Institut für Wirtschaftsforschung Halle
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July 2006 No. 12

IWH-Diskussionspapiere
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Vertical intra-industry trade between EU and Accession Countries

Abstract

The paper analyses vertical intra-industry trade between EU and Accession countries, and concentrates on two country-specific determinants: Differences in personal income distribution and in technology. Both determinants have a strong link to national policies and to cross-border investment flows. In contrast to most other studies, income distribution is not seen as time-invariant variable, but as changing over time. What is new is also that differences in technology are tested in comparison with cost advantages from capital/labour ratios. The study applies panel estimation techniques with GLS. Results show country-pair fixed effects to be of high relevance for explaining vertical intra-industry trade. In addition, bilateral differences in personal income distribution and their changes are positive related to vertical intra-industry trade in this special regional integration framework; hence, distributional effects of policies matter. Also, technology differences turn out to be positively correlated with vertical intra-industry trade. However, the cost variable (here: relative GDP per capita) shows no clear picture, particularly not in combination with the technology variable.

JEL: F14, F15

Keywords: Intra-industry trade, transition countries.

Vertikaler intra-industrieller Handel zwischen der EU und den Beitrittsländern

Zusammenfassung

Diese Studie konzentriert sich auf zwei länderspezifische Bestimmungsgrößen des vertikalen intra-industriellen Handels, die auch für den Handel zwischen der EU und den Beitrittsländern von Relevanz sein könnten: Unterschiede in der personellen Einkommensverteilung und in der verwendeten Technologie. Beide Determinanten weisen eine Verbindung zu nationalen Politiken und zu grenzüberschreitenden Investitionen auf. Anders als in den meisten Studien wird die Einkommensverteilung nicht als zeitinvariante Konstante, sondern als sich über die Zeit hinweg ändernde Variable gesehen. Neu ist ebenfalls, daß Unterschiede in den angewendeten Produktionstechnologien im Vergleich mit Kostenvorteilen getestet werden, die ihrerseits auf die Faktorausstattung (Kapital-Arbeit) zurückgehen. Die Studie verwendet Panel-Techniken mit GLS. Ihre Ergebnisse zeigen, dass länderpaarspezifische feste Effekte von hoher Relevanz für die Erklärung vertikaler Strukturen im intra-industriellen Handel sind. Gleichfalls sind bilaterale Differenzen in der Einkommensverteilung und ihre Veränderungen positiv mit vertikalem intra-industriellen Handel im vorliegenden regionalen Integrationsrahmen korreliert sind. Das heißt, die Verteilungseffekte der Politik spielen ebenfalls eine Rolle. Etwas Ähnliches gilt für die Bestimmungsgröße „Technologie“. Im Gegensatz dazu zeigt die Kostenvariable keine klaren Ergebnisse, vor allem dann nicht, wenn sie in Kombination mit der Technologievariable getestet wird.

Schlagworte:
internationaler Handel, intra-industrielle Handel, vertikaler intra-industrieller Handel, Europäische Union, Einkommensverteilung, Technologie, Panel-Analysen

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1 Introduction

There is a broad and still expanding library on vertical intra-industry trade around models, measurement problems and application to countries. This paper belongs to the latter strand of literature. What it is concerned with is to ask why product differentiation in trade of EU with 10 accession countries (ACs) is dominantly between high and low quality varieties of the same goods ('vertical'). Although this study does not explicitly discuss policy issues, its results may implicitly add to political considerations. For example, intra-industry trade is commonly related to the 'smooth labour market adjustment hypothesis', which states that workers of a given industry may easier find a job in another company of the same industry when international competition is within and not between industries. However, vertical intra-industry trade challenges this hypothesis, for technologies in producing similar goods are different, and skills may not suffice to find a job in another firm producing a similar good with different technology. A second example is personal income distribution. In intra-industry trade models, inequality in personal income distribution is disregarded, but in vertical trade models, income distribution plays a leading role as explanatory argument, and policy with its distributional effects comes into the play.

The trade relations between the two groups of countries – the ACs being former socialist countries – are characterised by a fast track of regional integration and short distances (compared to other empirical studies). However, they drew relatively little attention among trade economists (Gabrisch and Segnana 2002 and 2003 on European transition countries, and Zhang et al. 2005, for China are the exceptions). Industry-specific approaches (Djankov and Hoekman 1996, Thorn and McDowell 1998, Aturupane et al. 1999) seem to dominate among the few studies on transition countries. However, industry-specific approaches root rather in the industrial economics, that is a set of theories explaining product differentiation behaviour of firms (for example, Shaked and Sutton, 1987), and not in trade economics. The present paper is from the perspective of trade economics, in which country-specific determinants matter. Here, two sets of variables are of specific interest: The first one captures differences in income distribution. Contrary to other empirical research, the paper does not treat income distribution as a time-invariant variable. Rather the change of differences between countries is considered, not at least, since ACs experienced major changes in income distribution towards more inequality (and back) during their transition from a socialist to a market economy. The second set of variables includes relative factor endowment and/or differences in technology. Factor endowment and/or technology differences between EU and AC became visible after opening the economy and imposing free trade agreements in bilateral trade. Different to other research we try clearly to distinguish between cost and quality determinants, and aim to solve the long-lasting problem whether GDP per capita stands for technology or factor endowment differences.

The remainder of the study includes four sections: Section 2 describes the position of income distribution and technology and capital/labour ratios in the theory and empirics of intra-industry trade, and discusses the results of empirical studies. In section 3, it follows a presentation of the dependent and independent variables for estimations with the relevant stylized facts. Section 4 presents the empirical part of the study including the strategy for and the results of estimations. Section 5 provides conclusions and some policy-oriented hypotheses for further research.

2 Income distribution, cost and technology advantages in the theory and empirics of intra-industry trade

Income distribution within each country and differences in technology do not matter in first-generation models of intra-industry trade (see above all Helpman 1987, and Hummels' and Levinson's empirical study from 1995). The intra-industry shares in bilateral trade increase with rising similarity of countries in size and declines with rising differences in capital/labour ratios. The latter explain the inter-industry trade component in total trade. The models assume households in two countries to consume all varieties of the differentiated good of the same quality. In empirical research, GDP differences proxy the similarity in size. Similarity in size stands for similar consumer tastes and serves as argument for horizontal trade patterns. The GDP per capita (or worker) stands for different capital/labour ratios. A capital abundant country is thought to pay higher wages than a labour abundant country. While empirical estimations confirmed the positive impact of size similarity on intra-industry trade shares, Hummels and Levinsohn revealed a negative sign of the relative GDP per capita in pooled OLS estimations only (as predicted). When panel estimations with fixed effects were used in order to 'clear' the error term from truly idiosyncratic errors, the sign turned positive. Authors explained this change with country-pair specific effects like distance and land to labour ratios, which are beyond the theory on intra-industry trade. Durkin and Krygier (2000) challenged this conclusion, pointing at the possibility that intra-industry trade is not overwhelmingly horizontal but vertical and thus, the GDP per capita variable can obtain a positive sign in line with a theory that explains vertical intra-industry trade.

In contrast to first-generation models, vertical intra-industry trade models necessarily assume that each household consumes only one variety of the good, which is differentiated according to quality. Therefore, income distribution within a country matters with respect to the combination of varieties consumed by a nation. With rising differences in income distribution, the models predict a rising share of the vertical intra-industry share. Empirical research usually confirmed this relationship, so that in some approaches the variable is simply disregarded (Diaz Mora, 2002). Rather, empirical research focuses on production side structures, since the household side is not sufficient to explain, which of the varieties is produced in each of the trading countries. Borrowing from the traditional trade theory, vertical intra-industry trade models split into neo-Heckscher-Ohlin and neo-Ricardian approaches. In empirical neo-HO models, the GDP per capita stands for capital/labour ratio but, in contrast to first-generation theory, a positive correlation to intra-industry trade is predicted. However, when total trade includes vertical intra-industry trade and inter-industry trade, factor proportions cannot explain both. Falvey and Kierzkovski (1987) solved the problem at the theoretical level. In their model, inter-industry trade occurs by the exchange of the homogeneous against the differentiated good. The homogeneous good is produced with one single input factor and a technological advantage of one of the trading countries in its labour input function. The differentiated good is produced according to capital/labour ratios. Consequently, technology is negatively and capital/labour ratios are positively correlated with vertical trade, and vice versa with inter-industry trade. Most recent empirical studies try to test the relevance of a HO framework with factor endowment differences among countries (see, for example, Díaz Mora, 2002, Montaner and Orts Ríos, 2002) and find evidence for this approach.

A plausibility problem with the neo-HO approach is that the relative price of each variety of the differentiated good is driven by relative costs. Hence, quality differences reflect cost differences, an assumption, which hardly seems to have 'the right feel' (Krugman 1986, p. 37). Simply said, if one wants to have both vertical intra-industry trade and HO, one might be forced to make appropriate but implausible assumptions. The neo-Ricardian model of vertical intra-industry trade, which Flam and Helpman (1987) developed, might be a good candidate to solve this gap. With one factor input (labour) only, differences in technology explain one country's advantage in producing a higher quality of the differentiated good. With monopolistic competition, quality differences are reflected in price and wage differences. In this model, there is no room for factor endowment differences. An improvement in technology in the home country improves the advantage of this country in producing the high quality variety and raises the price of that variety, and the wage rate in producing it. A change in the relative price of the differentiated good sets incentives for the reallocation of production: more labour will be used for the-high quality variety in the home country and for low-quality variety in the foreign country. The Flam-Helpman model creates the room for a 'product-quality cycle in trade relations, which the Falvey-Kierzkowski model does not offer. This cycle opens the option that firms in the technologically advanced country s concentrate on the high-quality varieties after the technological innovation occurred, and shift production of the varieties with outdated technology to the backward country. To put it differently: upgrading in terms of technology is possible, but not catching-up, and this might shed new light on the foreign direct investment story. This perspective is not contained in the Falvey-Kierzkowski model, for technology matters in producing the homogeneous good. Durkin and Krygier (2000) tested the Flam-Helpman model for US trade with other OECD countries, however treating the GDP per capita variable as expression for technology differences. They found the expected positive correlations between the GDP per capita and vertical intra-industry trade. But it remains unclear what their test really revealed: the positive correlation between the GDP per capita and vertical intra-industry shares might stand for a HO interpretation, but also for a Ricardian framework. It seems necessary to insert an independent technology variable into econometric specifications in order to control explicitly for the character of cost and technology advantages.

3 Variables and stylized facts

3.1 Dependent variables

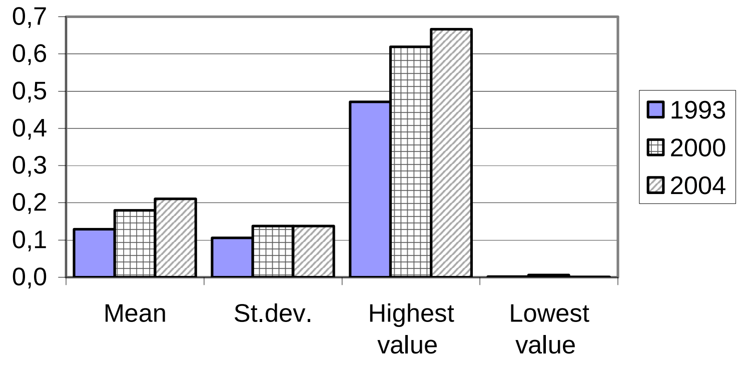
Intra-industry trade shares in total trade are calculated applying the Grubel-Lloyd index on 778 industries (4-digit level) of chapters 3 throughout 8 (manufacturing industries) of the Combined Nomenclature from Eurostat (for more details and problems see Annex I). We disentangle the both components, vertical and horizontal intra-industry trade, by following the usual calculation (Abd-el-Rahman 1984) and use unit values in exports and imports. Following the literature, we split vertical intra-industry indices into high-quality and low-quality components. From the theoretical perspective such a decomposition is not necessary, for vertical and high-quality vertical intra-industry trade models include the same set of (factor endowment) variables. We only report results.

We calculated country-pair indices for a matrix with m = 14 EU countries (excluding Luxembourg), and n = 10 Accession countries, and received 140 observations per year. Since data on income distribution is the limiting factor in comparative research and allows for only three years observations in this study, we calculated the trade variable for the years 1993,[1] 2000 and 2004. We start with 1993, when East European countries were still in an early stage of systemic transition. In this year, European agreements started to gradually impose a free trade zone between the EU and transition countries, which should end with their accession to the Union and the customs union. In May 2004, 8 of the 10 countries became members of the EU in with Bulgaria and Romania being the exceptions.

Figure 1 illustrate the descriptive statistics for (140x3 = 140) country-pair indices of total intra-industry trade. With trade liberalised step by step since 1993, the mean bilateral intra-industry share in total trade between EU and ACs rose from mere 13% on average to 21% in 2004. Nevertheless, yet trade between both regions is overwhelmingly inter-industry. The high standard deviations report strong differences. For example, intra-industry trade shares were between 67% (Germany-Czech Republic) and 1% for (Portugal-Latvia) in 2004. But intra-industry trade is vertically dominated (Figure 2). The mean values are fairly above 80% of intra-industry trade, although they decreased somewhat between 1993 and 2004.

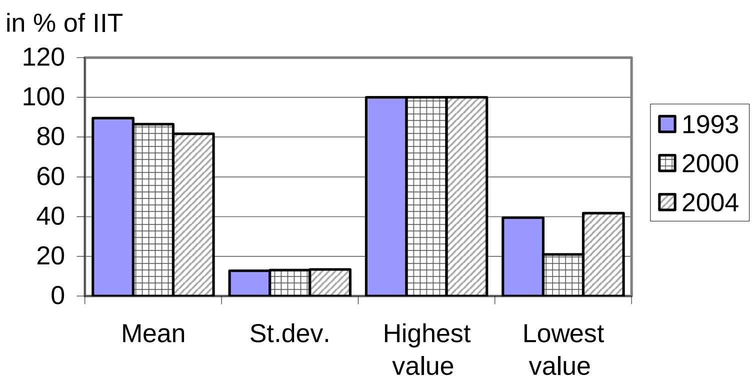
1 Data for Austria, Finland and Sweden are for 1995.

Figure 1:
GL-indices of total and vertical intra-industry trade in EU trade flows with Accession countries, 1993, 2000, 2004



Source: Eurostat Online database (2005a); author's calculations

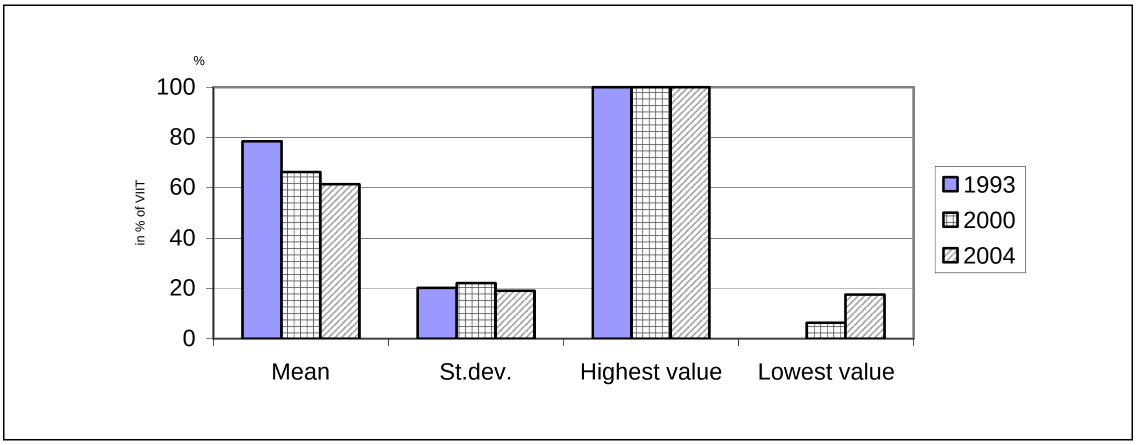
Figure 2:
Shares of vertical intra - industry EU trade flows in intra-industry trade (IIT) 1993, 2000, 2004



Source: Eurostat Online database (2005a); author's calculation

Figure 3 presents the EU's high-quality position in vertical trade with ACs. In general, we observe an erosion of the quality position of the EU. Nevertheless, most country-pairs include a quality advantage of the EU country. The lowest quality advantage for a EU country was (in 2004) in Finnish-Czech trade flows.

Figure 3:
Shares of EU high-quality position in total vertical intra-industry trade with ACs 1993, 2000, 2004 in %



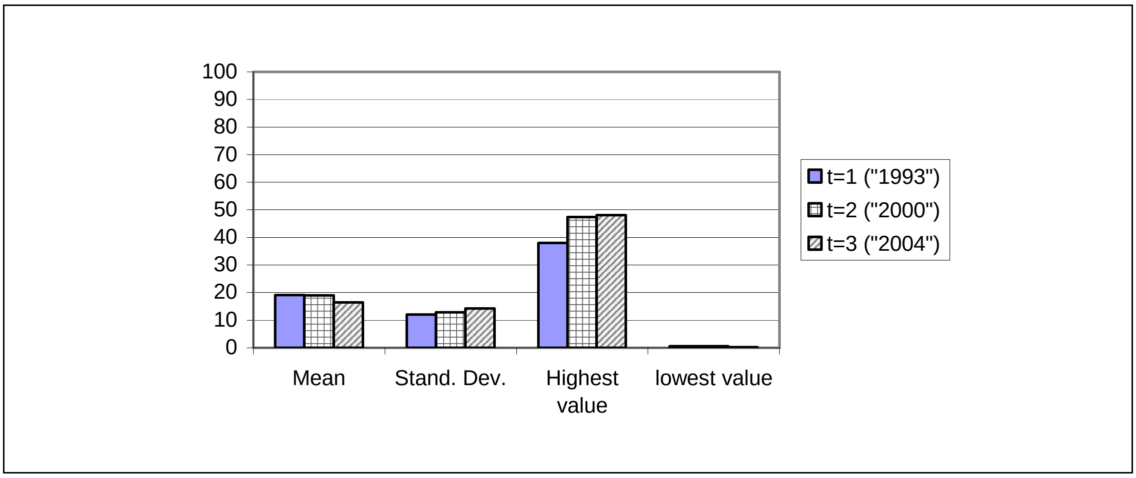
Source: Eurostat Online database (2005a); author's calculations.

3.2 Explanatory variables

(a) Personal income distribution

Inequality in income distribution is treated as a time-invariant country-pair specific effect in most research (Durkin and Krygier, 2000, Montaner and Orts Ríos, 2002, but not Zhang et al, 2005). The argument is that income distribution tends to remain stable over time. In a larger time horizon, this treatment is not plausible at least for European transition countries, where inequality increased quickly in the first stage of their transition (Milanovic 1998, Aghion and Commander 1999). This study uses personal income distribution, for it captures not only changes in the relation of market wages and market profits, but also redistribution from, tax policy and changes in the social system. Data is from UNU/WIDER on World Income Inequality Database (WIID2a 2005)), however, data do not fit precisely with the years used for trade indices. The country-pair observations of (changes of) differences in income inequality are calculated according to the overlap concept, which Flam and Helpman (1987) directly derived from theory. The concept assumes a dividing income class in each national economy (for detailed information see Annex II). Figure 4 presents the descriptive statistics of country-pair specific differences in income distribution for three years of observations since 1987. The highest value for the third observation ("2004") was the difference in income inequality between Denmark and Poland, the lowest value between France and Hungary. Values may fall into the range between 0 and 100. A value of 0 means no income distribution; the higher the value, the more relative inequality has a positive impact on vertical intra-industry trade. The first impression from Figure 4 is a declining difference in country-pair income distribution between EU and Accession countries. This general decline seems to reflect the reaction of policy to the increasing poverty ratios among population in transition countries. It seems to be in line with declining vertical shares in bilateral trade.

Figure 4:
Relative personal income distribution differences: country-pairs, overlap concept



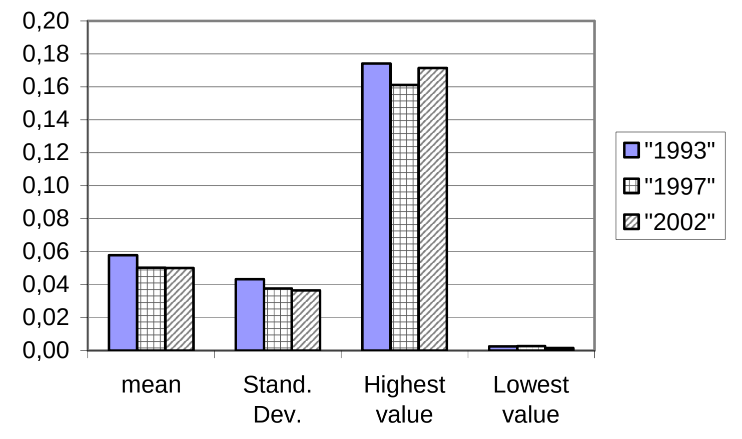
Sources: author's calculations; UNU/WIDER (2005),(WIID2a).

(b) Technology and factor endowment

When transition started, AC lagged behind in terms of technology. Since then, import of capital and capital goods contributed to a remarkable upgrading of technology. This study uses data on the number of firms applying leading technology and of firms with low technology for each country (Eurostat Online Database 2006). We decided for this indicator in order to obtain a picture, which is independent from any value calculations like cost variables.[2] Again, we have no precise fit of years with the other variables; we can calculate ratios for three years, which we assign to 1993, 2000, and 2004. We calculated the ratios of leading to low technology firms for each country and took the absolute difference between two countries. The indicator can take values between 0 and 1. The higher the value is, the larger is the technology difference. Figure 5 provides the descriptive statistics for country-pair ratios. In the third year of observation ("2004"), the largest bilateral difference was between Germany-Romania, and the lowest difference between Denmark-Poland. Mean values suggest a fall in technology differences, and the standard deviation reports some convergence among country-pairs.

2 An often used proxy for technology is based on R&D expenditures (Coe and Helpman 1995, Montaner and Orts Rios, 2002), presented, for example by the OECD (Basic Science and Technology Statistics). However, to obtain the R&D capital stock, a calculation procedures with some critical assumptions (about depreciation ratios, for example) is required.

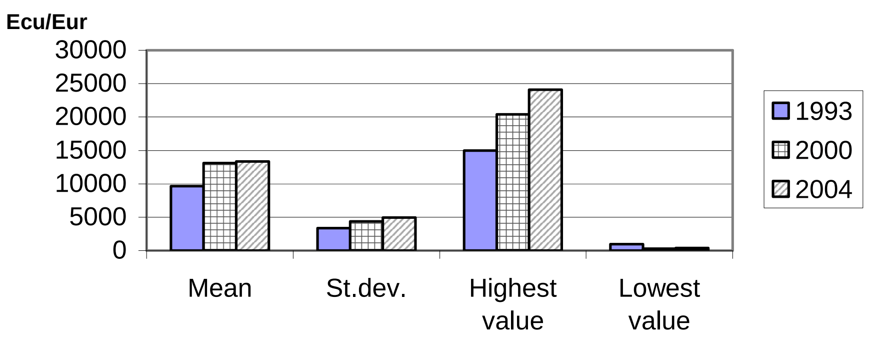
Figure 5:
Country-pair technology ratios: number of leading to low technology firms



Source: Eurostat Online database, (2006); author's calculations.

The relative GDP per capita may serve either as proxy for technology differences (Ricardian model) with a negative sign or for relative factor endowment (HO model) with a positive sign if combined with the independent technology variable. Data in Euro (Ecu) are taken from Eurostat Online; Figure 6 illustrates relative GDP per capita in exchange rates, measured as the mean value of 140 bilateral differences. The mean difference in GDP per capita between EU and ACs increased between 1993 and 2004. For example, the highest bilateral difference was Ireland-Bulgaria with 24.100 Euro in 2004, after 8.700 Euro in 1993 and 20.100 in 2000. The stylized facts suggest expecting a high (and even increasing) share of vertical trade pattern.

Figure 6:
Country-pair GDP per capita differences in Ecu/Euro (exchange rates)



Sources: Eurostat Online Database (2005b); author's calculations.

4. Empirical strategy and estimation results

4.1 Empirical strategy

We test a vertical intra-industry trade model directly and indirectly, and apply OLS and GLS specifications with pooled and panel data sets. Equation (1) presents the vertical model in the basic pooled version:

$$VIIT_{jk,t} = \beta_0 + \beta_1 REL\text{-}GDPC_{jk,t} + \beta_2 REL\text{-}TECH_{jk,t} + \beta_3 REL\text{-}INDIS_{jk,t} + \beta_4 MINSIZE_{k,t} + \beta_5 MAXSIZE_{k,t} + \beta_6 DISTANCE_{jk,t} + \beta_7 CUDUM_{jk,t} + \mu_{jk,t} \quad (1)$$

where $VIIT_{jk,t}$ is the vertical intra-industry index in trade of the reporting EU country *j* with its partner country *k* at time *t*. Since indices are between [0,1], we use logistic transformations for VIIT, while explanatory variables are in logarithmic expressions. Indirect tests serve to check the behaviour of coefficients, when total and horizontal intra-industry trade (TIIT and HIIT) replace for VIIT in equation (1). μ is the error term.

The next explanatory variable measures the difference in the GDP per capita between both countries ($GDPCC_{j,t} – GDPC_{k,t}$).[3] In first generation models of intra-industry trade, the variable explains (with a negative sign) the inter-industry trade component of total trade. In a world of vertical dominated trade, this variable can have a positive sign (explaining technology differences) or a negative sign (explaining differences in capital/labour ratios). Hence, a meaningful interpretation is possible only in the context with the sign the technology variable REL-TECH obtains in regressions. A positive sign of the latter and a negative sign or insignificance of REL-GDPC is a hint for technology differences, which determine vertical trade. On the other side, a positive sign of REL-GDP in combination with a negative sign (or insignificance) of the technology variable seems to confirm the neo-Heckscher-Ohlin perspective, where capital/labour ratios rule quality differences.

REL-INDIS stands for differences in income distribution, and the coefficient should be positive in explaining vertical intra-industry trade, and negative or insignificant in TIIT (and HIIT) specifications.

The MIN and MAX variables proxy size differences in terms of total GDP, and they stand for the similarity of consumer tastes and the power of HIIT. $MINSIZE_j$ (MAXSIZE) selects the lower (larger) GDP from a pair of countries. The first-generation theory of intra-industry trade predicts a positive (negative) sign for MINSIZE

3 The GDP per capita of EU countries is higher than in AC tn all bilateral cases; hence, we do not need to calculate absolute differences like usually in other research.

(MAXSIZE), since size stands for similarity and common consumer tastes.[4] Vertical intra-industry trade theory does not clearly predict the signs for size variables. Durkin and Krygier found the opposite behaviour of the variables in TIIT, VIIT and HIIT estimations. While similarity in size explains the increase of TIIT in total trade and of HIIT in total intra-industry trade, it might be insignificant or even negatively correlated with VIIT.

DISTANCE is a proxy for transactions costs of trade, which increase with a larger geographical distance. It brings the model closer to gravity models of trade. The variable is measured in kilometres between the capitals of both countries. The expected sign is negative in all specifications, for the relevance of transaction costs in trade with differentiated goods is higher compared to inter-industry trade with homogeneous goods. All specifications include a liberalisation dummy, which captures the membership of an accession country in the EU customs union (CUDUM). If an AC is a member of the union, the dummy receives the value 1 (which applies to 8 of 10 countries for 2004 with Bulgaria and Romania being the exceptions). In all other cases, the dummy receives the value 0. The predicted sign is positive for all specifications. To summarize, Table 1 provides an overview on signs of variables predicted thy theory:

Table 1:
Predicted signs of coefficients

	REL-GDPC	MAXSIZE	MINSIZE	DISTANCE	REL-TECH	REL-INDIS	CUDUM
VIIT	> 0 (HO) < 0 (Ric.)	> 0 (?)	< 0 (?)	< 0	< 0 (HO) > 0 (Ric.)	> 0	> 0
TIIT	< 0	< 0	> 0	< 0	< 0	< 0	> 0
HIIT	< 0	< 0 (?)	> 0 (?)	< 0	< 0	< 0	> 0

TIIT = Total IIT, VIIT = Vertical IIT, HIIT = Horizontal IIT. HO = Heckscher-Ohlin (relative factor endowment); Ric. = Ricardian (technology differences).

Complementary to regressions with pooled data we apply panel techniques with fixed effects (FE) specification. The time span (1993 throughout 2004) seems wide enough to run models. Pooled regressions produce a common constant for all country-pairs. It seems to be the appropriate specifications, since bilateral trade agreements between EU and AC are identical, for trade policy is a matter of the EU authorities and not of single member countries. However, one cannot exclude that apart from general trade rules of the EU, bilateral trade relations are ruled by other specifics, including non-economical

4 Assume GDP_j/GDP_k to be ratio illustrating similarity of the size of both countries j and k, and the ratio < 1. Then, we can write as empirical function $IIT = \alpha \ln GDP_j + \beta \ln GDP_k$, and we expect for β a negative sign. Since Loertscher and Wolter (1980, p. 283) most empirical studies, including that of Helpman (1987) used this empirical specification of the size-similarity variables.

ones. For example, border trade regimes (Germany-Poland, Austria-Hungary, Italy-Slovenia) might exert a certain impact on bilateral trade compared to other country pairs (France-Poland, Belgium-Slovenia). Further, different regimes of factor movement (capital, labour) might affect bilateral trade. Finally, in pooled regressions, the error term might include time-invariant effects beyond the distance variable. FE models try to capture cultural differences between country pairs. Indeed, the friendly relations between Austria and Hungary in their common history (until 1918) might influence trade patterns – a factor that certainly has no effect in Ireland-Hungary relations. We apply the likelihood ratio test in order to find out the superiority of a fixed effects model specification over a model with pooled data. Since the error term might be correlated with independent variables, we apply the Hausman test for the applicability of random effects (RE) estimators.

Finally, with OLS we assume a constant variance in the error term. In samples with very large differences in country pairs, like for example Germany-Slovenia and Austria-Slovenia, we might meet with heteroscedasticity. Indeed, GLS specifications with cross-section weights produce higher t-values compared to OLS, and we cannot assume constant variances to be appropriate. Tables report GLS results.[5]

4.2 Results

Table 2 reports the results for vertical, total, and horizontal intra-industry trade ((a), (b), and (c)) according to the three model specifications (pooled, fixed and random effects). In all pooled regression (specifications 1.1, 2.1 and 3.1), the common constant is insignificant. Distance is negatively correlated to the dependent variables as expected. The liberalization dummy is insignificant or only weakly significant.

Vertical intra-industry trade: neither Neither REL-GDP nor REL-TECH explains vertical intra-industry trade in pooled regressions (a.1.2). MIN- and MAXSIZE are significant and have a positive sign: with lower similarity, vertical trade increases. Because country-pair specific effects might bias the result, we move to the FE model (a.1.2). We find fixed effects to be highly significant,[6] and the F-test reveals a clear superiority of the FE model against the pooled model. Distance as a time-invariant determinant has to be deleted from the list of variables. Now, at least MAXSIZE is insignificant, while MINSIZE remains significant. REL-INDIS obtains the sign predicted by theory as well as the technology variable. Also, being a member of the EU tariffs union has a significant impact on total intra-industry trade. However, we are not able to draw any conclusion about the driving determinants for vertical intra-industry trade on the production side, for also REL-GDPC has a positive sign. The explanatory power (R^2) improves sig-

5 OLS results may be obtained from the author on request.

6 Results may be obtained from author on request.

Table 2:
Results of GLS estimations (420 observations)

(a) Dependent variable: vertical intra-industry trade			
	Pooled	Fixed effects	Random effects
Sub-model	a.1.1	a.1.2	a.1.3
C	0.032	---	-0.258
REL-GDPC	-0.006	0.046***	0.002
REL-TECH	-0.000	0.006**	0.004
REL-INDIS	-0.013***	0.006***	-0.001
MINSIZE	0.054***	0.024***	0.044***
MAXSIZE	0.037***	0.000	0.040***
DISTANCE	-0.106***	---	-0.107***
CUDUM	-0.008	0.033***	0.004
R^2 (unw.)	0.470	0.850	0.463
Likelihood Ratio[a]	---	21.85***	---
Hausman [b]	---	---	22.13***
(b) Dependent variable: total intra-industry trade			
Sub-model	b.1.1	b.1.2	b.1.3
C	0.001	--	-0.160
REL-GDPC	-0.021***	0.004	-0.023
REL-TECH	-0.002	0.015***	0.005
REL-INDIS	-0.013***	0.007***	-0.003
MINSIZE	0.077***	0.023**	0.061***
MAXSIZE	0.061***	0.051**	0.067***
DISTANCE	-0.146***	---	-0.165***
CUDUM	0.015	0.006***	0.039**
R^2 (unw.)	0.479	0.872	0.476
Likelihood Ratio[a]	---	16.47***	---
Hausman [b]	---	---	26.29***
(c) Dependent variable: horizontal intra-industry trade			
Sub-model	c.3.1	c.3.2	c.3.3
C	0.008	--	--0.021
REL-GDPC	-0.009***	-0.010**	-0.010**
REL-TECH	-0.001**	0.003***	0.000
REL-INDIS	0.003***	-0.001	-0.003
MINSIZE	0.011***	-0.001	0.011***
MAXSIZE	0.011***	0.020***	0.012***
DISTANCE	-0.018***	---	-0.022***
CUDUM	0.004*	0.014***	0.012**
R^2 (unw.)	0.290	0.621	0.292
Likelihood Ratio[a]	---	6.17***	---
Hausman[b]	---	---	10.33

[a] F test ; [b] Chi-square statistics . –* 10%, ** 5%, *** 1%.

nificantly compared to pooled regressions, which means that intra-industry trade is not a pure statistical phenomenon due to inappropriate calculation. With random effects (a.1.3) the cost and technology variables and income distribution become insignificant. However, the Hausman test shows that the RE model is not appropriate.

Total intra-industry trade: Pooled estimation (b.2.1) yields the expected sign for MINSIZE and REL-GDPC (explaining inter-industry trade), but MAXSIZE has the wrong sign. Again, the FE model (b.2.2) demonstrates superiority against pooled regressions. The country-pair constants are highly significant. The GDP per capita variable turns out to be insignificant. Furthermore, REL-TECH and personal income distribution differences explain total intra-industry trade. On the other side, the RE model (b.2.3) yields the predicted results, since all REL-variables become insignificant and do not explain total intra-industry trade. To sum up the results of our first indirect test do not reject the results of the vertical model.

Horizontal intra-industry trade: In the pooled version (c.3.1) we find the signs of coefficients to the REL- variables as predicted. Turning to panel estimations, the pecking order of specifications is now that the FE model (c.3.2) should not be used, since the insignificant chi-square statistics reveals correlation of the error term with independent variables. However, the explanatory power of the RE model (c.3.3) is rather low. REL-GDPC is negative in all estimations. Technology differences and differences in income inequality play no role in explaining horizontal intra-industry trade. In summary, typical vertical trade model variables cannot explain horizontal trade patterns.

5 Conclusions

A first result is that vertical intra-industry trade between old and new EU countries is ruled by determinants, which do not explain total and horizontal intra-industry trade. This finding is not new, but again confirmed by another regional framework. A second result is that personal income distribution plays a role for trade patterns in the given framework of regional trade integration. This brings us to the conclusion that the distributional effects of the various policies matter. When we assume that horizontal trade pattern base on advanced technologies and higher value added per worker, a government might influence the shift to more horizontal pattern by considering the distributional effects of its policies. In ACs, income distribution shifted towards more inequality in their early transition period, and might have contributed to the high vertical shares in trade. But later we observe a correction to more equality, which seems to have been a reason for falling vertical and increasing horizontal shares. Further research should compare the both regions of the enlarged Union individually in order to find out, whether income distribution schemes tend to converge or diverge, and whether this has an impact on trade patterns.

The third finding is an 'inconclusion' about the driving force for production localization: costs or technology. Estimations tend to produce a significant positive correlation between technology differences as well as GDP per capita differences and vertical trade in fixed effects specifications. Neither convincing support for relative factor endowment nor for differences in technology in explaining vertical trade in the differentiated good (in industry) was found. Therefore, there is no clear indication of a product-quality cycle in EU-ACs relations; upgrading and catching-up in terms of technology are both still possible scenarios. Obviously, this includes also statements on the contribution of foreign direct investment to structural change and growth in former transition countries. An interesting aspect might be that the increasing impulse from rising GDP per capita differences is much stronger then the combined decreasing impulse from eroding technology and inequality differences, which we observed in Figures 4 throughout 6. An issue for further research might be to check, whether these 'inconclusive conclusions' are due to some noise in the vertical intra-industry determinant. It cannot be excluded that at the 4-digit level of trade, the variables might be contaminated with a good portion of inter-industry elements. Finally, the unexpected results for the size variables (above all, MAXSIZE) are an issue for further research.

Annex I: Grubel-Lloyd index

In equation (2), T_{jk} is the intra-industry share in total trade between a pair of countries *j* (home) and *k* (foreign), and for a set of *n* industries with *X* being the exports of the home country and *M* being its imports from the foreign country in the individual industry *i*:

$$T_{jk} = \frac{\sum_{i=1}^{n} (X_j^i + M_k^i) - \sum_{i=1}^{n} \left| (X_j^i - M_k^i) \right|}{\sum_{i=1}^{n} (X_j^k + M_k^i)} \qquad (2)$$

The share of inter-industry trade in total trade is ($1\text{-}T_{jk}$). Although the prescription for calculation makes a sharp cut between inter and intra-industry trade, T_{jk} is necessarily contaminated with some noise, for the data are for industries and not single goods. And here, disaggregating is relevant. With low-digit disaggregation (2-digit, for example), the index includes some inter-industry trade (Celi and Smith, 1999). Therefore, a high-digit level is preferable for calculating the index. But with more disaggregated data, the number of empty entries in statistical reporting increases. In order to mitigate the trade-off problem[7] we decided for the 4-digit level. We pay particular attention to R^2 of regressions in order to become certain that the chosen level is not too much distorted by inappropriate calculation. Further, intra-industry trade models assume balanced total trade, and imbalances might distort the correct measurement of shares. However, the empirical literature has not confirmed the superiority of the trade-balance adjusted GL index, and we use the unadjusted index in regressions.[8]

Intra-industry trade in a specific good is horizontal, when the prices of the exported and imported good variety are close to each other. Trade statistics aggregate similar goods to industries and similar industries to sectors, for which ‘prices’ exist only under very restrictive conditions (identical costs, for example). Unit values (in this study: trade value divided by metric tons) are the usual proxy for identifying differences in price indexes, and relative unit values (RUV) relate the unit values of export to those in imports. Intra-industry trade is vertical, when the relative unit values of exports and imports in the same industry are less than 0.85 and larger than 1.15: >RUV = UVX/UVM >1.15. Within this range, trade is assumed to be horizontally differentiated. When only the industries with an RUV outside of the defined range are considered, equation (2) produces the share of vertical intra-industry trade. Those items with only a RUV_i >1.15 yield the high-quality position in EU’s trade, and those with lower than 0.85 yield the low-quality position.

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7 For 1993, no data were available in 13 cases, which is 1.9% of the entire 693 observations. Gaps were filled by extrapolating mean values from the remaining two entries (2000 and 2004).

8 We disregard also the Aquino-index, which corrects even for imbalances in the individual industries. See the critical review by Vona (1991) on calculating intra-industry indices.

Annex II: personal income distribution

In Flam and Helpman (1987), the overlap income distribution argument is

$$ID_{j-k} = \frac{F_j(h_{d,j})}{1 - F_k(h_{d,k})} \qquad (3)$$

$F_{j,k}$(.)are the cumulative distribution functions *f* in countries *j* ('EU') and *k* ('AC') up to the household *h* with the dividing (or marginal) income level *d*, which is in the interval $hj,k = [0,...h_{j,d}, h_{k,d},...1]$. Households with an income less than h_d consume the low-quality variety of the differentiated product, and consumers with a higher income the high-quality variety. Any change in the cumulative distribution functions is positively correlated with vertical intra-industry trade. In this study, the variable for a single country-pair is constructed according

$$\text{REL-}INDIS_{jk,t} = \ln\left|F_j(h_{d,j-k}) - (1 - F_k(h_{d,j-k}))\right|. \qquad (4)$$

The country-pair dividing income class is defined as

$$h_{d,j-k} = \frac{GDP_j^{PPS} + GDP_k^{PPS}}{POP_j + POP_k} \qquad (5)$$

where GDP^{PPS} is the GDP at purchasing power parities, and POP the population in both countries; we simply assume the dividing income class in the bilateral framework *j-k* to be around the average GDP per capita. GDP data for 1993, 2000 and 2004 are from Eurostat Online Database (2005b). Income distribution data is in per cent according household deciles, and taken from UNU/WIDER on World Income Inequality Database (WIID2a, 2005)).

In most cases, income is disposable income, and in some cases it is monetary income. We identified three observations for each country in this period, however, at different points of time. The latest reporting year is 2001, the earliest year 1987 (for Slovenia). In the case of t = 1, we linked data to intra-industry data of 1993, in the case of t = 2 to the year of 2000, and in the case of t = 3 to the year of 2004).

In order to find a distribution around the dividing income class in terms of average GDP per capita, we assume an equal distribution of the population across deciles (which is not very realistic, but the only practical way the data source allows). The GDP per capita for each household decile has been calculated according to $h(.) * \frac{GDP_{PPS}}{POP(.)}$. h (**.**) and POP(**.**) are the household shares in income and the population of each decile. Table 3 demonstrates the calculation modus by hand of the Austrian example for the year "2004":

Table 3:
Calculation example (Austria 2004) for relative income distribution

J	k	Bilateral GDP^{PPS} per capita (h_{dj-k}) in Euro	$F_j(h_{d,j-k})$ in per cent of total income	$F_k(h_{d,j-k})$ in per cent of total income	$\lvert F_j(h_{d,j-k} - (100 - F_k(h_{d,j-k})\rvert$
Austria	Bulgaria	17584	10	42	32
	Czech Republic	21185	17	36	19
	Estonia	25496	34	29	6
	Hungary	19951	17	25	8
	Latvia	23795	25	28	3
	Lithuania	22765	25	26	1
	Poland	14008	4	40	36
	Romania	12735	4	24	20
	Slovakia	21413	17	21	4
	Slovenia	25844	34	20	14

Source: author’s calculations.

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