Welfare gains from EU enlargement: a trade perspective

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Abstract

In this paper I attempt to quantify the welfare gains of the 2004 EU enlargement from a trade perspective both for incumbents and for new members. I build a multi-sector Ricardian model, allowing for linkages across sectors. Within the model, I compare the welfare changes for 23 countries between 2003 and 2006. I find that new entrants gained significantly more than old members from enlargement. However, the overall changes in real income are rather small, measured in single digits for new entrants and fractions of a percent for old members. I also break down total gains by source and find that allowing for interconnectedness across sectors amplifies the changes in welfare. Overall the model predicts a strong link between trade openness and welfare and fares pretty well when compared to the data.

Keywords: EU enlargement, Ricardian Model, structural estimates, welfare gains, multi-sector, calibration

JEL classification: F11, F14, F15

1 Introduction

Outside of the fall of communism, European Union (EU) enlargement has been the most significant political and economical event in the European landscape. Over its almost seventy year life, the EU in its various forms has experienced several enlargement waves. All these waves were accompanied by promises of tighter integration and economic benefits. But were these promises based on reality or were they just a means to further a political goal? Most of the beneficial effects of EU enlargement are hard to quantify: institutional stability and modernization, economic growth etc. How much of the positive domestic changes are due to Western European influence and how much would have happened on its own? Moreover, most of these effects manifested slowly over a decade and a half.

There is however one area where the gains are more palpable: international trade. The reason is that trade measure usually can be pinned down to at an exact moment in time and usually have concrete results. This paper looks at the welfare gains of EU enlargement from a trade perspective. Specifically, I look at the 2004 enlargement wave when the European Union, then 15 members strong, gained an additional 10 members, most of them former Communist countries from Central and Eastern Europe (CEE).

Changes in welfare are defined as changes in real income between the two points in time considered. While real income is typically available in the data or can be computed with relative ease, the exact source of gains is difficult, if not outright impossible to pin point outside of a model, based on data alone. As a result I adopt and adapt the model developed by Caliendo and Parro (2011), CP from now on. The model is a multi-sector version of the basic multi-country Ricardian model of Eaton and Kortum (2002), henceforth EK. The key feature of the model is that it allows for linkages across sectors within a country: the output of one sector is used as an input in other sectors based on the input-output tables of the economy. The inclusion of linkages between sectors amplifies the gains from trade liberalization by multiplying the channels through which gains are realized: a fall in the price of goods in sector j has an effect on the price of all goods. My paper relates to a growing literature of multi-sector extensions to the basic EK model. See, for instance, Kerr (2009), Burstein and Vogel (2010), Chor (2010), Donaldson (2010) or Costinot et al. (2012).

From a trade point of view the 2004 enlargement wave can be viewed at as a natural experiment. By that time, all traditional trade barriers (quantitative restrictions, rules of origin, tariffs) between the EU and CEE countries and between CEE countries themselves had been abolished or harmonized in previous trade liberalization episodes. As a result, the main trade effect of EU enlargement was a fall in trade costs due to the abolitions of border controls. As trade costs cannot be directly measured, I estimate them before and after enlargement based on the method in Novy (2012). The framework I am using is that of a computable general equilibrium. Using pre-enlargement trade costs and data I solve the model. I then plug the post-enlargement estimated trade costs in the model and observe how key variables change. Based on these differences I compute the total welfare changes.

Based on the existing literature[1], I have several expectations about the results: small countries, both incumbents and new members, will benefit more (the Casella (1996) effect and in CP the gains can be ranked by the country's economic size); the effect in new countries will be an order of magnitude higher than for old countries. However, the total effect is likely to be small, a few percentages points, for the new entrants. This is due to the fact that trade liberalization measures usually do not entail significant gains, amplified by the fact that in the case I consider, the fall in trade costs is small and the time frame considered is limited.

The results are in line with expectations: Gains are quite small, all of them below 6%. New entrants gained more than incumbents several times over. There appreas to be no link between country size and economic gains and geographical proximity seems to play no role.

The rest of the paper is organized as follows: section 2 presents some facts about the 2004 EU enlargement, section 3 describes the theoretical model used, section 4 present the identification and calibration strategy necessary to solve the model, section 5 describes the data used, section 6 presents the results, section 7 concludes.

2 EU Enlargement

On May 1^{st} 2004, eight Central and Eastern European (CEE) Countries, Estonia, Hungary, Latvia, Lithuania, Poland, Slovakia, Slovenia and the Czech Republic along with Cyprus and Malta joined the European Union. This has been the largest enlargement to date. While, initially European integration started as a process to avoid another large scale European conflict, the focus has shifted towards economic integration, especially in recent years.

EU Enlargement is not just a political process but also an economic one with deep implications. The degree of the economic impact of enlargement depends crucially on the degree of economic integration. The countries joining the EU in 2004 entered the highest degree of economic integration: the single market with the eventual prospective of adopting a single currency.

While normally trade liberalizations episodes involve tariff reduction this was not the case for the 2004 EU enlargement wave. Since 1997 there have been no tariffs on imports from CEE into EU15 and since 2002 none to CEE from EU15, except for agriculture Breuss (2001). This policy was the result of the European agreements and the interim agreements in the early 1990s: CEFTA (Central European Free Trade Agreement) in 1993 and BAFTA (Baltic Area Free Trade Agreement) in 1994. Concomitantly, traditional

[1] See for instance Klenow and Rodríguez-Clare. (1997), Arkolakis et al. (2008), Waugh (2010), Blalock and Gertler (2008), Mohler (2009)

trade barriers (tariffs, quantitative restrictions, rules of origin) had been also abolished between the CEE countries themselves through various bilateral agreements.

As a result, the main trade effect of enlargement was the abolition of customs control. Before enlargement, lengthy border controls hindered trade, adding to the overall trade costs. While these costs are very real, their effect is indirect and quite hard to quantify. As customs controls were abolished only for land transport (Hornok, 2011), for the rest of the paper I will focus on CEE countries, as Malta and Cyprus saw no significant reduction in trade costs as a result of enlargement.

One distinctive trait of EU enlargement as opposed to other forms of trade liberalization is that it takes place among highly diverse members in terms of economic size. This has been true for all EU enlargement waves including the 2004 one: in 2003 per capita GDP in new members was just 46% of that in incumbent EU members[2]. The same was true for labor productivity (Breuss, 2001).

As borders open up, trade costs will fall making goods that had until than been unaffordable due to high trade costs, more appealing. This increased competitive pressure will make some importers switch suppliers, choosing the cheapest ones available under the new market conditions. While there will likely be shifts of bilateral trade flows among all countries, the most important effect will be on the share of expenditure devoted to domestic production. The fall in trade costs between countries i and n will make it more profitable for country n to import some goods from country i than to consume the goods produced domestically, as country i enjoys a comparative advantage in producing these goods and vice-versa. However, as new countries are much smaller than the old ones it is most likely that their effect on old members was not very significant.

3 Theoretical Model

The framework of this paper is a multi sector Ricardian model similar to the one employed by CP. Unlike the more standard general equilibrium models, Ricardian models assumes that the main motive for trade are not the love of variety and increasing returns to scale, but technological differences between countries. The main advantage of these models, first pioneered by EK, is that they allow for more analytical flexibility and can provide more insight in the mechanism underpinning the model.

Let the world consist of N countries and within each country n=1. . . N. There are J sector, both traded and non-traded. Within each sector, output is produced by a combination of labor and an intermediary good, q. Labor is assumed to be immobile across countries, but mobile across sectors within the country. Like in all multi sector models, trade is unbalanced sector by sector. I further allow trade to be unbalanced at the country level. Let S_n be the net trade surplus of country n.

[2]Based on World Bank data adjusted for purchasing power parity and constant prices

In each sector there is a continuum of goods, ω^j. Each country has a different level of efficiency in the production of each good in each sector. Let $x_i^j(\omega^j)$ denote the efficiency of producing good ω^jin sector j in country i and let γ_i^k>0 be the amount of intermediary goods from sector k used to produce the composite good in country i. The production function for good ω^j is:

$$y_i^j\left(\omega^j\right) = x_i^j\left(\omega^j\right)\left(l_i\right)^{\beta_i^j}\left(\prod_{k=1}^{J}\left(m_i^k\right)^{\gamma_i^k}\right)^{1-\beta_i^j} \tag{1}$$

where $\beta_i^j$is the share of labor in country i. Denote c_i^j the cost of inputs for producing in sector j in country i. Let p_i^k be the cost of good k in country i. Then the cost of the input bundle is

$$c_i^j = \Upsilon_i^j w_i^{\beta_i^j}\left[\prod_{k=1}^{J}\left(p_i^k\right)^{\gamma_i^k}\right]^{1-\beta_i^j} \tag{2}$$

Trade between countries is subject to frictions. International shipments between countries i and n are subject to iceberg transport cost τ_{in}^j, which are allowed to be sector specific. These imply that in order for a quantity of 1 good j to arrive in country n from country i, a shipment of τ_{in}^j must be sent.

Following EK, in each sector I assume a probabilistic representation of technology. Let country i's efficiency in producing good ω^j be drawn from the country-sector specific distribution $F_i^j(x)$. Distributions are assumed to be independent across countries and sectors. Using the law of large numbers this implies that $F_i^j(x)$ is also the fraction of goods for which the efficiency of country i in sector j is below **x**. Let productivities follow a type II extreme distribution:

$$F_i^j(x) = \exp\left(\left(-x\right)^{-\theta} T_i^j\right) \tag{3}$$

This representation allows for a parsimonious representation of the state of the world and technology: T_i^j is a parameter shifting the location of the distribution and θ is a technology parameter common to all countries. Specifically, it refers to the dispersion of productivities across goods. That is, a high value of θ implies a higher level of average productivity. Production is constant returns to scale so goods are priced at their unit cost: $c_i/x_i^j(\omega^j)$. Therefore, the price in country n of a good from sector j produced in country i is:

$$p_{ni}^j(\omega^j) = \frac{c_i^j \tau_{ni}^j}{x_i^j(\omega^j)} \tag{4}$$

On the consumer side, households maximize a Cobb-Douglass utility across sectors subject to the budget constraint. The only source of revenue for households is the wage. Formally, households in country n maximize the following two-tier utility function:

$$U\left(C_n\right) = \textstyle\prod_{j=1}^{J}\left(C_n^j\right)^{\alpha_n^j}$$
$$C_n^j = \left[\int_0^1 u\left(\omega^j\right)^{(\sigma_j-1)/\sigma_j} du\right]^{(\sigma_j-1)/\sigma_j}$$

subject to

$$\sum_{j=1}^{J} p_n^j C_n^j = w_n L_n - S_n$$

where α_n^j is the share of sector j in the consumption of country n, w_n is the wage in country n and p_n^j is the price index of sector j goods in country n, to be defined later.

What sets apart Ricardian models is that consumers in country n search across all sources for good j and purchase only from the cheapest location. Let $p_n^j(\omega^j)$, the price of good ω^j in country n, be defined:

$$p_n^j\left(\omega^j\right) = \min\left\{p_{ni}^j\left(\omega^j\right), i = 1...N\right\} \tag{5}$$

As proven in EK or Alvarez and Lucas (2007), the distribution of the prices follows the distribution of the underlying productivity and it can be shown that the price index of sector j in country n is given by

$$p_n^j = A^j \left[\sum_i T_i^j \left[\tau_{ni}^j c_i^j\right]^{-\theta}\right]^{\frac{1}{\theta}} \tag{6}$$

where A^j is a sector-specific constant. Let π_{in}^j be the share of goods in sector j that country n imports from country i. Following the steps in CP, it can be shown that the share are given by:

$$\pi_{ni}^j = \frac{X_{ni}^j}{X_i^j} = \frac{\left(c_i^j \tau_{ni}^j\right)^{-\theta} T_i^j}{\sum_{i=1}^{N} \left(c_i^j \tau_{ni}^j\right)^{-\theta} T_i^j} \tag{7}$$

where X_{ni}^j is the expenditure of country n on sector j goods from country i and let X_n^j denote the expenditure of country n on sector j. Expenditure in sector j is given by the sum of household expenditure and firm demand in that sector to be used as intermediary in the other sectors of the economy.

$$X_n^j = \sum_{k=1}^{J} \left[\gamma_n^j \left(1 - \beta_n^j\right) \sum_{i=1}^{N} \pi_{in}^k X_i^k\right] + \alpha_n^j \left(w_n L_n - S_n\right) \tag{8}$$

The budget condition for each country implies:

$$\sum_{j=1}^{J} X_n^j + S_n = \sum_{j=1}^{J} \sum_{i=1}^{N} \pi_{in}^j X_i^j \tag{9}$$

4 Solving for the General equilibrium:

Definition 1: *For a given trade cost structure, τ, an equilibrium is a vector of wages, $\boldsymbol{w}$, and a vector of prices, $\boldsymbol{p}$, such that for every n and j, the following hold:*

$$p_n^j = A^j \left[\sum_i T_i^j \left[\tau_{ni}^j c_i^j\right]^{-\theta}\right]^{\frac{1}{\theta}} \tag{10}$$

$$c_i^j = \Upsilon_i w_i^{\beta_i^j} \left[\prod_{k=1}^{J} \left(p_i^k \right)^{\gamma_i^k} \right]^{1-\beta_i^j} \tag{11}$$

$$\pi_{ni}^j = \frac{X_{ni}^j}{X_i^j} = \frac{\left(c_i^j \tau_{ni}^j \right)^{-\theta_j} T_i^j}{\sum_{i=1}^{N} \left(c_i^j \tau_{ni}^j \right)^{-\theta_j} T_i^j} \tag{12}$$

$$X_n^j = \sum_{k=1}^{J} \left[\gamma_n^j \left(1 - \beta_n^j \right) \sum_{i=1}^{N} \pi_{in}^k X_i^k \right] + \alpha_n^j \left(w_n L_n - S_n \right) \tag{13}$$

$$\sum_{j=1}^{J} X_n^j + S_n = \sum_{j=1}^{J} \sum_{i=1}^{N} \pi_{in}^k X_i^j \tag{14}$$

Let τ' be a different trade cost structure and let **p'** and **w'** denote the equilibrium solutions under τ'. Assuming that S_n is constant, the equilibrium conditions under the new structure will be:

$$p_n^{j'} = A^j \left[\sum_i \left[\tau_{ni}^{j'} c_i^{j'} \right]^{-\theta} T_i^j \right]^{-\frac{1}{\theta}} \tag{15}$$

$$c_i^{j'} = \Upsilon_i w_i^{'\beta_i^j} \left[\prod_{k=1}^{J} \left(p_i^{k'} \right)^{\gamma_i^k} \right]^{1-\beta_i^j} \tag{16}$$

$$\pi_{ni}^{j'} = \frac{\left(c_i^{j'} \tau_{ni}^{j'} \right)^{-\theta} T_i^j}{\sum_{i=1}^{N} \left(c_i^{j'} \tau_{ni}^{j'} \right)^{-\theta} T_i^j} \tag{17}$$

$$X_n^{j'} = \sum_{k=1}^{J} \left[\gamma_n^j \left(1 - \beta_n^j \right) \sum_{i=1}^{N} \pi_{in}^{k'} X_i^{k'} \right] + \alpha_n^j \left(w_n' L_n - S_n \right) \tag{18}$$

$$\sum_{j=1}^{J} X_n^{j'} + S_n = \sum_{j=1}^{J} \sum_{i=1}^{N} \pi_{in}^{j'} X_i^{'j} \tag{19}$$

Based on these two equilibria, I can compute the changes between them[3].

$$\widehat{p}_n^j = \left[\sum_i \pi_{ni}^j \left[\widehat{\tau}_{ni}^j \widehat{c}_i^j \right]^{-\theta} \right]^{-\frac{1}{\theta}} \tag{20}$$

[3]The mathematical proofs can be found in the technical appendix of Caliendro and Parro (2011)

$$\widehat{c}_i^j = \widehat{w}_i^{\beta_i^j} \left[\prod_k \left(\widehat{p}_i^k \right)^{\gamma_i^k} \right]^{1-\beta_i^j} \tag{21}$$

$$\widehat{\pi}_{ni}^j = \left(\frac{\widehat{c}_n}{\widehat{p}_n^j} \widehat{\tau}_{ni}^j \right)^{-\theta} \tag{22}$$

Total welfare gains are defined as the change in real income, $\hat{w}_n / \prod_{j=1}^J \hat{p}_n^j$, which can be derived as:

$$\ln \widehat{W}_n = -\sum_{j=1}^J \frac{\alpha_n^j}{\theta} \ln \widehat{\pi}_{jj} - \sum_{j=1}^J \frac{\alpha_n^j}{\theta} \tilde{\beta}_n \ln \widehat{\pi}_{jj} - \sum_{j=1}^J \alpha_n^j \tilde{\beta}_n \left(\ln \widehat{p}_n^j + \sum_{k=1}^J \gamma_n^k \ln \widehat{p}_n^k \right) \tag{23}$$

where $\tilde{\beta}_n = (1 - \beta_n) / \beta_n$, the first term represents the gains derived from the consumption of final goods, the second term represents gains derived from the consumption of intermediary goods and the third term represents price index effects.

5 Calibrating the model

While at a first it may seem that the model requires a staggering amount of data, all the parameters are readily available or can be easily computed from the data.

I assume N=24, representing the 15 EU old members, the 8 CEE new entrants and the rest of the world (ROW). I assume there are 15 tradable sectors and 11 non-tradable ones, corresponding to the tradable goods in the ISIC 3^{rd} revision classification. The list of sectors along with their classification codes can be found in table 1.

The share of labor in each country is defined as value added divided by total output. Accordingly, household income, $w_n L_n$, is equal to the value added. The share of expenditure on good j, α_n, is obtained by dividing expenditure on sector j by total expenditure. I define domestic trade shares for each commodity, π_{nn}^j, as one minus total imports divided by total expenditure. In each sector, total expenditure is defined as the sum of domestic output plus imports. While this is a rather imprecise measure, all attempts to adjust for exports resulted in some shares having impossible values: either negative or above unity. The shares of intermediate goods in the composite good are derived from the national input output matrices:

$$\gamma_n^j = \frac{\text{intermediate consumption of good j}}{\text{total intermediate consumption}} \tag{24}$$

Trade costs are notoriously difficult to estimate and over the years a very large literature has developed aimed at investigating them. See Anderson and Van Wincoop (2004) for a review of the literature. In estimating trade costs I follow the approach used in Chen and Novy (2009) in and also used in Hornok (2011), for instance. While their approach

Table 1: Sector classification along with NACE classifiation

Sector	**Code**
AGRICULTURE, HUNTING, FORESTRY AND FISHING	AtB
MINING AND QUARRYING	C
FOOD , BEVERAGES AND TOBACCO	15t16
TEXTILES, TEXTILE , LEATHER AND FOOTWEAR	17t19
WOOD AND OF WOOD AND CORK	20
PULP, PAPER, PAPER , PRINTING AND PUBLISHING	21t22
COKE, REFINED PETROLEUM AND NUCLEAR FUEL	23
CHEMICALS AND CHEMICAL	24
RUBBER AND PLASTICS	25
OTHER NON-METALLIC MINERAL	26
BASIC METALS AND FABRICATED METAL	27t28
MACHINERY, NEC	29
ELECTRICAL AND OPTICAL EQUIPMENT	30t33
TRANSPORT EQUIPMENT	34t35
MANUFACTURING NEC; RECYCLING	36t37
ELECTRICITY, GAS AND WATER SUPPLY	E
CONSTRUCTION	F
WHOLESALE AND RETAIL TRADE	G
HOTELS AND RESTAURANTS	H
TRANSPORT AND STORAGE AND COMMUNICATION	I
FINANCIAL INTERMEDIATION	J
REAL ESTATE, RENTING AND BUSINESS ACTIVITIES	K
PUBLIC ADMIN AND DEFENCE; COMPULSORY SOCIAL SECURITY	L
EDUCATION	M
HEALTH AND SOCIAL WORK	N
OTHER COMMUNITY, SOCIAL AND PERSONAL SERVICES	O

is developed in the context of a new-trade monopolistic competition model, the same index can be derived in my model as the resulting gravity equations are similar. From equation (12), if I multiply the bilateral trade shares of countries i and n in commodity j and divide them by both their domestic shares I get

$$\frac{\pi_{ni}^{j}\pi_{in}^{j}}{\pi_{nn}^{j}\pi_{ii}^{j}} = \frac{X_{ni}^{j}}{X_{n}^{j}}\frac{X_{in}^{j}}{X_{i}^{j}} \Bigg/ \frac{X_{nn}^{j}}{X_{n}^{j}}\frac{X_{ii}^{j}}{X_{i}^{j}} = \left(c_{i}^{j}\tau_{ni}^{j}\right)^{-\theta} T_{i}^{j} \left(c_{n}^{j}\tau_{in}^{j}\right)^{-\theta} T_{n}^{j} \Bigg/ \left(c_{i}^{j}\right)^{-\theta} T_{i}^{j} \left(c_{n}^{j}\right)^{-\theta} T_{n}^{j} \tag{25}$$

Rearranging (25) , the average trade costs between i and n are given by

$$\Theta = \sqrt{\tau_{ni}^{j}\tau_{in}^{j}} = \left(\frac{\pi_{ni}^{j}\pi_{in}^{j}}{\pi_{nn}^{j}\pi_{ii}^{j}}\right)^{\frac{1}{2\theta}} \tag{26}$$

The above expression is computed for the two years under question: 2003 and 2006, yielding trade costs under the two regimes: τ and τ'.

For the model presented in this paper to be in equilibrium it must be such that equations (13) and (14) hold under trade costs τ. The two equations are a $\boldsymbol{N}$ **x** $\boldsymbol{J} + \boldsymbol{N}$ system of equations in $\boldsymbol{N}$ **x** $\boldsymbol{J} + \boldsymbol{N}$ unknowns: the expenditures of each country on each good and the aggregate trade surplus of each country, S_n. Once S_n are recovered, I can solve the model under the new trade cost structure. Rather than fully solve the model under the new trade cost structure one can just solve for the differences between them as these are the only necessary things to compute the welfare changes. That is, the system of equations (18), (19), (20), (21) and (22) form the system of equations to be solved.

First I guess a vector of values for $\widehat{\mathbf{w}}$. Then, given this guess, from (20) and (21), I solve for the vectors of changes in prices and changes in costs, which I plug in (22) and obtain the estimated change in the bilateral trade shares. Once I recover $\widehat{\pi}^j_{in}(\widehat{\mathrm{w}})$, I compute trade shares under the new cost structure $\pi'^j_{in}(\widehat{\mathrm{w}})$. Notice that (18) forms a linear identified system in $\boldsymbol{J}$ **x** $\boldsymbol{N}$ unknown expenditures. By defining $w'_n = \widehat{w}_n w_n$, the system can be solved based on the available data. Plugging the expenditures in (19), I check whether balanced budget holds. If it does not, I adjust the guess for $\widehat{\mathbf{w}}$ until it does.

5.1 Calibrating θ

As can easily be seen from (12), (17) or (22), θ is the key parameter governing trade flows. Given its importance finding a plausible calibration for the parameter is of paramount importance. While there have been several econometric attempts to recover the parameter of interest, there is no best method and the estimated coefficients vary wildly. EK alone propose three methodologies to recover it, although they yield different results.

First, having a random sample of the goods in the economy they compute the price index in each country. They compute the ratio of consumer prices between two countries for each good. This ratio will always be smaller than the trade cost for arbitrage reasons. They proxy trade cost by the second maximal ratio in order to alleviate measurement error. The intuition is that as the sample grows, the maximum ratio will hit the upper bound and provide a consistent estimate of the trade costs. Having all variables they recover θ by regressing the ratio of import shares to domestic trade shares on the price indices in two economies and the proxied trade costs.

Another method to recover θ they propose is based on wage data. Having obtained the estimated country fixed effect from the gravity equation, they regress it on R&D expenditure, human capital and wage data. The estimated value for the productivity dispersion is the wage coefficient. The third method they propose to estimate the parameter of interest is similar to the first one but relies on country fixed effect rather than estimated price indices. Their estimates range from 3.6 to 12 depending on the method and their preferred estimate is of 8.28.

Simonovska and Waugh (2011) criticize the methods of EK due to their severe small sample bias. Instead they propose a Simulated Method of Moments variant on the first approach of EK. Based on the gravity equation coefficients they simulate a large number of goods from which they draw a random sample to serve as their "observed prices" in order to construct the price index and proxy trade costs. The resulting coefficient is a much smaller estimate of 4.42.

Donaldson (2010) estimates θ by looking at salt trade in India. He argues that, as salt is only produced in a few locations, the differences in the price of salt across markets fully reflect trade frictions. His estimates are in the range 3.8 – 5.2. Head and Ries (2001) estimate the trade elasticity based on the gravity equation and direct measurements of trade barriers such as tariffs. Their estimates range between 5 and 10. This approach is appealing due to its simplicity. However, it is not without issues. They assume that the entire change in trade frictions is due to changes in tariffs. However, during a trade liberalization event both observed and unobserved trade barriers fall.

Another class of estimates is based on methods not involving the gravity equation of derivations of it. For instance, Bertand et al. (2003) or Eaton et al. (2011) estimate θ, using firm level sales data and obtain values in the range 3.6 – 4.8. Burstein and Vogel (2010)'s estimates based on skill intensity are 5.

Costinot et al. (2012) also use a form of the gravity equation to recover the trade elasticity in a multi-sector model without trade linkages. They argue that in a Ricardian world, firms are perfectly competitive and workers are paid their marginal product. Hence, the relative productivities across sectors and countries are fully reflected in the relative wages. They regress observed imports on the inverse of wages and fixed effects and recover the parameter of interest as the coefficient on wages.

CP use a similar approach to Head and Ries (2001) and rely on triple difference across countries in order to estimate sectoral θs. However, tariff data is usually only available for a handful of countries, typically developed ones. In my case, this makes no sense as tariffs had been mostly eliminated between the EU and CEE countries by the early 2000s. While their approach has the advantage of allowing productivity dispersion heterogeneity across sectors, their estimation strategy does not capture the interconnectedness of sectors in the model.

The above literature suggests that while the data provides a range of plausible values for θ, the exact value it takes depends on the model and the estimation method used. In this paper I choose to use the value preferred by Costinot et al. (2012) of 6,53 as there model shares quite a few properties with the model in this paper.

5.2 Data

Trade data

Trade data comes from the UN COMTRADE database. For each considered country, bilateral trade data with each other country was downloaded along with aggregate trade flows for 2003, 2004, 2005 and 2006. Data was classified at a 2 digit level according to SITC rev 3. In order to match output data, trade flows were aggregate 15 tradable sectors. In order to alleviate measurement error, I average estimated trade costs between 2002 and 2003 and 2005 and 2006 respectively, to obtain trade costs under the two different trade structures.

Domestic data

Output and Value added were taken from the EU KLEMS dataset, 2009 release. This dataset provides detailed annual information for 32 industries corresponding to the ISIC rev 3 classification for all EU25 countries along with several other developed countries. The advantage of this dataset is that as all the data were collected by the same institution, cross-country measurement differences are likely to be minimal. The data is collected at plant level and then aggregated at an industry level in a homogeneous way. In order to minimize the presence of zeros in my sample, I use a slightly broader classification resulting in 26 industries. I also downloaded the same data for 2002, 2005 and 2006 so that I could compute trade costs.

Research and development expenditure for 2003 was taken from the OECD STAN database. However, this data was not available for all countries[4].

Input-output tables for the 23 countries were taken from the EUROSTAT database. For all countries data was standardized according to NACE A60 or CPA P60 classification. This level proved to be too detailed for my purposes so I reclassified them into the 26 categories I used. Whenever possible I used 2003 data. When it was not available I chose the closest prior year.

Rest of the world

The ROW object is quite difficult to construct as worldwide detailed data is not available. As a result I defined the rest of the world as an aggregate composing of 22 non-EU countries: Australia, Argentina, Brazil, Bulgaria, Chile, China, India, Indonesia, Israel, Japan, South Korea, Mexico, New Zeeland, Norway, Romania, Russia, South Africa, Switzerland, Thailand, Turkey, the US and Vietnam. The parameters (expenditure share on European goods, share of labor, value added, and shares of sectors in total expenditure, share of intermediaries) were computed as the average or sum across these countries, depending on the parameter. This data was compiled from the OECD STAN dataset, although not all data was available for 2003 so I used the closest year available.

6 Results

Armed with the calibrated value of θ and the parameters obtained as described in section 5, I can proceed to estimate the welfare gains through equation (23). Table 2 and Figure 1 present the welfare gains from EU enlargement by country and broken down by source of gains. However, due to non-linear nature and high dimensionality of the system

[4]The Czech Republic, Denmark, Estonia, Latvia, Lithuania, Luxembourg and Sweden had no data available restricting my sample from 6578 to 3536 theoretically possible observations.

considered, the results are only approximate, although the approximation error should be small.

In the majority of cases, allowing for sectors to be interdependent amplifies the gains from trade. Accounting for the general equilibrium price effects increases the gains from liberalization, sometimes tenfold compared to the final good channel. The results are very much in line with those of CP who find that for NAFTA as well, intermediate goods play a strong role. However, in their case the price index, which they break down into two distinct components, has a net effect close to zero.

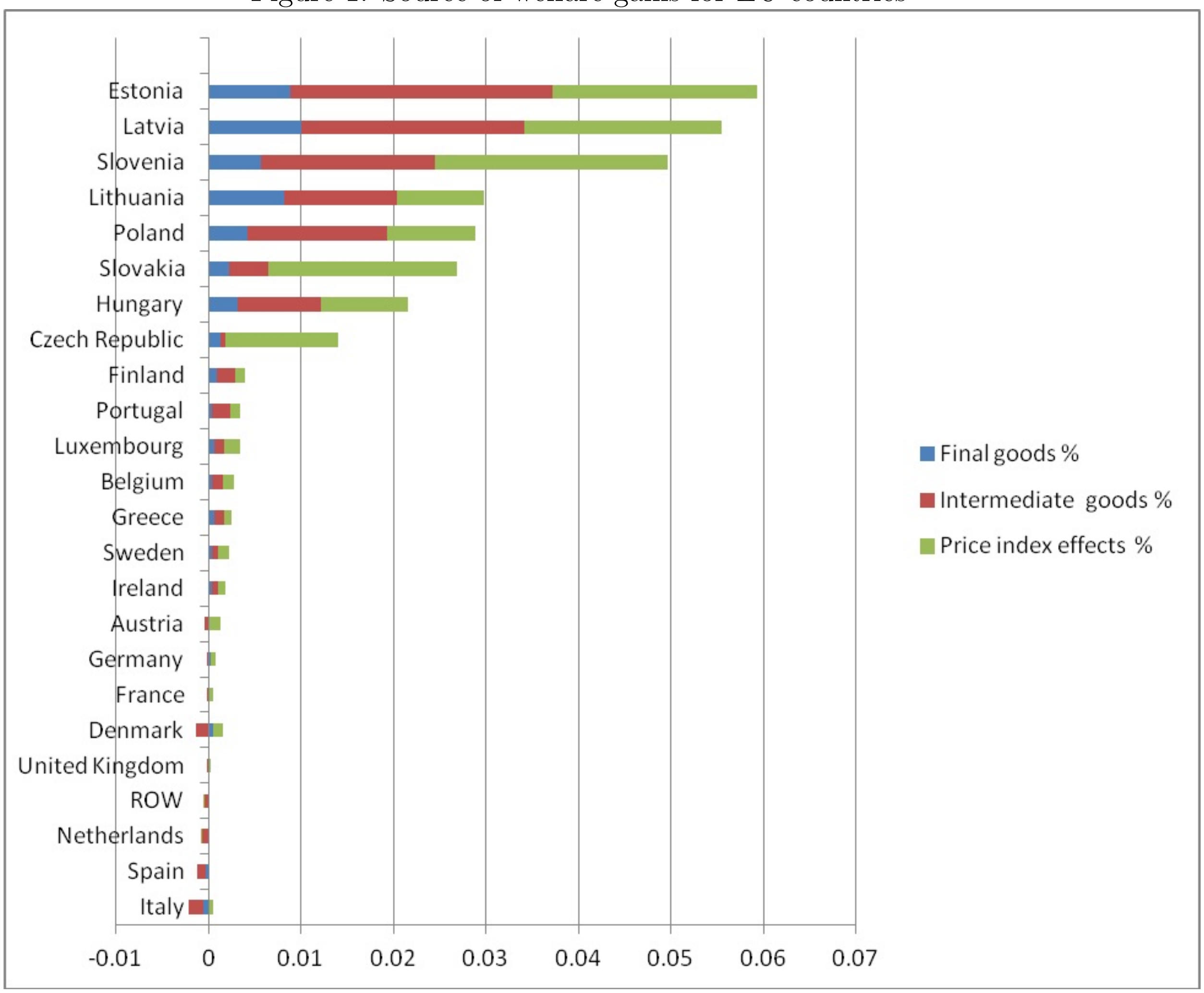
Table 2: Total gains from trade by country and source

	Total gains %	**Final goods %**	**Intermediate goods %**	**Price index effects%**
Austria	0.000981	9.00E-05	-0.00035	0.001239
Belgium	0.002816	0.000433	0.001164	0.00122
Czech Republic	0.014006	0.001377	0.000508	0.012121
Denmark	0.000235	0.000473	-0.0013	0.001064
Estonia	0.059325	0.008814	0.028426	0.022085
Finland	0.00391	0.000989	0.001855	0.001066
France	0.000407	0.000178	-7.53E-05	0.000304
Germany	0.000616	0.000268	-0.00013	0.000482
Greece	0.00256	0.000661	0.001064	0.000835
Hungary	0.021524	0.003173	0.00895	0.0094
Ireland	0.001784	0.000356	0.000701	0.000727
Italy	-0.00165	-0.00055	-0.00159	0.000491
Latvia	0.055487	0.010078	0.024032	0.021377
Lithuania	0.029823	0.008154	0.01223	0.009438
Luxembourg	0.003407	0.000639	0.001111	0.001657
Netherlands	-0.00059	7.24E-05	-0.0006	-6E-05
Poland	0.028816	0.004293	0.01497	0.009554
Portugal	0.003411	0.000448	0.001911	0.001052
Slovakia	0.026811	0.002284	0.00422	0.020306
Slovenia	0.049563	0.005711	0.018797	0.025054
Spain	-0.00101	-0.00028	-0.00088	0.000143
Sweden	0.002242	0.00038	0.000668	0.001193
United Kingdom	0.000219	0.000101	-1.21E-05	0.00013
ROW	-0.00048	-6.25E-05	-0.0004	-1.7E-05

Note: Countries underlined are new entrants

In rest, the results are pretty much in line with expectations: new entrants gained significantly more than incumbents: the Czech republic, the new entrant with the lowest gains, still had a welfare increase five times larger than Finland, the incumbent which enjoyed the largest gains. For incumbents, the welfare gains I observed are in line with observed by CP, given the much smaller timeframe I consider. In the case of new members, the welfare effects are several times larger than those of CP. This makes sense despite the short timeframe as these countries are much smaller and more open than those of NAFTA and it makes sense they should benefit more. One surprising feature of the model is that not all countries benefit: some of the incumbents incur a small welfare loss. CP also find this feature in their model, albeit only for the rest of the world[5]. While papers that loses from trade liberalization are quite rare, this usually happens in richer model structures[6]. This result can have several explanations, both economical and technical. It could be that due to the inclusion of non-traded sectors in the economy, easier exports caused a rise in the price level of the economy decreasing welfare. The technical, and more prosaic explanation, is that due to the way trade costs were estimated, it may appear that for the countries with welfare losses, trade costs increased.

Figure 1: Source of welfare gains for EU countries



[5]This appears in an earlier version of the working paper. The latest version does not report the data for the rest of the world.

[6]See for instance Corcos et al.(2012) who find a 1.37% productivity loss for Germany as a result of EU integration

There appears to be no consistent relation between size and gains, rejecting the Casella hypothesis: while the largest gains were enjoyed by small countries such as Estonia and Latvia, the Czech republic welfare improved less than that of Poland's, although there is a considerable difference in size between the two both in terms of population and economy. Among incumbents the relation doesn't hold either. Somewhat surprisingly, there appears to be no relation between geographic proximity and gains. However there is plausible explanation for this: close countries gain as the volume of trade between them is large while distant countries gain, as well, from the fact that now transports don't have to pass multiple border controls.

Table 3: % Changes in imports and exports

Country	**Model**			**Data**	
	(1) **Exports**	(2) **Imports**	(3) **Welfare Gains**	(4) **Exports**	(5) **Imports**
Austria	0.15	1.45	0.09809	46.6846	50.3186
Belgium	-0.25	0.41	0.28165	50.6915	44.5467
Czech Republic	7.54	6.74	1.40061	82.3393	95.2798
Denmark	-1.03	0.94	0.0235	51.687	41.7238
Estonia	39.81	41.65	5.93254	83.9332	78.3451
Finland	-0.86	1.56	0.39096	67.0036	47.1892
France	0.4	0.64	0.04066	46.4504	33.7533
Germany	0.36	0.52	0.06162	53.2524	49.8886
Greece	-1.33	1.07	0.25601	42.1015	53.3699
Hungary	11.83	8.23	2.15241	61.4665	72.2073
Ireland	-1.24	-0.69	0.17838	40.9641	16.9009
Italy	1.39	1.52	-0.16482	48.81	39.2991
Latvia	45.25	24.68	5.54872	117.913	103.599
Lithuania	9.49	9.85	2.98228	97.7677	97.3518
Luxembourg	-0.07	0.42	0.34067	43.924	42.0144
Netherlands	0.86	0.27	-0.05917	53.2114	51.3184
Poland	8.91	9.78	2.88163	87.1222	107.721
Portugal	-1.88	0.41	0.34107	41.4017	36.2035
Slovak Republic	12.29	9.78	2.68109	99.4059	90.2008
Slovenia	9.86	6.69	4.95628	65.6415	64.3528
Spain	0.72	0.64	-0.10109	58.2248	37.2146
Sweden	-0.49	0.67	0.22422	50.9522	43.901
United Kingdom	0.56	0.3	0.02189	54.4262	44.4387
Correlation with welfare gains	0.89095	0.87048			
Correlation with data	0.77625	0.62823			

Table 3 presents the changes in imports and exports in the model for each country along side with changes in welfare. There is a clear link in the model between openness to trade and welfare gains: Overall the correlation of exports and imports with welfare gains is

89% and 87%, respectively. Countries that gained the most from EU enlargement also saw a huge boost in their exports and imports. The two countries which gained the most, Estonia and Latvia, also saw a rise in their exports and imports of 39.8% and 41.6%, and 45.2% and 24.6%.

Columns (4) and (5) of the table show the data increases in the value of imports and exports for the analysed countries. While the data figures are much larger than the model ones, one needs to keep in mind that they are unadjusted for inflation or economic growth. Still, the model exports have a 77% correlation with the data. The model does not fare so well with respect to imports, although it does decent, where it only achieves a 62% correlation.

7 Conclusion

In this paper I investigated the implications of EU Enlargement on member countries by looking at the changes in trade flows. I do this in a multi-country multi-sector general equilibrium Ricardian model allowing for interconnectedness across sectors.

The estimated welfare gains are small, below 6%, and new entrants gain more than incumbents several times over. Allowing for sectoral links provides a channel through which additional gains can be obtained and in most cases these gains are considerable. The model indicates a clear link between trade openness and welfare gains and also shows a strong correlation with real life data.

References

Alvarez, F. and Lucas, R. 2007. General Equilibrium Analysis of the Eaton-Kortum Model of International Trade. Journal of Monetary Economics Vol. 54, No. 6, pp. 1726-1768.

Anderson, J. E. and Van Wincoop, E. 2004. Trade Costs. Journal of Economic Literature Vol. 42, No. 3, pp. 691-751.

Arkolakis, C., Demidova, S., Klenow, P. J. and Rodriguez-Clare, A. 2008. Endogenous Variety and the Gains from Trade. American Economic Review Vol. 98, No. 2, pp. 444-450.

Bertand, A., Eaton, J., Kortum, S. and Jensen, B. 2003. Plants and Productivity in International Trade. American Economic Review Vol. 93, No. 4, pp. 1268-1290.

Blalock, G. and Gertler, P. J. 2008. Welfare gains from Foreign Direct Investment through technology transfer to local suppliers. Journal of International Economics Vol. 74, No. 2, pp. 402-421.

Breuss, F. 2001. Macroeconomic Effects of EU Enlargement on Old and New Members. WIFO Monatsberichte (monthly reports) Vol. 74, No. 11, pp. 655-666.

Burstein, A. and Vogel, J. 2010. Globalization, Technology, and the Skill Premium: A Quantitative Analysis. NBER Working Papers 16459

Caliendo, L. and Parro, F. 2011. Estimates of the Trade and Welfare Effects of NAFTA.

Casella, A. 1996. Large countries, small countries and the enlargement of trade blocs. European Economic Review Vol. 40, No. 2, pp. 389 - 415.

Chen, N. and Novy, D. 2009. International Trade Integration: A Disaggregated Approach. 2009

Chor, D. 2010. Unpacking sources of comparative advantage: A quantitative approach. Journal of International Economics Vol. 82, No. 2, pp. 152-167.

Corcos, G., Gatto del M., Mion G. and Ottaviano G. 2012, Productivity and Firm Selection: Quantifying the ?New? Gains from Trade, Economic Journal, Vol 122 pp. 754-798.

Costinot, A., Donaldson, D. and Komunjer, I. 2012. What Goods Do Countries Trade? A Quantitative Exploration of Ricardo's Ideas. Review of Economic Studies Vol. 79, No. 2, pp. 561-608.

Donaldson, D. 2010. Railroads of the Raj: Estimating the Impact of Transportation Infrastructure

Eaton, J. and Kortum, S. 2002. Technology, Geography, and Trade. Econometrica Vol. 70, No. 5, pp. 1741-1779.

Eaton, J., Kortum, S. and Kramarz, F. 2011. An Anatomy of International Trade: Evidence from French Firms. Econometrica Vol. 79, No. 5, pp. 1459-1498.

Head, K. and Ries, J. 2001. Increasing Returns versus National Product Differentiation as an Explanation for the Pattern of U.S.-Canada Trade. American Economic Review Vol. 91, No. 4, pp. 858-876.

Hornok, C. 2011. Need for Speed: Is Faster Trade in the EU Trade-Creating? CEPR Discussion Paper 8451 8451

Kerr, W. 2009. Heterogeneous Technology Diffusion and Ricardian Trade Patterns. Unpublished Manuscript

Klenow, P. J. and Rodríguez-Clare., A. 1997. Quantifying Variety Gains from Trade Liberalization.. manuscript

Mohler, L. 2009. Globalization and the gains from variety: size and openness of countries and the extensive margin. MPRA Paper 17592

Novy, D. 2012. Gravity Redux : Measuring International Trade Costs with Panel Data. CEP Discussion Papers 1114

Simonovska, I. and Waugh, M. 2011. The Elasticity of Trade: Estimates and Evidence. National Bureau of Economic Research Working Paper Series 16796

Waugh, M. 2010. International Trade and Income Differences. The American Economic Review Vol. 100, No. 5, pp. 2093-2124.