Specialization, gravity, and European trade in final goods

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Abstract

Building on Haveman and Hummels (2004), we develop and test a gravity specification rooted in a Heckscher-Ohlin framework that views bilateral gravity equations as statistical relationships constrained on countries’ multilateral specialization patterns. According to our results, specialization incentives do not seem to play much of a role in the average European bilateral final goods trade. However, this aggregate view conceals that trade in final goods between Western and Eastern Europe is driven by countries’ multilateral specialization incentives, as expressed by supply-side country differences relative to the rest of the world, fully compatible with incomplete specialization. This indicates that many of the final goods traded between Western and Eastern Europe are still different, rather than differentiated, products.

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1. Introduction

While empirical gravity approaches have been used with great success since the early sixties, their theoretical foundations have been somewhat slower to come. As a result, bilateral gravity frameworks for analyzing gross trade flows are still often set up as eclectic combinations of determinants to test for influences beyond partner incomes and trade barriers. As our first contribution we show that ad hoc augmented gravity equations, specifically those augmented by absolute supply-side country differences or similarities, run into conflict with the supposed theoretical foundations, i.e., they are mis-specified. As a remedy we extend the approach of Haveman and Hummels (2004) to formulate an estimable specification of bilateral gravity on the basis of partner incomes and country-specific supply-side differences relative to the world average. Our second contribution is that we apply our framework to analyze bilateral trade patterns in capital and consumer goods among old and new European Union (EU) members. We show that, different from the average European bilateral final goods trade relationship, trade in final goods between Western and Eastern Europe is driven by countries’ multilateral specialization incentives.

Our interest in trade patterns among the old and new EU members is driven by the new opportunities for specialization and trade created by the European integration process. After embarking on the uneasy path of economic transformation, the first four Central and Eastern European (CEE) countries that would become EU members signed in December 1991 the so-called “European Agreements” with the European Union. Subsequently, they strove to establish a workable framework for international trade and co-operation in order to facilitate the transition process and in March 1993 they established the Central European Free Trade Area (CEFTA; Kocenda and Poghosyan, 2009). CEFTA was later enlarged by virtually all of the rest of the CEE countries and helped to remove barriers to trade among its members as well as with the EU. Many CEE countries applied for EU membership in 1995–1996 and from 1998–1999 underwent a lengthy and thorough screening process towards EU accession; some CEE countries followed at later dates. The CEE countries finalized their process towards their “seal of approval” (Gray, 2009; p.932) as full EU members and on May 1, 2004 the first round of CEE countries joined the EU followed by a second round in 2007.

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1 For a recent survey of the relevant literature, see Stack (2009).
2 In the text the old EU (EU-15) countries are sometime referred as Western Europe. New EU members that joined the EU in 2004 and later (EU-10) are often referred as Eastern Europe. The detailed grouping is given in Appendix Table A.1.
3 The first four countries are the Czech Republic, Hungary, Poland, and Slovakia. See Table A.1 for a complete list of the CEE countries under research.
EU integration has impacted international trade between old and new EU members even before actual enlargement. First, association agreements signed in the early 1990s were found to have a positive and significant impact on trade flows between the transformation and EU countries (Caporale et al., 2009; Egger and Larch, 2011). Second, despite existing economic differences among countries, the new EU members quickly became an important part of the EU-wide manufacturing and distribution web (Kaminski and Ng, 2005). In this respect Egger et al. (2008) show that the larger the difference in relative goods and factor prices of two integrating countries before integration, the larger are the potential overall gains from trade. Further, lowering the fixed cost of trade during European integration has prompted trade to increase (Frensch, 2010). These features are relevant to the composition and characteristics of EU members’ trade and correlate with the empirical fact that trade in final goods (i.e. consumer and capital goods) has been increasing at a pace of about 6% a year for much of the period under research (Miroudot et al., 2009). Direct benefits resulting from the increased availability and choice of the traded final goods are likely to be complemented by less obvious advantages. Coe and Helpman (1995) theoretically show that trade can function as a channel to diffuse technology, which is also quite important in the case of final goods. Añón Higón and Stoneman (2011) provide empirical evidence for welfare growth in the economy through the benefits from innovations embodied in imported final goods.4

The set of new and old EU countries is appealing to analyze also from another theoretical perspective. The EU is a functioning free trade area and its strong tariff reduction was shown to be trade creating (Eicher and Henn, 2011). New EU members were accepted to the free trade area after their accession in 2004 and 2007, but they were already removing trade barriers before and during their accession process (Egger and Larch, 2011). Hence, we analyze a set of countries that impose no barriers on trade among themselves and for this reason the data are not contaminated by differences in tax/tariff regimes or customs rules. Further, despite a gradual catching-up process the new EU members still exhibit lower price levels for both consumer and durable goods (Égert, 2011) that along with lower labor costs

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4 Añón Higón and Stoneman (2011) show the effect of innovations via imports of final goods in five old EU countries. This indirect innovation effect is likely to materialize in the new EU countries as well and can be further paired with a direct effect caused by the innovation activities by multinationals (through FDI), who dominate the innovation process in new EU economies, as shown in Uzagalieva et al. (2012).
may represent types of potential comparative advantages that could prove relevant for specialization and bilateral EU trade patterns during the period under research.\(^5\)

Further, elaborating on the issues raised above, our results are rather striking. First, we demonstrate that a correctly specified gravity approach allowing for European final goods trade resulting from incomplete specialization must always formulate countries’ multilateral specialization incentives, as expressed by supply-side country differences relative to the world average. Second, our results show that while correctly specified specialization incentives seem not to play much of a role in the average European bilateral final goods trade relationship, trade in final goods between Western and Eastern Europe is driven by supply-side country differences relative to the rest of the world. This points to the special relevance of incomplete specialization models such as Heckscher-Ohlin for East-West trade across Europe—against a predominant significance of complete specialization models for the average European trade relationship. Accordingly, our third result can be read as a corollary: despite the gradual catching-up process of the new EU members, many of the final goods traded between Western and Eastern Europe are still different, rather than differentiated, products.

The rest of the paper is organized as follows. In the next section we elaborate in detail why the \textit{ad hoc} gravity specifications are mis-specified. Section 3 develops our framework to estimate the trade and gravity specification with incomplete specialization and its application. In section 4 we describe our European data on trade in final goods. Our results are presented in section 5. Conclusions follow in section 6.

\textbf{2. \textit{Ad hoc} augmented gravity equations and complete specialization}

When testing for gravity influences beyond partner incomes and trade barriers, it appears tempting to proxy supply-side country differences or similarities by absolute values of differences in per capita incomes or wages between exporter and importer countries. Then one would formulate prior expectations on the coefficient for per capita income differences according to alternative trade theories. On the one hand, trade driven by comparative advantages based on factor proportions would imply a positive coefficient for the per capita income gap. On the other hand, the existence of horizontal intra-industry trade driven by new trade theories \textit{à la} Krugman (1980) could be taken to imply a negative coefficient for the per capita income gap.

\(^5\) Auer et al. (2012) show that when non-European exporters from low-wage countries capture 1% of a European market, producer prices decrease by about 3%. Further, they show that import competition has a pronounced effect on average productivity.
capita income gap.\textsuperscript{6} However, testing the influences of various trade theories against each other within one and the same gravity specification assumes that these theories can be reduced to the same gravity specification. We argue that gravity equations augmented by \textit{ad hoc} absolute supply-side country differences are mis-specified since they neglect the key issue of specialization. Factor proportions theories of trade are incomplete specialization models while new theories of trade provide for complete specialization.

According to Deardorff (1998) and Haveman and Hummels (2004), four assumptions suffice to build the simplest possible bilateral gravity structure for trade between more than two countries. These assumptions are: (i) trade is only in final goods, (ii) trade is frictionless and balanced, (iii) preferences over final goods are identical and homothetic, and (iv) each good is produced in and exported out of only one country independent from the details on the supply side that give rise to this complete specialization. Then it follows that bilateral trade is simply log-linear in both countries’ incomes, and there is no scope for “augmenting” the gravity equation by adding the absolute values of differences in per capita incomes, as in equation (1) below. As we will clarify in the next section, a gravity specification describing trade flows as log-linear in both country sizes and absolute country income differentials does not describe the data well against incomplete specialization models either, i.e., it is mis-specified.

3. Trade and gravity specification with incomplete specialization and its application to European trade in final goods

As already argued above, European integration created new opportunities for specialization and trade among the old and new EU members -- Table A.1 in the appendix contains the list of countries. We know that an EU-incumbent country was on average capital-abundant compared to the labor-abundant average accession country (Egger et al., 2008) around the time of accession. These supply-side country differences in factor-proportions should play a role for specialization. One would expect the old EU members (EU-15) to specialize in capital-intensive final goods. Similarly, the Central and Eastern European new members that joined the EU in 2004 and 2007 (EU-10) would be expected to specialize in labor-intensive final goods, giving way to a Heckscher-Ohlin type pattern of trade. Consequently, it might be

\textsuperscript{6} Rault et al. (2009, p. 1551): “Concerning the sign of the difference of GDP per capita, it is positive if the Heckscher-Ohlin (H-O) assumptions are confirmed. On the contrary, according to the new trade theory, the income per capita variable between countries is expected to have a negative impact.” In the same spirit, see also Egger (2002) and Kimura et al. (2007).
promising to analyze final goods trade flows across Europe within an incomplete specialization gravity framework compatible with factor proportions theories of trade. In fact, complete specialization will emerge as a natural special case as the absence of any specialization.\(^7\)

3.1 Trade incentives and trade costs shaping gravity

Gravity relationships express gross bilateral trade as depending on trade incentives and trade costs. We follow the literature (see especially Deardorff, 1998; Evenett and Keller, 2002; Haveman and Hummels, 2004) by making two dichotomies our point of departure for deriving bilateral gravity equations: first, complete versus incomplete specialization, and second trade incentives versus trade costs.

Full theoretical derivation of bilateral gravity in the presence of trade costs is so far limited to complete specialization cases. Deardorff (1998) shows that gross bilateral trade in final goods in a multi-country world is simply log-linear in nominal terms in partner incomes \(Y_j\) and \(Y_i\), and world income \(Y_w\) when there are strictly zero costs of both internal and external trade, preferences are homothetic and identical, and trade is balanced. This case of the bilateral flow is depicted as:

\[
EX_{ji} = IM_{ij} = \frac{Y_j Y_i}{Y_w},
\]

where \(EX_{ji}\) and \(IM_{ij}\) denote exports from country \(j\) to \(i\) and imports into \(i\) from \(j\), respectively. All variables are nominal. Remarkably, (1) holds for both complete and incomplete specialization patterns in equilibrium, no matter which theory of trade drives observed gross bilateral trade. This particular functional form of bilateral gravity can be straightforwardly derived for complete specialization patterns. However, it takes an additional statistical argument for arriving at the same expression when equilibrium specialization is incomplete. Hence, as in a Heckscher-Ohlin framework, with incomplete specialization (full diversification) and factor price equalization, homogenous goods are equally priced across countries such that consumers are indifferent among sourcing from any country, including their own. Resolving this indifference by random choice, however, reproduces (1). For each country’s trade with the rest of the world, and thus for countries’ average bilateral trade

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\(^7\) This is in accordance with Jakab et al. (2001) who show that the gravity equation for the CEE countries during accession period was consistent with several assumptions regarding the structure of both product and factor markets.
relationships, (1) holds even when preferences are not identical or not homogeneous. Thus, when trade costs are zero, gross bilateral gross trade flows are sufficiently described by partner country and world incomes. Equilibrium patterns of specialization and trade – in the Heckscher-Ohlin context formulated on a net trade basis – find no reflection in incentives for bilateral gross trade flows, such that gravity is no help for identifying which theory of trade drives observed bilateral trade.

Identification of which theory drives observed bilateral gross trade requires assuming more structure, either with respect to trade costs or to links between trade theories and trade flows. It is with respect to the former that both Evenett and Keller (2002) and Haveman and Hummels (2004) make the seemingly innocuous assumption of equating gross and net trade flows when specialization is incomplete in equilibrium. This, however, expresses – different from Deardorff (1998) – that consumers are not perfectly indifferent between home and foreign products: they consume home-made products before international trade sets in. With homogenous goods, for this to happen, there must be some sort of a potentially only infinitesimal border effect, i.e., a difference between internal versus external trade costs of trade. As will also be shown below, this transforms each country’s multilateral gravity equations, describing exports into the world or imports from the world, to include a term reflecting a pattern of specialization vis-à-vis the world. Thus, adding trade costs in form of a border effect impacts the role of trade incentives in gravity model: trade incentives and trade costs are not independent from each other in gravity framework. The existence of trade costs rather plays a knife-edge role on the formulation of trade incentives in a gravity model. Hence, equation (1) is not a robust gravity specification for both complete and incomplete specialization outcomes.

3.2 Bilateral gravity and the extent of specialization in the presence of trade costs
How can there be incomplete specialization in a Heckscher-Ohlin framework in the presence of trade costs? Would not minimum trade cost select only one supplier of each homogenous good when production technologies are the same and with factor endowments “similar enough” guaranteeing factor price equalization? On this, Deardorff (1998) concludes that once there are trade costs, complete specialization must be the relevant equilibrium outcome even in the Heckscher-Ohlin context. However, starting from a bilateral framework to formulate a gravity one, Evenett and Keller (2002) find empirical support for the incomplete specialization version of Heckscher-Ohlin rather than for complete specialization. Haveman and Hummels (2004), attempting to extend Evenett and Keller (2002) by deriving bilateral
gravity within a multilateral world, resolve this puzzle by a simulation exercise in which infinitesimally small trade costs do not change prices but the ordering of minimum cost suppliers. Hence, there is only one supplier country for each good and each customer country, in line with descriptive statistics of disaggregated trade data where we observe this result more often than not as the modal outcome. Nevertheless, the result gives rise to incomplete specialization in the sense of more than one country in the world producing and exporting one particular good to the rest of the world and each supplier country supplying a particular good to more than one customer country, in line with Evenett and Keller (2002).

To make this point clearer, assume a Heckscher-Ohlin world with equal technologies, two factors of production, capital and labor, many homogenous goods, and many countries. From the point of view of one destination country, when there are zero trade costs, destination country consumers are indifferent from where to source a particular homogenous good among all supplier countries, including their own country. This arrangement results in random rationing à la Deardorff (1998). When trade costs vary by distance, one would expect that adding trade costs eliminates all but one supplier of this particular good to this particular country. However, any of the other suppliers may still be minimum total cost supplier to other countries, given variations in distance between countries. So even if bilateral trade becomes completely specialized, worldwide production does not need to be as shown by the outcome of the Haveman and Hummels (2004) simulation exercise, already hinted at in Deardorff (1998).

However, we should not just add unequal transport cost to equal production cost as equilibrium outcome. What matters for general equilibrium specialization and trade is the minimum of total cost, eg. the sum of production and trade costs. Then, in equilibrium there may be a minimum total cost supplier to a particular country that is not the minimum production cost supplier but sufficiently close in distance to warrant minimum transportation cost, or the other way around. There might even arise situations of equal minimum total cost supplies, again evoking a rationale for random rationing. Without specifying the technology of overcoming trade barriers, equilibrium diversification and trade are determined by a trade-off between factor endowment and transport cost influences.

While there is no full-fledged higher dimensional Heckscher-Ohlin theory with trade costs upon which to rest our gravity derivation, this is how we will look at it. Our approach blends Deardoff (1998), Evenett and Keller (2002), and Haveman and Hummels (2004), to come up with bilateral gravity equations subject to incomplete specialization in equilibrium, based on Heckscher-Ohlin framework, with complete specialization as a natural limiting
case. Specifically, we put a multi-country, multi-product, two-factor Heckscher-Ohlin framework into Haveman and Hummels’ (2004) description of incomplete specialization as our starting point, arguing that what we add in terms of trade cost structure upon the seamless world fits European realities. Assuming an infinitesimally small border effect – but no other transport costs – implies that each customer country is indifferent among all potential supplier countries except itself, motivating random rationing à la Deardorff (1998) to decompose countries’ multilateral gravity. Adding specific effects in the econometric specification finally introduces the trade-off between incomplete specialization forces and distance in bilateral gravity equations. In testing this specification, we use sub-sampling in the spirit of Evenett and Keller (2002) to identify which theory of trade propels observed bilateral trade driving forces for different subsamples of bilateral trade relationships across Europe.

3.3 Bilateral gravity and incomplete specialization in the presence of trade costs

In order to derive bilateral gravity subject to incomplete specialization across Europe, we first make basic assumptions on geography to match the European landscape: there are more than two countries, all countries are small and encircled by other equidistant small countries. In consequence, distance effects are of a second order as compared to border effects. We assume infinitesimally small border effects, such that product prices remain virtually unaffected but each country’s net exports, i.e. the difference between its production and consumption, are also gross exports to the rest of the world, and factor price equalization does not need to hold in equilibrium. We follow Haveman and Hummels (2004) in that trade is balanced and frictionless beyond border effects, preferences over final goods are identical and homothetic, and trade is carried only in final goods.

Based on the homotheticity assumption and using nominal values, consumption in country $j$ can be described as distributed over final goods indexed by $k$ ($C_j^k$), according to fixed proportions ($\lambda_j^k$) of income ($Y_j$). Hence, consumption is formally defined as $C_j^k = \lambda_j^k Y_j$ and $\sum_k \lambda_j^k = 1$. This can also be done for the world ($w$) as a whole, $C_w^k = \lambda_w^k Y_w$. Further, production can be described as being allocated over the different final goods according to $X_j^k = \delta_j^k Y_j$ and $\sum_k \delta_j^k = 1$, where $X$ indicates production and the $\delta$’s describe the allocation of the value added of final goods production in each country. This allocation can be also formulated for the world as a whole, $X_w^k = \delta_w^k Y_w$. With infinitesimally small border effects, worldwide exports of good $k$ from country $j$ ($EX_j^k$) are given by the difference between
production and consumption, \( EX^k_j = X_j^k - C_j^k = \delta_j^k Y_j - C_j^k \). Due to homothetic preferences, each country consumes each good according to its income share in the world. As the worldwide consumption of each good equals its production, consumption in country \( j \) \((C_j^k)\) can be rewritten as \( C_j^k = (Y_j/Y_w) C_w^k = (Y_j/Y_w) X_w^k = (Y_j/Y_w) \delta_w^k Y_w = (Y_j/Y_w) \delta_w^k Y_w \).

Summing over all goods and selecting export items with positive exports into the set \( K_{EX_j} \), Haveman and Hummels (2004) derive country \( j \)'s multilateral exports \((EX_j)\) as log-linear in income \((Y_j)\) and a specialization pattern relative to the world average \((\delta_j^k - \delta_w^k)\),

\[
EX_j = Y_j \sum_{k \in K_{EX_j}} (\delta_j^k - \delta_w^k). \tag{2}
\]

From our earlier exposition it can be seen that the specialization pattern stems from the difference between the value added of final goods production in country \( j \) and its world average. Analogously we derive a specification for imports:

\[
IM_j = Y_j \sum_{k \in K_{IM_j}} (\delta_w^k - \delta_j^k). \tag{3}
\]

With complete specialization, each good is exclusively supplied by one country. This means that good \( k \) imports of country \( i \) from the world are in fact the good \( k \) imports of country \( i \) from some country \( j \). As country \( i \) uses all goods supplied by country \( j \), this decomposition of multilateral trade immediately implies that bilateral trade in final goods subject to complete specialization is log-linear in both countries’ incomes, as already described in equation (1).

In contrast, with incomplete specialization and no further cost of trade considered, it is not possible to analytically decompose (2) and (3) into bilateral trade relationships. As there is no full-fledged higher dimensional Heckscher-Ohlin theory with trade costs upon which to rest our gravity derivation, we follow Haveman and Hummels (2004) and do not attempt to solve the bilateral trade indeterminacy analytically. Rather, as argued above, we will account for trade costs apart from infinitesimally small border effects in terms of fixed effects in the econometric model below. At this stage, we will use results from the existing literature to conjecture a testable hypothesis of the interaction between factor endowments/prices and

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8 In principle, this method can be adapted to motivate trade in intermediate goods resulting from the horizontal or vertical fragmentation of production, see Frensch et al. (2012).
border effects within a gravity framework to view bilateral trade equations as statistical relationships constrained on countries’ multilateral specialization patterns.

In particular, bilateral trade relationships will be distributed in a statistical sense across a sample of countries, as (2) and (3) must be met on the average of all bilateral trading relationships for each country. In consequence, Haveman and Hummels (2004) note that in a sample of heterogeneous countries, larger countries can be expected to trade more with each other while controlling for their specialization patterns. They they *ad-hoc* proxy specialization patterns by specialization sources in terms of partner countries’ capital-labor ratios relative to world averages. Accordingly, the basis for their econometric specification of bilateral trade is the log-linear relationship:

\[
\log EX_{ji} = \beta_0 + \beta_1 \log(Y_j \times Y_i) + \beta_2 \log(|w_j - w_w| + \beta_3|w_i - w_w|).
\]

However, the particular form of the influence of Heckscher-Ohlin sources of specialization patterns is our major point of interest in this paper. For this, we refine and extent Haveman and Hummels’ (2004) argument. Especially, we make use of Deardorff’s (1998) random choice argument, which in our context states that a country’s consumers, due to small border effects, prefer their home product to foreign products, but are indifferent between foreign produced products. Hence, that good \(k\) imports of country \(i\) from country \(j\) are given by country \(i\)’s worldwide imports of good \(k\) times country \(j\)’s share in worldwide exports of \(k\):

\[
IM_{i}^{k} = IM_{w}^{k} \frac{EX_{i}^{k}}{\sum_{j} EX_{j}^{k}}
\]

Incentives driving countries’ bilateral trade under incomplete specialization must match our underlying Heckscher-Ohlin framework. To see how, consider again that worldwide exports of good \(k\) from country \(j\) are given by \(EX_{j}^{k} = Y_j(\delta_j^{k} - \delta_w^{k})\). We can understand this multilateral gravity equation as a bilateral gravity equation between countries \(j\) and \(w\). Then, using the argument put forward in Evenett and Keller (2002, p. 286), in a 2×2×2 Heckscher-Ohlin world, if country \(j\) is relatively capital-rich and good \(k\) is capital intensive, value added \(\delta_j^{k}\) is positively related to country \(j\)’s capital-labor ratio \(\kappa_j = (K/L)_j\), and value added \(\delta_w^{k}\) is inversely related to \(w\)’s capital-labor ratio, \(\kappa_w = (K/L)_w\). Then, the volume of trade increases with the difference between capital-labor ratios, \((\kappa_j - \kappa_w)\), such that \(EX_{j}^{k} \propto Y_j(\kappa_j - \kappa_w)\).
Analogously, we can write \( IM_i^k \propto Y_i(\kappa_w - \kappa_i) \) for relatively labor-rich country \( i \) exporting the labor-intensive good and importing the capital-intensive good \( k \). Accordingly, for any two countries \( j \) and \( i \) that are capital-rich and labor-rich relative to the world \( w \), respectively, the good \( k \) imports of country \( i \) from country \( j \) are defined as

\[
IM_{ij}^k \propto Y_j Y_i (\kappa_j - \kappa_w) (\kappa_w - \kappa_i),
\]

as \( \sum_j EX_{ji}^k \) is given for each particular country.

According to Ethier (1985), the Heckscher-Ohlin theorem carries through to the case of more than two goods, such that specialization patterns between \( j \) and \( w \) and \( w \) and \( i \) continue to be shaped by differences in capital-labor ratios, at least in terms of correlations. Deardorff (1979) shows that, in a two-country, two-factor model, trade in more than two goods accords with the ranking of goods by factor intensity if there are unequal factor prices, as is possible here, due to infinitesimally small home country effects. Accordingly, if \( j \) is capital-richer than \( w \), \( j \) will export the more capital intensive goods, and its wage-rental ratio will be higher than that in \( w \). Thus, the predictive power of \( Y_j(\kappa_j - \kappa_w) \) for exports from \( j \) to \( w \) continues to hold. We can, however, generalize that for exports from capital-rich \( j \) to \( w \) in fact \( Y_j(w_j - w_w) \) has predictive power, where \( w_j \) and \( w_w \) represent supply-side differences either in form of capital-labor or wage-rental ratios.

As the analogous reasoning can be applied to labor-rich country \( i \) imports from \( w \), we can generalize proportionality (6) to the multi-product case, to describe total imports to labor-rich \( i \) from capital-rich \( j \), with or without factor price equalization,

\[
IM_{ij} \propto Y_i Y_j (w_j - w_w)(w_w - w_i).
\]

For any pair in a sample of heterogeneous countries, we now return to Haveman and Hummels’ (2004) absolute values formulation, such that the basis for our econometric specification of bilateral trade is the log-linear relationship,

\[
\log EX_{ji} = \beta_0 + \beta_1 \log(Y_j \times Y_i) + \beta_2 \log(|w_j - w_w| \times |w_i - w_w|).
\]
Specification (4’) is an extension of Haveman and Hummels’ (2004) approach to formulate bilateral gravity equations in the presence of incomplete specialization as statistical relationships constrained on countries’ multilateral specialization patterns, with respect to both partner incomes and specialization patterns, and it is easy to interpret. Assuming a sample of heterogeneous countries, bilateral trade volumes \((EX_{ij})\) will increase with the product of trading countries’ incomes \((Y_j \times Y_i)\) and with the countries’ degree of specialization against the world average. Specifically, bilateral trade volumes are expected to increase with the product of countries’ respective supply-side differences against the world, \(|w_j - w_w| \times |w_i - w_w|\). Hence, specification (4’) captures the fact that bilateral trade flows will increase with relative, rather than absolute, supply-side country differences.

3.4 European trade in final goods

Despite being simple and directly related to the specialization patterns described in (2) and (3), specification (4’) is still incomplete. The reason is that relative supply-side country differences in (4’) predict large trade volumes also for countries that lack complementary specialization. To account for this potential problem, we deviate further from Haveman and Hummels (2004) adding another condition according to which bilateral trade relationships must be distributed in a statistical sense across a sample of countries: as already noted above, equations (2) and (3) describe countries’ multilateral trade, i.e., (2) and (3) must be met on the average of all bilateral trading relationships. But second, for bilateral trade to occur, countries’ specialization patterns as described in (2) and (3) must be complementary: there must be at least one good that is both exported by country \(j\) and imported by country \(i\). To let the data reveal specialization patterns, we make use of a sub-sampling strategy, in the spirit of Evenett and Keller (2002), i.e., we select relative supply-side country differences for particular bilateral trade relationships. This is done by assigning dummy variables to bilateral trade relationships between countries expected to be characterized by complementary specialization from \(a priori\) known information, e.g., on the basis of \(w_j > w_w\) and \(w_i < w_w\).\(^9\)

Our prior expectation on specialization has already been outlined above: we expect the old capital-rich EU members (EU-15) to specialize in capital-intensive goods, the labor-rich Central and Eastern European new members that joined the EU in 2004 and 2007 (EU-

\(^9\) An alternative is to introduce simple absolute supply-side country differences, \(|w_j - w_i|\). Doing so in a log-linear fashion within a gravity framework implies substitutability between countries’ complementary specialization and their relative supply-side country differences, \(|w_j - w_w||w_i - w_w|\). However, this would actually again amount to mis-specifying the gravity model against our two conditions governing the statistical distribution of bilateral trade relationships.
10) would be expected to specialize in labor-intensive goods. Hence, by letting the data speak for themselves, we could assign a combined dummy variable to conveniently detect specialization patterns between old (EU-15) and new EU countries (EU-10), e.g. $\text{DummyEU15/10}_{ji,t} \log(|w_{j,t} - w_{w,t}| \times |w_{i,t} - w_{w,t}|)$.

Further, given the progress in the integration process between both groups of countries we expect that the pattern will show a dynamic development that represents technological progress through decreasing trade costs. Technological progress is exogenous to our model and can be represented by time effects. Our motivation of trade implies complementarity between technological progress and the possibility of using supply-side country differences. Hence, we model this by interacting the combined variable $\text{DummyEU15/10}_{ji,t} \log(|w_{j,t} - w_{w,t}| \times |w_{i,t} - w_{w,t}|)$ with time-period effects and for this purpose we divide the sample period (1992–2008) into five sub-periods ($s$) of (almost) equal length. The division of the time span into several periods reflects: (i) the different stages of economic transition in the CEE countries (from the early 1990s until the middle 2000s), (ii) preparations for EU accession (1995–2004) with the relevant effects on their bilateral trade and aggregate output (Egger and Larch, 2011), and (iii) changes in manufacturing patterns related to FDI (Hanousek et al., 2011).

Thus, within a panel of EU-25 countries, bilateral trade in final goods ($EX_{ji,t}$) can be described by the following specification:

$$\log EX_{ji,t} = \beta_0 + \beta_1 \log(Y_{j,t} \times Y_{i,t}) + \beta_2 \log(|w_{j,t} - w_{w,t}| \times |w_{i,t} - w_{w,t}|) +$$
$$+ \sum_{s=1}^{5} \gamma_s \text{Dummy(EU15/10)}_{ji,s} \log(|w_{j,t} - w_{w,t}| \times |w_{i,t} - w_{w,t}|) + \epsilon_{ji,t}.$$

(8)

In specification (8) the dummy variable $\text{DummyEU15/10}$ equals one for trade relationships between EU-15 and EU-10 countries, and zero otherwise. All trade barriers are subsumed under time-invariant country-pair-specific as well as country-pair-invariant time-specific omitted variables, to be controlled for by appropriate fixed effects (Baldwin and Taglioni, 2006), with the advantage of also controlling for countries’ multilateral trade resistance (Anderson and van Wincoop, 2003).

The theoretical background behind our specification rests in incomplete specialization models such as Heckscher-Ohlin and, therefore, incentives for incomplete specialization and trade are supply-side country differences in factor endowments, relative to the world average. In the presence of factor price equalization, relevant factor endowments like capital-labor
ratios can be proxied by average GDP per capita. In terms of theory, factor price equalization may break down, as argued above. Further, in terms of empirical work, using GDP per capita might create a problem at the estimation stage due to potential correlation with the dependent trade flow variable. Hence, we employ in our benchmark regression data on wages in pairs of exporting \((w_j)\) and importing \((w_i)\) European countries to capture supply-side country differences in wage-rental ratios, assuming much lower variation in interest rates than in wages across Europe. For robustness purposes GDP per capita is still used as an alternative measure of the supply-side country differences.

4. Data

Final goods exports from country \(j\) to \(i\), \((EX_{ji})\), from 1992 to 2008 are from the BACI database drawn from UN COMTRADE (see Gaulier and Zignago, 2010). All our trade data are reported according to the Standard International Trade Classification, Revision 3 (SITC, Rev.3). Data are used at all aggregation levels: 1-digit-level aggregate trade flows and 3,114 entries at the 4- and 5-digit levels to distinguish and count SITC categories for the definition of extensive versus intensive margins of trade flows. The definition of final goods follows the BEC categorization of UN Statistics.\(^{10}\) \(Y_j\) and \(Y_i\) are exporter and importer GDP at current prices, respectively, obtained from the World Development Indicators (accessed via the DCI database). Our direct measure for forming relative supply-side country differences are wages, measured as annual wage averages in the manufacturing sector of the exporting or importing country \((w_j\) and \(w_i)\). The data were obtained from LABORSTA (International Labour Office statistical databases (http://laborsta.ilo.org/). As an alternative measure of the supply-side country differences we employ exporter and importer GDP per capita at current prices obtained from the World Development Indicators. To construct relative supply-side country differences, \(|w_j - w_w| \times |w_i - w_w|\), world GDP per capita at current prices and world average wage \((w_w)\) are measured as mean GDP per capita in the world and the mean wage in the world, respectively. The world is defined by our full reporting sample of countries described in Appendix Table A.1. Following Debaere (2003) we also construct weighted averages of world GDP per capita and wages, in which population sizes \((p_i)\), obtained from the World Development Indicators, serve as weights. The weighted averages are used as a robustness check to account for differences in country sizes; more discussion is offered in

\(^{10}\) United Nations Statistics Division, Methods and Classifications: Classification by Broad Economic Categories, defined in terms of SITC, Rev.3 (BEC Rev.3). Available online at http://unstats.un.org/unsd/class/family/family2.asp?Cl=10
section 6. Time-specific effects in specification (8) also control for each year’s data using a
different numéraire since GDP and trade values are all current (Baldwin and Taglioni, 2006),
where the original US dollar-denominated data are converted to euros.

5. Estimation
We use two types of final goods—capital and consumer goods—to estimate specification (8)
on unbalanced panel data with a mean length of time dimension of about 10 years.¹¹ In order
to obtain consistent estimates we employ a dynamic panel-data model following Arellano and
Bond (1991), Arellano and Bover (1995), Blundell and Bond (1998), and Blundell, Bond, and
Windmeijer (2000). The estimator is implemented in STATA 12 as the command xtdpd and it
uses moment conditions in which lagged levels of the dependent and predetermined variables
serve as instruments for the differenced equation.¹²

We begin our estimation by performing a Hausman-type specification test to assess
the potential endogeneity of the explanatory variables by comparing a standard fixed effects
model with the Arellano-Bond-Bover-Blundell technique. The test confirms the endogeneity
of the explanatory variables. Therefore, we proceed with instrumentation.

Technically, we estimate the theoretically motivated specification (8) in a panel
setting with fixed effects plus instrumental variables to overcome problems of omitting
variable bias and to control for time-invariant endogeneity and selection bias. This is done
because some of the right-hand-side variables are correlated with the dependent variable.
Specifically, given that specification (8) is rooted in models of incomplete specialization and
trade, such as Heckscher-Ohlin, existing wage differences may be subject to factor price
equalization tendencies by the very offshoring trade they induce. We follow Arellano and
Bond (1991) and apply the simplest possible remedy in choosing the second lags of the
explanatory variables as instruments. Further, let us note that GDP by standard identities
contains corrections for international trade flows and therefore using a GDP measure, either
absolute values or scaled per capita values, would create problems even in a panel setting.
The reason is that, by construction, the unobserved panel-level effects are correlated with
potentially endogenous independent variables that cause standard estimators to be
inconsistent. Our estimation approach controls for the potential endogeneity of explanatory

¹¹ One drawback to using panel data lies in the potential non-stationarity of trade and income data, likely
implying biased estimates with fixed effects models. However, since the mean time length of our panel is about
10 years, the unit root is not a real issue.
¹² As we do not encounter any zero trade flows, there is no need for a two-step procedure, such as in Helpman et
al. (2008).
variables and performs well even with low-order moving average correlations in error terms or predetermined variables as in Blundell and Bond (1998).

Since bilateral trade volume will increase with the product of trading countries’ incomes, we expect that $\beta_1 > 0$. As equations (1) and (2) describe the expected values of bilateral trade relationships, we may even expect $\beta_1$ to equal one, provided the extent of specialization is uncorrelated with income. We cannot form an unambiguous a priori expectation on $\beta_2$ without further information on the sample of countries. If the sample is heterogeneous in terms of complementary specialization, we expect $\beta_2 > 0$. On the other hand, if the sample is sufficiently homogenous, with say all $w_i > w_w$, then there is no reason to assume the majority of country pairs to be complementarily specialized. In this case higher $|w_j - w_w| \times |w_i - w_w|$ will even generate less trade, as both countries together move away from the world average and we may expect $\beta_2 < 0$. Finally, if the dummies DummyEU15/10 select from the data country pairs exhibiting complementary specialization we expect $\gamma_s > 0$. Of course, for the limiting case of complete specialization, we would not find specialization incentives to play any role, in which case $\beta_2 = \gamma_s = 0$.

As already argued above, complete specialization is in principle compatible with both (new) new theories of trade, based on monopolistic competition models of trade, and Heckscher-Ohlin. Evenett and Keller (2002) discriminate between the two on the basis of the presence of intra-industry trade, assuming that all observed intra-industry trade is solely accounted for by monopolistic competition models of trade. We have reservations about this identification, given the increasing literature pointing to Heckscher-Ohlin forces yielding different forms of intra-industry trade (see, e.g., Davis, 1995). Rather, we argue on the basis of Debaere and Demiroglu (2003) and simulation results in Haveman and Hummels (2004). Debaere and Demiroglu (2003) find evidence of similar factor endowments among large parts of our country sample, to potentially enable them to produce the same set of goods. Simulation results in Haveman and Hummels (2004) with infinitesimally small trade costs changing the ordering of minimum cost suppliers without changing prices result in only one supplier country for each good and each customer country, in line with empirically observed trade facts from disaggregated trade data where we observe this result more often than not (modal outcome). Nevertheless, the result gives rise to incomplete specialization in the sense of more than one country in the world producing and exporting one particular good to the rest of the world and each supplier country supplying a particular good to more than one customer country. On this basis, we will identify our limiting case of $\beta_2 = \gamma_s = 0$ as complete
specialization based on monopolistic competition models of trade, indicating trade in
differentiated rather than different products.

6. Empirical results
We introduce our benchmark results for capital and consumer trade flows across Europe
based on specification (8) in Tables 1 and 2. Each table contains estimates for a specific
variable to represent supply-side country differences based on simple world means, for wages
in Table 1 and GDP per capita in Table 2. Statistically significant coefficients \( \beta_1 \) demonstrate
that larger European countries indeed trade more final goods with each other. However,
estimated trade flow elasticities with respect to income are substantially lower than one,
suggesting that the extent of specialization is negatively correlated with income, and more so
for consumer than for capital goods. Technical progress in terms of declining trade costs, as
captured by the sub-period dummies, appears to positively influence both types of final goods
trade for EU-15/EU-10 pairs as coefficients \( \gamma_s \) are increasing slowly over time; there is only
one exception of a lower coefficient in the final sub-period.

The specialization effect on final goods trade flows of relative supply-side country
differences is captured by coefficients \( \gamma_s \). When relative supply-side country differences are
measured by wages (Table 1), \( \beta_2 \) is negative and very small for capital goods trade flows and
positive but very small for consumer goods. When relative supply-side country differences
are measured by GDP per capita (Table 2), \( \beta_2 \) is insignificant for both types of final goods
trade. This finding confirms that specialization incentives compatible with theories of
incomplete specialization and trade do not play much of a role for final goods trade in our
sample of European countries. Rather, the average European bilateral trade relationship in
final goods appears to be represented by a simple gravity specification, “as if” driven by
factors compatible with complete specialization theories (such as economies of scale and
product differentiation).

This average pattern, however, conceals a significant role for specialization incentives
across Europe, as becomes evident when we compare the coefficient \( \beta_2 \) with always
significantly positive and much larger coefficients \( \gamma_s \). The sum of the coefficient pairs \( \beta_2 \) and
\( \gamma_s \) (\( \beta_2 + \gamma_1 \) for the first period 1992–1995, \( \beta_2 + \gamma_2 \) for the second period 1996–1998, etc.)
shows that relative supply-side country differences drive capital goods trade between the
original EU-15 and the ten accession countries (EU-10), rather than within each of the two
country groups or across the average of all bilateral European trade relationships.
Specifically, when measuring relative supply-side country differences by wages (Table 1),
capital goods trade flows between Eastern and Western Europe react with an elasticity growing from about 6% to some 14%. Consumer goods trade flows (Table 2) react about twice as elastically. Measuring relative supply-side country differences by per capita GDP (Table 2) lowers both elasticities to a range between 12% and 15% when not accounting for the insignificant coefficient $\beta_2$. Consequently, bilateral capital goods trade flows between old and new EU members appear to be driven by incomplete specialization motives, and this is even more evidenced for consumer goods trade.

Finally, we perform several robustness checks to verify the validity of our results. As discussed in Debaere (2003), measuring world averages in relative supply-side country differences matters a lot. Therefore, in Tables 3 and 4 we employ the world wage and per capita GDP averages weighted by countries’ populations, as comparable work force data are unavailable on the scale of our full sample. The results in Tables 3 and 4 are not materially different from those reported in Tables 1 and 2. Hence, our results are quite robust to this change in measurement.

We also complement our robustness results by a statistical comparison of the coefficients derived from the estimated specification (8) where wages serve as a measure for supply-side country differences, i.e., we compare the coefficients presented in Table 1 (simple averages) and Table 3 (weighted averages). In Figure 1 we present the plots of the confidence intervals of the above coefficients. Dark and blank bars depict simple and weighted means, respectively. The shapes of the blank bars reflect the lower dispersion due to weighting. The two graphs in Figure 1 show that there is an ample overlap of the confidence intervals of coefficients. Hence, our results are in a statistical sense robust to our world average measurement in terms of simple or weighted averages.

In the above account we have shown that European trade in final goods on average appears as if driven by forces compatible with complete specialization models. The driving factors of complete specialization models are economies of scale and product differentiation. Hence, we may conclude that for the average European trade relationship, traded final goods are differentiated products, as is expected for trade relationships between similar countries. However, given the special relevance of incomplete specialization models for East-West trade across Europe, many of the final goods traded between Western and Eastern Europe are different products rather than differentiated products.

Further, we can extend our results by decomposing trade in final goods along its two margins, based on the highly disaggregated nature of our original trade data. The extensive margin denotes the number of exported goods, while the intensive margin refers to average
volumes per exported good. We report results for trade in capital goods in the Appendix Table A.2. First, coefficients associated with market size ($\beta_1$) are about 60% larger for the intensive margin than for the extensive margin. This reveals that trade in capital goods across Europe is predominantly realized along the intensive margin with respect to the size of the economy. Second, when we inspect the sum of coefficient pairs $\beta_2$ and $\gamma_s$, these are consistently larger along the extensive rather than the intensive margin. Accordingly, more capital goods trade for EU-15/EU-10 country pairs in response to relative supply-side country differences in wages is mostly realized along the extensive margin. The difference in the effects on the two margins of trade becomes consistently larger for our first four sub-periods until 2004, but decreases during 2005–7. We identify the same pattern for consumer goods as well.\(^{13}\)

The relevant empirical literature, quoted in section 1, emphasizes that European integration results in more trade between new and old EU members. We accentuate these findings. Our trade flow results indicate that final goods traded between Western and Eastern Europe are different products rather than differentiated products. Our margin results corroborate that more trade between new and old Europe in response to supply-side country differences is realized in an increased number of different products rather than more trade in established products.

7. Conclusions
Gravity equations employed to analyze gross trade flows are frequently augmented by ad hoc measures of supply-side country differences. We first argue that gravity formulations of this sort are mis-specified, due to theoretically unmotivated attempts to allow for both complete and incomplete specialization influences on trade within the same gravity framework. Building on Haveman and Hummels (2004), we then suggest an alternative specification rooted in incomplete specialization; complete specialization emerges as a natural special case in terms of the absence of specialization. This view reveals countries’ multilateral specialization incentives as driving bilateral trade, corresponding to and competing with the role of multilateral trade resistance. We then apply our framework to analyze European trade in final goods.

\(^{13}\) We perform the analysis also in terms of GDP per capita as relative supply-side country differences. The results are qualitatively the same. We do not report detailed results due to space, but they are readily available upon request.
Our results show that trade in final goods between Western and Eastern Europe is driven by countries’ multilateral specialization incentives that are expressed by supply-side country differences relative to the rest of the world. In addition, more trade between new and old Europe in response to supply-side country differences is realized in an increased number of different products rather than more trade in established products. At the same time, for the majority of European bilateral trade relationships, insignificant or comparatively very small specialization coefficients indicate that specialization incentives do not play much of a role in final goods trade. Hence, European trade in final goods in our data on average appears as if driven by forces compatible with complete specialization models. As the driving factors of complete specialization models are economies of scale and product differentiation, we may conclude in a corollary that for the average European trade relationship, traded final goods are differentiated products, as expected in trade relationships between similar countries. However, given the special relevance of incomplete specialization models for East-West trade across Europe, many of the final goods traded between Western and Eastern Europe are still different products rather than differentiated products, despite the gradual catching-up process of the new EU members.
References


Table 1: Capital goods and consumer goods flows, w=wages (simple world averages)

<table>
<thead>
<tr>
<th></th>
<th>Capital goods</th>
<th>Consumer goods</th>
</tr>
</thead>
<tbody>
<tr>
<td>$\log Y_j Y_i$</td>
<td>0.704***</td>
<td>0.537***</td>
</tr>
<tr>
<td></td>
<td>(0.023)</td>
<td>(0.024)</td>
</tr>
<tr>
<td>$\log (</td>
<td>w_j - w_w</td>
<td>\times</td>
</tr>
<tr>
<td></td>
<td>(0.019)</td>
<td>(0.022)</td>
</tr>
<tr>
<td>1992-1995</td>
<td>0.122***</td>
<td>0.210***</td>
</tr>
<tr>
<td></td>
<td>(0.033)</td>
<td>(0.038)</td>
</tr>
<tr>
<td>1996-1998</td>
<td>0.139***</td>
<td>0.210***</td>
</tr>
<tr>
<td></td>
<td>(0.033)</td>
<td>(0.038)</td>
</tr>
<tr>
<td>1999-2001</td>
<td>0.178***</td>
<td>0.209***</td>
</tr>
<tr>
<td></td>
<td>(0.033)</td>
<td>(0.037)</td>
</tr>
<tr>
<td>2002-2004</td>
<td>0.200***</td>
<td>0.231***</td>
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<tr>
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<td>(0.031)</td>
<td>(0.035)</td>
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<tr>
<td>2005-2008</td>
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<td>0.246***</td>
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<td>(0.034)</td>
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<tr>
<td>N</td>
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<td>26,969</td>
</tr>
</tbody>
</table>

Table 2: Capital and consumer goods flows, w=GDP per capita (simple world averages)

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<td>$\log Y_j Y_i$</td>
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<td>(0.020)</td>
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<td>(0.028)</td>
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<tr>
<td>1992-1995</td>
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<td>1996-1998</td>
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<td>(0.024)</td>
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<td>1999-2001</td>
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<td>(0.024)</td>
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<tr>
<td>2002-2004</td>
<td>0.152***</td>
<td>0.150***</td>
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<td>(0.023)</td>
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<tr>
<td>2005-2008</td>
<td>0.141***</td>
<td>0.155***</td>
</tr>
<tr>
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<td>(0.021)</td>
<td>(0.023)</td>
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<tr>
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<td>33,451</td>
<td>32,390</td>
</tr>
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</table>
Table 3: Capital and consumer goods flows, w=wages (population-weighted world averages)

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<tr>
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<tbody>
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<td>( \log Y_j Y_i )</td>
<td>0.701***</td>
<td>0.533***</td>
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<tr>
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<td>(0.008)</td>
<td>(0.006)</td>
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<tr>
<td>( \log (</td>
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<td>\times</td>
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<tr>
<td></td>
<td>(0.014)</td>
<td>(0.011)</td>
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<td>1992-1995</td>
<td>0.133***</td>
<td>0.203***</td>
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<td>(0.010)</td>
<td>(0.008)</td>
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<tr>
<td>1996-1998</td>
<td>0.149***</td>
<td>0.201***</td>
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<tr>
<td></td>
<td>(0.009)</td>
<td>(0.008)</td>
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<tr>
<td>1999-2001</td>
<td>0.190***</td>
<td>0.202***</td>
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<tr>
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<td>(0.007)</td>
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<tr>
<td>1999-2004</td>
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<td>(0.007)</td>
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<td>2005-2008</td>
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<td>N</td>
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<td>26,969</td>
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Table 4: Capital and consumer goods flows, w=GDP per capita (population-weighted world averages)

<table>
<thead>
<tr>
<th></th>
<th>Capital goods</th>
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<tbody>
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<td>( \log Y_j Y_i )</td>
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<td>0.595***</td>
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<td>(0.005)</td>
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<td>w_j - w_i</td>
<td>\times</td>
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<tr>
<td></td>
<td>(0.012)</td>
<td>(0.010)</td>
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<td>1992-1995</td>
<td>0.121***</td>
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<td>(0.005)</td>
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<td>0.132***</td>
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<td>(0.006)</td>
<td>(0.005)</td>
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<td>1999-2001</td>
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<td>(0.005)</td>
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<td>2002-2004</td>
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<td>(0.005)</td>
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<td>2005-2008</td>
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<td>0.160***</td>
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<td>(0.006)</td>
<td>(0.005)</td>
</tr>
<tr>
<td>N</td>
<td>33,451</td>
<td>32,390</td>
</tr>
</tbody>
</table>
Appendix

Figure 1. Comparison of confidence intervals for coefficients in specification (8)

A. Capital Goods

B. Consumer Goods

Note: Confidence intervals are labeled in the following way: GDP denotes the coefficient of the log $Y_j Y_i$ and $W$ denotes coefficient of the log $(|w_j - w_u| \times |w_i - w_u|)$ where $w$ stands for wages. Remaining confidence intervals refer to coefficients of the log $(|w_j - w_u| \times |w_i - w_u|)$ for the EU-15/10 dummy, computed over specified time periods, i.e. 1992–1995 to 2005–2008.
Table A.1: Import-reporting countries and trade data availability

<table>
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<tr>
<th></th>
<th>Country</th>
<th>Start Year–End Year</th>
<th></th>
<th>Country</th>
<th>Start Year–End Year</th>
<th></th>
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</tr>
</thead>
</table>

Notes: Belgium and Luxembourg are treated as one country. EU-15 countries are underlined, EU-10 are in italics. Each reporting country’s import data are given for all reporter countries for the indicated time period. Reporter countries plus Albania, Armenia, Azerbaijan, Bosnia and Herzegovina, Belarus, Canada, Switzerland, Cyprus, Georgia, Iceland, Kazakhstan, Kyrgyzstan, Moldova, Macedonia, Malta, Norway, Russia, Tajikistan, Turkmenistan, Turkey, Ukraine, Uzbekistan, the U.S., China, Hong Kong, Japan, South Korea, Taiwan, and Thailand (54 countries in all, on average accounting for above 90 per cent of reported imports) constitute the “world” for the computation of our world averages.
Table A.2: **Capital goods margins** (simple and population-weighted world averages)

<table>
<thead>
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<th>Period</th>
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<th>Weighted average</th>
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<tbody>
<tr>
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<td>Intensive Margin</td>
</tr>
<tr>
<td>log $y_j/y_i$</td>
<td>0.272***</td>
<td>0.433***</td>
</tr>
<tr>
<td></td>
<td>(0.013)</td>
<td>(0.013)</td>
</tr>
<tr>
<td>log $(</td>
<td>y_j - w_0</td>
<td>\times</td>
</tr>
<tr>
<td></td>
<td>(0.011)</td>
<td>(0.012)</td>
</tr>
<tr>
<td>1992-1995</td>
<td>0.086***</td>
<td>0.036**</td>
</tr>
<tr>
<td></td>
<td>(0.021)</td>
<td>(0.018)</td>
</tr>
<tr>
<td>1996-1998</td>
<td>0.099***</td>
<td>0.040**</td>
</tr>
<tr>
<td></td>
<td>(0.020)</td>
<td>(0.018)</td>
</tr>
<tr>
<td>1999-2001</td>
<td>0.125***</td>
<td>0.053***</td>
</tr>
<tr>
<td></td>
<td>(0.020)</td>
<td>(0.017)</td>
</tr>
<tr>
<td>2002-2004</td>
<td>0.139***</td>
<td>0.061***</td>
</tr>
<tr>
<td></td>
<td>(0.019)</td>
<td>(0.017)</td>
</tr>
<tr>
<td>2005-2007</td>
<td>0.116***</td>
<td>0.076***</td>
</tr>
<tr>
<td></td>
<td>(0.019)</td>
<td>(0.017)</td>
</tr>
<tr>
<td>N</td>
<td>27681</td>
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