Need for Speed: The Role of Timeliness in the Trade Effect of EU Accession

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Abstract

Timeliness has gained growing importance in international trade due to the fragmentation of production and the increasing use of just-in-time logistics. By eliminating the need for customs administration and the customs clearance procedure at national borders, the enlargement of the EU in 2004 can be considered as a large-scale experiment that improved the timeliness in European trade. This paper uses a difference-in-difference econometric strategy to uncover the role of improved timeliness in the EU's effect on trade by applying a new measure for industry-specific trade barriers that was introduced by Novy (2008). The elimination of each additional border is estimated to act like a 2% reduction in ad valorem tariffs. Saving an hour waiting at an inland border has a 0.4% ad valorem equivalent effect. The decline in trade barriers was larger, the worse quality the customs administration was in terms of efficiency and bribery. Cross-checking the estimates by splitting the sample along the transport mode, the time-sensitivity of industries, or the extent of production fragmentation yield dominantly the expected results, although tests on the equality of coefficients are significant only in a few cases.

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1 Introduction

Time matters in trade and it has been getting even more so in the recent decades. Some traded goods are inherently perishable such as fresh food and need fast deliveries. Others depreciate fast because of quickly varying consumer tastes such as the latest fashion articles. The fast development of transportation technologies enabled the spread of international production fragmentation, which increasingly requires timely trade. The importance of timeliness is multiplied if several intermediate production stages at different parts of the world should be synchronized in a timely fashion.

An influential article that calls the attention to this phenomenon is Deardorff (2002), which sketches an informal model on the implications of timeliness on international trade. He starts with the assumption that time is costly in production and trade, because the consumer valuation of products depreciate with time. Moreover, some goods depreciate faster than the others. Reducing delays require effort, which is intensive in physical and/or human capital. Hence, it will be the more capital abundant country, which tend to have comparative advantage in producing and delivering the more time-sensitive goods. Evans and Harrigan (2003) build a formal model, where timeliness is important for matching variable demand. Their model implies that products with more variable demand are delivered from more proximate locations even at the expense of higher wages. Hence, theory suggests that the cost of time in trade can hinder the outsourcing of time-sensitive production to more distant and/or less developed locations, thereby reducing the volume of international trade

Harrigan and Venables (2004) complement the previous models by arguing that it is not solely the depreciation of a product that makes delays costly but also the increased uncertainty that comes with longer delays. The possibility of delays make it uncertain when the final product reaches the market if production stages are located in different venues. If delays are expected, production should be started and orders must be placed earlier, even before demand and cost conditions are known, which again creates uncertainty for the firm. In this respect, time cost is qualitatively different from the monetary costs of trading, and its effect on the trading activity can be substantially larger.

Empirical evidence on the time cost of trade is however scares. An important piece is Djankov *et al.* (2006), who use Doing Business data on the time needed for exports and imports and estimate the effect of time cost on trade volumes for a large cross-section of countries. They find that an additional day reduces the volume of trade by at least 1%. The effect is larger for less developed countries and products that are classified as time-sensitive. A strongly related policy-oriented literature provides empirical evidence on the trade effect of 'trade facilitation', i.e. “improved efficiency in the administration, procedures, and logistics at ports and customs” (Wilson *et al.* (2003)). Many of those studies evaluate trade facilitating reforms in various developing countries and find sizeable cost-reductions and trade-creating effects.

Against this background, one would expect that completely eliminating the time-consuming customs procedures and border controls must have a positive effect on trade. To measure this effect one can find a reasonably good natural experiment at hand with many countries involved: the enlargement of the European Union (EU) in 2004 by eight Central and Eastern European countries.[1] It can be considered an experiment because it happened with most other factors that usually matter for international trade being unchanged. Traditional trade policy barriers between these eight countries and the EU15, as well as among the eight themselves, had already been abolished or harmonized by around year 2000 in the trade of a large subset manufactured products.

Without investigating into the causes, Hornok (2009) presents several empirical findings on the response of trade to the EU enlargement. Trade flows with at least one of the partners being a newly acceeding country accelerated after 2004. The overall effect is estimated to be comparable to a 1.5-3.5% reduction in ad valorem tariffs and a significant “anticipatory” effect is also detected in year 2003. The acceleration of trade was present in several industries, it was significantly stronger for trade among new countries than for trade between new and old member states, and was mostly happening on the intensive margin.

Tentative explanations for the causes of the effect can be the followings. One is the reduced delay of cargos at borders and ports and the abolition of the whole customs procedure, which improved the timeliness of trading. Another possible explanation relates to the so-called Technical Barriers to Trade, which could change by accession for some countries. Unfortunately, however, no hard information is available on such changes. Finally, the trade effect could stem from the harmonization of legal frameworks and the unequivocal move of EU entry itself, which could create more certainty in the beliefs of economic agents regarding the legal and political stability in the region. This latter factor may be very important and, in fact, can be responsible for the sizeable anticipatory effect in 2003, the year when the final decision on the accession was made. Nevertheless, it is extremely hard to measure it for an empirical analysis.

This paper focuses on the effect of the improved timeliness in the trade effect of EU accession. The analysis exploits the close-to-natural-experiment nature of the episode by building up a difference-in-difference econometric strategy, where the treatment group involves country pairs with at least one new member and the control group is old member country pairs. Identification

[1] I do not consider the two other acceeding countries, Cyprus and Malta, because they are very different in several aspects.

is supported by the use of a new measure for trade barriers, first introduced by Novy (2008). This measure, derived from the gravity theory of Anderson and Van Wincoop (2003), has the advantage that it fully controls for all the country-level variables in the gravity equation, most notably the so-called multilateral trade resistance terms. Estimation is done on a panel of 21 countries ($21 \cdot 20$ country pairs) and 19 manufacturing industries over the period 2000-2006.

The overall treatment effect, which shows the size of a hypothetical ad valorem tariff reduction equivalent to the effect of EU entry, is measured to be 5.6%. Improvement in timeliness is captured by three variables that refer to the pre-accession situtation: the pre-accession number of borders (with border controls) between the trading parties, the average waiting hours at inland border crossings, and a survey variable on the quality of the customs procedure. The main findings are the following. The elimination of each additional border is estimated to act like a 2% reduction in ad valorem tariffs. Saving an hour waiting at an inland border has a 0.4% ad valorem equivalent effect. And the decline in trade barriers was larger, the worse quality the customs administration was in terms of efficiency and bribery.

The results are cross-checked by splitting the sample along certain country-industry characteristics. The measured effects vary with the dominant mode of transportation mostly in line with the expectations. The number of borders to cross and the waiting time matter the most where inland transportation is more frequent. Customs quality has the strongest impact on trade barriers, where air transportation is relatively often used. In contrast, trade barriers in sea transportation do not seem to be affected significantly by any of the timeliness variables. Intra-EU maritime trade remained subject to customs clearance even after 2004, which explains this finding. I also test the hypothesis that the trade creating effect of reduced time is larger in more time-sensitive industries, where time-sensitivity was defined according to Hummels (2001b). The results seem to support the hypothesis. Finally, the main estimates are also cross-checked along the extent of production fragmentation, where intra-industry trade and the share of intermediate goods are taken as proxies.

The paper is structured as follows. Section 2 introduces the trade barrier measure and presents its evolution around EU enlargement. Section 3 builds the empirical framework and derives the estimating equation. Section 4 presents the results, both accounting for the role of the different modes of transportation and the time-sensitivity of industries. Section 5 concludes.

2 Industry-specific trade barriers

An alternative method for estimating trade barriers was developed by Novy (2008), in the spirit of an earlier paper of Head and Ries (2001). Based on the industry-specific gravity theory of Anderson and Van Wincoop (2004) he derives a measure of bilateral trade frictions that fully controls for the multilateral trade resistance. The measure is however not restricted to the gravity theory; Jacks, Meissner and Novy (2009) show that the same measure can in fact be derived from several competing trade theories.[2]

2.1 Model framework

Take the *intra*national trade analogue of the gravity equation for country i and industry k

$$X_{ii}^k = \frac{Y_i^k E_i^k}{Y_W^k} \left(\frac{T_{ii}^k}{\Pi_i^k P_i^k} \right)^{1-\sigma^k} \tag{1}$$

where Y_i^k is output of and E_i^k is expenditure on products specific to industry k, Y_W^k is world output in the same industry, T_{ii}^k is intranational trade cost in country i and industry k and Π_i^k and P_i^k are country i's outward and inward oriented multilateral trade resistance terms, respectively, specific to industry k. The elasticity of substitution among varieties σ^k is also industry-specific. Note that the market clearing condition, $E^k = Y^k$, does not need to hold for individual industries, while in a one-sector economy Anderson and Van Wincoop (2003) impose $E = Y$.

Express the product of the two multilateral resistance terms from (1) as

$$\Pi_i^k P_i^k = \left(\frac{X_{ii}^k Y_W^k}{Y_i^k E_i^k} \right)^{\frac{1}{\sigma^k - 1}} T_{ii}^k \tag{2}$$

Now take the gravity equation for *inter*national trade between i and j and multiply the bilateral trade flows of the two opposite directions

$$X_{ij}^k X_{ji}^k = \frac{Y_i^k E_j^k Y_j^k E_i^k}{\left(Y_W^k\right)^2} \left(\frac{T_{ij}^k T_{ji}^k}{\Pi_i^k P_i^k \Pi_j^k P_j^k} \right)^{1-\sigma^k} \tag{3}$$

Substitute for the multilateral trade resistance terms in (3) using equation (2) and rearrange terms to get

$$X_{ij}^k X_{ji}^k = X_{ii}^k X_{jj}^k \left(\frac{T_{ii}^k T_{jj}^k}{T_{ij}^k T_{ji}^k} \right)^{\sigma^k - 1} \tag{4}$$

[2] Such as the models of Deardorff (1998), Eaton and Kortum (2002), Chaney (2008), as well as Melitz and Ottaviano (2008).

Bilateral international trade barriers relative to intranational trade barriers can be expressed as

$$\frac{T_{ij}^k T_{ji}^k}{T_{ii}^k T_{jj}^k} = \left(\frac{X_{ii}^k X_{jj}^k}{X_{ij}^k X_{ji}^k} \right)^{\frac{1}{\sigma^k - 1}} \tag{5}$$

from which the average bilateral trade barrier (θ_{ij}^k) is defined as the geometric mean

$$\theta_{ij}^k \equiv \left(\frac{T_{ij}^k T_{ji}^k}{T_{ii}^k T_{jj}^k} \right)^{\frac{1}{2}} = \left(\frac{X_{ii}^k X_{jj}^k}{X_{ij}^k X_{ji}^k} \right)^{\frac{1}{2(\sigma^k - 1)}} \tag{6}$$

Trade barriers between two countries are larger the less open the countries are in terms of the ratio of intra- to international trade. Note that θ is only a relative measure: the level of cross-country barriers is compared to the level of within-country ones. In theory, the lower bound is $\theta = 1$, when international trade is just as costly as intranational trade. A special case is frictionless trade, when $T_{ij} = T_{ji} = T_{ii} = T_{jj} = 1$. In the case of a closed economy, when international trade is zero, θ approaches infinity.

The measure for trade barrier also corrects for the level of the substitution elasticity between home and foreign goods (σ). When σ is high, i.e. demand shifts rapidly between domestic and imported varieties in response to a relative price change, relatively large openness can prevail under high trade barriers. On the contrary, when σ is low, the economy can be considerably closed even under small trade barriers.

A big advantage of the method of Novy (2008) over the traditional way of inferring trade barriers from the gravity estimation is that it completely wipes out the multilateral trade resistance terms, i.e. it does not depend on the evolution of trade barriers with third-countries. Multilateral resistance is mostly unobservable and can cause omitted variable bias in the traditional gravity estimation. Moreover, the above solution does not require the direction-specific bilateral trade barriers to be symmetric ($T_{ij}^k = T_{ji}^k$), since it is only the product of them which matters. The other side of the coin is however that the above measure cannot treat direction-specific trade flows separately.

2.2 The time path of θ around EU accession

By measuring θ for several years and observing its time path one can infer the evolution of total trade costs for several industries separately. Of course, interpreting the θ's as trade barriers for different points in time requires the assumption that the gravity equation holds through the entire period and for each industry.

The dataset is a balanced panel of yearly data for 7 years between 2000 and 2006. The set of countries include 13 old members and 8 new members of the EU, altogether the EU25 less Greece, Ireland, Cyprus and Malta. Only manufacturing industries are considered in the 2-digit NACE classification, excluding food and beverages as well as energy manufactures.[3][4] Due to missing data only 52% of the maximum possible countrypair-industry observations are retained in the balanced panel.[5] The number of observations is around 30,000, 55% of which belong to country-pairs, where at least of the country is a new member (treatment group).[6]

I calculate θ for each country-pair, industry, and year. An empirical challenge is to find a measure for intranational trade (X_{ii}). A good candidate is gross domestic sales, which can be calculated as gross production minus exports, i.e. the amount of goods that are produced domestically but not sold abroad. There is however one important discrepancy in this definition: exports also include re-export, which is then mistakenly subtracted from domestic production. To overcome this problem I correct for re-exports with the help of national input-output tables.[7]

Industry-specific elasticities of substitution (σ^k) are taken from Chen and Novy (2008), who borrow the estimates from Hummels (2001a), and transform them to the NACE industry classification (Table 7 in the Appendix). It is important to note that, as opposed to the levels of the the θ's, the time paths are robust to different value for the σ^k, as long as they are time-constant. Since I am going to identify the treatment effect from the time change of θ, there is no need to worry about how accurate the assumed values for σ^k are.

Figure 1 shows the simple arithmetic averages of the logarthims of θ's over groups of country-pairs. Country-pairs are grouped according to whether both countries are old members (old-old), both countries are new members (new-new), or one is old and the other is new (old-new). There are several points to be noticed.

First, there are large differences in the level of trade barriers across the country groups. The

[3]Manufacture of food products and beverages (NACE code 15) and Manufacture of coke, refined petroleum products and nuclear fuel (23).

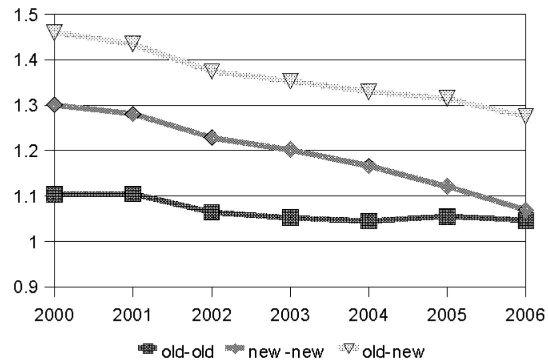
[4]Unfortunately, data limitations preclude me from doing the calculation at a more disaggregate level. National accounts gross output data is not available for a finer than 2-digit industry breakdown, while the solution of Chen and Novy (2008) to use the Prodcom production data at the 4-digit industry level is not applicable to the Central and Eastern European countries due to lots of missing observations.

[5]Year 2007 is completely left out, because output data for this year is missing in 80% of the cases.

[6]Unfortunately, some countries and industries are under-represented in the balanced panel (see Tables 7 and 9 in the Appendix). These are Luxembourg and Latvia, as well as industries 25 (Rubber and plastic) and 30 (Office machinery and computers).

[7]For more details see the data description and Table 7 in Appendix.

Figure 1: The time path of trade restrictiveness



initial level was the smallest for the control group, which was followed by new-new and then old-new pairs. Trade barriers among new countries however declined to the level of the control group by 2006, while barriers among old and new countries remained at a higher level. Old countries and new countries tend to be more integrated among themselves than between each other due to the usual gravity forces, i.e. closeness in geographical, cultural or political characteristics of countries such as smaller geographic distance, common language, common currency, etc.

Second, bilateral trade restrictiveness for the control group is relatively stable, though slightly declining, over the period. In contrast, trade barriers seem to have declined steadily for the treatment group, i.e. among new countries and between new and old countries. It suggests that, regardless the one-off event of EU enlargement, an overall trade integration process was present in the treatment group through the whole period. This has to be accounted for when trying to identify the EU effect.

Third, the paths of the θ's are quite smooth, there is no visible break at the date of enlargement. When we simply look at trade flows, the evidence is the contrary: trade activity alone accelerated sharply as of 2004. The fact that θ is relatively smooth unveils that, along with international trade, industrial production and *intra*national trade also accelerated as a result of a general economic upturn. Nonetheless, the decline of θ for the treatment country-pairs *relative* to that of the control group was stronger for the period after 2004 than before, which suggests that apart from a general integration trend, the EU accession also contributed to the decline in barriers.

The effect of the entry to the EU is more apparent from the industry-specific θ's. Figures for the 19 industries (presented in the Appendix) reflect remarkable differences in the trends of industry-specific trade barriers. The time paths of θ's are generally declining for new-new and old-new country pairs and relatively stable for old-old pairs in most of the manufacturing industries. In some industries, the decline in barriers is already strong in the pre-accession years with no visible break around accession (Textiles, Furniture and manufacturing n.e.c.), while in others the break around accession is clearly apparent. The latter group of industries, which include Office machinery, Motor vehicles, Chemicals, Communication equipment, etc. are those that seem to have experienced a significant mitigation in trade restrictiveness due to EU accession.

3 Empirical framework

What explains the apparent change in the time path of the θ's for new countries after 2004 and why is the change more apparent in some industry and not in others? Improved timeliness is a possible explanation. Before EU enlargement, trade between certain countries could be hindered more strongly due to lengthy customs and border crossing procedures. Similarly, certain products are more sensitive to such barriers than others. In the followings, I carry out an empirical analysis that aims to identify the role of timeliness in the decline of trade barriers around accession.

3.1 Identification strategy

I take old and new EU members and their bilateral trade both before and after accession. Country-pairs are either always inside the EU (old-old pairs; control group) or get inside only from the second period (all pairs involving at least one new member; treatment group). Since our measure of trade barriers cannot differentiate between the direction of trade, exports from old to new and exports from new to old countries are commonly denoted as the old-new group. The identification is based on a difference-in-difference strategy: before- versus after-accession changes in the treatment group are taken relative to before- versus after-accession changes in the control group. Note that the time dimension is an important source of the identifying variation, hence it needs to be introduced into the notation.

Let us assume that the average trade barrier is a function of a set of countrypair- and/or industry-specific characteristics (Z_{ij}^k), a price vector corresponding to the characteristics (ζ) and other time-varying factors ($H_{ij,t}^k$), where t denotes time: $\theta_{ij,t}^k \equiv f\left(Z_{ij}^k, \zeta, H_{ij,t}^k\right)$. The identification strategy is ultimately based on the Z's and the ζ's, while accounting for the

H's is important in order to control for all the heterogeneity and ensure unbiasedness of the results.

The characteristics do not change in time, while the price vector changes with the policy action, i.e. with EU entry. To provide some first insight let us take a simple example. A relevant countrypair-specific characteristic can be the average time required for customs clearance in the two countries, which is then transformed to ad-valorem equivalents with the relevant price term. Since there is no customs clearance within the EU, the price term declines from a positive value to zero when both countries become EU members.

Joint EU membership of country i and j implies different trade barriers compared to the case when at least either of the countries is not an EU member. Subtracting from the ij and k indices, for any given H_t at a given point in time,

$$\theta = \begin{cases} f\left(Z, \zeta^{EU}, \cdot\right) & if\ joint\ EU \\ f\left(Z, \zeta^{NEU}, \cdot\right) & if\ not\ joint\ EU \end{cases} \tag{7}$$

Note that for a trade-inducing EU effect to exist it must be true that for an average set of characteristics $f\left(\bar{Z}, \zeta^{EU}\right) < f\left(\bar{Z}, \zeta^{NEU}\right)$, i.e. common EU membership comes with a decline in bilateral trade barriers.

For simplicity, let us denote the country-pair with T when it is in the treatment group and with C when it is in the control group. Also, denote the pre- and post-accession time periods by $t = 0$ and $t = 1$, respectively. Then, in the current difference-in-difference setup the measured treatment effect will be

$$\begin{aligned} &f\left(Z_T, \zeta^{EU}, H_{T,t=1}\right) - f\left(Z_T, \zeta^{NEU}, H_{T,t=0}\right) - \\ &- \left[f\left(Z_C, \zeta^{EU}, H_{C,t=1}\right) - f\left(Z_C, \zeta^{EU}, H_{C,t=0}\right)\right] \end{aligned}$$

In order to identify part of the treatment effect, namely the role of timeliness, a functional form should be assumed for $f(\cdot)$. Let us suppose that it takes the log-linear form of $f(Z, \zeta, H_t) = e^{Z'\zeta} H_t^{\eta}$, where η is a parameter. Then the logarithm of the measured treatment effect becomes

$$\left(\zeta^{EU} - \zeta^{NEU}\right) Z_T + \eta \left[h_{T,t=1} - h_{T,t=0} - \left(h_{C,t=1} - h_{C,t=0}\right)\right] \tag{8}$$

where small h denotes logarithm of H. The first part of the formula allows us to associate parts of the total treatment effect to the observed characteristics (Z) and estimate the corresponding effects ($\zeta^{EU} - \zeta^{NEU}$). In a regression framework it can be done by interacting the treatment dummy with the Z's. The estimated coefficients give the change in the corresponding price term, i.e. the effect on trade barriers in ad-valorem equivalent terms.

If the treatment and the control group is completely homogenous in all respects other than EU entry, the second part of the expression should sum up to zero. Such a pure natural experiment however is rare and certainly it is not the case here. Nevertheless, the problem is already partly reduced by the definition of θ. Within the gravity theory, θ is already net of the ikt or jkt factors, which are the income variables and the trade barriers with the rest of the world (multilateral resistance). To fully overcome the problem of heterogeneity, also reflected by the transition trend on the graphs of the θ's, I propose control varables that capture the these trends.

3.2 Estimating equation

I model the logarithm of the average trade restrictiveness. Since θ is already adjusted by the elasticity of substitution, the estimated coefficients can directly be interpreted as ad-valorem tariff equivalents. The estimating equation is the following

$$\ln \theta_{ij,t}^{k} = \gamma_{ij}^{k} + \delta_t + \beta_1 D_{ij,t} + \beta_2 D_{ij,t} Z_{ij}^{k} + \beta_3 h_{ij,t}^{k} + \varepsilon_{ij,t}^{k} \tag{9}$$

Countrypair- and industry-specific fixed effects γ_{ij}^{k} control for all the time-invariant heterogeneity and common year dummies δ_t for the common trend in trade restrictiveness ("globalization" trend). The measure for trade restrictiveness is symmetric for the direction of trade. It makes no difference if exports is from i to j or from j to i, because it is only the trade restrictiveness *averaged* over the two directions that is measured. Hence, whenever country-specific controls are included, they are averages of the exporter- and importer-specific variables.

The treatment dummy $D_{ij,t}$ is zero before enlargement for all country-pairs, while after enlargement it takes value 1 if the country-pair does not belong to the control group.

$$\begin{aligned} D_{ij,t<2004} &= 0 \\ D_{ij,t\geqq 2004} &= \begin{cases} 0 & if\ ij = T \\ 1 & if\ ij = C \end{cases} \end{aligned}$$

The estimated treatment effect measures the impact of two countries jointly becoming members of the EU. This involves the case when one country is already a member and the case when neither of them is a member before the treatment takes place. Such a treatment implies that it is primarily the joint membership that reduces bilateral trade barriers. In other words, when one country is already a member but the other is not does not add (significantly) to bilateral trade facilitation relative to the case when neither of the countries is a member.

The term $D_{ij,t}Z_{ij}^{k}$ refers to the interactions of the treatment dummy with the country-pair and/or industry characteristics that can help explaining the sources of the treatment effect and, in particular, the contribution of the improved timeliness. Of special importance are the coefficient estimate of β_1 and β_2, which can be interpreted as ad-valorem equivalent declines in trade barriers.

As it is pointed out above, the treatment and the control group may not be considered as homogenous in all respects. One can argue that the new member states are still in a convergence process which, apart from EU accession, justifies faster growth for their exports. To control for such differences in the convergene trends I include $h_{ij,t}^{k}$ as additional controls. Aggregate country convergence trend can be captured by variables like the real effective exchange rate (real convergence comes with real appreciation) or per capita GDP levels. Both industry- and countrypair-specific differences in the convergence trends can be controlled for by variables like the share of intra-industry trade within an industry and between countries, as well as across-country differences in industry capital income shares. Large share of intra-industry trade with small differences in factor endowments capture the importance of horizontal intra-industry trade, which is shown to be increasing with real economic convergence by e.g. Durkin and Krygier (2000).

4 Main results

As Table 1 shows, the pure treatment effect is -5.6%, which means that, due to EU enlargement, bilateral trade barriers declined as if there was a 5.6% reduction in ad valorem tariffs. This is an average decline of trade barriers across country pairs that involved at least one new member state. As it was already demonstrated in Hornok (2009), this decline was larger for only new-new country pairs than for other treatment country pairs. This finding is reassured here: if the regression is run for new-new and old-new (new-old) pairs separately, the treatment effect is -8.5% for the former and -5.4% for the latter group.

Interactions of the three timeliness variables with the treatment dummy reveal that reduced trading time must have played a significant role in the overall effect. The more national borders (with customs inspection) a trader had to cross before accession, the larger the decline in trade

Table 1: Main results

Variable				
D	-0.056***	-0.033***	-0.045***	0.028
	[0.004]	[0.010]	[0.007]	[0.023]
D x border number		-0.021**		
		[0.008]		
D x wait hours			-0.004*	
			[0.002]	
D x customs survey				-0.026***
				[0.007]
REER	-0.183***	-0.182***	-0.202***	-0.187***
	[0.036]	[0.036]	[0.038]	[0.036]
GDP capita	-0.172***	-0.139**	-0.146**	-0.179***
	[0.061]	[0.061]	[0.061]	[0.061]
Grubel-Lloyd index	-0.138***	-0.138***	-0.137***	-0.137***
	[0.009]	[0.009]	[0.009]	[0.009]
Diff in capital share	0.007**	0.007**	0.007**	0.007***
	[0.003]	[0.003]	[0.003]	[0.003]
Constant	2.294***	2.256***	2.356***	2.321***
	[0.172]	[0.172]	[0.178]	[0.172]
Countrypair-industry fixed effects	yes	yes	yes	yes
Year effects	yes	yes	yes	yes
Observations	31084	31084	31084	31084
Number of groups	4516	4516	4516	4516
Adj. within R^2	0.22	0.22	0.22	0.22

Notes: Robust standard errors (in brackets) are adjusted for clustering at the country-pair and industry level. * significant at 10%; ** significant at 5%; *** significant at 1%.

barriers happened to be. According to the second column in Table 1, the overall treatment effect can be decomposed as follows: two countries that share a common border experienced a decline of 3.3% of trade barriers in ad valorem tariff equivalents, while in trade of more distant countries, the elimination of each intermediate border acted like a 2% further decline in tariffs.

If the the treatment dummy is interacted with the cumulative waiting hours at borders, one can get the cost of an hour waiting. The second column shows that a 1 hour delay in international trade is similar to a 0.4% tariff. In the case of exports from Poland to Germany, for example, the average pre-accession border waiting time (5 hours) acted like a 2% ad valorem tariff. This may not be merely the cost of waiting per se, but also the cost of uncertainty to the trader regarding the delay, which e.g. could lead to otherwise sub-optimal logistical decisions. Note that at some border crossings in some years waiting time between Poland and Germany could be more than half a day (Table 8 in Appendix).

Finally, the survey variable on the customs procedure also plays a role in explaining the treatment effect. In fact, including its interaction makes the coefficient on the treatment dummy become insignificant. Interpreting this piece of result in an intuitive way is less straightforward than the previous two. The survey variable, constructed as the simple average of 4 survey measures from the Global Competitiveness Report of the World Economic Forum, captures companies' overall opinion about the efficiency of customs administration and the extent of bribery on a 1 (good) to 7 (bad) scale. The survey was done in the months preceding EU enlargement, so it reflects the immediate pre-accession situation. For countries, where companies reported worse conditions, EU enlargement brought a significantly larger decline in trade barriers, than for countries with better scores.

Coefficients on the additional control variables that capture country and industry trends are signficant and have the expected sign. The country-specific real effective exchange rate and the GDP per capita suggest that trade barriers decline with the real convergence process. In contrast with the previous two, the Grubel-Lloyd index of intra-industry trade and the absolute difference of the captial shares between the exporting and the importing countries are countrypair- and industry-specific controls. Larger intra-industry trade and smaller difference in the capital shares, the latter suggesting more horizontal type intra-industry trade, also seem to be valid controls for the declining trend in trade barriers.

Table 2: Industry results

	Industry	Treatment effect	Border number	Wait hours	Customs survey	N
17	Textiles	-0.043***	-0.041*** $<^c$	-0.009*** $<^c$	-0.074*** $<^a$	1830
18	Wearing apparel	0.031*	-0.015	-0.014*	-0.032	902
19	Leather, luggage, footwear, etc.	-0.020 $>^c$	-0.049**	-0.015*** $<^b$	-0.045*	860
20	Wood, excl. furniture	-0.037***	-0.085** $<^c$	-0.007	-0.034	2358
21	Pulp, paper products	-0.080***	0.021 $>^c$	0.013* $>^b$	0.099*** $>^a$	2260
22	Publishing, printing	-0.069***	0.041 $>^b$	0.006	-0.020	2496
24	Chemical prods	-0.035*** $>^a$	-0.042**	-0.011**	-0.020	1650
25	Rubber and plastic prods	-0.010	0.105*** $>^a$	0.004 $>^a$	-0.173*** $>^a$	268
26	Other non-metallic mineral prods	-0.023 $>^c$	0.026	0.014	-0.027	2552
27	Basic metals	-0.100*** $<^b$	0.089*** $>^a$	-0.008	-0.086** $<^c$	1234
28	Fabricated metal prods	-0.026*** $>^a$	-0.026	-0.004	-0.011	2524
29	Machinery and equipment	-0.047***	-0.009	-0.003	-0.037***	2316
30	Office machinery and computers	0.053* $>^a$	n.a.	-0.003	-0.133*** $<^a$	240
31	Electrical machinery and apparatus	-0.063***	-0.032***	-0.011*** $<^c$	0.002 $>^c$	2288
32	Radio, tv and communication equip.	-0.054**	-0.015	-0.021** $<^b$	-0.018	1428
33	Medical, precision and optical instr.	-0.061***	0.002 $>^c$	-0.002	-0.027*	1760
34	Motor vehicles, trailers, semi-trailers	-0.022*** $>^a$	-0.061*** $<^a$	-0.009*	-0.016	1248
35	Other transport equipment	-0.067***	-0.114*** $<^a$	0.069*** $>^a$	-0.055	1456
36	Furniture, manufacturing n.e.c.	-0.043***	0.042	0.002	-0.046*	1414

Notes: Equation (9) estimated for each industry. 1st column: treatment effect when no timeliness variable is included. 2nd-4th columns: coefs on timeliness variables, included one-by-one. Additional controls: REER, per capita GDP, Grubel-Lloyd index, capital share differences. Country-pair and industry fixed effects, common year effects included. $<^a$, $<^b$, $<^c$ coefficient estimate is significantly smaller than the sample average at 1, 5, 10 percent significance level.

Industry-level results confirm that the treatment effect was widespread and often sizeable in many of the industries (Table 2). Moreover, for most of the industries, at least one of three timeliness variables plays significant role in explaning the treatment effect. In the industry of medical, precision and optical instruments (code 33) for example it is the customs survey variable that matters, while the other two does not seem to play a role. A logical explanation might be that for these product air transportation is especially widespread, hence the number of border crossings and inland waiting hours are not relevant. The industry of communication equipment has the largest cost of an hour waiting, which is reasonable, since the market value of these products (e.g. mobile phones) tend to depreciate fast. The second largest cost of an hour is for wearing and apparel, in line with the fact that just-in-time logistics is widespread in this sector (see Evans and Harrigan (2003)). All in all, however, it is difficult to assess why some industries are affected by one indicator and not by the other. Results for some industries should be especially taken with care because of the insufficient number of observations.

5 Cross-checks for the main results

I cannot be sure that my specification has controlled for all the important factors that underlie the treatment effect. At this point I cannot rule out that omitted factors that correlate with the timeliness variables can bias the estimates. Cross-checking the results along several dimensions, which help identify the separate role of timeliness is therefore crucial. In the followings I carry out three of such cross-checks. The first accounts for the mode of transportation, the second for the time-sensitivity of industries as defined by Hummels (2001b), and the last for the prevalence of international production fragmentation, an important driver of the increasing demand for timely trade.

5.1 The role of the transportation mode

The treatment effect and the importance of the timeliness variables may vary across the mode of transportation for at least two reasons. First, the abolition of the customs procedure did not take place in intra-EU maritime transport.[8] Trade in goods that are dominantly transported within the EU via sea therefore should be affected less than air and inland trade. Second,

[8]"Unlike road transport, which has been reaping the benefits of the internal market since 1993, shipments of goods by sea between the ports of the European Union are treated in the same way as shipments to third countries. Consequently, maritime transport between Member States involves many documentary checks and physical inspections by the customs, health, veterinary, plant health and immigration control officials." European Commission, Directorate-General for Energy and Transport: Memo - Maritime Transport without Barriers, 2007

two of the timeliness measures, i.e. the number of borders to cross and the waiting time, are expected to be important only for inland transportation. Of course, only to the extent that they do not proxy other elements of timeliness, which are present also in other types of transportation.

Unfortunately, there is no data on the mode of transportation of foreign trade in the EU at the country-pair and industry detail. Such data is however available for trade of EU members with third countries. Therefore I construct a variable for the likely mode of transportation for each country-pair and industry by making projections based on the transportation choices in extra-EU trade.

The sample is a cross-section with data averaged over the two immediate pre-accession years (2002 and 2003) and it includes the same 2-digit industries and the same exporting country set as the sample for the baseline estimation. Deciding on the set of importing countries is less straightforward. I opt for taking only a set of importers that corresponds to most of the useful variation in transport mode choice. This means taking trade partnerships, where more or less the same transport mode options are present as in intra-EU trade. Practically, this makes me exclude far-distanced importers, where inland transportation is not feasible. A group of 34 importing countries is chosen, which involves EFTA, Balkan and East European countries, Turkey, as well as some countries of the Middle East, Central Asia and North Africa.[9] Since the importing country set includes more lower-income countries, it becomes important to control for differences in income levels.

I model the choice of transport mode by applying the 2-step Heckman estimation procedure. First, the decision is made whether countries in a given industry trade with each other or not, which is modelled in a Probit framework. Then, a selection-corrected OLS regression is run for the share of each transport mode in the total trade value. Projection of the likely transport mode for intra-EU trade is based on the estimated coefficients from the second equation. Regression is run separately for each 2-digit NACE industries.

The first-stage (selection) equation is the following:

$$P(X_{ijk} > 0) = \Phi(\gamma_i + \gamma_k + \kappa R_{ij}) \tag{10}$$

where $\Phi(\cdot)$ is the standard normal cumulative distribution function, γ_i and γ_k are exporter and 4-digit industry dummies, R_{ij} includes variables that determine bilateral trade such as

[9] Iceland, Norway, Switzerland, Albania, Bosnia and Herzegovina, Bulgaria, Croatia, Macedonia, Romania, Belarus, Moldova, Russia, Ukraine, Turkey, United Arab Emirates, Israel, Iran, Jordan, Kuwait, Lebanon, Oman, Saudi Arabia, Syria, Yeman, Tunisia, Armenia, Azerbaijan, Georgia, Kazakhstan, Turkmenistan, Uzbekistan, Algeria, Egypt, Morocco.

GDP of the importer, the presence of an FTA between the two countries, and typical gravity variables such as bilateral distance, dummies for the continent, common language, colonial ties, common border and being landlocked.

In the selection-corrected second-stage regression I differentiate among three types of transport mode: inland (road, rail, inland waterways), maritime, and air.[10] The following regression is estimated separately for the share of each transport mode in total export.

$$E\left(s^m_{ijk} \mid X_{ijk} > 0\right) = \alpha_i + \alpha_k + \upsilon V_{ij} + \lambda IMR_{ijk} \qquad (11)$$

where $s^m_{ijk} = \frac{X^m_{ijk}}{X_{ijk}}$ is the share of transport mode m in the total value of bilateral exports within a 4-digit industry. On the right-hand side exporter and 4-digit industry fixed effects (α_i, α_k) and country-specific regressors (V_{ij}) are included. The latter includes the log of bilateral distance, dummy variables for common border, the importer being landlocked, and the importer's continent (Africa, Asia, Europe), as well as the log of the GDP per capita of the importer country. Finally, IRM_{ijk} is the inverse Mills ratio from the first-stage regression that corrects for the possible selection bias. Estimation of the second-stage equation is by simple OLS, i.e. for the sake of simplicity I apply a linear probability model for the transport choice. Note that this has the drawback that the projected transport shares may sometimes lie outside the (0,1) interval.

Based on the estimated coefficients from the second-stage equation I project transport shares ($\tilde{s_{ijk}}$) for bilateral trade among the 21 (old+new) EU member countries in each 2-digit NACE industry. To some extent, I also account for the differences in the product composition of trade by weigthing the estimated coefficients on the 4-digit industry dummies (α_k) by the corresponding industry shares in intra-EU bilateral trade.

Table 3: Highest and lowest ranked observations by projected transport shares

transport mode	exporter	importer	industry
HIGHEST			
air	Lithuania	Portugal	30 Office machinery and computers
inland	Slovakia	Hungary	18 Wearing apparel
sea	United Kingdom	Finland	34 Motor vehicles, trailers
LOWEST			
air	Slovakia	Hungary	18 Wearing apparel
inland	United Kingdom	Denmark	35 Other transport equipment
sea	Czech Republic	Slovakia	27 Basic metals

[10]Self propulsion of vehicles is included in the group the vehicle belongs to, i.e. road and rail vehicles to inland, air vehicles to air, and maritime vehicles to maritime. I do not consider other modes of transportation: post because of its marginal importance, or fixed mechanism, which is important mainly for energy products that are excluded from this analysis.

Then, I define an air/inland/sea sub-sample from the observations, for which the share of air/inland/sea transport falls in the upper third part of its own distribution. In addition, I exclude from each sub-sample those observations, which would belong to more than two sub-samples (only 8.8% of all observations are such). The dummy variables that define the sub-samples are therefore constructed as $D^m_{ijk} = 1$ if $\tilde{s}^m_{ijk} \geqslant \tilde{s}^m_{2/3}$ and $D^l_{ijk} \neq 1, l \neq m$, where $\tilde{s}^m_{2/3}$ denotes the $66\frac{2}{3}$ percentile of the cumulative distribution function of the projected shares for transport mode m. The construction of the dummies ensures that the sample size remains sufficient for each transport mode.

I estimate equation (9) separately for each sub-sample, also including the timeliness variables. The estimated total treatment effects are sizeable and significant for all transport modes. This suggests that the sources of the EU effect on trade are certainly not limited to the improved timeliness. As expected, none of the timeliness variables (interacted with the treatment dummy) are significant for the sea sub-sample. Moreover, the coefficients on the number of borders and the waiting hours interaction variables are not significant in the case of the air sub-sample either. Again along with the expectation, the number of borders is a significant determinant of the treatment effect in the inland sub-sample: an additional border acts like a 3% ad valorem tariff in inland transportation. Finally, the measured effect of the customs quality is especially large in the air sub-sample. A large effect for air transport is reasonable: shipments via air are usually more time-sensitive, that is why firms are willing to pay for the more costly, but much faster, air transportation.

Table 4: Results by transport mode sub-samples

		Treatment effect	Border number	Wait hours	Customs survey
Sea	Coef	-0.046***	0.030	0.009	-0.024
	Robust s.e	[0.007]	[0.029]	[0.005]	[0.015]
	Adj. within R^2	0.20	0.20	0.20	0.20
	N	8980	8980	8980	8980
	Chow F	2.17	2.93*	4.95**	0.01
Air	Coef	-0.078***	0.000	-0.004	-0.045***
	Robust s.e	[0.009]	[0.022]	[0.004]	[0.018]
	Adj. within R^2	0.22	0.22	0.22	0.22
	N	6045	6045	6045	6045
	Chow F	7.19***	1.19	0.01	1.21
Inland	Coef	-0.023***	-0.030***	-0.004	-0.026**
	Robust s.e	[0.009]	[0.011]	[0.003]	[0.012]
	Adj. within R^2	0.23	0.23	0.23	0.23
	N	9839	9839	9839	9839
	Chow F	18.26***	0.35	0.21	0.62

Notes: Equation (9) estimated for each sub-sample. 1st column: treatment effect when no timeliness variable is included. 2nd-4th columns: coefs on timeliness variables, included one-by-one. Additional controls: REER, per capita GDP, Grubel-Lloyd index, capital share differences. Country-pair and industry fixed effects, common year effects included.

The results are however quite noisy. Chow tests show whether the coefficient estimates on a sub-sample, where a transport mode is typical, significantly differ from the estimates in the rest of the sample, where the same transport mode is not typical. The test is significant only in the case of sea transportation for the border number and waiting hours interaction variables. Trade where sea transportation is typical is therefore significantly less (or not at all) affected by the abolition of borders. The rest of the Chow test results for the interaction variables are not significant, possibly also due to the relatively small sample sizes.

5.2 Time sensitivity as a product characteristic

Theories on the timeliness of trade refer to time-sensitivity as a product characteristic. Products can be time-sensitive for several reasons. Some like fresh food are inherently sensitive to delays due to perishability. Others may be very valuable and exposed to theft or may need special treatment, so that depositing them for long time is especially costly. The time-sensitivity of other goods is more of a systemic origin. Demand for some goods can change fast when consumer taste is changing, like in the case of fashion articles or fast developing IT technology products. Geographically fragmented production processes also need fast deliveries for the different stages of production to be well synchronized.

Separating time-sensitive products from time-insensitive ones is not a straightforward exercise. Most previous attempts were restricted to a narrow subset of products, where time-sensitivity can be easily defined. Fresh foodstuff is clearly more time-sensitive than preserved foodstuff, for instance. Evans and Harrigan (2003) restrict attention to apparel products and use a special database to distinguish between 'replenishment' versus 'non-replenishment' clothing.

The only comprehensive estimation for time-sensitivity, to my knowledge, is Hummels (2001b). He uses information on the choices between air and ocean transportation in US imports and builds the identification on the trade-off between differences in freight charges and transportation time between the two modes of transportation. Below I use these estimates to define time-sensitive and time-insensitive industries. Hummels (2001b) reports the estimates for 2-digit SITC product groups. I create broad correspondence between SITC product groups and NACE industries and define two sub-samples (time-sensitive and time-insensitive) accordingly (see Table 12 in the Appendix). If the estimates for the SITC groups corresponding to an industry are mixed, the industry is left out from both sub-samples.[11]

The results in Table 5 support the hypothesis that the measured effects are the strongest for more time-sensitive industries. Estimates for the treatment effect and its interactions with the timeliness variables are large and significant for the industries, which are classified as

[11] Evaluation is based on results in Table 3 in Hummels (2001b). A product group is time-sensitive, when the estimate for the Days/Rate ratio is significantly positive.

Table 5: Results by time-sensitivity of industries

Time-sensitivity	Treatment effect	Border number	Wait hours	Customs survey	N
yes	-0.065***	-0.025**	-0.009***	-0.025***	10736
	[0.005]	[0.010]	[0.003]	[0.010]	
no	-0.057***	-0.018	0.001	-0.022*	14492
	[0.007]	[0.014]	[0.004]	[0.012]	
			$1 <^b 0$		

Notes: Equation (9) estimated for each sub-sample. 1st column: treatment effect when no timeliness variable is included. 2nd-4th columns: coefs on timeliness variables, included one-by-one. Additional controls: REER, per capita GDP, Grubel-Lloyd index, capital share differences. Country-pair and industry fixed effects, common year effects included. $<^a$, $<^b$, $<^c$ significantly smaller for the sensitive than for the insensitive sub-sample at 1, 5, 10 percent.

more time-sensitive. At the same time, estimates are smaller and in many cases not different from zero statistically for the time-insensitive sub-sample. However, when the equality of the coefficient estimates across the two sub-samples are tested, it is only the effect of the reduced waiting hours that seems to affect time-sensitive industries significantly more than time-insensitive ones.

5.3 Fragmentation of production

One reason for the increasing demand for timely trade is that production processes within the firm are increasingly fragmented and stages of production are located in different parts of the world. This phenomenon can be captured by the increasing importance of intra-firm trade in cross-country trading. A possible cross-check for the importance of timeliness in the EU effect is to look at whether the effect is larger for intra-firm trade.

Lacking the data on intra-firm trade, one can experiment with proxy variables. I took two possible proxies and their interaction. One is the share of intra-industry trade, the other is the share of intermediate goods trade, both calculated for each country-pair and industry for the immediate pre-accession years (2002-2003).[12] I divide the sample at the median values for both proxies and their interaction. The above-median sub-sample is meant to capture observations, where the extent of intra-industry trade is relatively large and vice versa.

[12]The index of intra-industry trade is calculated on a broad 2-digit industry level in order not to exclude cases of vertical specialization. The share of intermediate goods is calculated at the most detailed 6-digit product level with the help of the correspondance table, which links the HS to the BEC classification.

Table 6: Results by intra-industry and intermediate trade share

IIT share	Treatment effect	Border number	Wait hours	Customs survey	N
above-median	-0.051***	-0.027***	-0.007***	-0.028***	15620
	[0.004]	[0.010]	[0.003]	[0.008]	
below-median	-0.061***	-0.019	-0.002	-0.024**	15464
	[0.006]	[0.012]	[0.003]	[0.011]	
Intermediates share					
above-median	-0.056***	-0.026**	-0.003	-0.024**	15422
	[0.006]	[0.013]	[0.003]	[0.011]	
below-median	-0.057***	-0.015	-0.005*	-0.029***	15662
	[0.005]	[0.010]	[0.003]	[0.009]	
IIT x intermediates share					
above-median	-0.052***	-0.041***	-0.005	-0.032***	15513
	[0.005]	[0.014]	[0.004]	[0.010]	
below-median	-0.060***	-0.005	0.002	-0.022**	15571
	[0.006]	[0.010]	[0.003]	[0.010]	
		$1 <^b 0$			

Notes: Equation (9) estimated for each sub-sample. 1st column: treatment effect when no timeliness variable is included. 2nd-4th columns: coefs on timeliness variables, included one-by-one. Additional controls: REER, per capita GDP, Grubel-Lloyd index, capital share differences. Country-pair and industry fixed effects, common year effects included. $<^a$, $<^b$, $<^c$ significantly smaller for the sensitive than for the insensitive sub-sample at 1, 5, 10 percent.

Results...

6 Conclusion

Timeliness has gained growing importance in international trade due to the fragmentation of production and the increasing use of just-in-time logistics. This paper used the episode of EU enlargement in 2004 to infer the importance of timeliness in international trade. By eliminating the need for customs administration and the customs clearance procedure at national borders, the enlargement of the EU can be considered as a large-scale experiment for improved timeliness. A difference-in-difference econometric strategy was used and identification was supported by the use of a new measure for industry-specific trade barriers.

The findings are as follows. The elimination of each additional border was estimated to act like a 2% reduction in ad valorem tariffs and saving an hour waiting at an inland border has a 0.4% ad valorem equivalent effect. The decline in trade barriers was larger, the worse quality the customs administration was in terms of efficiency and bribery. The results were cross-checked by splitting the sample according to country- and industry-specific characteristics such as the likely transport mode, the time-sensitivity of industries, and proxies that are meant to capture the extent of intra-firm trade. The results from the cross-checks dominantly support the a priori expectations on how the timeliness effects should vary with the above characteristics, although differences across sub-samples are statistically significant only in a few cases.

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Appendix

Data Description

Exports of goods is in euro value terms from Eurostat’s Comext database. Original data is available either in 6-digit HS or in 5-digit SITC product-level breakdown, which was classified into 2-digit NACE industries using the relevant correspondance tables.

Gross output value for 2-digit NACE industries is from Eurostat’s National Accounts database. Missing data could in some cases be adjusted for with the corresponding figures from the OECD Structural Analysis database. Data in national currencies is converted to euros at the annual average exchange rates for non-euroarea members.

Domestic sales is defined as gross output minus exports plus, if possible, a correction for re-exports. The share of re-exports in total exports can be especially sizeable for countries with important maritime ports such as the Netherlands ("Rotterdam effect"). The re-export share is calculated for each country and 2-digit NACE industry from input-output tables for year 2000 (the year for which I-O tables for most countries are reported by Eurostat). The same re-export share is assumed for all years in the sample. Because information on re-exports is limited or missing in several of the cases, the calculated domestic sales may sometimes become negative. The share of negative figures is 14% in the whole sample; the 3 largest shares being for Luxembourg (64%), Belgium (38%) and Latvia (28%). In case of negative values, I set domestic sales observations to zero.

Industry-specific elasticities of substitution. Figures are taken from Chen and Novy (2008), who convert the estimates of Hummels (2001a) to 4-digit NACE industries. Originally, Hummels (2001a) estimates the σ's on a 2-digit SITC breakdown, which classifies all traded goods into 63 product categories.

Real effective exchange rate based on consumer prices against 35 major trading partners is from the Eurostat New Cronos database.

GDP per capita in purchasing power parity is from the Eurostat New Cronos database.

Capital share is value added minus compensation of employees over value added. Data is from Eurostat New Cronos but missing data is in some cases complemented from the OECD STAN database.

Intra-industry trade index (Grubel-Lloyd index) is calculated at the 2-digit NACE industry detail as $GLI_{ij}^{k} = 1 - \frac{|X_{ij}^{k} - X_{ji}^{k}|}{X_{ij}^{k} + X_{ji}^{k}}$. It is not straightforward to decide at what level of aggregation the index is to be computed. At the more aggregate level the index is calculated, the more it also reflects vertical specialization of production instead of merely reflecting trade in similar but differentiated varietes.

Number of borders to be crossed before accession for a shipment transported from country i to country j. It takes value 0 for old-old trade, 1 for old-new and new-old trade (since all new countries either share a border with the EU15 territory: CZ, PL, SK, HU, SI or have a direct sea access: EE, LT, LV) and varying values for new-new relationships (for instance, 2 for CZ-HU with a Slovakian transit, 3 for HU-LT with Slovakian and Polish transit)

Waiting hours at border crossing points for road transportation before EU enlargement. The value is an average of years 2000-2002 and several border crossing points (22 for new-old/old-new, 17 for new-new trade) in a direction-specific way. Waiting hours are regularly reported by road transporters to the International Road Union (IRU).[13] The original data is available for neighbouring countries. Unfortunately no data is available for Estonian and Latvian borders. In the estimation I will either assume that waiting hours for these countries are equal to the Lithuanian ones or simply leave them out from the sample. The final data is constructed by the author so that it takes into account multiple border crossings by combining the waiting hours and the number of borders variables.

Customs procedure and bribery survey variable is the composite of 4 survey measures from the Global Competitiveness Report 2004/2005 of the World Economic Forum: (1) efficiency of customs procedures, (2) business impact of customs procedures, (3) hidden trade barriers, (4) irregular payments in exports and imports. The measures can take value from 1 to 7, where a higher value indicates better conditions (more efficiency, less corruption). Due to the strong correlation among the 4 measures the simple average of them is taken as a composite indicator. The survey was carried out right before EU enlargement in early-2004. Exact survey questions: (1) For imports, inbound customs activities in your country are 1=slow and inefficient, 7=among the world's most efficient; (2) What is the impact of your country's customs procedures on your business? 1=damaging, 7=beneficial; (3) In your country, hidden import barriers (i.e. barriers other than published tariffs and quotas) are 1=an important problem, 7=not an important problem; (4) In your industry, how commonly would you estimate that firms make undocumented extra payments or bribes connected with export and import permits? 1=common, 7=never occurs.

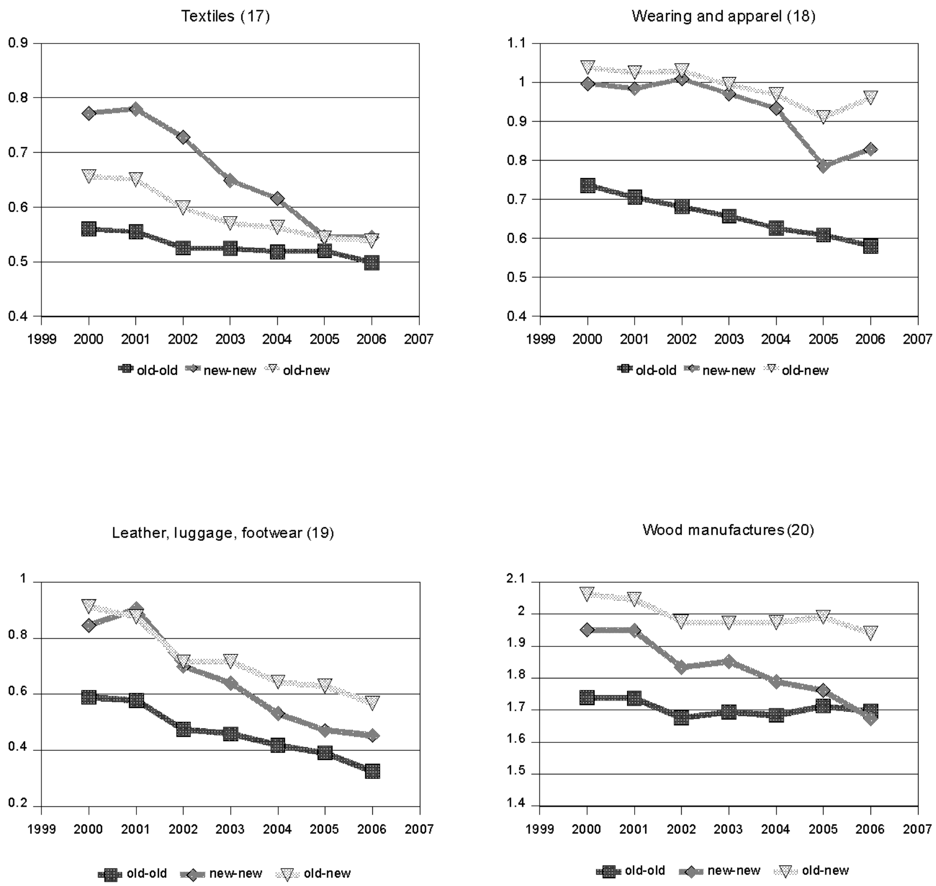
Gravity variables in the transport regresssions, i.e. bilateral distance, dummies for common language, colonial ties, common border and being landlocked are from the CEPII database under http://www.cepii.org/anglaisgraph/bdd/distances.htm.

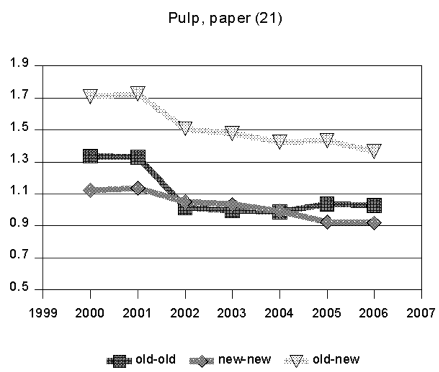
Share of intermediate goods by industry is calculated as the euro value share of intermediate goods in the total trade flow within each 2-digit NACE industry. Each 6-digit HS product is classified as intermediate, consumption or capital good according to the BEC (Broad Economic Categories) classification.

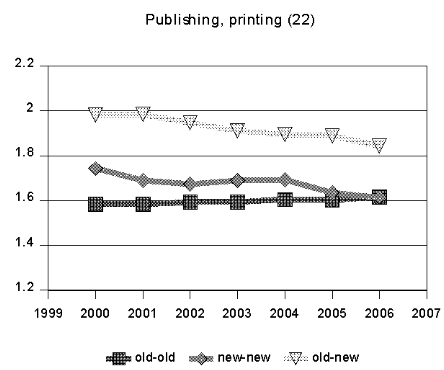
[13] I express my gratefulness to Peter Krausz (IRU) for providing me the data.

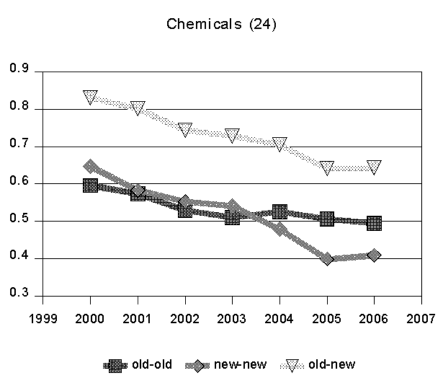
Figures and Tables

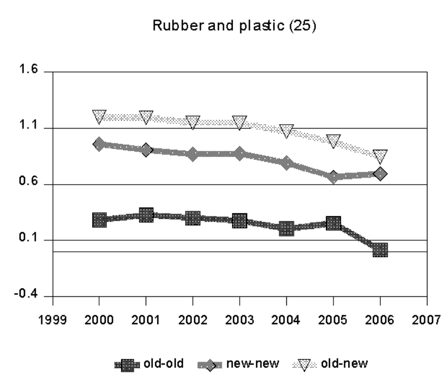
Figure 2: Trade restrictiveness by industry ($\ln\theta$)

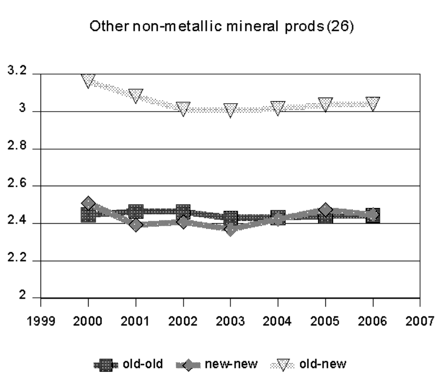


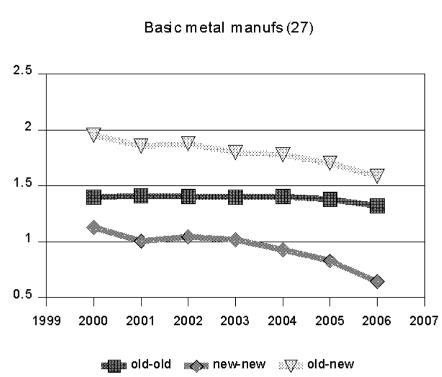

Pulp, paper (21)
old-old
new-new
old-new

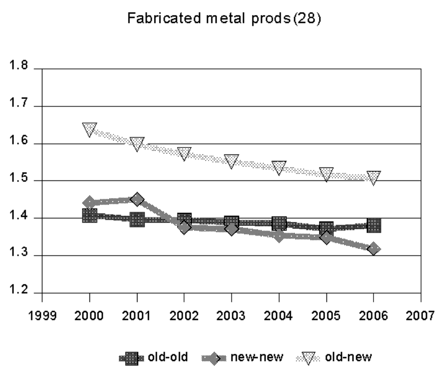

Publishing, printing (22)
old-old
new-new
old-new

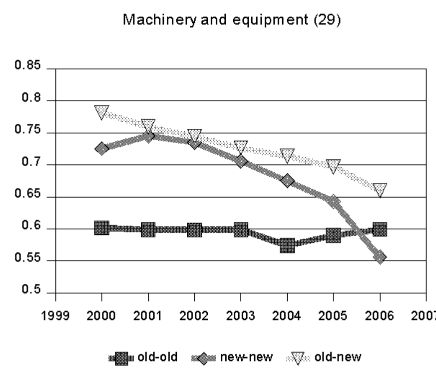

Chemicals (24)
old-old
new-new
old-new

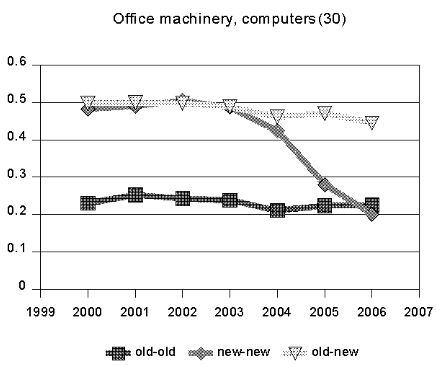

Rubber and plastic (25)
old-old
new-new
old-new

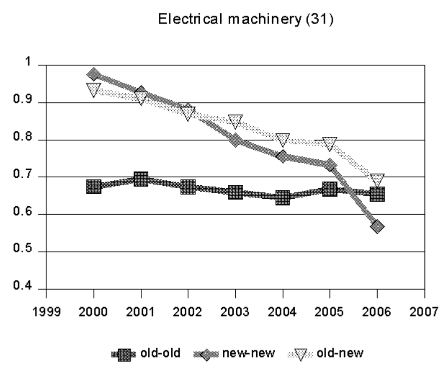

Other non-metallic mineral prods (26)
old-old
new-new
old-new

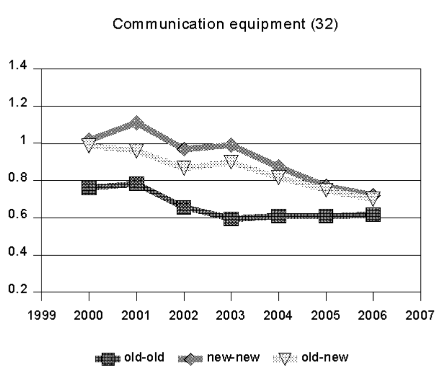

Basic metal manufs (27)
old-old
new-new
old-new

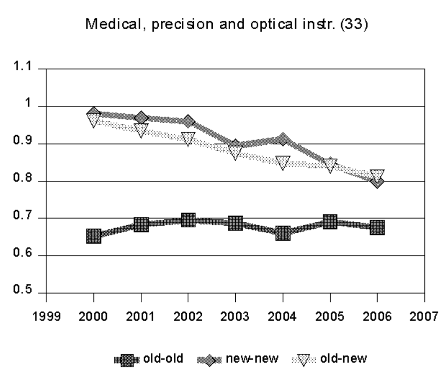

Fabricated metal prods (28)
1.8
1.7
1.6
1.5
1.4
1.3
1.2
1999 2000 2001 2002 2003 2004 2005 2006 2007
old-old
new-new
old-new


Machinery and equipment (29)
0.85
0.8
0.75
0.7
0.65
0.6
0.55
0.5
1999 2000 2001 2002 2003 2004 2005 2006 2007
old-old
new-new
old-new


Office machinery, computers (30)
0.6
0.5
0.4
0.3
0.2
0.1
0
1999 2000 2001 2002 2003 2004 2005 2006 2007
old-old
new-new
old-new


Electrical machinery (31)
1
0.9
0.8
0.7
0.6
0.5
0.4
1999 2000 2001 2002 2003 2004 2005 2006 2007
old-old
new-new
old-new


Communication equipment (32)
1.4
1.2
1
0.8
0.6
0.4
0.2
1999 2000 2001 2002 2003 2004 2005 2006 2007
old-old
new-new
old-new


Medical, precision and optical instr. (33)
1.1
1
0.9
0.8
0.7
0.6
0.5
1999 2000 2001 2002 2003 2004 2005 2006 2007
old-old
new-new
old-new

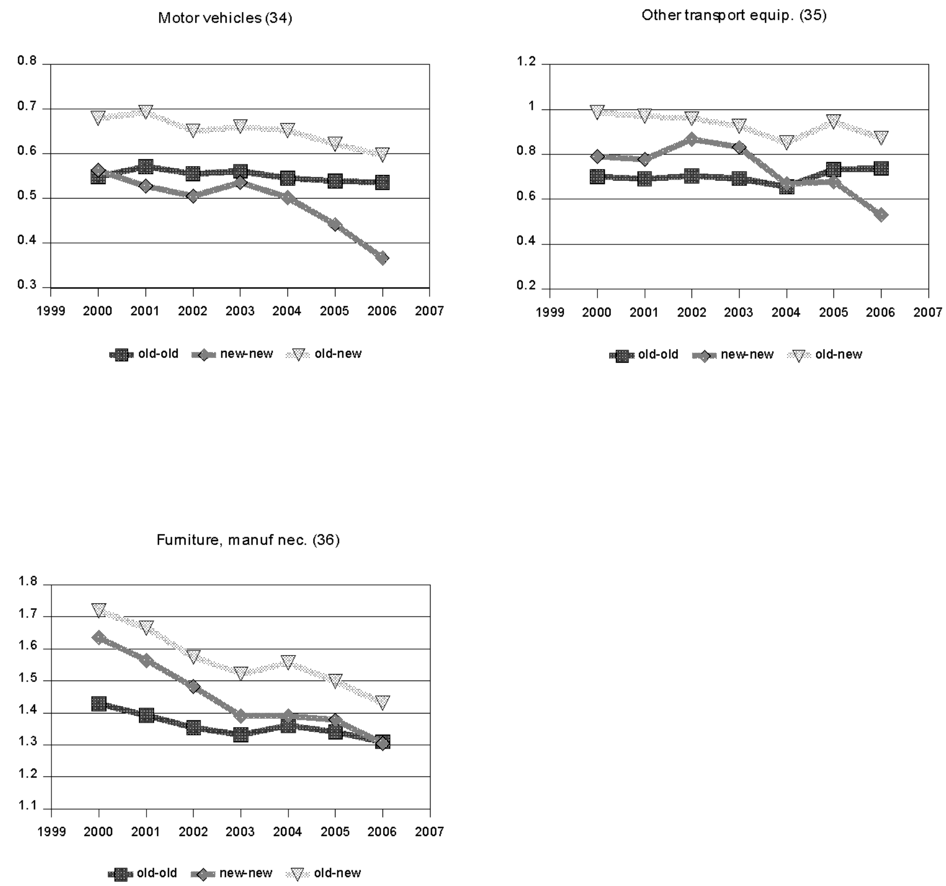


Figure 3: Real effective exchange rates

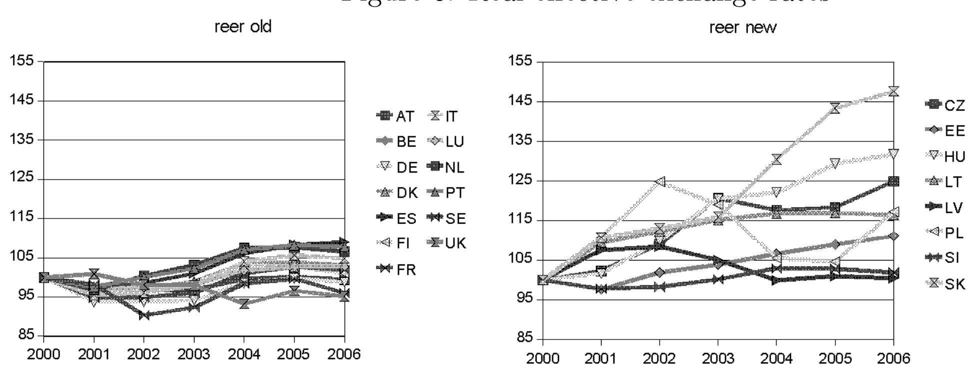


Figure 4: PPP GDP per capita

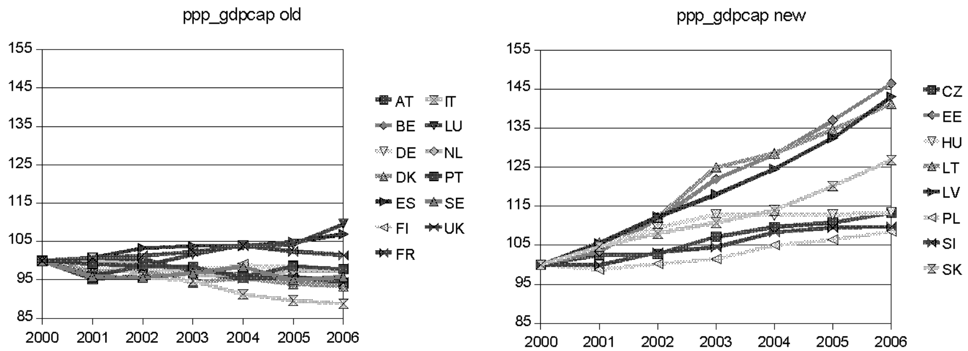


Table 7: Industry-level descriptive statistics

NACE	Industry	Share in bilateral exports (%)	Share in gross production (%)	σ	θ	N
17	Textiles	3.3	2.7	7.3	1.8	1848
18	Wearing apparel	2.1	1.3	5.7	2.5	910
19	Leather, luggage, footwear, etc.	1.1	0.8	7.2	2.0	882
20	Wood, excl. furniture	2.1	3.4	3.7	7.2	2618
21	Pulp, paper products	4.5	4.3	4.4	4.2	2268
22	Publishing, printing, reprod of rec media	1.3	6.8	5.1	6.5	2506
24	Chemical prods	15.2	11.7	7.1	1.9	1666
25	Rubber and plastic prods	1.0	0.8	5.2	2.6	252
26	Other non-metallic mineral prods	3.0	5.8	3.0	20.8	2562
27	Basic metals	8.1	5.2	3.5	5.8	1232
28	Fabricated metal prods	4.7	11.7	4.9	4.7	2534
29	Machinery and equipment	13.8	14.3	7.2	2.0	2338
30	Office machinery and computers	0.5	0.2	10.9	1.5	252
31	Electrical machinery and apparatus	6.8	6.8	6.0	2.2	2296
32	Radio, tv and communication equipment	5.6	3.3	5.9	2.3	1456
33	Medical, precision and optical instruments	2.7	2.8	6.6	2.3	1764
34	Motor vehicles, trailers, semi-trailers	17.0	11.7	7.3	1.8	1260
35	Other transport equipment	4.3	3.5	7.5	2.3	1442
36	Furniture, manufacturing n.e.c.	3.0	3.0	4.1	4.9	1442

Notes: Simple averages across all countries and years 2000-2006 in the balanced panel.

Table 8: Waiting hours at border crossings before EU enlargement

from	to	number of border crossing points	average hours	maximum hours
Lithuania	Poland	1	5.6	5.7
Czech Republic	Poland	3	5.2	8.3
Poland	Germany	8	5.0	13.8
Poland	Czech Republic	3	4.4	7.9
Poland	Slovakia	2	4.2	7.7
Slovakia	Poland	2	3.9	7.1
Germany	Poland	8	3.6	11.3
Poland	Lithuania	1	3.4	9.3
Czech Republic	Germany	7	3.3	6.6
Germany	Czech Republic	7	2.8	5.6
Hungary	Austria	3	2.3	3.7
Austria	Hungary	3	2.0	3
Czech Republic	Slovakia	6	1.9	3.9
Slovakia	Austria	1	1.8	2.3
Slovakia	Czech Republic	6	1.8	2.9
Hungary	Slovakia	4	1.7	3.2
Hungary	Slovenia	1	1.6	1.8
Slovakia	Hungary	4	1.4	2.3
Slovenia	Hungary	1	1.3	1.8
Austria	Slovakia	1	1.1	1.3
Czech Republic	Austria	3	1.1	1.8
Austria	Czech Republic	3	0.9	1.7

Source: IRU. Average waiting hours across inland border crossings in years 2000-2002. Maximum is for year and border crossing point.

Table 9: Country-level descriptive statistics

exporter	bilateral export (mn euro)	gross output (mn euro)	domestic sales (mn euro)	θ	N
AT	159	6569	2884	4.5	1610
BE	232	6625	3046	4.5	1197
DE	952	63849	40206	2.7	1918
DK	64	3550	1952	4.7	1575
ES	231	18464	13120	4.9	1932
FI	71	5299	3061	5.3	1848
FR	505	33944	21312	3.8	1869
IT	393	39161	27128	3.9	1946
LU	14	567	295	10.9	651
NL	273	9444	5342	3.8	1673
PT	63	3084	1862	7.3	1736
SE	139	10089	5891	4.5	1722
UK	316	30150	19976	4.2	1477
All old	263	17754	11236	5.0	21154
CZ	96	3988	1975	4.5	1757
EE	9	322	138	5.1	910
HU	73	2830	1349	5.4	1631
LT	7	325	157	7.1	1414
LV	13	437	131	11.6	392
PL	120	5279	2961	4.0	1757
SI	18	919	418	6.0	1456
SK	41	1093	422	6.9	1057
All new	47	1899	944	6.3	10374
All	155	9826	6090	5.7	31528

Notes: Simple averages across all importers, industries and years 2000-2006.

Table 10: Survey results on customs procedure

country	Efficiency of customs procedures	Irregular payments in exports and imports	Hidden trade barriers	Business impact of customs procedure	Average
PL	4.3	2.5	3.0	3.8	3.4
LV	3.5	2.3	2.5	3.3	2.9
LT	3.9	1.8	2.4	3.2	2.8
CZ	3.3	2.3	2.4	3.1	2.8
HU	3.7	1.7	2.2	3.2	2.7
IT	3.4	1.4	2.3	3.3	2.6
SK	3.0	2.1	2.3	2.4	2.5
FR	3.0	1.2	1.8	3.0	2.3
ES	2.9	1.3	1.6	2.9	2.2
SI	2.8	0.9	1.8	3.1	2.2
PT	2.7	1.0	1.1	2.3	1.8
EE	2.2	1.1	1.3	2.4	1.8
BE	2.3	1.0	1.3	2.2	1.7
AT	2.2	0.7	1.1	2.3	1.6
IE	2.0	0.8	1.5	1.8	1.5
LU	1.7	1.0	0.9	2.2	1.5
DE	1.9	0.7	1.2	1.8	1.4
UK	1.9	0.6	0.9	1.5	1.2
NL	1.6	0.7	0.9	1.6	1.2
DK	1.4	0.2	1.0	1.7	1.1
FI	1.4	0.4	0.6	1.7	1.0
SE	1.3	0.4	0.7	1.5	1.0

Source: WEF. Original score reversed: higher is worse. In descending order of average.

Table 11: Correlation coefficients of survey scores

	Efficiency of customs proc.	Irregular payments	Hidden trade barriers	Business impact of customs proc.
Efficiency of customs proc.	1			
Irregular payments	0.89	1		
Hidden trade barriers	0.94	0.92	1	
Business impact of customs proc.	0.94	0.82	0.89	1

Table 12: Time-sensitivity of industries based on SITC-2 estimates by Hummels (2001b)

Time-sensitive		Time-insensitive	
NACE	industry	NACE	industry
29	Machinery and equipment	17	Textiles
30	Office machinery and computers	18	Wearing apparel
31	Electrical machinery and apparatus	19	Leather, luggage, footwear, etc.
32	Radio, tv and communication equip.	20	Wood, excl. furniture
33	Medical, precision and optical instr.	21	Pulp, paper products
34	Motor vehicles, trailers, semi-trailers	22	Publishing, printing
35	Other transport equipment	26	Other non-metallic mineral prods
		27	Basic metals