

# Factory Europe? Brainier but not Brawnier

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*Abstract: While intermediates comprise the majority of total goods trade in the EU, their share of total trade has remained flat since 1996. This implies that EU enlargement has had a limited effect on the size of Factory Europe. However, enlargement coincides with an increase in Factory Europe's complexity. Using two new measures of the complexity of intermediates products, we show that internal EU intermediates trade has become more sophisticated and uses more relationship-specific inputs over time and relative to external EU trade. In other words, Factory Europe has become brainier but not necessarily brawnier. There is also an asymmetry. While the 1995 EU members have not become more significant trading partners for the new members, the new members have become a more important source of intermediates for the EU15 and also a more important market. In sum, the structure of EU trade has changed--not only is the EU15 giving the new members a bigger share of its tasks, it is also giving them harder ones.*

## 1 INTRODUCTION

“Like some gigantic, impossibly complex and wonderfully efficient factory, the region churns out millions of different products ... by sourcing billions of different parts and components from plants spread across a dozen nations.” Baldwin (2008:1) on the “Factory Asia” phenomenon.

The Barbie doll, which is assembled in China and consists of pieces from many Asian countries, has been used to highlight the large and increasing fragmentation of production across borders in the region (Tempest, 1996, Gill & Kharas 2007). But such examples are not unique to Asia. Siemens has organized its activities in a global value chain, which include engineering activity in Western Europe and assembly in Eastern Europe (Marin, 2010a). Skoda in the Czech Republic makes hi-tech components, including transmissions and entire engines for VW. The production line for the Porsche Cayenne ends in Leipzig, Germany, but stretches out to Slovakia to obtain painted bodies (Watson, 2010). These examples are indicative of fragmentation of production between new and old EU members, even in the most high-end products. In this paper, we examine how fragmentation in Europe has evolved.

Intermediates trade is likely to be especially important for income growth. Productivity growth within each firm is enhanced by improved access to more and/or cheaper inputs, greater varieties of inputs and more complexity. In addition, being part of a production chain encourages more co-operation in technology and knowledge-

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transfer than might be the case for trade in final products.<sup>1</sup> Expansion of the European Union (EU) may affect patterns of intermediates trade to a greater extent than standard trade. As borders become invisible and institutions and legal systems converge, the costs of fragmentation of production decline.

Expansion of the EU can transform the nature, quantity and variety of intermediates traded through various channels. For example, the removal of borders results in less waiting time and lower transport costs, which allows flexible manufacturing and reduces the importance of home market effects and thus encourages the relocation of stages of production to lower cost regions. As part of deeper integration, expansion entails the adoption and harmonization of EU standards and norms. Harmonization across multiple markets encourages more experimentation with new products and therefore increases the variety of products available. Harmonization of standards also permits the combination of increasingly complex tasks across borders and encourages knowledge transfer, which means intermediates traded become more sophisticated. The adoption of EU institutions by the new members also allows the formation of relationship-intensive supply chains within those countries. As a result, we investigate to what extent the integration process in the EU has coincided with an increase in the quantity, variety and complexity of intermediates trade within the region.

To preview the results, intermediates now make up more than half of total EU trade and almost ten percent of GDP. While this is sizeable, the growth reflects global trends and the level is not high by world standards. Moreover, unlike in Asia, the importance of intermediates in total EU trade has not increased substantially since 1996.<sup>2</sup> In this sense, Factory Europe is less impressive than Factory Asia and has not grown since EU enlargement.

However, this masks an important asymmetry between the countries who were already EU members in 1995 (the EU15) and those who only joined in 2004 (the NMS or new member states). We find that EU15 intermediates trade with the NMS as a share of intermediates trade with the world has almost doubled from 1996 to 2007, rising to more than 7% for exports and more than 5% for imports. There has also been a rise in the variety of intermediates sent from the 2004 members to the EU15 relative to varieties sent by the NMS or received by the EU15 from elsewhere. On the other hand, the EU15 is not becoming a more important intermediates trading partner for the new members, who are expanding intermediates trade quantities with other regions just as much as with the EU partners and receiving fewer varieties from the EU15.

Our most important results concern the complexity of production stages, which we measure using two indices constructed specifically for intermediates. The first adapts the Hausman, Hwang & Rodrik (2007) sophistication measure. We find that NMS intermediates exports to the EU15 have become 15% more sophisticated. At the same time, the rest of the world's exports to the EU15 have become less sophisticated. Intermediates flowing from the EU15 to the new members have become 7% more sophisticated. Intermediates sent from the EU15 or NMS to the outside world have become relatively less sophisticated. The second measure of complexity refers to the relationship-specificity of the inputs used to make a product (Nunn, 2007), which captures the complexity embodied in trade by measuring the proportion of differentiated inputs used to produce the traded good. The

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<sup>1</sup> See Grossman & Helpman (1991), Dixit & Stiglitz (1977), Romer (1990) and Frankel & Romer (1999).

<sup>2</sup> See Barba Navaretti, Haaland & Venables (2002) for an example of increased intermediates:GDP shares. See Mirodout et al (2009) for a recent example of intermediates to total trade shares.

proportion rose by five percentage points. Both indices show that the new members are carrying out more complex tasks.

In sum, EU enlargement has had a limited effect on the size of Factory Europe, but it has influenced its complexity. In this sense, factory Europe has become brainier but not necessarily brawnier. There is also an asymmetry, with the expanded union being both a more important source of intermediates and a more important market. Not only is the EU15 giving the new members a bigger share of its tasks, it is also giving them harder ones.

The outline of this paper is as follows: Section 2 provides a contextual and theoretical background. It briefly outlines the EU enlargement process, and argues that European integration is not discrete change associated with formal joining but a gradual process. The section discusses why the quantity, variety and complexity of intermediates are important for income or productivity on the one hand and hypothesizes why EU expansion can be expected to influence intermediates trade on the other. It provides a case study from the automotive industry which illustrates many of the concepts and outlines the more general patterns we will search for in the data. Section 3 describes the data used and how we calculated various measures describing the nature of intermediates trade. These include intermediates intra-industry trade (IIIT), intermediates sophistication of exports and imports ( $I\_Expy$  and  $I\_Impy$ ), and the relationship-specificity of intermediates ( $RSI$ ).

Section 4 focuses on trade quantities. It includes our results on total trade, on sectoral shifts and on the importance of intermediates trade. Section 5 considers the nature of intermediates, including its variety and complexity. Section 6 briefly concludes.

## 2 INTEGRATION, INTERMEDIATES AND PRODUCTIVITY

### 2.1 EU integration as a process<sup>3</sup>

The recent expansion of the EU eastward is formally marked by the large addition of ten members in 2004 and the further addition of two members in 2007. However, formal enlargement is in many cases towards the end of the integration and harmonization process.<sup>4</sup> Many other concrete measures are taken well before the accession year. These come through two key mechanisms, which are often negotiated and implemented in parallel.

1. Free or preferential trade agreements. While the EU has many different kinds and motivations for agreements, one form is especially designed for countries applying to join the EU and this intention is made explicit. These introduce free trade in almost all industrial products but not agriculture. As part of the process, countries must relinquish all other bilateral trade agreements.

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<sup>3</sup> This section draws on Ahearn (2010) and European Commission (2010).

<sup>4</sup> There are exceptions. It is the intention for many reforms (eg governance/corruption related) to be completed as a condition for entry. Some countries are thought to have secured entry with just the promise of further reforms.

2. Association agreements. Trade agreements are nested in a package known as association agreements, which are typically aimed at aligning legislation with that of the EU and recognizing intellectual property. For the Balkans, for example, this comes as part of a *Stabilization and Association Process*. Tellingly, an explicit objective is “to encourage the countries of the region to behave towards each other and work with each other in a manner comparable to the relationships that now exist between EU Member States.”<sup>5</sup> It also includes integration of these countries into regional infrastructure networks. A brief timeline is indicated below.

- Mid to late 90s: Countries who eventually become part of EU27 sign Association Agreements with EU (eg Hungary 1994, Romania and Bulgaria 1995, and the Baltics and Slovenia relatively in the late 90s).
- 1995 association agreement signed with Turkey; customs union formed on 31 December 1995.<sup>6</sup>
- Late 90s: Accession talks for some of the 2004 members begin; talks for others begin in early 00s.
- 1998: Ukraine-EU partnership and co-operation agreement (association agreement negotiations still underway as at end 2010).
- 2000: Prospects of joining EU mooted for Balkan countries in Zagreb, including intention to form Stabilization and Association Agreements (SAAs). 2003: Thessaloniki Agenda gives renewed impetus.
- 2004: Ten new members join the EU (Poland, Hungary, Czech Republic, Slovakia, Slovenia, Latvia, Lithuania, Estonia, Cyprus, Malta.)
- 2004: Former Yugoslav Republic of Macedonia signs SAA. It is the first (West) Balkan country to do so and others follow (Croatia 2005, Albania end 2006, Montenegro and Bosnia & Herzegovina 2008). Free trade still a work in progress.
- 2007: Bulgaria and Romania join EU27

During the period we study (up to 2008), official candidate countries are Croatia, Macedonia and Turkey. (Iceland and Montenegro have recently been granted candidate status). As noted, a number of Balkan countries have signed association agreements. Ukraine’s negotiations have stalled.

Integration with the EU cannot be viewed as a discrete change upon membership. The process of actual reforms precedes entry to a large extent and does so at a different pace for different countries. For those who joined in 2004 for example, tangible steps were taken a decade earlier.

## 2.2 Intermediates and income

Cross-country regression analysis shows a causal effect of trade on per-capita income and productivity (Frankel & Romer, 1999; Alcalá & Ciccone, 2004). There is also evidence that the sophistication of goods exports is associated with subsequent growth rates (Hausman, Hwang & Rodrik, 2007) and recent work has shown a similar pattern for the sophistication of services (Mishra, Lundstrom & Anand, 2011). We estimated a positive

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<sup>5</sup> Quoted from

[http://ec.europa.eu/enlargement/enlargement\\_process/accession\\_process/how\\_does\\_a\\_country\\_join\\_the\\_eu/sap/history\\_en.htm#1](http://ec.europa.eu/enlargement/enlargement_process/accession_process/how_does_a_country_join_the_eu/sap/history_en.htm#1)

<sup>6</sup> At the time, the EU15. As the EU enlarges, the customs union is automatically extended.

and significant relationship between GDP per capita and the sophistication of intermediate goods imported (0.69) or exported (0.74). We also find a positive and significant correlation between GDP per capita and the share of intermediates imports (0.12) or exports (0.15) of GDP.

We are not aware of a systematic cross-country econometric analysis of the links between intermediates trade and growth. However, there are a number of micro-level empirical studies linking access to imported intermediates with productivity. We briefly mention some that use European firm-level data. Marin (2010b) reports that intra-firm trade with Eastern European affiliates has allowed German firms to gain competitiveness. According to some of their estimates, productivity rose by more than 20%. Hansen (2010) constructs intra-firm tariffs and input tariffs in order to capture the off-shoring relationship between German or Austrian firms and their Eastern European affiliates. He finds that these tariff reductions, which are associated with EU enlargement, raised their total factor productivity.

Furthermore, German offshoring to Europe raised the productivity of the subsidiaries by almost threefold compared to local firms (Marin 2010b). Halpern, Koren & Szeidl (forthcoming) estimate that increasing the share of imported inputs raises Hungarian firms' productivity and that this is to a large extent driven by access to increased variety or complexity of inputs and not just volumes.

The above studies and correlations support the view that trade affects income through a number of channels, including access to cheaper or more varied inputs and technology / know-how acquisition. It is arguably the case that these channels are widest for trade in intermediates. Productivity growth within each firm is enhanced by improved access to inputs that are cheaper or more plentiful, of higher quality, and wider in variety as well as through technology and knowledge they embody (Grossman and Helpman 1991; Dixit & Stiglitz 1977, Feenstra , Markusen & Ziele, 1992).

International trade can directly provide a source of greater input quantities or these inputs may embody a higher level of technology than locally available ones. When part of a fragmented supply chain, relationships between producers and consumers of intermediates are likely to be closer. Therefore, there are stronger opportunities for transfers of best-practice production methods and other know-how to less-developed exporters from more developed customers than is the case for consumption goods. One should therefore expect a link between fragmentation – manifested in the form of intermediates trade quantities - and productivity or income.

Fragmentation can also be represented by IIIT. However, IIIT may capture increased differentiation of inputs and not necessarily the overall quantities (Jones & Kierzkowski, 2005). As in expanding variety models of endogenous growth (Romer, 1990; Ethier 1982) supported by empirical work by Feenstra & Kee (2004), the availability of a bigger variety of inputs is a source of increasing productivity and income.

Rather than a large range of inputs, gains can come in the form of access to better inputs. These may come in the form of high quality but also in terms of their complexity (Grossman & Helpman, 1991). They may be complex because the production of those inputs involved a more sophisticated and nuanced production process or better inputs themselves. For example, Nunn (2007) builds a measure of how much of a good consists of differentiated inputs. Hausman, Hwang & Rodrik (2007) construct indices of the sophistication of products based on how advanced the exporters of such products are.

In summary, we have provided evidence of a link between intermediates trade, productivity and income. We have discussed how intermediates trade can allow firms to increase output or productivity by having more of a given input, a greater variety of inputs, or inputs which are better because they are more complex or of a higher quality.

### 2.3 Integration and the quantity/nature of intermediates trade

Having reviewed how intermediates trade can influence income, this section investigates the links between integration and intermediates trade. Regional agreements tend to have a material impact on trade through a reduction in trade costs, including lower tariffs, waiting times and transport costs. For Europe, Egger & Larch (2011) calculate that integration increased trade within the region partly at the expense of trade with elsewhere and that it had a large impact on both GDP and welfare in the newer members but moderate impacts on the older members.<sup>7</sup> While the literature on integration, trade costs and trade volumes is vast, little attention has been paid to intermediates. We hypothesize how EU enlargement may have facilitated the volume and complexity of intermediates. For expositional purposes, we discuss separate channels below, but their existence and impact is not necessarily mutually exclusive.

I. Reduced waiting times and uncertainty (eg no internal borders).

This makes it relatively cheaper to source goods from another country. For intermediates in particular, it reduces the amount of money that needs to be held up in inventories or work-in-progress in transit. It also shortens response times, which is an important feature of flexible manufacturing and just-in-time processes. Therefore, reduced waiting times facilitate the fragmentation of production across borders.

Reduced waiting times also make it more affordable to commit working capital to high value-added intermediates in transit.

II. Home market effects and reductions in trade costs (free-trade)

Lower tariff levels, tariff complexity, and transport costs facilitate the trade of more varieties of products, including intermediates. This makes intermediates sourced from other countries more viable but also allows for alternative varieties of these differentiated inputs.

One explanation for intra-industry trade is increasing returns to scale. Industries exhibiting scale economies and incurring high transport costs tend to be located in bigger markets so that Western Europe would tend to be a net exporter of such products. This is known as the home market effect. However, access to lower wages and reduced trade costs could encourage the relocation of some industries further east, which would tend to expand intra-industry trade in the enlarged union.

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<sup>7</sup> General examples include Baier & Bergstrand (2007), Anderson & van Wincoop (2004), Freund & Orneleas (2010) and Behar & Venables (2011).

- III. The expanded EU also provides a larger testing ground for the introduction of new products. Export product discovery involves sunk costs (for finding importers, meeting product standards, marketing etc). The union would help lower the costs directly (by for example removing visa requirements for business travel and making the product standards requirements clear). It may also allow given costs to be amortized across a larger consistent market due to the harmonization across intra-EU borders. In these ways, integration can encourage more experimentation, which can result in more product varieties including intermediate products being available in more countries.
- IV. Deeper integration including an improved legal framework towards EU standards and cross-border harmonization (for example through the association agreements discussed). This makes it easier to build goods that are more complex, in the sense of requiring complicated relationships between the producers of various inputs used to make the product in the country. This increases the comparative advantage in such goods and hence exports of such goods.

By reducing transaction costs, harmonization facilitates the building of *cross-border* arms-length relationships and also reduces the within-firm co-ordination costs so that the boundaries of the entity can be extended across borders. As a consequence, harmonization allows a better mutual understanding of what might be expected from a complex product and there is a common understanding of the legal recourse to redress should requirements not be met. This encourages cross-border trade in more complex intermediates.

To clarify some of the phenomena we wish to investigate, we take an illustrative example from the automotive industry. Volkswagen (VW) acquired Skoda in 1991. Skoda has its own branded cars but also makes components for VW to use. These are hi-tech components, including transmissions and entire engines. One example is the Mlada Boleslav engine plant, which is part of an increasingly integrated supplier network. Milan Kocka from Ernst & Young, notes that the simple parts of the production process shifted east ten years ago and have continued to move further east. The Czech Republic has expanded towards higher value-added activities that are more complex technically.

Starting with the basics, VW helped Skoda transition into a market economy. VW allowed Skoda to benchmark its production practices against those of VW in Germany. The quality of Skoda's own cars has improved, overcoming a reputation for bad quality,<sup>8</sup> and the components are now shared in Skoda and VW cars. The Mlada Boleslav plant started making a cutting-edge 1.2TSI petrol forced-induction engine that can produce 77KW in 2009 and is the product of collaborative R&D. VW used to fear the loss of intellectual property, which limited their willingness to share technology and know-how, but the 1.2TSI is an example of how this has clearly changed.<sup>9</sup>

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<sup>8</sup> Their reputation motivated a joke. Why did the old Skodas have rear-window heating? So your hands didn't freeze when you pushed it.

<sup>9</sup> This case draws on the following sources: Ledgard (2005), Watson (2010) and Volkswagen (2010). For a more general discussion of the car industry in Europe, see Rhys (2004).

This case is an example of how VW outsourced the important and complex parts of a car to Central and Eastern Europe. This is an illustration of production moving beyond basic final assembly into sophisticated products. Skoda enjoyed process and quality improvements through contact with best practice, managed to engage in more complex activities, experienced transfers of intellectual property, and, crucially, sells sophisticated components to VW. The Czech auto-industry includes a broad and complex supplier network within its borders.

In line with some arguments above, Baldwin & Venables (2010) produce a theoretical model to show how reductions in trade costs beyond a threshold can result in discrete changes in location for stages of production. They note how many production chains are regional. Distances in Asia and Europe are both short so natural barriers are low. The fall of the iron curtain removed a high artificial barrier and EU enlargement removed many others. While points I-III are closely related to transport costs, IV is more about deeper integration. Marin (2006) records a rising share of intra-firm imports by Germany and Austria from Eastern Europe, which she ascribes in part to falling trade costs but also to lower corruption and improvements in the contracting environment in Eastern Europe.

While the VW-Skoda example and hypotheses are supported by theoretical work and country-specific empirical work, is there broader evidence on EU enlargement and intermediates? In a gravity framework, Martinez-Zarzoso, Voicu & Vidovic (2011) investigate the role of the EU in stimulating production networks in the machinery and equipment sectors. They produce evidence that (i) EU accession had a positive effect on intermediates imports by Central and Eastern European countries (CEECs), (ii) bilateral imports of intermediates are positively associated with bilateral exports of final goods and (iii) EU accession has a positive effect on CEEC final goods exports, an effect which is diminished once one controls for (ii). They also suggest that the effect of the EU on intermediates is higher than for final goods.

In a similar spirit, the quantitative analysis in this paper looks for more general evidence of this example. In particular, we search for evidence of

- Increased trade volumes as a whole and within the EU
- Shifts in the type of products, including the importance of intermediates (eg engines and not just cars)
- Increased incidence of intermediates intra-industry trade (eg engines being traded in both directions)
- Increased varieties of trade in intermediates (eg access to different engine varieties)
- Increased complexity of intermediates trade, where complexity can come in the form of
  - Sophistication of trade (making and exporting hi-tech engines)
  - Relationship-specificity of new members' exports (complex engine supplier networks)

### 3 Overview of data sources and construction

This section provides an outline of the data used and the measures constructed for the purposes of the paper.

#### 3.1 Scope of the data

The analysis considers trade within the full expanded EU27. We also examine separately the trade behavior of the 1995 EU members and the acceding countries. Of the newer members, our interest is primarily in the ten countries that joined the EU in 2004. This is mainly because our data coincides with the period covering their accession process (since the mid 90s) and formal joining. These countries are Czech Republic, Slovak Republic, Slovenia, Hungary, Poland, Latvia, Lithuania, Estonia, Cyprus and Malta and the group is referred to as “new members”, “2004 members” or the “NMS” (New Member States).

We also consider a group known as the “potential members”. This includes Bulgaria and Romania (because they only joined in 2007, towards the end of our data set), the Western Balkans (Albania, Bosnia & Herzegovina, Croatia, Macedonia and Yugoslavia – they are at various stages of accession), Turkey (which has a customs union with the EU and is an official accession candidate) and Ukraine (even though it has neither). This is a diverse group, so it is in some cases necessary to look at groups or countries within this group. We do not consider Iceland or Montenegro.

For comparison, we compute statistics for Asia using the nine countries studied by Kimura et al (2007). These are Japan, Hong Kong, Rep. of Korea, Singapore, Indonesia, Malaysia, Philippines, Thailand and China.

We mostly use data going back to 1996 as this is when it is reliably and consistently available for the 2004 members or potential members (except for Bosnia & Herzegovina, who start reporting in 2003).

#### 3.2 Intermediates trade volumes

To assess the importance of intermediates, we rely on the BEC nomenclature unless stated otherwise. This classification groups products into consumption goods, capital goods, and intermediate goods or leaves them unclassified (Figure 1). One disadvantage is that goods are classified according to expert judgment and, at this level of aggregation, may not fall neatly into one category. For example, it is not obvious whether fruits belong in the consumption or intermediates category. However, this approach has the advantage of covering a wide spectrum of goods trade. In contrast, studies identifying parts or components can only reliably do so for a subset of sectors (eg Kaminski & Ng, 2005; Kimura et al, 2007).

Classification by Broad Economic Categories (BEC)	Basic classes of goods in the System of National Accounts (SNA)
1 Food and beverages	
11 Primary	
111 Mainly for industry	Intermediate
112 Mainly for household consumption	Consumption
12 Processed	
121 Mainly for industry	Intermediates
122 Mainly for household consumption	Consumption
2 Industrial supplies not elsewhere specified	
21 Primary	Intermediate
22 Processed	Intermediate
3 Fuels and lubricants	
31 Primary	Intermediate
32 Processed	
321 Motor spirit	Not classified
322 Other	Intermediate
4 Capital goods (except transport equipment), and parts and accessories thereof	
41 Capital goods (except transport equipment)	Capital
42 Parts and accessories	Intermediate
5 Transport equipment, and parts and accessories thereof	
51 Passenger motor cars	Not classified
52 Other	
521 Industrial	Capital
522 Non-industrial	Consumption
53 Parts and accessories	Intermediate
6 Consumer goods not elsewhere specified	
61 Durable	Consumption
62 Semi-durable	Consumption
63 Non-durable	Consumption
7 Goods not elsewhere specified	Not classified

Figure 1: Table taken from Miroudot et al (2009)

### 3.3 Intra-industry trade

To measure intra-industry trade, we construct Grubel-Lloyd indices of intermediates intra-industry trade (IIIT), which is a measure of how much of a particular product or industry is both exported and imported by a pair of countries or regions.<sup>i</sup> Trade flows for each industry use SITC (Rev 2) 4-digit data. We used SITC-BEC concordance information to consider the subset of 4-digit products that are classified by the BEC nomenclature as intermediates.

The IIIT index measures the share of intermediates trade that a country has with its partners that is intra-industry. For example, if exports from country A to country B in a sector are 100 and imports are 50, then intra-industry trade in the sector between country A and B is 100 in that sector (50 of exports and 50 of imports). If all trade is completely balanced across sectors and countries, i.e. imports are equal to exports in every sector in every country the index takes the value of one. In contrast, if a country's exports to all trade partners are in different sectors from its imports, then the index will take a value of zero. Specifically, the index for a country is calculated as

$$(1) \quad IIIT_c = \frac{\sum_{p=1}^j \sum_{i=1}^k 2 * \min(x_{pi}, m_{pi})}{\sum_{p=1}^j \sum_{i=1}^k (x_{pi} + m_{pi})}$$

Where  $p$  is partner, and there are  $j$  partners;  $i$  is industry and there are  $k$  industries;  $x_{pi}$  is export to partner  $p$  in industry  $i$  and  $m_{pi}$  is import from partner  $p$  in industry  $i$ . The numerator is the sum of intermediates trade between a country and its partners that qualifies as intra-industry. The denominator is all intermediates trade for a country. The index can be aggregated up for a region as

$$(2) \quad IIIT_R = \frac{\sum_{c=1}^n \sum_{p=1}^j \sum_{i=1}^k 2 * \min(x_{pi}, m_{pi})}{\sum_{c=1}^n \sum_{p=1}^j \sum_{i=1}^k (x_{pi} + m_{pi})},$$

where  $c$  are the  $n$  countries in region  $R$ . The numerator is the sum of intermediates trade between the countries in a region with the world that qualifies as intra-industry. Note that intra-industry trade is still at the bilateral level. It is the sum of trade among all country pairs that is intra-industry, where one partner is in a given region. The denominator is the region's intermediates trade. We primarily use the aggregate numbers based on (2) but also calculated the average of the countries' IIITs in region  $R$ :

$$(3) \quad AVEIIIT_R = \frac{\sum_{c=1}^j IIIT_c}{n}$$

### 3.4 Complexity of intermediates

To investigate the complexity of intermediates, we develop two alternative measures.

The first measure of complexity is the sophistication of intermediates. To construct the sophistication measure for each product, we adapt the method in Hausman, Hwang & Rodrik (2007, pp9-10). They measure the sophistication of each product using the GDPs per capita of those countries who export it. Every product's share in each country's total exports is calculated. This share for the country is standardized by dividing it by the average share of this product for all countries. The key step is that this is multiplied by the GDP per capita of that country. Summing across all countries gives the sophistication of that product, known as *Prody*. The sophistication of a country's export basket, known as *Expy*, is calculated by multiplying the sophistication of each product by the share of that product in the country's exports and summing across all products. This is done for a cross section of countries at a single point in time. In this case, we took averages of GDP per capita (2005 PPP dollars sourced from the World Development Indicators) and exports over the years 2001-3. The sophistication of products is held fixed over time such that any changes observed by countries are due to changes in the export basket from year to year.

Our main adaptation restricts this to intermediates rather than all goods. For the BEC classification, we concentrate on those 4-digit SITC Rev. 2 goods classified by the BEC as intermediates. The summary statistics and diagnostics (not reported) are similar to those in Hausman et al (2007). To distinguish these measures of intermediates sophistication from those for all goods, we use the terms  $I\_Prody$  and  $I\_Expy$ . We also produce an analogue for imports and refer to it as  $I\_Impy$ . Mishra et al (2011) have a similar procedure for services trade.

The second measure of complexity is the relationship-specificity of products. This measure is due to Nunn (2007), who constructs the fraction of each product exported by a country that was itself made with

differentiated inputs within the country. The higher the fraction, the less regulated the process by which the good was put together. Because this requires more relationships, this gives the relationship-specificity of the product. Nunn's measures use input-output data to construct the share of each product that uses differentiated inputs as defined by Rauch (1999) and the underlying data are taken from Nathan Nunn's website:

[http://www.economics.harvard.edu/faculty/nunn/data\\_nunn](http://www.economics.harvard.edu/faculty/nunn/data_nunn)

In particular, we use his constructed measures for 3-digit ISIC data and map them to our 4-digit data using the appropriate concordance information. We are interested primarily in the fraction of intermediates using differentiated inputs and make use of a further concordance to BEC-defined intermediates categories to construct our index of relationship-specificity of intermediates (*RSI*).

The two measures provide alternative accounts of the complexity of the products being traded. The *RSI*, which is affected by the rule of law and other behind the border factors, accounts for the complexity of production chains *within* a country. It therefore does not matter whether these chains are complete (exports of final goods) or part of a broader chain (intermediates). Therefore, even if we consider cross-border trade in all goods, the *RSI* still speaks to the complexity of the steps needed to make those goods. The sophistication measure, which can be influenced by harmonization as well as reduced cross-border trade costs, incorporates the complexity of trade *across* countries. Because this reduces co-ordination costs within a cross-border supply chain, we would expect to see a disproportionate effect on intermediates.

## 4 TRADE QUANTITIES

### 4.1 Total trade

Trade:GDP ratios have risen worldwide and Europe is no exception. For the EU15, the ratio rose from 45% to 54% from the late 90s to the late 00s. For the 2004 members, the ratio rose from 63% to 94%. For the potential members, the change was smaller, rising from 43% to 52%. Trade within the EU27 also rose – the export:GDP ratio increased from 15 to 19% – but this masks an asymmetry within the union. As Figure 2 shows, exports from the EU15 to the NMS as a share of total exports doubled over the period, reflecting how the 2004 members became increasingly important for old Europe.

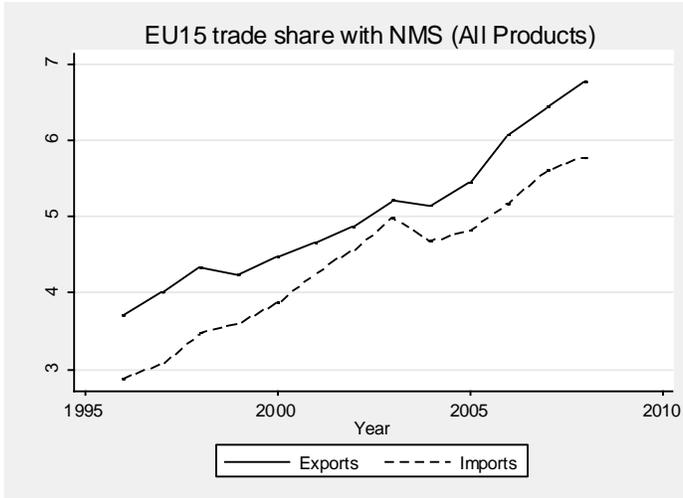


Figure 2: Authors' calculations using BEC Nomenclature and UN COMTRADE data

In contrast, Figure 3 indicates declining importance of old Europe for the new members. It is important to note that the large and proximate markets are still important destinations and sources of goods but, due in part to relatively slow GDP growth, their importance has been falling since the turn of the century.

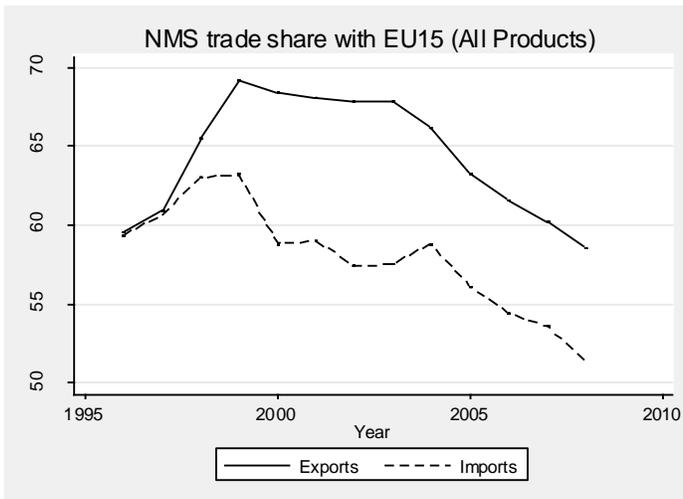


Figure 3: Authors' calculations using BEC Nomenclature and UN COMTRADE data

## 4.2 Sectoral shifts

Have there been sectoral shifts in the composition of goods traded within the EU and with the rest of the world? To investigate this, we use SITC (Rev 2) data disaggregated at the 1-digit level. For the 2004 members, Machinery & Transport equipment comprise more than a third of imports (Figure 4). The proportion has risen slightly, but the absolute and relative decrease in the height of the darker portion indicates a relative shift away

from the EU15 as a source of this product category. The importance of the EU15 has fallen across the other sectors due in part to shifts away from these sectors and in part to the decreased importance of the EU15 for all products, which we noted earlier.

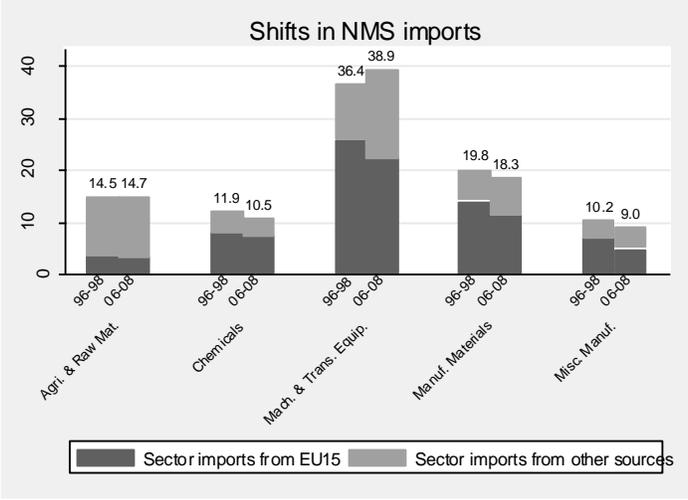


Figure 4: Authors’ calculations using 1-digit SITC (Rev 2) data from UN COMTRADE. Codes 0-4 aggregated into an agriculture and raw materials grouping. Period averages for the years 1996-1998 and 2006-2008.

New members’ exports saw a more marked shift towards Machinery & Transport (SITC code 7), such that it now comprises almost half of all NMS exports. Exports of only this category to the EU15 comprise 30% of exports of all products to all destinations (Figure 5). Furthermore, this sector accounts for more than half of exports bound only for the EU15. For the EU15, this sector has become a slightly less important part of worldwide imports. Despite this, machinery & transport equipment sourced from the new members has almost tripled as a share of all products from all sources.

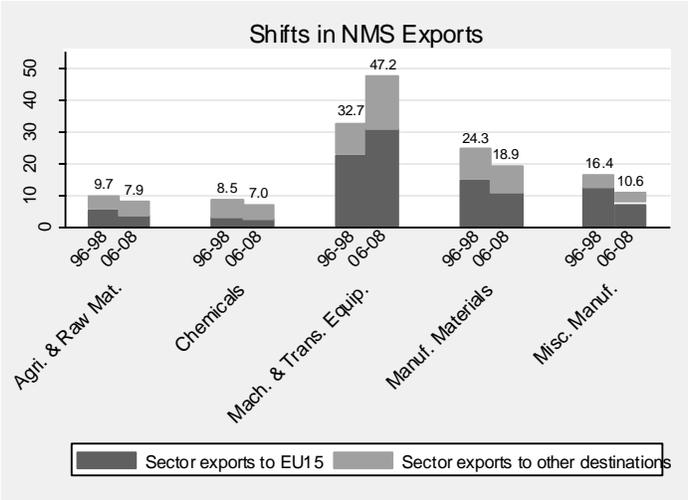


Figure 5: Authors’ calculations using 1-digit SITC (Rev 2) data from UN COMTRADE. Codes 0-4 aggregated into an agriculture and raw materials grouping. Period averages for the years 1996-1998 and 2006-2008.

Focusing on the machinery and transport sector, Figure 6 illustrates its importance in the basket of goods shipped from the 2004 members to the EU15. However, it suggests the transition had run its course by 2002 and that its importance in the basket of goods shipped from potential members has continued growing towards a third.

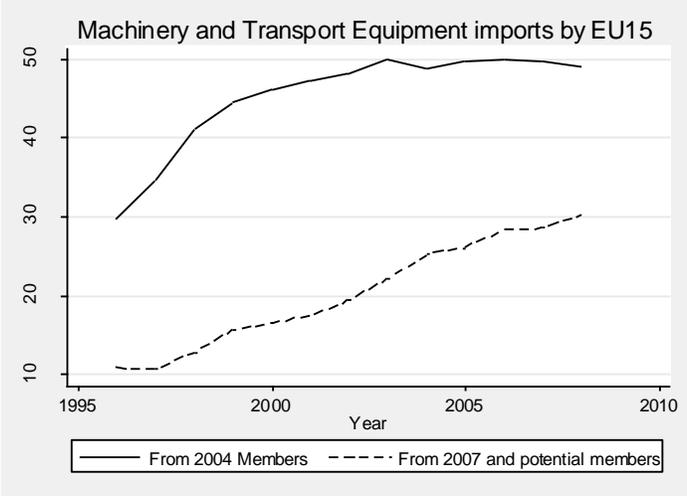


Figure 6: Authors’ calculations using 1-digit SITC (Rev 2) data (SITC code 7) from UN COMTRADE.

Machinery and Transport Equipment includes cars and other road vehicles, from which we took our illustrative VW-Skoda example. Figure 8 indicates a substantial rise in the importance of Passenger cars in 2004 members’ exports, where the share almost doubled. For the 2004 members, this segment has a higher share than for all other regions including Asia. Furthermore, the potential members of the EU (EUP) have seen a very large rise in both exports and imports, but we note that this is driven by Turkey.<sup>10</sup> For the 2004 members, the importance of cars in the EU15-headed export basket is higher than worldwide and grew relatively fast at least since 2004 (Figure 8).

<sup>10</sup> By this measure, exports for Turkey are more than ten times those of the next biggest exporter in this category (Romania), which in turn is much bigger than the third biggest. Turkey’s car exports more than tripled and the share went from 0.7% to 6.7%. Entry into the customs unions 31 December 1995 may have had a lot to do with this. For the other countries, cars are a small part of exports and are unimportant for the region’s car trade.

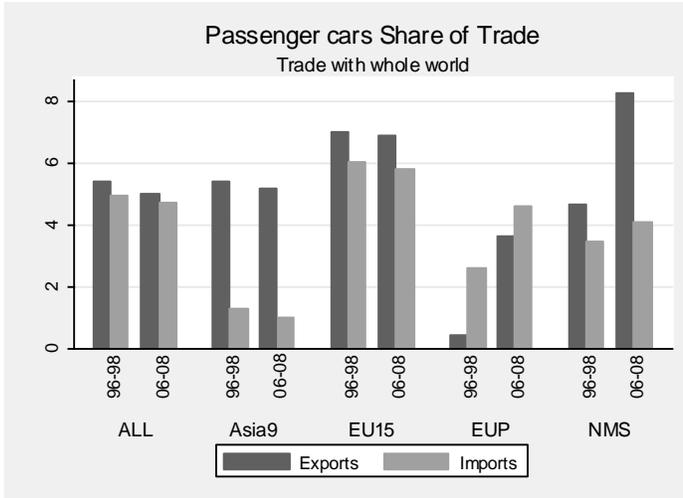


Figure 7: Authors' calculations using BEC classification code 51 for Passenger Motor Cars and UN COMTRADE.

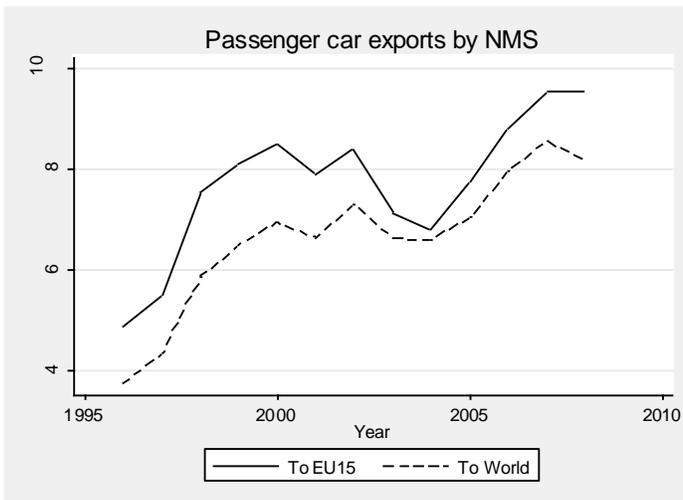


Figure 8: Calculations using BEC classification code 51 for Passenger Motor Cars and UN COMTRADE.

Using an alternative measure, the share of Road vehicles (which includes cars) in Machinery & Transport Equipment (SITC code 7) is not dominant but rising. For 2004 members' exports to the EU15 (Figure 9), this has risen from about a quarter to a third, so part of the shift to machinery/transport is due to the production of cars or road transport. For the 2007 and prospective members, the ratio appears to have risen steeply. However, this is driven by Turkey, whose share rose steeply to over 50% and whose automotive exports<sup>11</sup> dominate the other countries in volume terms.

<sup>11</sup> This is based on the share of SITC code 78 in 7 but also draws on a number of previous exercises, which use the Kimura et al (2007) definition. They use selected 4-digit codes and define intermediates according to whether the word "part" or "component" appears in the product description, The 4-digit codes are not a strict subset of 2-digit code 78.

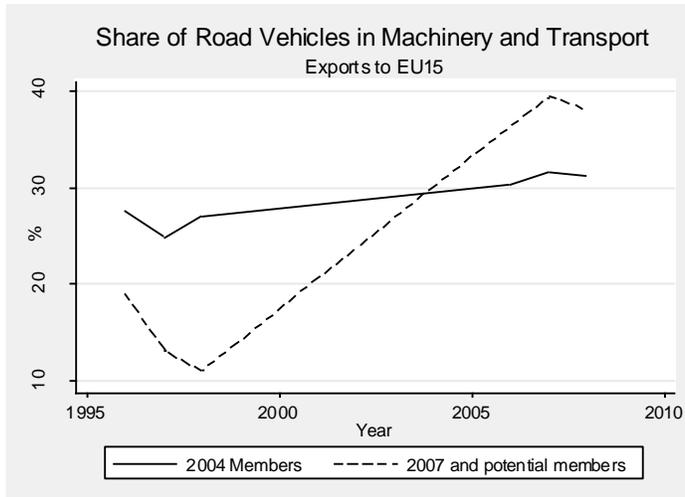


Figure 9: Authors' calculations using SITC code 7 (Machinery & Transport Equipment) and SITC code 78 (Road vehicles) and UN COMTRADE.

### 4.3 Intermediates

We calculate that the share of intermediates in worldwide GDP grew by a third from 9% to 12%. For OECD countries, growth was relatively slow from 8% to 10%. For the 2004 members, the share rose from 15% to almost 25%. At 21%, Asia's ratio is lower despite doubling. To compare 'Factory Europe' with 'Factory Asia', we consider trade in intermediates within the respective regions.<sup>12</sup> Figure 10 shows that the proportion of EU27 output traded across borders as intermediates did rise, but the proportion in Asia overtook it in 2004 such that it is more than 10%.<sup>13</sup>

<sup>12</sup> Intermediates to the world as a share of GDP for the EU27 rose modestly from 12% to 14%. In other words, this is more about the NMS vs the EU27 than about regional trade vs total trade.

<sup>13</sup> This measure divides by GDP to control for total output (supply capacity) but within-region calculations arguably should divide by the square of GDP to account for total demand as well. Doing so does not affect the main conclusions.

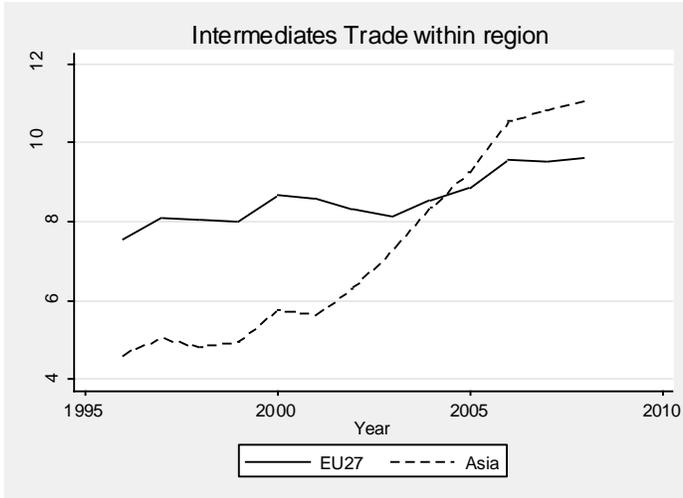


Figure 10: Authors' calculations using current GDP values from the World Development Indicators and The BEC Intermediates Nomenclature from UN COMTRADE

While intermediates appear to have become more important relative to GDP over time, a very different picture emerges when comparing intermediates trade to total goods trade. The importance of intermediates in the basket of all goods traded within the EU27 is no higher than in the late 90s. However, there seems to have been a steady rise since the early 2000s (Figure 11). Asia, in contrast, has experienced a consistent increase such that two thirds of goods traded within the region are intermediates. This pattern for Asia is consistent with Gill & Kharas (2007).

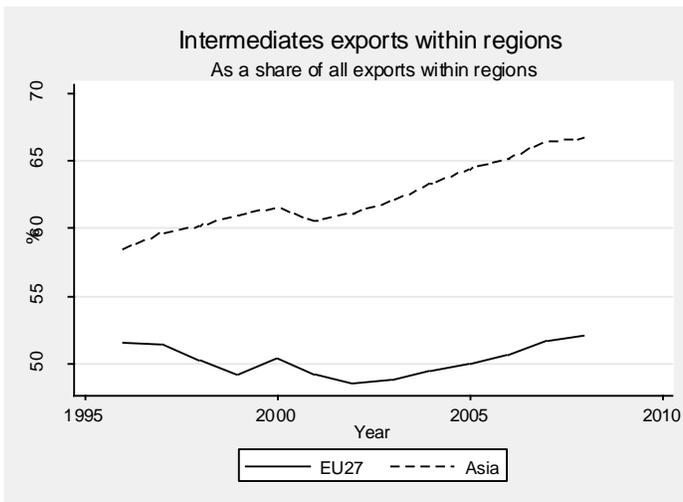


Figure 11: Authors' calculations using BEC Nomenclature and UN COMTRADE data.

Figure 12 shows intermediates trade with the world rather than within regions. For all three European groupings, the changes are barely noticeable. (In fact, EU27 intermediates exports shares to the whole world were 50.6% in both periods and import shares rose from 55% to 57%). While Asia’s intermediate exports share to the world fell by less than 1% to 51%, import shares rose dramatically from 64% to 73%. Furthermore, prospective EU members (EUP) saw only a small rise in the intermediates exports share together with a fall in the intermediates imports share. Worldwide, the importance of intermediates rose only slightly from 56% to 60% (using import data).

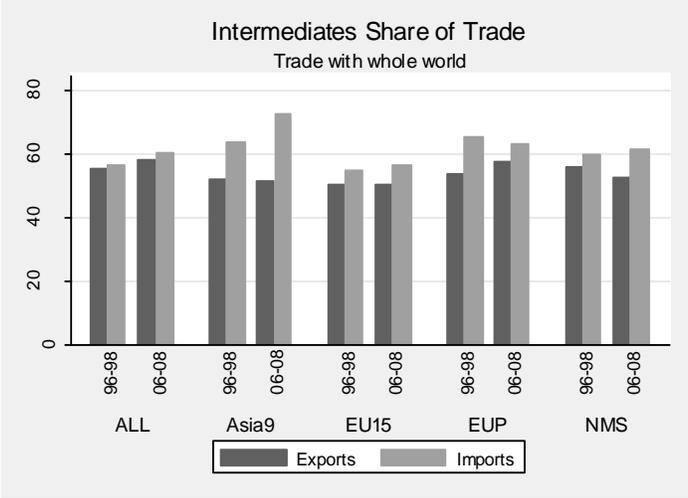


Figure 12: Authors’ calculations using BEC Nomenclature taken from UN COMTRADE.

We listed a number of examples of products with multiple stages of production and the data on the share of intermediates in total trade is consistent with these anecdotes. However, the data suggest the rises are more modest than popularly believed. Outside of Asia, it is far from clear that production has become *more* fragmented in recent times. While the Ipod is a new product whose production is shared across multiple borders, the data does not provide evidence that increased fragmentation generalizes across more goods.

Our results are consistent with other work. Mirodout et al (2009) record that the share of intermediates in total exports was consistently about 55% since 1995 for the OECD.<sup>14</sup> Over a more limited period, they find that the share of intermediates in services was also flat. Curran & Zignago (2009) also show a constant share within Europe. However, Baldwin & Venables (2010) argue that macroeconomic data does not capture this particular phenomenon well.

Turning instead to firm-level data used by Marin (2006), the indicators of fragmentation were high for Germany. However, they were far higher in Germany than Austria – the two countries in their dataset – and it is not clear that this would apply to firms in other Western European countries rather than Germany being a special case. Besides, they have information on inputs flowing from East to West and not vice versa. In Hungary, more firms

<sup>14</sup> For a longer-term perspective, Hummels et al (2001) report that intermediates as a share fell from 1970 to 1992 but cite Yeats (1998), whose parts-based measure shows a rise. Using their preferred I-O based measure, vertical specialization as a share of exports rose from 16.5% to 21% in ten OECD countries. This occurred across many sectors and countries and is not due to compositional shifts.

started importing intermediates between 1992 and 2003 goods (Halpern et al, forthcoming) but we do not know where the imports came from nor how this compares to final goods. Thus, while the macroeconomic data may have deficiencies, we are not yet aware of strong evidence of rises from other types of data.

Returning to the macroeconomic data, the patterns presented so far mask a number of asymmetries and geographical shifts. Figure 13 demonstrates that the new members form an increasingly important market for EU15 intermediate products. The rise of 60% over the period in the figure is the same as for all goods (which we showed in Figure 3) but is more than for consumption goods (results available on request). Similarly, the figure shows the EU15 is sourcing more of its intermediates from the new members, but there was a slow down since the early 2000s and the pattern also applies to consumption goods (results available on request).

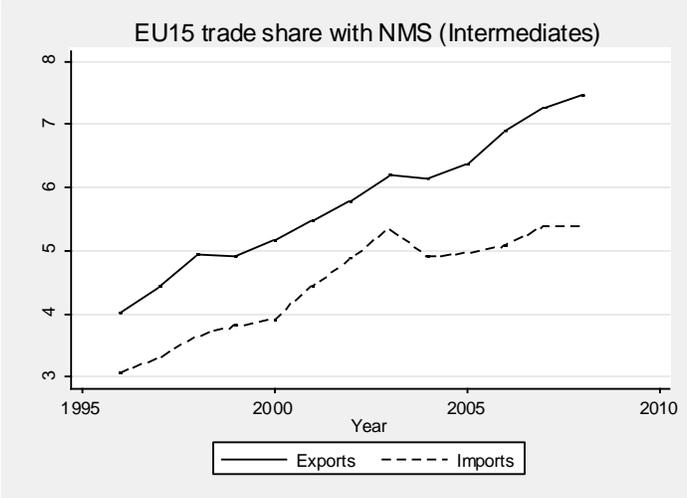


Figure 13: Authors’ calculations using BEC Nomenclature and UN COMTRADE data

The importance of the EU15 for the new members is falling. In Figure 14, the new members now import less than half of their intermediates from the EU15. This fall from above 60% is quicker than the fall for consumption goods (58% in 1996-8 to 54% in 2006-8). As we saw for all goods, the share of intermediates sent to the EU15 rose and then fell such that it was at the same level in the late 00s as in the late 90s.

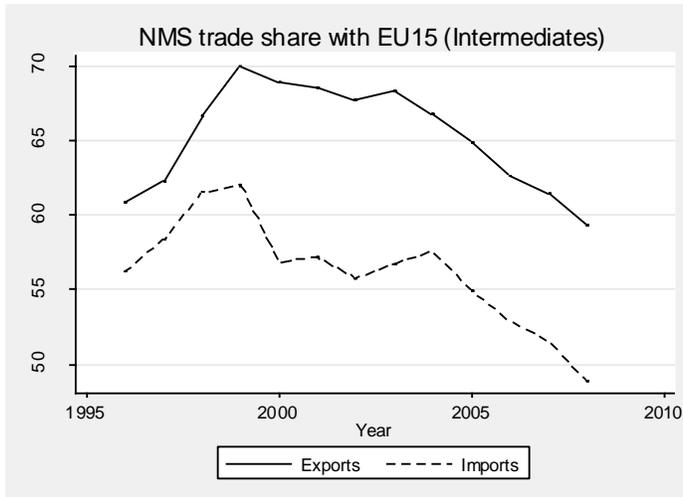


Figure 14: Authors' calculations using BEC Nomenclature and UN COMTRADE data

While we have recorded an asymmetry between the EU15 and new members over time, Gill & Kharas (2007) document an interesting asymmetry in intra-Asian trade. They show that intermediates tend to be imported by China from the rest of the region (especially from Japan and the newly industrialized economies) such that it runs a trade deficit with the region. In turn, China exports finished goods to the rest of the world including the EU and United States such that it runs a trade deficit with the rest of the world. We used information on trade balances (including intermediates) in search of a European analogue. The new members have trade deficits with the region and the rest of the world while Germany has trade surpluses with both the region and the rest of the world. There is therefore no prima facie evidence of a large country or group of countries taking on the role of China in Europe.

Earlier, we recorded a sectoral shift towards product code SITC 7 including transport equipment or passenger cars. Because the BEC nomenclature includes car parts and accessories, it does not classify code 51 as an intermediate, capital or consumption good. However, we follow Kimura et al (2007) and Kamniski & Ng (2005) to study the share of parts and components in automotive exports.<sup>15</sup> The share of components in automotive exports from the 2004 members to the EU15 rose from less than 40% in 1996 to 50% in 1997 and over 60% in 2003 before falling back towards 50% in 2007. This hump shape, which results in unchanged components shares, is consistent with what we found for intermediates.<sup>16</sup> Beyond the automotive sector, we also saw no material rise in the share of components in manufacturing. Results are available on request.

In summary, intermediates are an important part of trade in the EU. The new members are becoming increasingly important sources of EU15 intermediate inputs as well as more important markets for them, but the

<sup>15</sup> This uses a number of 4-digit SITC codes and is not a strict subset of code 78.

<sup>16</sup> Many 2007/potential members have very high parts shares (over 80%) but Turkey's share fell dramatically from 70% to 25%, possibly because of more final car sales or, perhaps, the move from CKD or SKD units to final cars after joining the customs union.

EU15 is not becoming correspondingly more important relative to other locations for the new members. Further, these phenomena are by and large reflective of all products and not just intermediates. Within the enlarged EU, the importance of intermediates in total trade has not changed but this is in the context of only modest rises worldwide.

## 5 THE NATURE OF INTERMEDIATES TRADE

### 5.1 IIIT and variety

Figure 15 presents Grubel-Lloyd indices of intermediates intra-industry trade (IIIT), which we construct using the method described in Section 3.3. IIIT between the NMS and EU15 (with data from the new member countries) is higher than for the world. It also rose since the late 1990s albeit at an imperceptibly higher rate than to the whole world. This 22% rise for intermediates is also higher than that for all products, which we report is 15%. A sharper contrast is visible from the point of view of the EU15. IIIT with the NMS (as measured using EU15 data, which in theory would be the same as the solid line), rose by about 30%. In contrast, IIIT with the world as a whole actually fell over the period. The rise in IIIT with the NMS also exceeded that for all products.<sup>17</sup>

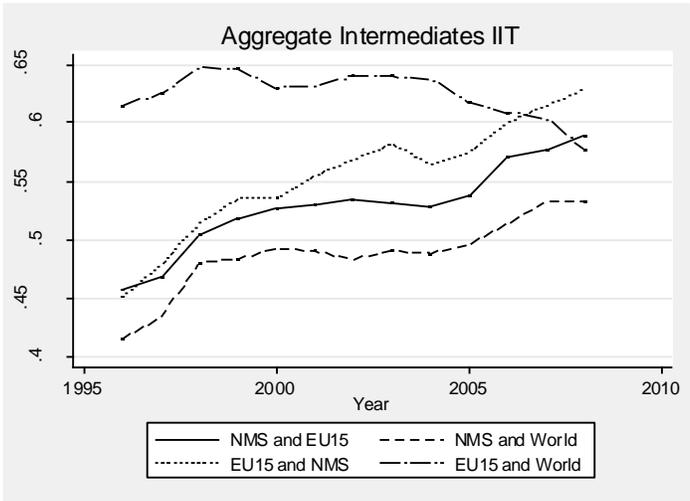


Figure 15: Authors’ calculations using SITC (Rev 2) 4-digit data, BEC-SITC concordances and UN COMTRADE data. Regional aggregates.

We see in Figure 16 that the 2007 joiners have higher IIIT with the EU15 than the Ukraine, Turkey or the Balkans. Romania’s IIIT grew fast and is at a similar level as that between the 2004 members and the EU15 in Figure 15.

<sup>17</sup> With averages rather than aggregate, the importance of the NMS for EU15 is preserved but the small differences between EU15 and the world and between total/intermediate goods from the point of view of the new members are clouded.

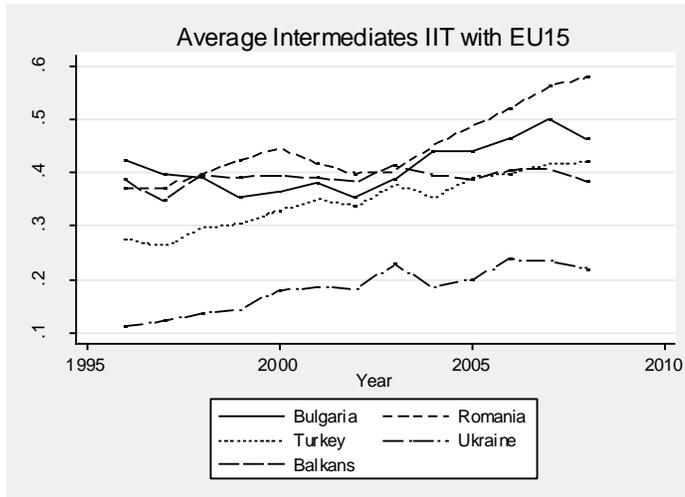


Figure 16: Authors' calculations using SITC (Rev 2) 4-digit data, BEC-SITC concordances and UN COMTRADE data. Regional aggregates for the Balkans.

One interpretation of intra-industry trade is that this is due to fragmentation of production. The rise in EU15-NMS IIIT is consistent with what we observed for intermediates in the EU15, for whom the relative importance of the new members rose. An alternative interpretation of IIIT is increased horizontal differentiation in intermediates trade (Jones & Kierzkowski, 2005), which can manifest itself through the number of varieties sold. To investigate this possibility, we count the number of intermediates varieties traded.

On balance, the evidence suggests the new members are sending a broader range of intermediates to the EU15 than before. Nine out of thirteen<sup>18</sup> EU15 countries increased the variety of intermediates they source from the new members. As shown in Table 1, the simple average across the importers rose from 1718 to 1807. Similarly, seven out of ten new members increased the variety of goods sent to the EU15 and, as shown in the table, the simple average rose from 1482 to 1591. In aggregate, the picture is less clear, with the EU15 region as a whole appearing to import slightly fewer products according to import data but importing slightly more according to new member export data. So, while the picture for the region is mixed, more EU15 countries are receiving more varieties from more 2004 members.

In contrast to Table 1, the variety of goods shipped by the new members (in aggregate or on average) to the world as a whole fell. The variety of goods imported by the EU15 from the world also fell. In other words, a bigger share of EU15 intermediate varieties is coming from the new members and a larger share of new members' intermediate varieties is destined for the EU15.

<sup>18</sup> We exclude Belgium and Luxembourg.

Table 1: Variety of intermediate goods sent from 2004 members to EU15

	1996-1998	2006-2008
Average EU15 imports	1718	1807
Average NMS exports	1482	1591
Aggregate EU15 imports	2997	2942
Aggregate NMS exports	2914	2924

Notes: Average EU15 imports is simple mean across EU15 importers, average NMS exports is average across 2004 member country exporters; aggregates are for the whole region using either EU15 import data or 2004 members export data. HS96 6-digit data for those products classified as intermediates by the BEC nomenclature. Source: UN COMTRADE and HS-BEC concordances.

This phenomenon is not confined to intermediates. The variety of consumption goods exported by the new members to the EU15 rose by a similar amount as intermediates. However, the variety of consumer goods sent to the world as a whole also rose, so the redirection of varieties towards the EU15 is more of an intermediates phenomenon.

Having discussed varieties of intermediate goods sent from the 2004 members to the EU15, we briefly discuss the flow of varieties in the opposite direction in Table 1. The data are mixed but on balance suggest a fall in the variety of products being sent by the EU15 to the 2004 members. Aggregate measures and the average across EU15 exporters point to a fall while the average across 2004 importers implies a rise. The variety of intermediates exported by the EU15 to the whole world also fell, so this may reflect a pattern of specialization rather than a re-orientation away from the new members.

Using SITC Rev 3 data at the 5-digit level for Machinery and Transport Equipment (codes 7 and 8) and identifying those codes corresponding to parts and components, Martinez-Zarzoso, Voicu & Vidovic (2011) see a rise in the variety of intermediates exported from six Central and Eastern European countries to the EU at the same time as a fall in the varieties exported to non-EU OECD countries. This is broadly consistent with our results. However, for imports, our results differ. They also find a rise in the number of varieties imported by their six countries from the EU at the same time as a fall in the variety of imports from non-EU OECD countries.

We saw IIIT between EU and NMS and found evidence that this is in part due to the 2004 members supplying a greater quantity of intermediates to the EU15 and also being a bigger market for the EU15. We also found evidence that the variety of goods sent from the new members to the EU15 rose, but not vice versa. These product variety counts can point to horizontal differentiation but, at the 6 digit level, may not be able to disclose increased vertical differentiation, which can come in the form of product quality. For this reason, we consider related measures of what we call product complexity.

## 5.2 Complexity

This section analyzes the complexity of intermediates using two measures described in Section 3.4. The first is the sophistication of a country’s basket of intermediates traded using the  $I\_Expy$  and  $I\_Impy$ . The second is the relationship-specificity of the process used to make the intermediate product exported using the  $RSI$ .

Figure 17 shows the sophistication of NMS exports to the EU15 as measured by the  $I\_Expy$  rose by about 15% since 1996 and remained flat since 2005. The figure also shows sophistication of NMS exports to the EU15 rose faster than to the world (exports to the world outside Europe fell). Although the  $I\_Expy$  for NMS exports flattens out, this coincides with a fall in the sophistication of EU15 imports from the world since 2000. The figure uses world export data but is similar for EU15 import data.

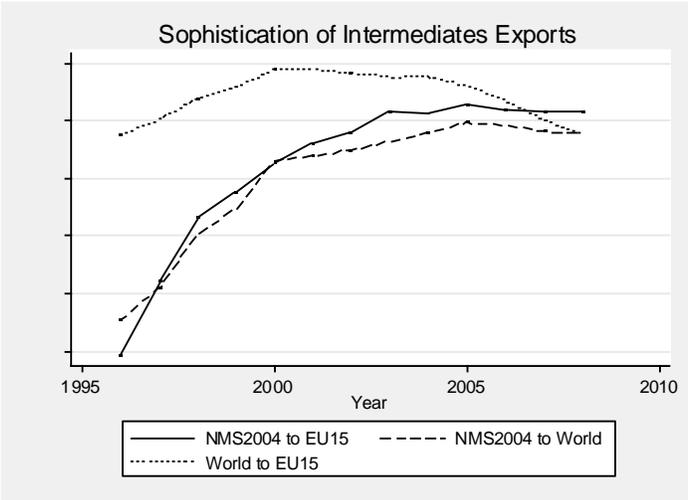


Figure 17: Authors’ calculations using UN COMTRADE, World Development Indicators and BEC Nomenclature.

For EU15 exports to the whole world, the  $I\_Expy$  is barely changed relative to 1996 after a steady decline since 2000 (Figure 18). In contrast, the sophistication of EU15 exports to the 2004 members has risen by 7% over the period despite a slight decline since 2004 (as measured by the  $I\_Impy$  for the NMS). The 2004 members also imported increasingly sophisticated intermediates from the rest of the world such that the increase from the EU15 was only marginally faster. Echoing an asymmetry from earlier, changes in the nature of goods received by the new members are not specifically those coming from EU15. In contrast, from the perspective of the EU15, the new members are becoming an increasingly sophisticated source and market relative to other regions.

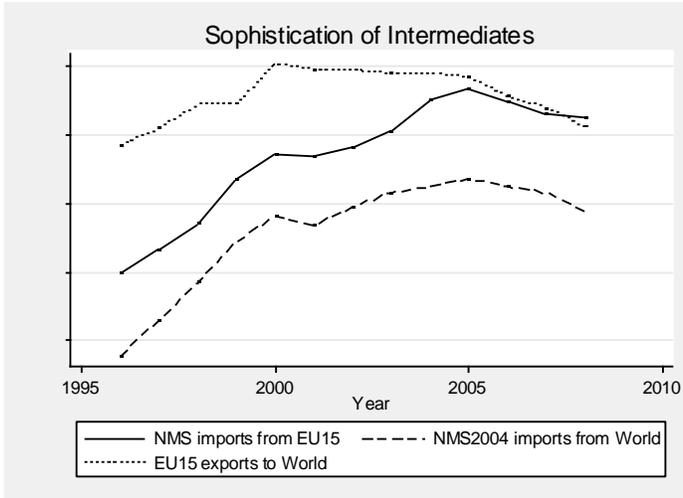


Figure 18: Authors' calculations using UN COMTRADE, World Development Indicators and BEC Nomenclature

Figure 19 reproduces the sophistication of 2004 members' intermediates exports to and imports from the EU15 and compares them to consumption goods. The analogues for consumption are denoted by  $C\_Expy$  and  $C\_Impy$ . We can see that the evolution of consumption sophistication stutters over time such that both measures are only slightly higher than at the start of the period. While the patterns are cyclical, consumption imports have in particular shown a decline in sophistication of late. So it appears that this important pattern for intermediates is not pervasive across all goods.

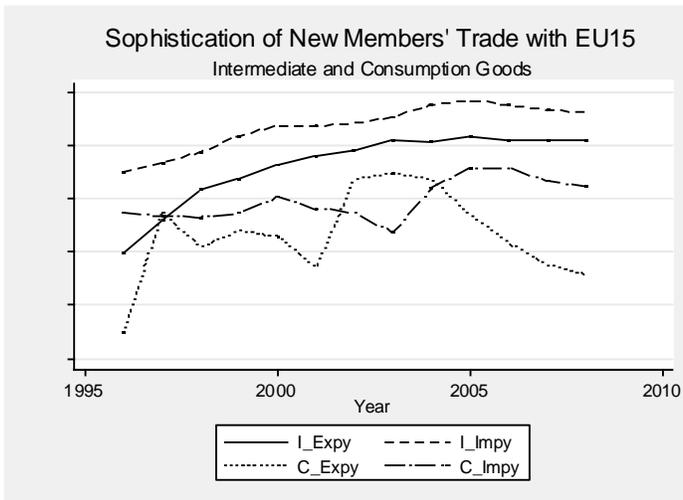


Figure 19: Authors' calculations using UN COMTRADE, World Development Indicators and BEC Nomenclature.  $I\_Expy$  refers to NMS intermediates exports to the EU15,  $I\_Impy$  refers to NMS intermediates imports from the EU15.  $C\_Expy$  refers to NMS exports of consumption goods to the EU15.  $C\_Impy$  refers to NMS imports of consumption goods from the EU15.

Finally, the sophistication of intermediates in the potential members has also grown overall (Figure 20). It is important to note that these results, for both exports and imports, are largely influenced by Turkey. This is in part because of its size but also because its sophistication is the highest in levels and has shown the clearest

upward trend. The other countries in this group, including 2007 joiners Bulgaria and Romania, have experienced far less confident rises.

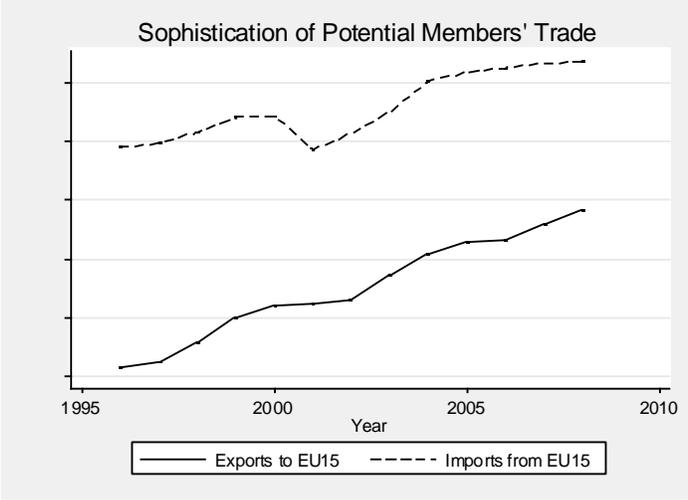


Figure 20: Authors’ calculations using UN COMTRADE, World Development Indicators and BEC Nomenclature

Figure 21 plots our second measure of complexity based on the relationship specificity of intermediates (*RSI*). It presents the fraction of differentiated inputs embodied in the products exported. As we noted in Section 3.4, this pattern we are looking for applies to exports of any kind of product, which is why we display the statistics for total trade. We also display the statistics for the subset of intermediate products for comparison with the rest of the paper. Consistent with the discussion in Section 3.4, our results for all goods or just intermediates are very similar. The figure shows the *RSI* for the world’s exports fell (by less than one percentage point to 69% for all goods and 63% for intermediates) while that of the new members rose (by seven percentage points to 70% for all goods and by six percentage points to 67% for intermediates). For intermediates exports in particular, the new members’ exports have a higher *RSI* than the world as a whole. Potential members have less complex exports but have experienced a fast proportional rise.<sup>19</sup>

<sup>19</sup> Interestingly, while Turkey was driving the previous results on sophistication in intermediates, its rise of 12% for intermediates is not the highest here. In fact, Romania (28%) and Bulgaria (13%) had the biggest rises. This may not be surprising since the *RS* measure is a potentially strong indicator of deeper integration that goes beyond a customs union.

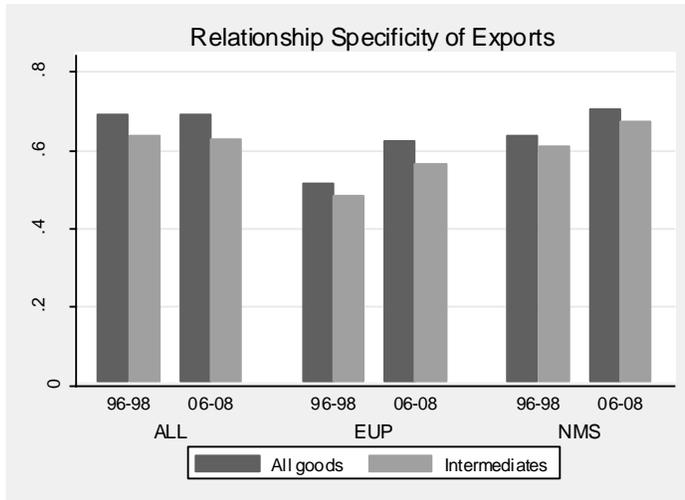


Figure 21: Authors' calculations using BEC-SITC concordances and data taken from [http://www.economics.harvard.edu/faculty/nunn/data\\_nunn](http://www.economics.harvard.edu/faculty/nunn/data_nunn)

Because integration allowed the 2004 members to produce more relationship-specific goods, the EU15 can source relatively more relationship-specific products from them. We confirm this in Figure 22, which shows a rise in the *RSI* to (by six percentage points to 69% for intermediates and by five percentage points to 72% for all goods) alongside a marginal fall (to 61% and 68%) in the relationship-specificity of the goods received from all countries by the EU15.

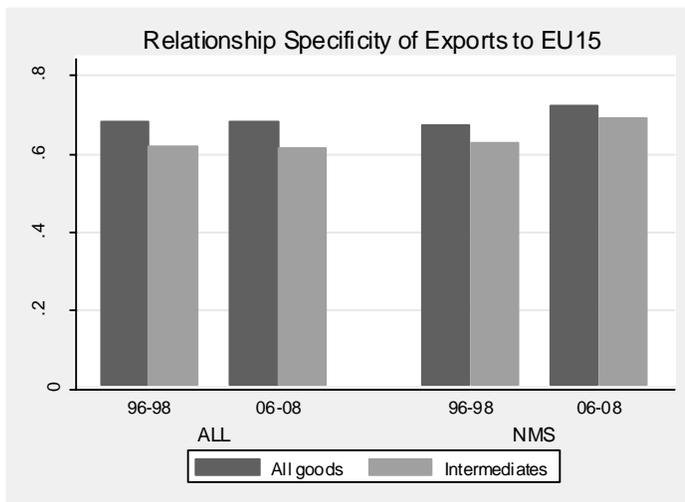


Figure 22: Authors' calculations using BEC-SITC concordances and data taken from [http://www.economics.harvard.edu/faculty/nunn/data\\_nunn](http://www.economics.harvard.edu/faculty/nunn/data_nunn)

Although the mechanisms and concepts of complexity are different, this finding using *RSI* is consistent with our finding that the goods imported by the EU15 from the new members are increasingly sophisticated. Overall, this suggests that the EU15 is assigning increasingly complex tasks to the new members.

## 6 CONCLUSION

To summarize our findings, we refer to the patterns we set out to find in Section 2.3. We have found evidence of:

- Increased trade volumes as a whole and within the EU as a share of GDP. EU15 exports to the NMS as a share of exports worldwide doubled over the period, yet the EU15 has become a less important trading partner for the NMS relative to the rest of the world.
- Shifts towards machinery and transport equipment such that they now comprise almost half of NMS exports. However, while intermediates comprise over half of intra-EU goods trade, this proportion is not higher than in the mid 1990s. Intermediates do not comprise a bigger share of the EU's export basket to the world than they used to. There is also an asymmetry in the evolution of intermediates trade, with the NMS being a more important destination for and source of intermediates for the EU15 and the EU15 being less significant as an intermediates trading partner.
- Increased IIIT between the NMS and EU15, whose rise of 22% is faster than IIIT between the EU15 and the world as a whole but not faster than the rise between the NMS and the world.
- More intermediate product varieties sent from the NMS to the EU15 at the same time as fewer products traded with the rest of the world.
- Increased complexity of intermediates trade.
  - The sophistication of intermediates exports from the NMS to the EU15 rose by 15%, which is faster than exports to elsewhere and of late coincides with lower sophistication of EU15 imports from elsewhere. Similarly, EU15 exports to the NMS became 7% more sophisticated while EU15 exports to the world as a whole were unchanged.
  - New members' exports embody more complex relationships. The share of differentiated inputs in NMS exports rose five percentage points at the same time as the share in world exports fell.

We argued that EU integration is a gradual process and proposed that enlargement would affect the quantity and nature of intermediates trade through (I) reduced waiting times and uncertainty, (II) home market effects and reduced trade costs, (III) larger testing grounds for new products and (IV) deeper integration and behind-the-border changes.

Our finding that the goods being traded are increasingly sophisticated is indicative of the deeper integration associated with cross-border harmonization and our finding that new members' exports are more relationship-specific points to behind-the-border reforms like an improved legal framework. Harmonization would tend to have a proportionately larger effect on intra-EU trade, while behind-the-border reforms can raise new members' trade with all destinations, not just the EU. Together with the fact that the world's fastest growing economies are not in Western Europe, this may be a reason for the asymmetries in our results, namely the rise in the importance of the NMS for the EU but not the reverse.

The increased varieties of goods traded are consistent with the view that the expanded EU provides a larger testing ground, but can also be due to reductions in trade costs. Furthermore, increased IIIT and trade volumes are associated with lower transport costs and reduced waiting times. However, the data do not provide

evidence that enlargement has disproportionately encouraged intermediates goods trade through reduced waiting times, uncertainty or transport costs.

The finding that the importance of intermediates has remained constant is a global pattern. This does not support the popular narrative that world trade has become increasingly fragmented. Alternative analysis may uncover evidence of such a rise for the world or specific regions other than Asia and may even find a link with EU enlargement by using different methods or data. For example, a more illuminating analysis of fragmentation could be available if cross-border trade was measured in value added terms or if we had the relevant firm-level information for a variety of EU countries.

Nonetheless, on the basis of the evidence in this paper, integration has affected the complexity of intermediates traded more than their quantity. Factory Europe has become brainier but not brawnier. This suggests that the benefits from integration have less to do with trade costs and more to do with deeper integration.

## REFERENCES

- Ahearn, R (2010), “Europe’s Preferential Trade Agreements: Status, Content, and Implications”, *Congressional Research Service*
- Alcala, F & A Ciccone (2004), “Trade and Productivity”, *The Quarterly Journal of Economics*
- Anderson, J & E van Wincoop (2004), “Trade Costs”, *Journal of Economic Literature*
- Baier, S & J Bergstrand, (2007), ‘Do free trade agreements actually increase members' international trade?’, *Journal of International Economics* 71 (1), 72–95.
- Baldwin, R (2008), “Managing The Noodle Bowl: The Fragility Of East Asian Regionalism”, *The Singapore Economic Review*
- Baldwin, R & A Venables (2010), “Relocating the value chain: off-shoring and agglomeration in the global economy”, mimeo
- Barba Navaretti, G, J Haaland & A Venables (2002), *Multinational Corporations and Global Production Networks: The Implications for Trade Policy*, Report prepared for the European Commission, London: Centre for Economic Policy Research
- Behar, A. & A Venables (2011) Transport costs and International Trade, in *Handbook of Transport Economics*, eds André de Palma, Robin Lindsey, Emile Quinet & Roger Vickerman
- Curran, L & S Zignago (2009), “Evolution of EU and its Member States’ Competitiveness”, *CEPII Working Paper in International Trade*
- Dixit, A. & J Stiglitz (1977): “Monopolistic Competition and Optimum Product Diversity,” *American Economic Review*
- Egger, P & M Larch (2011), “An assessment of the Europe agreements’ effects on bilateral trade, GDP, and welfare”, *European Economic Review*
- Ethier, W (1982), “National and International Returns to Scale in the Modern Theory of International Trade”, *American Economic Review*
- European Commission (Accessed December 17, 2010), documentation on EU accession found at [http://ec.europa.eu/enlargement/enlargement\\_process/accession\\_process/how\\_does\\_a\\_country\\_join\\_the\\_eu/sap/history\\_en.htm#1](http://ec.europa.eu/enlargement/enlargement_process/accession_process/how_does_a_country_join_the_eu/sap/history_en.htm#1)
- Feenstra, R & HL Kee (2004), “On the Measurement of Product Variety in Trade”, *American Economic Review*
- Feenstra, R, J Markusen & W Zeile (1992), “Accounting for growth with new inputs: theory and evidence”, *American Economic Review*
- Frankel, J & P Romer (1999), “Does Trade Cause growth?”, *American Economic Review*
- Freund, C & E Orneleas (2010), “Regional Trade Agreements”, *World Bank Policy Research Working Paper*
- Gill, I & H Kharas (2007), *An East Asian Renaissance: Ideas for Economic Growth*, World Bank

- Grossman, G & E Helpman (1991) *Innovation and Growth in the Global Economy*, MIT Press
- Halpern, L, M Koren & A Szeidl (forthcoming), “Imported inputs and productivity”, *American Economic Review*
- Hansen, T (2010), “Tariff Rates, Offshoring and Productivity: Evidence from German and Austrian Firm-Level Data”, *Munich Discussion Paper No. 2010-21*
- Hausmann, R, J Hwang & D Rodrik (2007), “What you export matters”, *Journal of Economic Growth*
- Hummels, D, J Ishii & K Li (2001), “The nature and growth of vertical specialization in world trade”, *Journal of International Economics*
- Jones, R. W. and H. Kierzkowski (2005) 'International Trade and Agglomeration: An Alternative Framework', *Journal of Economics*
- Kaminsky, B & F Ng (2005), “Production disintegration and integration of Central Europe into global markets”, *International Review of Economics and Finance*
- Kimura, F, Y Takahashi & K Hayakawa (2007), “Fragmentation and parts and components trade: Comparison between East Asia and Europe”, *North American Journal of Economics and Finance*
- Ledgard, J (2005), “Skoda Leaps to Market”, *Strategy+business*
- Marin, D (2006), “A New International Division Of Labor In Europe: Outsourcing And Offshoring To Eastern Europe”, *Journal of the European Economic Association*
- Marin, D (2010a), “The Opening Up of Eastern Europe at 20-Jobs, Skills, and ‘Reverse Maquiladoras’ in Austria and Germany”, *Munich Discussion Paper No. 2010-14*
- Marin, D (2010b), “Germany’s super competitiveness: A helping hand from Eastern Europe”, *VOX*
- Martinez-Zarzoso, I, A Voicu & M Vidovic (2011), “Ceecs Integration Into Regional And Global Production Networks”, mimeo
- Mirodout, S, R Lanz & A Ragoussis (2009), “Trade in Intermediate goods and Services”, *OECD Trade Policy Working Paper*
- Mishra, S, S Lundstrom & R Anand (2011), “Service Export Sophistication and Economic Growth”, *World Bank & IMF*
- Nunn, N (2007), “Relationship-Specificity, Incomplete Contracts, and The Pattern Of Trade”, *QJE*
- Rauch, J (1999), “Networks versus Markets in International Trade,” *Journal of International Economics*
- Rhys, G (2004), “The Motor Industry in an enlarged EU”, *Economic Journal*
- Romer, P (1990), “Endogenous Technological Change”, *JPE*
- Tempest, R (1996), “Barbie and the World Economy,” *Los Angeles Times*, September 22
- Volkswagen (2010), *Facts and Figures*, Volkswagen Group January to December 2010
- Yeats, A (2001), “Just how big is global production sharing” in S Kierzkowski & H Arndt (eds) *Fragmentation: New Patterns in the World Economy*, OUP
- Watson (2010), N “Manufacturers in a drive forward at expense of west”, *Financial Times*, 22 November