bundles relative to the U.S. in each country and each sector. Armed with those values, it is straightforward to back out the relative technology parameters:

$$\frac{T_n^j}{T_{us}^j} = S_n^j \left(\frac{c_n^j}{c_{us}^j} \right)^{\theta}.$$

A.2 Trade Costs

The bilateral, directional, sector-level trade costs of shipping from country i to country n in sector j are then computed based on the estimated coefficients as:

$$\ln \hat{d}_{ni}^j = \theta \hat{d}_k^j + \theta \hat{b}_{ni}^j + \theta \widehat{CU}_{ni}^j + \theta \widehat{RTA}_{ni}^j + \theta \widehat{ex}_i^j + \theta \widehat{\nu}_{ni}^j,$$

for an assumed value of θ. Note that the estimate of the trade costs includes the residual from the gravity regression $\theta \widehat{\nu}_{ni}^j$. Thus, the trade costs computed as above will fit bilateral sectoral trade flows exactly, given the estimated fixed effects. Note also that the exporter component of the trade costs $\widehat{ex}_i^j$ is part of the exporter fixed effect. Since each country in the sample appears as both an exporter and an importer, the exporter and importer estimated fixed effects are combined to extract an estimate of $\theta \widehat{ex}_i^j$.

A.3 Complete Estimation

So far we have estimated the levels of technology of the tradeable sectors relative to the United States. To complete our estimation, we still need to find (i) the levels of T for the tradeable sectors in the United States; (ii) the taste parameters ω_j, and (iii) the nontradeable technology levels for all countries.

To obtain (i), we use the NBER-CES Manufacturing Industry Database for the U.S. (Bartelsman and Gray 1996). We start by measuring the observed TFP levels for the tradeable sectors in the U.S.. The form of the production function gives

$$\ln Z_{us}^j = \ln \Lambda_{us}^j + \beta_j \alpha_j \ln L_{us}^j + \beta_j (1 - \alpha_j) \ln K_{us}^j + (1 - \beta_j) \sum_{k=1}^{J+1} \gamma_{k,j} \ln M_{us}^{k,j}, \tag{A.2}$$

where Λ^j denotes the measured TFP in sector j, Z^j denotes the output, L^j denotes the labor input, K^j denotes the capital input, and $M^{k,j}$ denotes the intermediate input from sector k. The NBER-CES Manufacturing Industry Database offers information on output, and inputs of labor, capital, and intermediates, along with deflators for each. Thus, we can estimate the observed TFP level for each manufacturing tradeable sector using the above equation.

If the United States were a closed economy, the observed TFP level for sector j would be given by $\Lambda_{us}^j = (T_{us}^j)^{\frac{1}{\theta}}$. In the open economies, the goods with inefficient domestic productivity draws will not be produced and will be imported instead. Thus, international trade and competition introduce selection in the observed TFP level, as demonstrated by Finicelli, Pagano and Sbracia (2009a). We thus use the model to back out the true level of T^j_{us} of each tradeable sector in the United States. Here we follow Finicelli et al. (2009a) and use the following relationship:

$$(\Lambda^j_{us})^\theta = T^j_{us} + \sum_{i \neq us} T^j_i \left(\frac{c^j_i d^j_{us,i}}{c^j_{us}} \right)^{-\theta}.$$

Thus, we have

$$(\Lambda^j_{us})^\theta = T^j_{us} \left[1 + \sum_{i \neq us} \frac{T^j_i}{T^j_{us}} \left(\frac{c^j_i d^j_{us,i}}{c^j_{us}} \right)^{-\theta} \right] = T^j_{us} \left[1 + \sum_{i \neq us} S^j_i \left(d^j_{us,i} \right)^{-\theta} \right]. \tag{A.3}$$

This equation can be solved for underlying technology parameters T^j_{us} in the U.S., given estimated observed TFP Λ^j_{us}, and all the S^j_i's and $d^j_{us,i}$'s estimated in the previous subsection.

To estimate the taste parameters $\{\omega_j\}_{j=1}^J$, we use information on final consumption shares in the tradeable sectors in the U.S.. We start with a guess of $\{\omega_j\}_{j=1}^J$ and find sectoral prices p^k_n as follows. For an initial guess of sectoral prices, we compute the tradeable sector aggregate price and the nontradeable sector price using the data on the relative prices of nontradeables to tradeables. Using these prices, we calculate sectoral unit costs and Φ^j_n's, and update prices according to equation (2), iterating until the prices converge. We then update the taste parameters according to equation (5), using the data on final sectoral expenditure shares in the U.S.. We normalize the vector of ω_j's to have a sum of one, and repeat the above procedure until the values for the taste parameters converge.

Finally, we estimate the nontradeable sector TFP using the relative prices. In the model, the nontradeable sector price is given by

$$p^{J+1}_n = \Gamma (T^{J+1}_n)^{-\frac{1}{\theta}} c^{J+1}_n.$$

Since we know the aggregate price level in the tradeable sector p^T_n, c^{J+1}_n, and the relative price of nontradeables (which we take from the data), we can back out T^{J+1}_n from the equation above for all countries.

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Table 1. Country-Pair Correlations

	BGR	CZE	EST	HUN	KAZ	LTU	LVA	MKD	POL	ROM	RUS	SVK	SVN	UKR	Mean
AUT	0.761	0.795	0.584	0.594	0.530	0.846	0.907	0.918	0.902	0.829	0.735	0.902	0.912	0.719	0.757
BLX	0.559	0.582	0.371	0.357	0.273	0.683	0.745	0.765	0.766	0.725	0.580	0.738	0.760	0.488	0.585
CHE	0.985	0.973	0.720	0.796	0.795	0.867	0.965	0.951	0.975	0.901	0.926	0.980	0.987	0.975	0.928
DEU	0.903	0.832	0.474	0.544	0.524	0.745	0.901	0.889	0.984	0.976	0.933	0.923	0.959	0.830	0.880
DNK	0.869	0.895	0.674	0.704	0.660	0.898	0.967	0.970	0.960	0.878	0.824	0.968	0.973	0.841	0.845
ESP	0.946	0.884	0.545	0.619	0.609	0.783	0.931	0.916	0.997	0.978	0.955	0.952	0.979	0.888	0.912
FIN	0.969	0.928	0.622	0.697	0.689	0.828	0.956	0.941	0.998	0.956	0.950	0.974	0.993	0.930	0.926
FRA	0.861	0.827	0.512	0.562	0.525	0.789	0.912	0.908	0.968	0.939	0.875	0.927	0.955	0.797	0.846
GBR	0.715	0.770	0.593	0.592	0.519	0.846	0.883	0.901	0.864	0.776	0.677	0.876	0.881	0.680	0.714
GRC	0.959	0.989	0.798	0.852	0.840	0.929	0.991	0.984	0.959	0.857	0.870	0.994	0.986	0.966	0.905
IRL	0.377	0.458	0.357	0.306	0.201	0.638	0.636	0.669	0.608	0.537	0.372	0.614	0.621	0.328	0.417
ISL	0.684	0.576	0.178	0.228	0.187	0.531	0.711	0.707	0.848	0.898	0.791	0.736	0.795	0.562	0.698
ITA	0.937	0.862	0.502	0.581	0.571	0.752	0.911	0.896	0.993	0.984	0.959	0.936	0.969	0.870	0.905
NLD	0.246	0.426	0.506	0.412	0.296	0.685	0.582	0.628	0.454	0.315	0.159	0.539	0.507	0.256	0.282
NOR	0.737	0.711	0.411	0.437	0.380	0.725	0.838	0.842	0.897	0.879	0.773	0.848	0.879	0.658	0.744
PRT	0.847	0.968	0.956	0.982	0.971	0.957	0.922	0.921	0.792	0.622	0.670	0.908	0.860	0.922	0.779
SWE	0.801	0.761	0.439	0.480	0.434	0.742	0.870	0.869	0.937	0.921	0.834	0.884	0.917	0.724	0.798
Mean	0.823	0.807	0.533	0.575	0.537	0.782	0.886	0.884	0.921	0.879	0.820	0.895	0.916	0.772	

Notes: This table reports the correlations in sectoral technological similarities between each West European-East European country pair. The correlations are between T_n^j's demeaned by the country-specific geometric average T_n^j. The last column and the last row report GDP-weighted average correlations.

Table 2. The Fit of the Baseline Model with the Data

		model	data
Wages:			
	mean	0.390	0.351
	median	0.133	0.150
	corr(model, data)	*0.994*	
Return to capital:			
	mean	0.896	0.939
	median	0.674	0.698
	corr(model, data)	*0.950*	
π_{nn}^{j}			
	mean	0.614	0.569
	median	0.676	0.609
	corr(model, data)	*0.922*	
π_{ni}^{j}, $i \neq n$			
	mean	0.0053	0.0056
	median	0.0001	0.0001
	corr(model, data)	*0.910*	

Notes: This table reports the means and medians of wages relative to the U.S. (top panel); return to capital relative to the U.S. (second panel), share of domestically produced goods in overall spending (third panel), and share of goods from country i in overall spending (bottom panel) in the model and in the data. Wages and return to capital in the data are calculated as described in Appendix A.

Table 3. Welfare Gains in Western and Eastern Europe

West	Δ Welfare	East	Δ Welfare
Austria	0.400 %	Bulgaria	12.571 %
Belgium-Luxembourg	0.131 %	Czech Republic	6.152 %
Denmark	0.202 %	Estonia	19.858 %
Finland	0.273 %	Hungary	8.117 %
France	0.074 %	Kazakhstan	9.654 %
Germany	0.226 %	Latvia	15.396 %
Greece	0.150 %	Lithuania	10.725 %
Iceland	0.211 %	Macedonia, FYR	10.914 %
Ireland	0.154 %	Poland	4.078 %
Italy	0.134 %	Romania	7.580 %
Netherlands	0.154 %	Russian Federation	2.855 %
Norway	0.116 %	Slovak Republic	8.220 %
Portugal	0.027 %	Slovenia	7.308 %
Spain	0.063 %	Ukraine	5.792 %
Sweden	0.177 %		
Switzerland	0.078 %		
United Kingdom	0.075 %		
Mean	0.156 %		9.230 %

Notes: This table reports the percentage changes in welfare due to the trade integration of Eastern Europe. It compares welfare in the baseline scenario under the estimated trade costs in the 2000s to a counterfactual scenario in which each and every East European country is in autarky.

Table 4. Welfare Gains, Technological Similarity, and Trade Costs

	(1) Equal-Weighted	(2) Population-Weighted	(3) GDP-Weighted
		Panel A: Western Europe	
Dep. Var.: Change in Welfare			
Technological Similarity	-0.244	-0.060	-0.065
	(0.617)	(0.371)	(0.378)
Trade Costs	-6.047***	-5.643***	-5.551***
	(1.386)	(1.536)	(1.503)
Real GDP	-0.456***	-0.500***	-0.491***
	(0.075)	(0.094)	(0.092)
Constant	12.080***	12.581***	12.276***
	(2.574)	(3.052)	(2.972)
Observations	17	17	17
R^2	0.704	0.653	0.650
		Panel B: Eastern Europe	
Dep. Var.: Change in Welfare			
Technological Similarity	-0.968***	-0.858***	-0.845***
	(0.262)	(0.256)	(0.251)
Trade Costs	-0.182	-0.105	-0.108
	(0.373)	(0.395)	(0.392)
Real GDP	-0.347***	-0.335***	-0.336***
	(0.035)	(0.037)	(0.036)
Constant	8.390***	8.160***	8.173***
	(0.694)	(0.726)	(0.719)
Observations	14	14	14
R^2	0.889	0.880	0.881

Notes: Robust standard errors in parentheses; ***: significant at 1%. All left-hand side and right-hand side variables are in natural logs. The sample is of West European countries in Panel A, and of East European countries in Panel B. "Equal-Weighted," "Population-Weighted," and "GDP-Weighted" refers to how Technological Similarity and Trade Cost variables are averaged for each country across its trading partners in the other region. Variable definitions and sources are described in detail in the text.

Table 5. Percentage Changes in Cross-Regional Trade Volumes

	Source country groups						
Destination Country Groups	Western Europe	Non-Europe OECD	Latin America /Caribbean	Middle East /North Africa	East and South Asia	Sub-Saharan Africa	Total
Western Europe		-1.45	-2.85	-4.09	-2.91	-1.95	4.67
Non-Europe OECD	-0.89		-0.25	0.30	-0.15	0.34	0.91
Latin America/Caribbean	-0.83	-0.20		-0.06	-0.21	-0.79	0.36
Middle East/North Africa	-3.63	-1.79	-4.88		-2.04	-8.36	3.90
East and South Asia	-1.41	-0.52	-1.84	-0.48		-1.84	1.32
Sub-Saharan Africa	-3.59	-1.79	-8.40	-7.92	-2.10		0.45

Notes: This table reports the percentage changes in imports from regions in the columns to regions in the rows. The last column reports the percentage changes in total imports for each region in the row. That value includes the East European imports.

Table 6. Welfare Gains in Western Europe, Alternative Scenarios

	(1) West European Integration	(2) Gains from Trade	(3) Gains from EU Eastern Europe	(4) Gains from non-EU Eastern Europe	(5) Gains from Growth in Eastern Europe
Austria	2.728 %	4.430 %	0.329 %	0.070 %	0.055 %
Belgium-Luxembourg	4.551 %	7.597 %	0.097 %	0.034 %	0.025 %
Denmark	3.369 %	5.612 %	0.150 %	0.052 %	0.016 %
Finland	2.133 %	3.586 %	0.156 %	0.118 %	0.019 %
France	1.229 %	1.950 %	0.050 %	0.024 %	0.021 %
Germany	1.388 %	2.680 %	0.168 %	0.058 %	0.045 %
Greece	1.600 %	2.727 %	0.030 %	0.120 %	0.067 %
Iceland	3.766 %	8.453 %	0.163 %	0.047 %	0.002 %
Ireland	3.923 %	9.327 %	0.096 %	0.058 %	0.054 %
Italy	1.333 %	2.155 %	0.080 %	0.054 %	0.025 %
Netherlands	3.874 %	7.051 %	0.092 %	0.061 %	0.040 %
Norway	2.181 %	3.513 %	0.110 %	0.006 %	0.016 %
Portugal	2.963 %	3.810 %	0.018 %	0.009 %	0.015 %
Spain	1.450 %	2.085 %	0.040 %	0.023 %	0.021 %
Sweden	2.415 %	3.741 %	0.137 %	0.040 %	0.023 %
Switzerland	3.061 %	5.164 %	0.051 %	0.026 %	0.018 %
United Kingdom	1.114 %	3.257 %	0.044 %	0.032 %	0.013 %
Mean	2.534 %	4.538 %	0.107 %	0.049 %	0.028 %

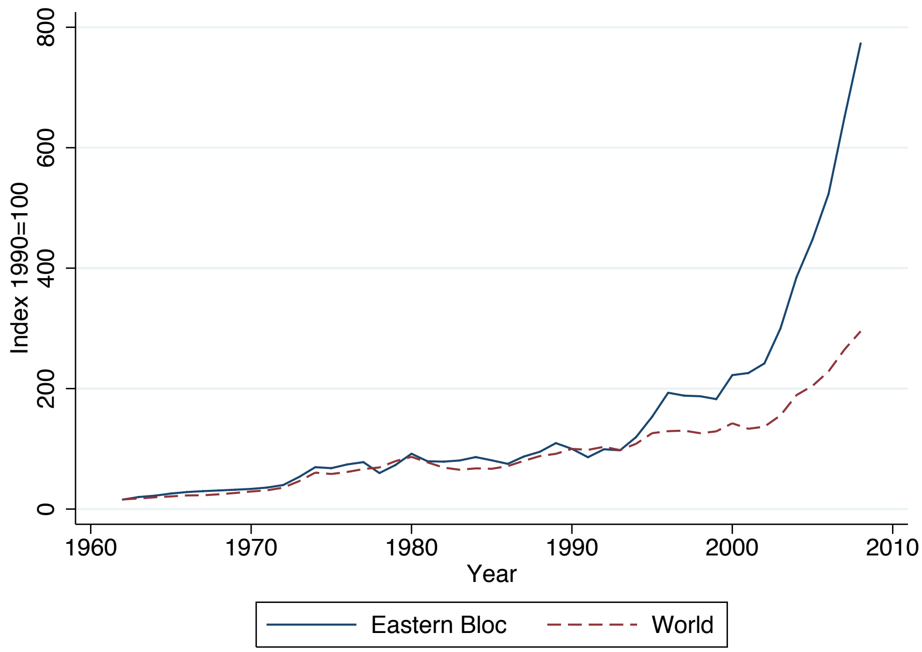
Notes: This table reports the percentage welfare changes. Column 1 reports the welfare impact of reducing the iceberg trade costs between West European countries from their 1960s's levels to their 2000s levels. Column 2 reports the welfare gains from trade relative to complete autarky. Column 3 reports the welfare gains from trading with EU East European countries. Column 4 reports the gains from trading with non-EU East European countries, conditional on already trading with EU East European countries. Column 5 reports the welfare impact of observed productivity growth and capital accumulation in Eastern Europe between the 1990s and the 2000s.

Table 7. Welfare Gains in Western and Eastern Europe, No Factor Reallocation

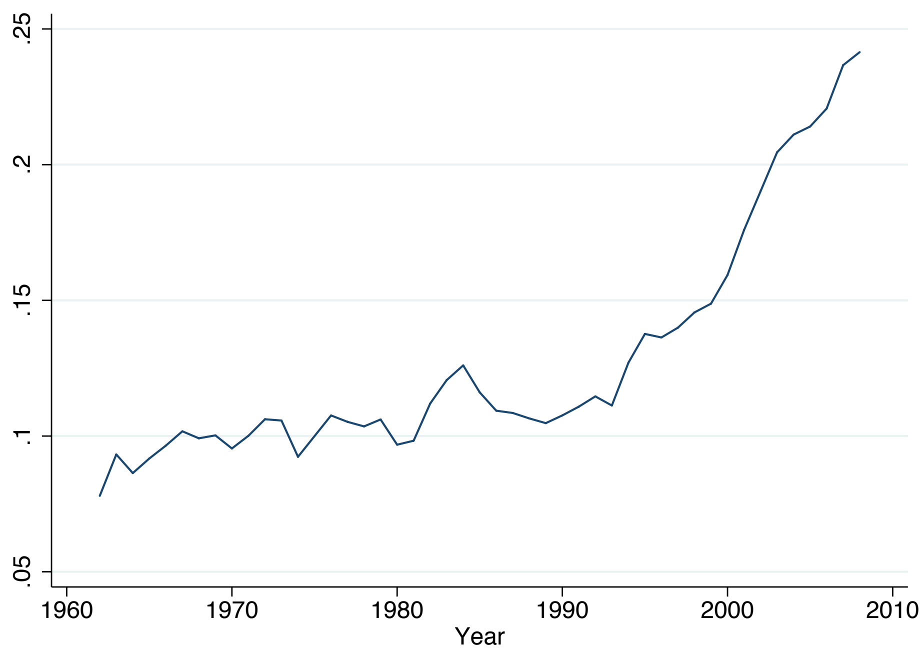
West	Δ Welfare	East	Δ Welfare
Austria	0.388 %	Bulgaria	10.566 %
Belgium-Luxembourg	0.119 %	Czech Republic	6.033 %
Denmark	0.170 %	Estonia	17.251 %
Finland	0.240 %	Hungary	7.860 %
France	0.074 %	Kazakhstan	6.777 %
Germany	0.213 %	Latvia	11.931 %
Greece	0.136 %	Lithuania	8.911 %
Iceland	0.180 %	Macedonia, FYR	8.733 %
Ireland	0.157 %	Poland	3.891 %
Italy	0.126 %	Romania	6.848 %
Netherlands	0.120 %	Russian Federation	2.349 %
Norway	0.100 %	Slovak Republic	8.053 %
Portugal	0.024 %	Slovenia	6.702 %
Spain	0.058 %	Ukraine	5.263 %
Sweden	0.170 %		
Switzerland	0.079 %		
United Kingdom	0.066 %		
Mean	0.142 %		7.941 %

Notes: This table reports the percentage changes in welfare due to the trade integration of Eastern Europe, under the assumption that factors of production cannot reallocate across sectors. It starts with the counterfactual scenario in which each and every East European country is in autarky, and lowers the trade costs to their levels as of the 2000s, but assuming that factors cannot reallocate across sectors from their counterfactual values.

Figure 1. International Trade in Eastern Europe, 1962-2007



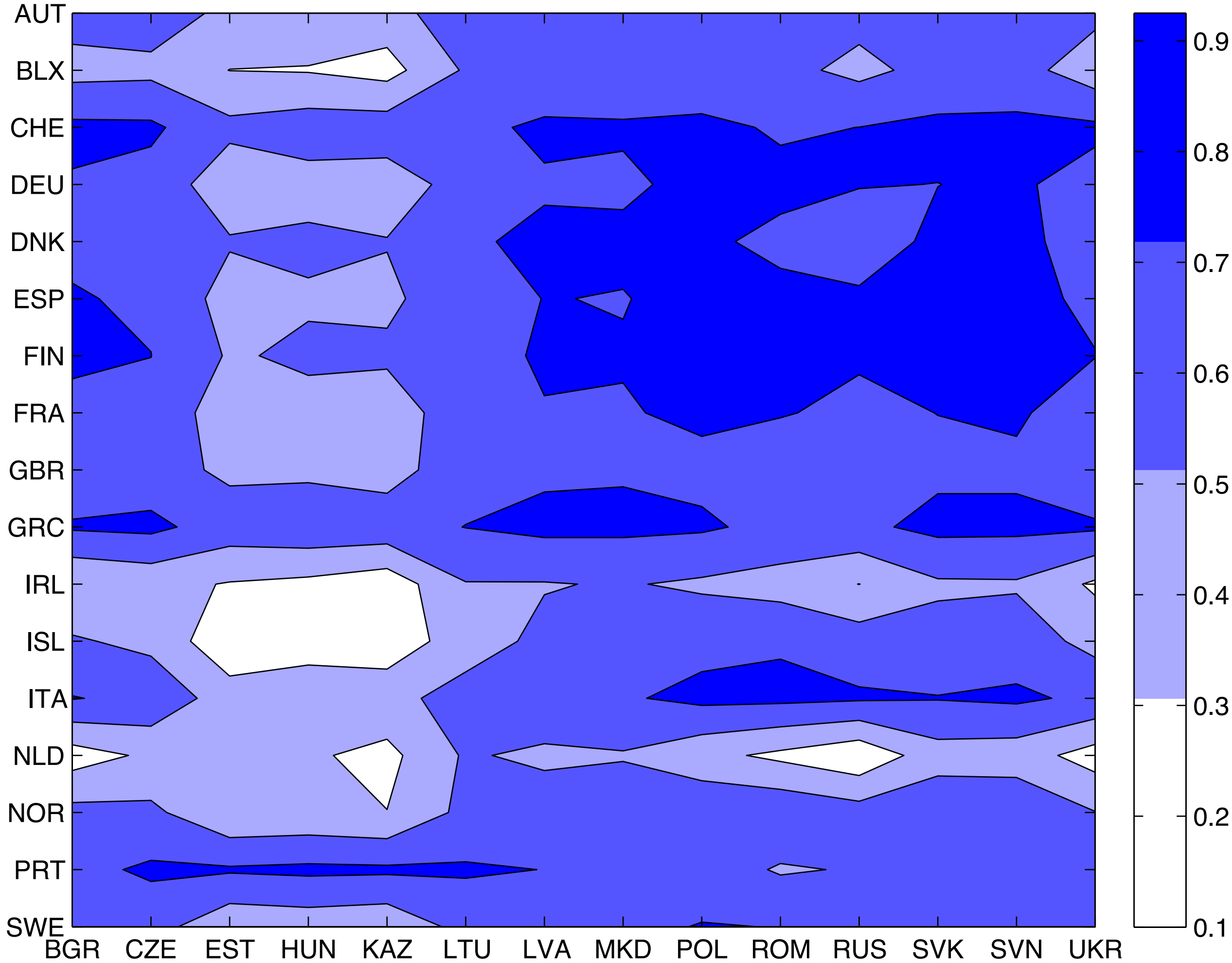
(a) East European and World Trade, Index Number, 1990=100



(b) Share of Imports from Eastern Europe in Total West European Imports

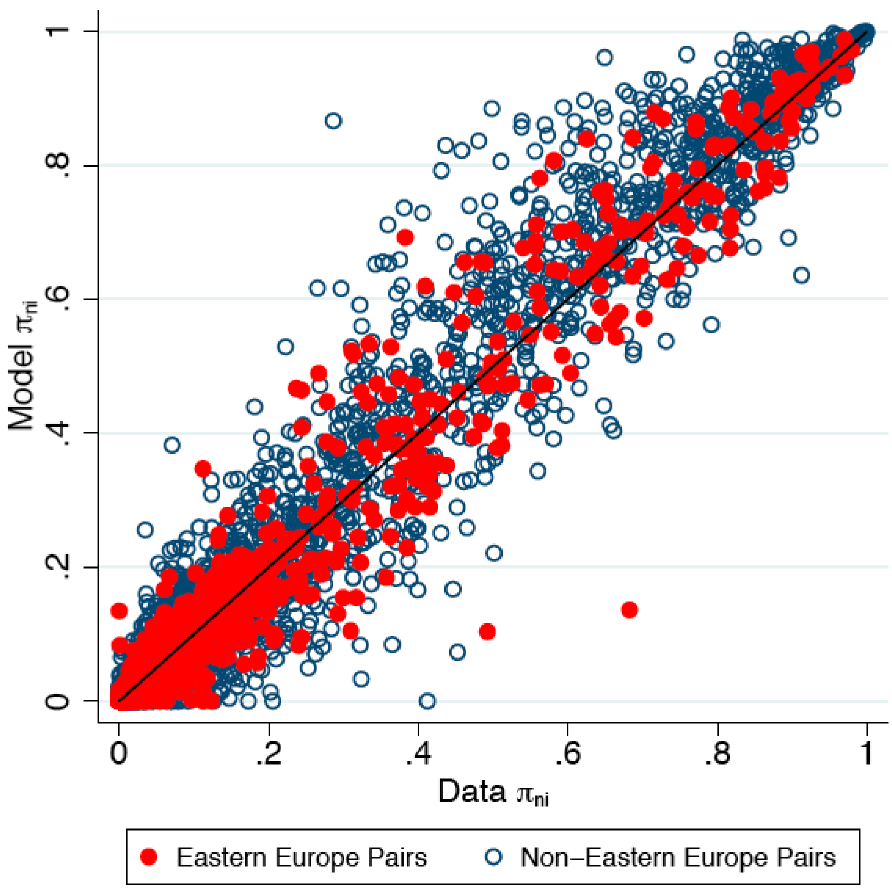
Notes: Figure 1(a) plots the total real (inflation-adjusted) exports from Eastern Europe (solid line), and the total real (inflation-adjusted) world exports (dashed line), for the period 1962-2007. Both series are normalized such that the 1990 value equals 100. Figure 1(b) plots the share of imports coming from Eastern Europe in the total imports of Western Europe from the rest of the world, 1962-2007.

Figure 2. Sectoral Similarity, Contour Plot



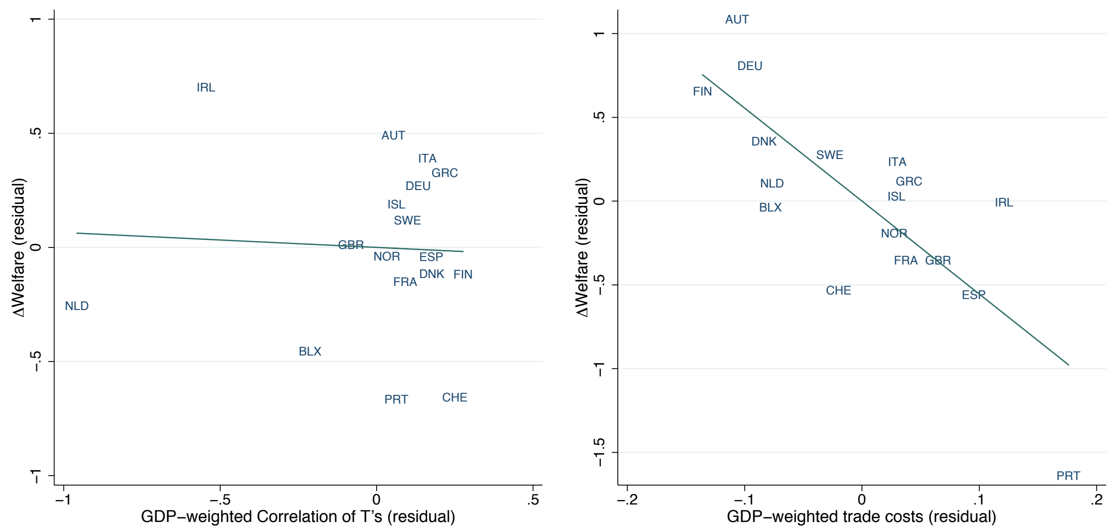
Notes: This figure displays the contour plot of sectoral T_n^j correlations between West European countries (rows) and East European countries (columns). Darker shades indicate higher correlations.

Figure 3. Benchmark Model vs. Data: π^j_{ni} for Eastern Europe and the Rest of the Sample

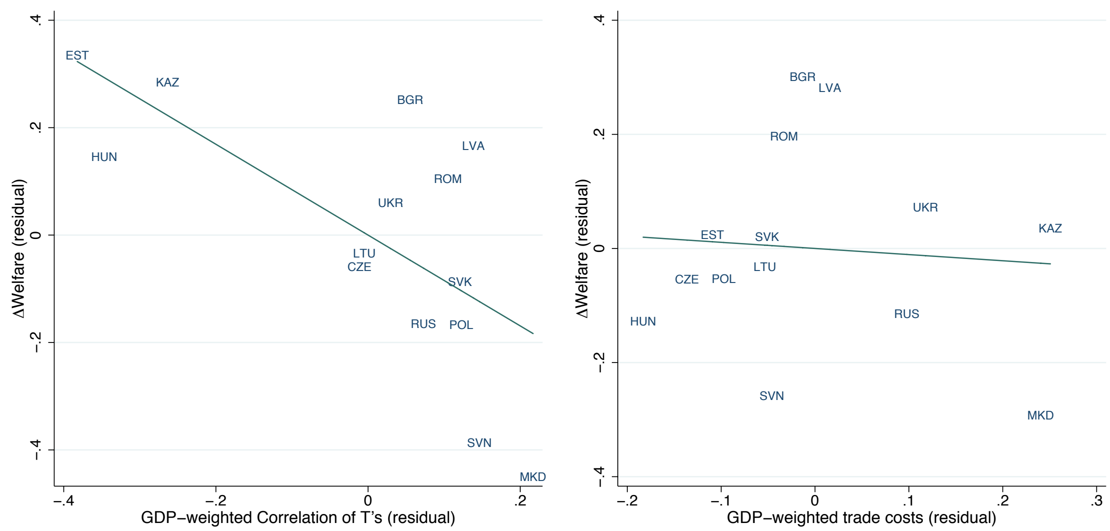


Notes: This figure displays the model-implied values of π^j_{ni} on the y-axis against the values of π^j_{ni} in the data on the x-axis, where π^j_{ni} is defined as the share of spending on goods produced in country i in total sector j spending in country n (see equation 6). Solid red dots depict π^j_{ni} in which either n or i is an East European country. Hollow dots represent the non-Eastern Europe π^j_{ni}'s. The line through the points is the 45-degree line.

Figure 4. Welfare Gains, Similarity, and Trade Costs



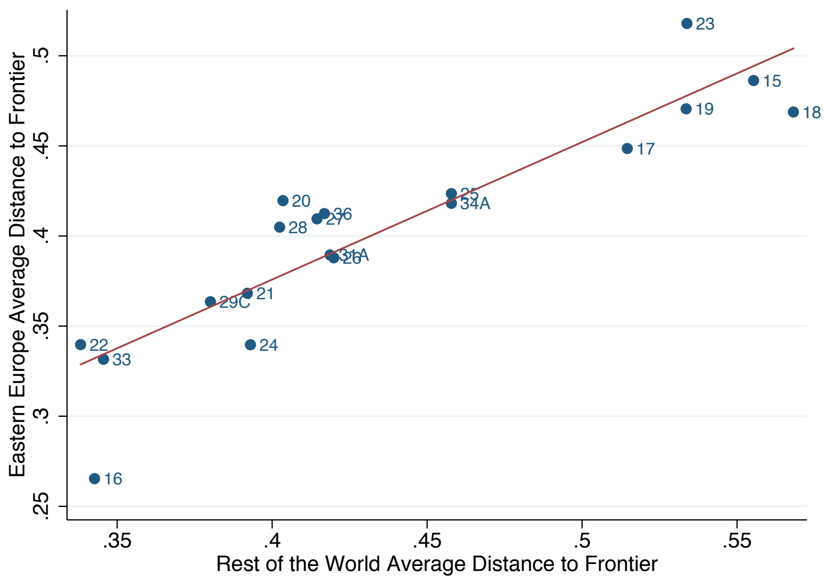
(a) Western Europe



(b) Eastern Europe

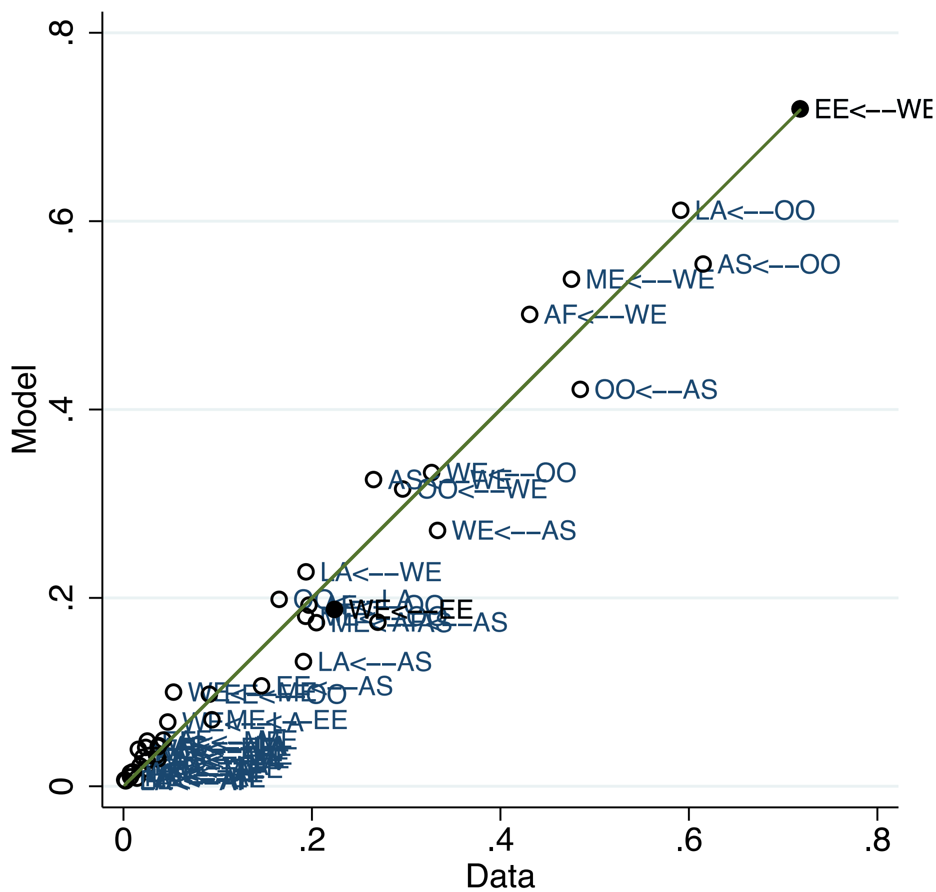
Notes: This figure plots the partial correlations between log welfare gains from European integration and the log GDP-weighted sectoral similarity (left graph), after netting out trade costs and total country GDP, and the partial correlation between log welfare gains from European integration and the log GDP-weighted trade costs, after netting out sectoral similarity and total country GDP (right graph). The top panel depicts these relationships for Western Europe, the bottom panel for Eastern Europe.

Figure 5. Eastern Europe and Rest of the World Average Comparative Advantage



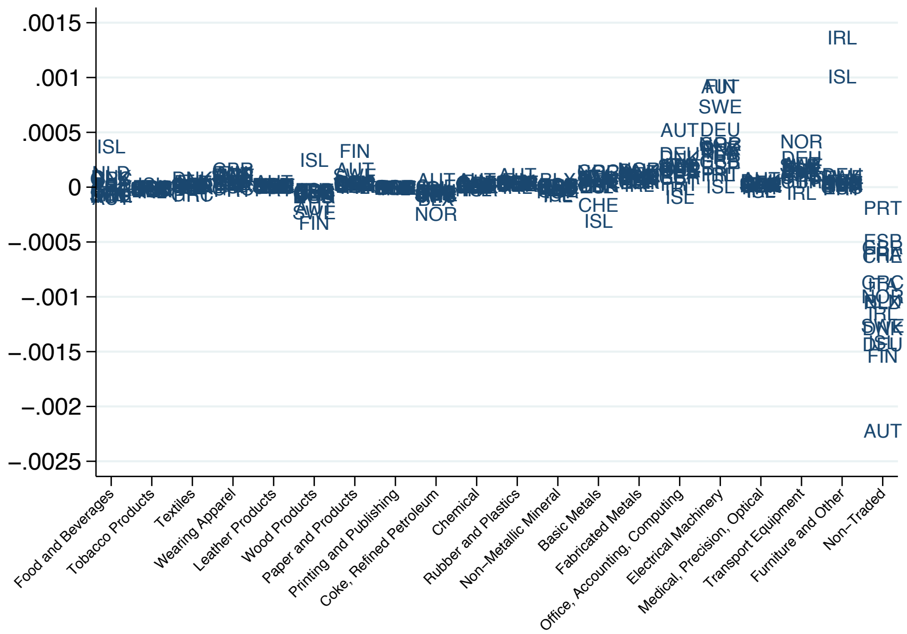
Notes: This figure displays the average distance to the global frontier in each sector for Eastern Europe (y-axis) against the simple average of the distance to frontier in that sector in the world excluding Western and Eastern Europe. The key for sector labels is reported in Table A2.

Figure 6. Shares of Manufacturing Imports: Model vs. Data

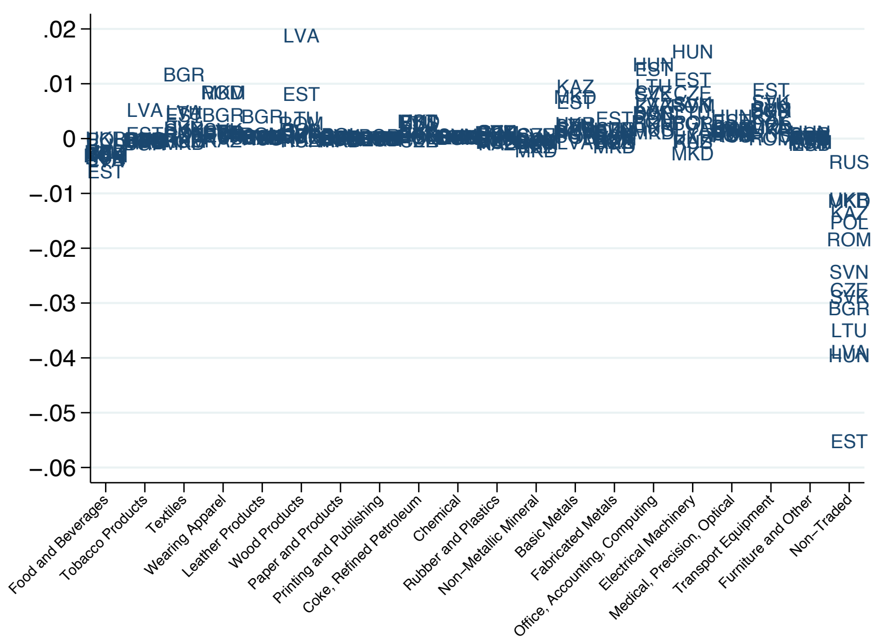


Notes: This Figure displays the scatterplot of the share of manufacturing imports from each region to each region in the data (x-axis) against the model (y-axis). For convenience, a 45-degree line is added to the plot. Data labels: WE=Western Europe; EE=Eastern Europe; OO=non-Europe OECD countries; LA=Latin America and the Caribbean; ME=Middle East and North Africa; AS=East and South Asia; AF=Sub-Saharan Africa. The first label represents the importing region, the second label the exporting region (thus, WE←EE is the share of West European imports coming from Eastern Europe).

Figure 7. Changes in Sectoral Composition: Shares of Value Added



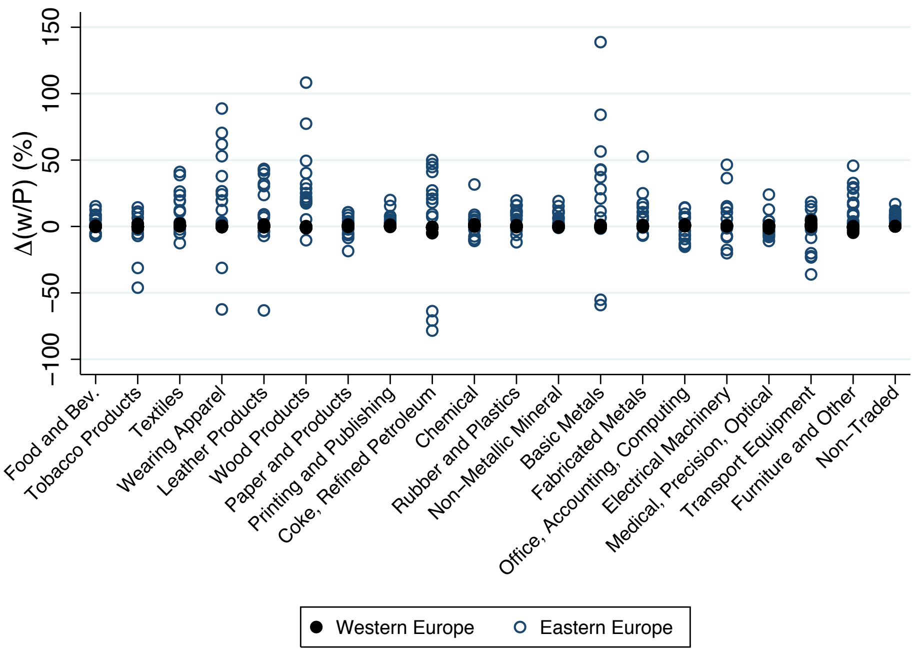
(a) Western Europe



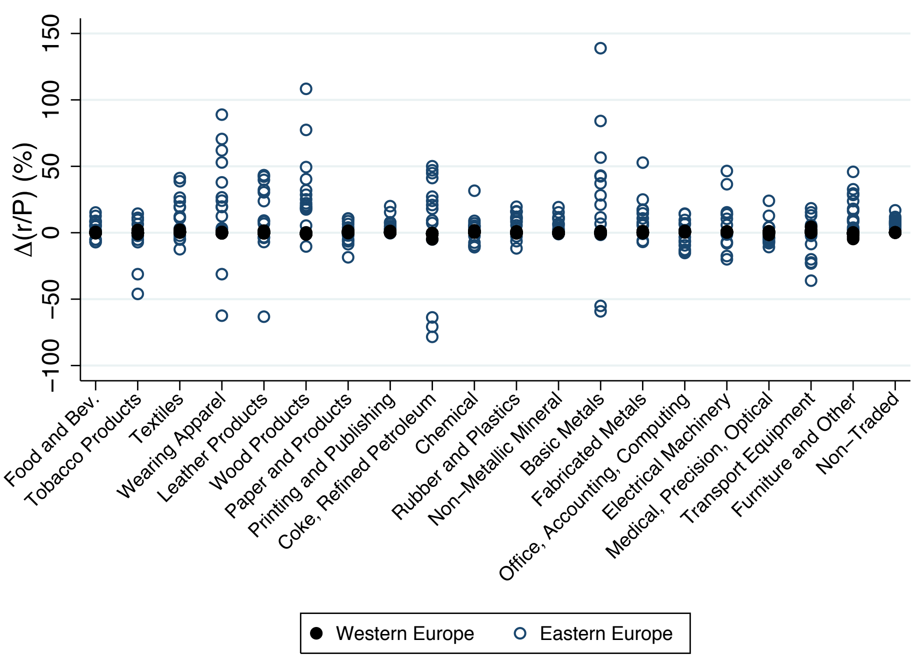
(b) Eastern Europe

Notes: This figure displays the absolute changes in the shares of value added when Eastern Europe opens to trade, for each sector and each West European country (top panel) and each East European country (bottom panel).

Figure 8. Changes in Real Wages and Return to Capital, No Factor Reallocation



(a) Real Wages



(b) Real Return to Capital

Notes: This figure displays the scatterplots of the changes in real wages (top panel) and real returns to capital (bottom panel) in each sector and each country when Eastern Europe opens to trade but factors cannot reallocate across sectors.

Table A1. Country Coverage

West European		East European	
Austria	Greece	Bulgaria	Macedonia FYR
Belgium-Luxembourg	Ireland	Czech Republic	Poland
Switzerland	Iceland	Estonia	Romania
Germany	Italy	Hungary	Russian Federation
Denmark	Netherlands	Kazakhstan	Slovak Republic
Spain	Norway	Lithuania	Slovenia
Finland	Portugal	Latvia	Ukraine
France	Sweden		
United Kingdom			
Rest of World			
United States	Costa Rica	Jordan	Philippines
Canada	Ecuador	Kuwait	Thailand
Japan	El Salvador	Saudi Arabia	Vietnam
Turkey	Guatemala	Egypt Arab Rep.	Ethiopia
Australia	Honduras	Bangladesh	Ghana
New Zealand	Mexico	Sri Lanka	Kenya
South Africa	Peru	Taiwan Province of China	Mauritius
Argentina	Uruguay	India	Nigeria
Bolivia	Venezuela RB	Indonesia	Senegal
Brazil	Trinidad and Tobago	Korea Rep.	Tanzania
Chile	Iran Islamic Rep.	Malaysia	Fiji
Colombia	Israel	Pakistan	China

Notes: This table reports the countries in the sample.

Table A2. Sectors

ISIC code	Sector Name	α_j	β_j	$\gamma_{J+1,j}$	ω_j
15	Food and Beverages	0.290	0.290	0.303	0.166
16	Tobacco Products	0.272	0.490	0.527	0.014
17	Textiles	0.444	0.368	0.295	0.019
18	Wearing Apparel, Fur	0.468	0.369	0.320	0.105
19	Leather, Leather Products, Footwear	0.469	0.350	0.330	0.014
20	Wood Products (Excl. Furniture)	0.455	0.368	0.288	0.008
21	Paper and Paper Products	0.351	0.341	0.407	0.012
22	Printing and Publishing	0.484	0.453	0.407	0.004
23	Coke, Refined Petroleum Products, Nuclear Fuel	0.248	0.246	0.246	0.175
24	Chemical and Chemical Products	0.297	0.368	0.479	0.009
25	Rubber and Plastics Products	0.366	0.375	0.350	0.013
26	Non-Metallic Mineral Products	0.350	0.448	0.499	0.070
27	Basic Metals	0.345	0.298	0.451	0.002
28	Fabricated Metal Products	0.424	0.387	0.364	0.012
29C	Office, Accounting, Computing, and Other Machinery	0.481	0.381	0.388	0.062
31A	Electrical Machinery, Communication Equipment	0.369	0.368	0.416	0.028
33	Medical, Precision, and Optical Instruments	0.451	0.428	0.441	0.041
34A	Transport Equipment	0.437	0.329	0.286	0.179
36	Furniture and Other Manufacturing	0.447	0.396	0.397	0.066
4A	Nontradeables	0.561	0.651	0.788	
	Mean	0.414	0.393	0.399	0.053
	Min	0.244	0.243	0.246	0.002
	Max	0.561	0.651	0.788	0.209

Notes: This table reports the sectors used in the analysis. The classification corresponds to the ISIC Revision 3 2-digit, aggregated further due to data availability. α_j is the value-added based labor intensity; β_j is the share of value added in total output; $\gamma_{J+1,j}$ is the share of nontradeable inputs in total intermediate inputs; ω_j is the taste parameter for tradeable sector j, estimated using the procedure described in Section A.3. Variable definitions and sources are described in detail in the text.