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Declining Export Prices due to Increased Competition from NIC – Evidence from Germany and the CEEC

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The aim of this annual workshop is to offer a forum for young researchers from the field of International Economics to present and to discuss their current topics of research with other experts. The workshop also provides the opportunity to gain an overview of recent developments, problems and methodological approaches in this field.

Detailed information on past workshops and the planning for the 2008 workshop are available at http://www.vwl.wiso.uni-goettingen.de/workshop. Do not hesitate to contact Prof. Dr. Gerhard Rübel, *CeGE* (gruebel@uni-goettingen.de) for further questions.

Declining Export Prices due to Increased Competition from NIC – Evidence from Germany and the CEEC

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Abstract: In this paper the export demand and supply of German manufacturing industry is estimated for the period 1993:1 through 2005:4. The Johansen (1991, 1994) procedure is applied to estimate the long-run relationship in a VECM. Special attention is pointed on the development of the German export price being exposed to the competitive environment of fast growing countries like Hungary, the Czech Republic and Poland. Since they offer similar high-technology products on international export markets and are gaining market share Germanys export price suffers downward pressure.

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1 INTRODUCTION

In an open economy like Germany the macroeconomic environment is heavily influenced by the development of international trade patterns. In Germany the fear of decreasing welfare due to globalization, especially caused by the growing new EU Member States[1] Poland (henceforth PL), Czech Republic (CR) and Hungary (HU), henceforth summarized as Central East European Countries (CEEC), plays a major role in the political and public discussion since the opening of these former communistic countries in the beginning of the nineties. The concerns cover mainly labour markets and thus future job security.

In times of globalization the trade and capital movements increased considerably. The trade in goods and services grew faster than the GDP in the last twenty years and accordingly the degree of openness increases in almost every country that has opened up to free market-economy. Particularly the growth of the newly industrializing countries and developing countries is driven or at least accompanied by increasing exports. Thus, trade from these fast growing lower wage countries has a considerable impact on industrial countries like Germany and is a challenge for both firms and labour markets. The bulk of globalization impact and economic research refer to outsourcing and the structural change influencing the labour markets and the production process of the industrialized countries. The results are often not clear-cut because of the gains from trade when importing cheaper intermediate or consumer goods. Besides, in the theory of international trade the fear of industrial countries towards fast growing newly industrializing countries and developing countries is based on the situation of biased growth and specialisation. If a new competitor imports and exports the same goods as the incumbent, the terms of trade can deteriorate due to increasing import prices and declining export prices or a loss of export market share (see Krugman, P. (1985) and Samuelson, P. (2004)). Since the CEEC are not the cheap working bench of the industrialized countries any

[1] This list can be arbitrarily resumed with developing countries like China, India and Pakistan. But for sake of data reliability the analysis is concentrated on the CEEC and here on PL, HU, CR.

more but producing high-technology intensive goods which become more expensive and the CEEC emerge as a competitor of German exports in terms of cost and quality, the theory admits for decreasing terms of trade of the already industrialized country indicating a draw back to the autarky welfare level (see Samuelson (2004)). That is, in addition to outsourcing, the case since the CEEC have opened up to international trade quite rapidly after the break down of the closed system of communism, which was not based on concepts of comparative advantage. How Germany is facing this new environment can be seen regarding the competitiveness of the country. How is Germany performing in the international market of manufactured exports? What determines the export price and how did it develop since the opening-up of the CEEC? Does the growth of the CEEC has an impact to Germany and is it negative or is the influence to small to show up in the data?

In search of answers the development of export prices of manufactured goods are used to analyze the impact of increased competition on an already industrialized country and the potential terms of trade loss due to a decline in export prices ceteris paribus. Goldstein and Khan (1976), (1985) and Hooper and Marquez (1995) made a great contribution to the topic of simultaneous export demand and supply equations. Most empirical work on foreign trade doesn't include the supply side of the markets in their analysis. They assume the export price as exogenous due to infinite supply price elasticity (see also Goldstein and Khan (1985), p. 1087). Besides, Goldstein and Khan and Hooper and Marquez empirically estimated jointly determining the export supply income and price elasticities for imports and exports of several industrial countries. Sawyer and Sprinkle (1999) give a large overview of the empirical work on price and income elasticities for international trade. In this work the trade equations for manufactured exports are estimated using cointegration and error-correction estimation techniques according to Johansen (1991) and Johansen and Juselius (1994) in order to detect the long-term relationships. Similar proceedings for Germany are found in Clostermann (1996),

Hooper, Johnson and Marquez (1998), Meurers (2004) and Strauß (2004) taking into account latest issues that have come up in time-series econometrics (see Sawyer / Sprinkle (1999), p. 13 et sqq.). Besides, the above mentioned empirical work is more interested in the long-run income and price elasticity for exports but in the importance of intensified export competition. This part of the long-run relationship will be modelled in this paper by the market share of the CEEC in the observed export market of manufactured goods.

The paper is structured as follows: The second chapter describes the structural change and the catch up process of the manufacturing industries and exports of the CEEC closing the technology gap. This can be seen from the stylized facts of the development of high tech exports, market shares and export prices relative to Germany. In the third chapter the determinants of the export demand and supply in an imperfect substitute trade model will be specified. Following this the empirical data are described. Chapter four explains the time series analysis prerequisites before applying the vector error correction model (VECM). After, the empirical results are presented. The paper closes with some concluding remarks.

2 THE CEEC AS A NEW COMPETITOR IN THE EXPORT MARKETS

2.1 STRUCTURAL CHANGE AND TECHNOLOGY CATCH UP PROCESS

The Europe Agreements[2] of 1991, 1993 and 1995 and the opening up of the market were the starting point for liberalized and intensified trade and capital flows in Eastern Europe, in particular for Poland, the Czech Republic and Hungary that joined the European Union on 1st May 2004.

During the transition period and thereafter a large structural change in the composition of GDP took place in the CEEC characterized by de-agrarianization, de-industrialization and tertiarization (see Havlik, P. (2005), pp. 6-10 and more general about the CEEC see also Com-

[2] Due to the Europe Agreements the EU and the CEEC have phased out all statutory tariffs on industrial goods.

mission of the European Communities (2003) and European Central Bank (2005)). A long with the sharp increase in trade volume and the structural change in the composition of GDP during 1993-2005 the trade pattern of the CEEC were accordingly rearranged as well.

In 1995 the exports of the CEEC were relative labour intensive due to the comparative advantage provoked by low labour costs. Table 1 shows the technology intensity of manufactures exports from the CEEC and Germany. In 1995 the whole CEEC exported more not technology intensive products like apparel, iron, steel and metal products than technology intensive products. Besides, Germany already had its comparative advantage in high-tech manufactures[3] exporting 67,8 per cent of total manufactures.

Table 1: Technology intensity of total world manufactures exports, CEEC and Germany, 1995, 2004

1995		CR	HU	PL	GY
High-technology manufactures		4,1%	10,1%	4,2%	15,4%
Medium-high technology manufactures		37,0%	32,8%	24,6%	52,4%
	High-tech	41,1%	42,9%	28,7%	67,8%
Medium-low technology manufactures		31,9%	19,8%	31,7%	16,0%
Low technology manufactures		27,0%	37,3%	39,5%	16,2%
	Low-tech	58,9%	57,1%	71,3%	32,2%
2004		CR	HU	PL	GY
High-technology manufactures		16,2%	34,8%	6,2%	20,2%
Medium-high technology manufactures		44,4%	39,6%	38,2%	51,3%
	High-tech	60,6%	74,4%	44,4%	71,5%
Medium-low technology manufactures		22,9%	11,2%	27,3%	15,3%
Low technology manufactures		16,6%	14,4%	28,3%	13,2%
	Low-tech	39,4%	25,6%	55,6%	28,5%

Source: OECD, Bilateral Trade Database, own calculations.

Classification: High-technology: Aircraft and spacecraft; pharmaceuticals; office, accounting and computing machinery; radio, TV and communication equipment; medical, precision and optical instruments. Medium-high-technology: Electrical machinery and apparatus; motor vehicles, trailers and semi-trailers; chemicals excluding pharmaceuticals; railroad equipment and transport equipment; machinery and equipment. Medium-low-technology: Building and repairing of ships and boats; rubber and plastic products; coke, refined petroleum products and nuclear fuel; other non-metallic mineral products; basic metals and fabricated metal products. Low-technology: Manufacturing, Recycling; wood, pulp, paper, paper products, printing and publishing; food products, beverages and tobacco; textiles, textile products, leather and footwear. Source: OECD, ANBERD and STAN databases.

Between 1995 and 2004 a restructuring of trade patterns in the CEEC towards more technology intensive branches took place. The high-tech exports of CEEC boosted and attained growth rates between lowest 524 per cent in Poland and 798 per cent in Hungary compared to

[3] High-tech is defined as the sum of high-technology and medium-high technology.

182 per cent in Germany from 1995-2004. Nowadays the structure is becoming similar to the one of the EU 15 with competitiveness in technology intensive branches reflecting the economic characteristics of countries and commodities like in the Heckscher-Ohlin model (see similar in Havlik, P. (2003), p. 30-32). In 2004 all CEEC countries except Poland exported more technology intensive products than not-technology intensive ones with Hungary ranking first (74,4 per cent). The strongest branches are automobile and parts, machinery and in the case of Hungary communication equipment. The underlying reasons for this catching-up are on various occasions. The pattern of comparative advantage changes as relative factor endowments and available technology changes. According to the Rybczynski effects the sector expands that intensively uses the growing and accumulated factor while the others shrink absolutely. Thus relative factor supplies change away from land and labour towards capital and skills and increase output in sectors that use capital and skills relative intensely and reduce output in sectors that use other factors relative intensely.

According to that the specialisation patterns of the CEEC in labour and resource intensive commodities and that of Germany in technology-intensive and capital-intensive products are melting off or already melted off. The pattern of export structure is becoming similar. Especially regarding the strong export branches like machinery and automobile and parts the CEEC are reducing their comparative disadvantage or even reverse it. From the perspective of trade in manufactured goods the CEEC have reached the level of industrialized countries (see similar in Havlik, P. (2003), p. 28-32).

2.2 MARKET SHARE AND EXPORT PRICES

The technology catch up process of the CEEC in manufactured goods evolves a new competitor for German exports in the common export market.[4] The export market consists of 20

[4] Besides, this effect is only one part of the trade pattern. The other reflects the increased division of labour and accordingly production. Some fraction of trade between the market and the CEEC is taking part in the same in-

mainly OECD-countries where data were available for. Since in this open n-country world the relative prices of tradable goods are determined by the relative prices of the world market, Germany suffers downward pressure on their export prices due to increased competition from CEEC, from a theoretical view respectively. In theory Germany can react by pricing to market (PTM) in order to keep the market share approximately constant or is loosing market share. PTM forces a supplier to tie his export price to the competitor's one or to make price discrimination across markets (see Goldberg / Knetter (1997), p. 1252-1268). The latter will not be followed up later. The supply of manufactured goods of the CEEC will increase in accordance with the profitability of producing and selling exports. Thus, the CEEC experiences an export price increase due to higher demand and more expensive and sophisticated goods. We can conclude that if the new competitor closes the technology gap towards the technology leader (in this case Germany) and has lower absolute factor prices, competition and augmented supply lead to downward pressure on the prices of the incumbents export goods. As a result the export price of the advanced country can decline and the terms of trade are ceteris paribus worse off yielding a welfare reduction by falling real income (see Krugman (1985), p. 45-47).

Figure 1 shows the development of the market share and export price of Germany and the CEEC in the period of 1993:1-2005:4 and confirms the strengthened competitiveness of the CEEC in the export market. The plot seems to follow theory explained above. The market share of the CEEC increased considerably throughout the period from 1,4 per cent to 4,6 per cent. The export price index of the CEEC increased by 40,5 per cent experiencing the sharpest increase in the period from 1994:1-1999:4. For the rest of the time period the export price is quite stable while the market share is still growing. This empirical picture does not seem to be in line with the economic theory of strong export growth. Here a strong growing region is as-

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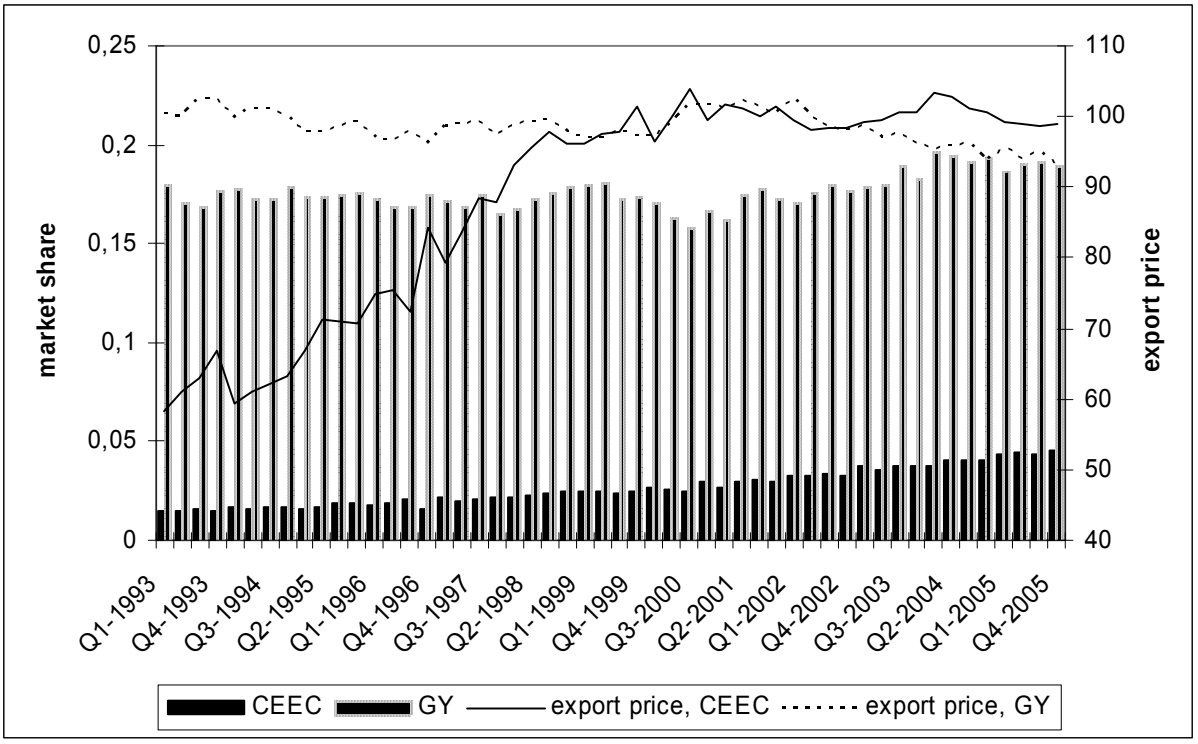
dustry (intra-industry trade) due to outsourcing of production parts from advanced countries to the CEEC. This impact on the increased market share will be controlled for in the empirical analysis by the fraction of inward FDI in GDP of the CEEC.

sumed to have declining export prices because the rest of the world can absorb the additional supply only via a decline in prices if the rest of the world grows at a lower pace. But in the case of the CEEC the technological and quality catch up process of the manufactured exports enables a country to experience increasing market shares in combination with stable or increasing export prices. Germany is facing slightly falling export prices (-7 per cent) in accordance with quite unstable market shares during the period. But regarding the beginning and the end of the period gives almost unchanged market shares with 18 per cent in 1993:1 and 18,8 per cent in 2005:1. Regarding the interaction of these two variables shows growing market shares in connection with shrinking export prices in the period of 2000:3 to 2005:4. This gives some support for PTM and adjustment pressure stemming from intensified competition.

Figure 1: Market share and export price, Germany and CEEC, 1993-2005 (quarterly data)



Source: OECD, Monthly Statistics of International Trade, own calculations.

Export price of GY is a unit value index of machinery and transport equipment in national currency. Export price of CEEC is the mean of the export price index of machinery and transport equipment from CR, the unit value index of machinery and transport equipment from HU and of the unit value index of non-commodity goods and services exports from PL in national currency. The market shares are real exports (US-$) of manufactured goods (SITC 5-8) of GY, the CEEC relative to the total exports of 20 OECD countries. See the data description in Appendix A1 for more details.

3 DETERMINANTS OF EXPORT DEMAND AND SUPPLY

3.1 THEORETICAL CONCEPT

In the n-country case we perform an imperfect substitute trade model allowing for different exporters to charge different prices. The key reason for assuming an imperfect substitute model is the fact that Germany is heavily linked into intra-industry trade indicating that the exports and imports are no perfect substitutes. Intra-industry trade implies that countries are both exporters and importers of the same good.[5] Another reason are the price differences for the "same" product in different countries (see Goldstein / Khan (1985), p. 1044). The assumption of an imperfect substitutes model instead of a perfect substitutes model follows the mainstay of empirical work on international trade (see Goldstein / Khan (1985), p. 1050 et sqq. and Sawyer / Sprinkle (1999), p. 5 et sqq.). The n counties are represented by the 20 countries forming the export market.

The export demand function is specified in [1] as follows:

$$EX^D = f\,(Y^*, P_{EX}, (P_{EX}{}^* + WEXR)) \qquad [1],$$

where EX^D: export demand

Y^*: import of manufactured goods from the export market

P_{EX}: Export unit value index of manufactured goods

$P_{EX}{}^*$: Competitors (export market) trade weighted export unit value index of manufactured goods

WEXR: trade weighted nominal exchange rate

Since [1] is specified in logarithms you can easily interpret the coefficients as elasticities. The equation [1] is based on the following assumptions (see also Goldstein / Khan (1985), p. 1045-1047, Goldstein / Khan (1978), p. 276, Stern / Francis / Schumacher (1976), p. 4 et sqq. and Sawyer / Sprinkle (1999), p. 8-11). First, export demand EX^D of the observed country

[5] In the case of the trade between the advanced countries and the CEEC this will be controlled for in the econometric analysis by the FDI variable.

from the whole analyzed market is negatively dependent on the export price P_{EX}, i.e. using the log of the variables the price elasticity of demand is $\delta EX^D/\delta P_{EX}<0$. An increase in the price of an export good leads ceteris paribus, particularly in terms of constant quality, to a decrease in demand. Second, the national price of an export good has always to be judged relative to competitive foreign suppliers because there is competition in the export market. A country's export faces not only competition from the importing sector of the trading partner but from the third countries exports represented by the export market to the importing country. Even, since in an n-country world the dominant competition stems from exports of different countries rather than from the import competing domestic production like in the two-country case, the competitors export price (P_{EX}^*) captures the foreign substitutes effect and demand is positively dependent. For the sake of a relative measure the domestic and the foreign export price should be expressed in the same currency. Therefore the exchange rate (WEXR) is implemented in the export demand function. Third, the exports of one country are the imports of the rest of the world.[6] Thus, an increase in foreign imports of the analyzed market Y^* leads to an increase of export demand. This follows from the consumption side of the GDP. A distinct fraction of the GDP will be consumed by imports. The advantage of using imports of the market instead of foreign GDP or foreign industrial production like in other related empirical and theoretical work is the possibility to compare the exports directly with the market volume and thus the relative development. If the elasticity of imports in export demand is unity, the observed home country has constant market shares, if <1, the country is loosing market share. This conclusion is feasible since most of the trade is taking part in between the analyzed countries. Therefore an increase of imported manufactured goods coincides with an increase of the export market.

The variables in the export price function [2] are also specified in logarithms:

$$P_{EX} = f((P^*_{EX}+WEXR), P) \qquad [2],$$

[6] Here, the rest of the world is captured by the analyzed market. This is possible since the bulk of trade is taking part between the analysed industrial countries.

where P: acronym for different national cost factors.

The determinants of the export price can be put into two categories. First the domestic cost side and second the competitive world export market (see Goldstein / Khan (1978), p. 276, Goldstein / Khan (1985), p. 1047 et sqq., Hooper / Marquez (1995), p. 142 et sqq. and Möller / Jarchow (1990), p. 530 et sqq.).

The domestic cost side (P) can be represented by the producer price index (PPI) or by the unit labour costs (ULC). The price of imports represented by the price of imported intermediate goods or imported raw materials can also be considered, since the globalization enables firms to slice up their production chain and accordingly influences the cost side or a country is scarce of raw materials, respectively. Since these variables mirror the (factor) costs of the export production the export price is positively dependant on an increase of the domestic cost side. From the theoretical point of view the PPI is assumed to be the best choice. It can serve as either sales prices of tradables on the domestic market and thus the profitability to sell exports or as marginal production costs and thus as the profitability to produce exports. Goldstein and Khan (1985, p. 1047) already mentioned this dual role of the PPI. If the export price is given, the profitability to sell exports decreases when the production costs increase. Regarding this side of price determination Beenstock and Minford (1976) classify a country as "price-transmitter". Besides, a country is a "price-receiver" if the export price is predominantly set by competitors on world markets. Consequently, the more price elastic the export demand is the stronger depend the export prices on competitors export price P_{EX}^{*}. Besides, in case of a low price elasticity of export demand the country's export products differ more from competitors products and are less substitutable as in case of a high elasticity. This refers to the PTM behaviour of exporters and their care about the price competitiveness of their exports and market shares as mentioned above.

Since Germany is a large and open country in economic sense both sides presumably play an important role. A large country usually has lower marginal production costs and lower de-

mand price elasticity; i.e. the export prices are more driven by the domestic factor costs. On the other side, a large degree of openness to trade implies a high share of exports in total GDP and thus a higher weight of competitors export prices (see Goldstein / Khan (1985), p. 1091 et sqq.).

From a modelling perspective we have to mention that P_{EX} in equation [1] is an endogenous explanatory variable because it is jointly determined in equation [2] of the same economic model (see Goldstein / Khan (1985), p. 1071). Equation [1] and [2] are a simultaneous equation system and we are facing the problem of simultaneity bias, respectively (see Greene (2003), p. 379). Any change in the price of the exports resulting from equation [2] has an impact on the quantity of exports via the export price elasticity of demand. This problem is overcome using the Johansen procedure (1991) which allows for several potential endogenous variables in the system. Former empirical work applied Two-Stage Least-Squares method (see Goldstein / Khan (1985) and Hooper / Marquez (1995), Möller / Jarchow (1990)) and Full Information Maximum Likelihood method (see Goldstein / Khan (1978)).

3.2 DATA

The data are time series from the *OECD Monthly Statistics of International Trade* and *Main Economic Indicators*. The observation period extends from 1993:1 to 2005:4 using quarterly data, respectively. Unfortunately, earlier data was not available without losing plenty of information and consistency especially concerning the CEEC. Besides this shortcoming for the empirical robustness this period corresponds with the era of structural change and opening up in the CEEC and with Germany after reunification adjustments. As usual for that kind of analysis, all variables included in the estimations are logarithms. The export market is defined by 17 industrial countries for which data was available and the CEEC referring to Germany, Poland, Hungary, Czech Republic, Australia, Canada, Switzerland, Denmark, Spain, Finland, France, United Kingdom, Ireland, Italy, Japan, Korea, Norway, New Zealand, Sweden, and

the United States. For the export prices of Germany and the competitors export unit value indices (base year: 2000) are used, for the import price the price index of imported raw material (base year: 2000) is used, for the producer price index of the German manufacturing industry an index based in 2000 is used, the same for the unit labour cost index of the manufacturing industry. The competitors price is a trade weighted index using the export market shares of the OECD countries as weights. The competitors export price is converted into the domestic currency (€) by the weighted nominal effective exchange rate (domestic currency relative to foreign currency). The weights are the same as described above. For Germany machinery and transport equipment unit values was used as a proxy for the export price of manufactured goods. In the case of the competitors price the machinery and transport equipment unit value indexes were used for most countries as well. Due to data availability the export unit value of machinery and transport equipment was substituted for some countries by the export unit value of manufactured goods. The German exports are aggregated exports from the Standard International Trade Classification (SITC 5-8) measured in f.o.b. values in Billions of US-$ converted into €. The activity parameter in the export demand equation are the SITC 5 to 8 imports from all observed OECD countries without Germany measured in Billions of US-$ converted into €. The exports and the imports are real values since they are deflated with the equivalent change of the underlying price indices. The nominal effective exchange rate index (base year: 2000) (wexr) is the trade weighted relation of the domestic currency (€) relative to the national currencies of the export market countries. The foreign variables (exchange rate and prices) are weighted averages according to their real export shares across the countries included in the export market not included the home country Germany. In the econometric model the variable ms is included to capture the competition effect on the German export price originating from the technological catch up process and market share gain of the CEEC. The variable is constructed as the share of SITC 5-8 exports from CEEC in total SITC 5-8 ex-

ports including Germany. The variable is transformed into an index (base year: 2000) and calculated as logarithm.

The conversion of the competitors export value index into € ensures that all price variables (domestic and foreign) are expressed in the same currency (€). The nominal effective exchange rate enters the analysis indirectly through the conversion of foreign prices, the combined variable competitors export unit value index of machinery and transport equipment in national currency, respectively. The main reason for using a combined variable is the advantage of complexity reduction of the system from 7 to 6 variables which yields better estimation results regarding the small sample size. An overview over all variables used in the estimation is given in Appendix A1.

4 EMPIRICAL MODEL

The econometric methodology employed in this paper uses Johansen's cointegration methodology to identify the long-run relationship among the trade variables of the system. This is suitable because the long-term equilibrium should correspond with the economic theory outlined before and due to the endogeneity of some variables. But before estimating the VECM the stochastic properties of the data are analyzed by unit root tests in order to avoid the problem of spurious regression.

4.1 UNIT ROOT AND COINTEGRATION

The trending behaviour of the time series is important in order to specify the economic model correctly and imply cointegration relationships in levels. I use the Augmented Dickey Fuller test (ADF) for testing for unit roots. The results are summarized in table 2. Before performing this test it is important to specify the deterministic components (time trend, intercept) of the variables. Like for most macroeconomic time series (see Perron (1988), p. 304) and after visual inspection of the graphs a deterministic trend is incorporated into all regression equations

except the one for the wexr and the competitors export price (pex_comp). In the case of the increase of exports and imports, the producer price and the market share of the CEEC economic judgement gives support for a deterministic trending behaviour (see similar considerations in Strauß (2004), p. 52 et sqq.).

Table 2: Unit root tests

time series	lags	ADF			integration grade
		for levels		for 1st differences	
		i	i, t	i	
ex	4	-0964230	-2,698173	-3,357574**	I(1)
wexr	0	-1,408194	-1,358849	-6,295524***	I(1)
ms	0	0,740433	-8,800318***	-11,68048***	I(0)
pex_comp	1	-1,631616	-1,493348	-5,319528***	I(1)
pex_eu	3	-1,564617	-3,269780*	-6,251798***	I(1)
pex	0	-1,668156	-2,272036	-9,006679***	I(1)
y	5	-1,095451	-1,977652	-3,426326**	I(1)
ppi	1	0,419365	-2,060454	-3,783418***	I(1)
pim	3	-0,613420	-3,881714**	-4,204181***	I(0)
ulc	2	0,835118	-1,412319	-4,352144***	I(1)

***,** and * significant at the 1%-, 5%- and 10%-level. The included lags are based on Schwarz Information Criterion (SIC) in a model with a trend and intercept. The lag length was restricted to p=4 in order to improve the power of the test following the procedure proposed by Said and Dickey (1984). i=intercept, t=trend.

The number of lags (p) in the system using a model with intercept and trend has to be selected by Schwarz Information Criteria in such a way that the residuals are not autocorrelated. The result can be seen in the second column of table 2. The unit-root hypothesis of the ADF is: H_0: The process has a unit root. Hence, if the null hypothesis is rejected, the process is stationary. As shown in table 2, for the unit root test in levels only the variable ms and pim are stationary, thus I (0), if using a trend and an intercept, i.e. they are trend-stationary.[7] For all other variables the null hypothesis of a unit root is not rejected. Proceeding with testing for a second unit root, the null hypothesis of a unit root in first differences can be clearly rejected (at a significance level of at least 5 %) for ex, wexr, pex_comp, pex_eu, pex, y, ppi and ulc. Thus, all of the variables included in the system are integrated of order one except ms and pim. Due to that shortcoming using cointegration the latter is excluded from the model specification. The

[7] The trend was significant in both ADF-tests. Yet leaving the trend out the null could be clearly rejected.

regression equations for the first differences were specified without a linear trend, since I(1) is assumed.

In a system of I(1) variables the variables are called cointegrated if there exists a linear combination between I(1) that is stationary (see for example Johansen (1992b), p. 313). Before estimating the long-run relationships of the system some preliminary specifications have to be done (see Harris (1995), pp. 76-96). The deterministic specification and the lag length of the system influence the estimation results and have to be determined. As in the case of the unit root testing procedure visual inspection and economic reasoning give support for assuming a model with an intercept and a deterministic trend restricted to the cointegration space in the time series. In trade equation systems the trending behaviour can be interpreted as the increasing impact of globalization being equivalent to a long-run linear trend, i.e. trade liberalization, division of labour and falling transaction and transportation costs. The intercept accounts for units of measurement. The optimal lag structure was determined using an unrestricted VAR. Calculating Hannan-Quinn information criterion and sequential modified likelihood ratio tests I choose a lag length of three in levels based on the model with trend and intercept in order to ensure that the residuals are free from autocorrelation, non-normality etc.[8] Additional to the information criteria the autocorrelation ML test reports no residual serial correlation at a lag length of three as well. White heteroskedasticity test clearly rejects the null of heteroskedastic residuals.

The number of cointegration relations was specified employing the Johansen procedure as described in Johansen (1991) and Johansen and Juselius (1994). Which kind of deterministic component should finally be applied and how many cointegration vectors are accepted in the system is determined jointly following the Pantula principle proposed in Johansen (1992a) and Pantula (1989) (see also Harris (1995), p. 97). The results are shown in table 3. The so-called Pantula principle starts with the most restrictive model (model 1 and r=0) and moves

[8] The Akaike Information Criterion voted for a lag length of 4, the Schwarz Information Criterion for two lags.

over the next restrictive model (Model 2) to the least restrictive one (Model 3) regarding the trace or max-eigenvalue statistics till the null hypothesis is not rejected for the first time. Accordingly, starting with the value of 227,95 or 74,88, respectively and moving through the rows the procedure stops at 44,64 or 32,10, when the null hypothesis is the first time not rejected at the five per cent significance level. We can determine the time series having a linear deterministic trend and at least r=2 cointegrating relations. But depending on the significance level the max-eigenvalue statistics identifies r=3 cointegrating relations as does the trace statistic at the 5 per cent level. Since the stationary variable ms is included in the procedure, there exists automatically one cointegrating relation and we justify three cointegration relationships. The trend-stationary variable ms forms a cointegrating relation by itself (see Harris (1995), p. 80).[9]

Table 3: Johansen test for the number of cointegrating relations

r under H_0	*Trace statistic*			*Max-eigenvalue statistic*		
	Model 1	*Model 2*	*Model 3*	*Model 1*	*Model 2*	*Model 3*
	no deterministic trend (restricted constant)	linear deterministic trend	linear deterministic trend (restricted)	no deterministic trend (restricted constant)	linear deterministic trend	linear deterministic trend (restricted)
0	227,9538***	192,7368***	229,7207***	74,87891***	70,98278***	70,99017***
1	153,0749***	121,7540***	158,7306***	45,02733**	45,00966**	51,28060***
2	108,0476***	76,74438**	107,4500***	39,08246**	32,10848*	35,66485*
3	68,96510***	44,63590*	71,78512***	29,37053**	21,92600	31,07870*
4	39,59457**	22,70990	40,70641*	20,64288*	14,42128	19,18749
5	18,95457*	8,288617	21,51893	10,80879	8,181085	13,75464
6	8,142903	0,107532	7,764290	8,142903*	0,107532	7,764290

***, ** and * significant at the 1%-, 5%- and 10%-level. Critical values from MacKinnon-Haug-Michelis (1999). The deterministic trend models follow the considerations of Johansen (1995). In Model 1 there are no trends, but a constant term is allowed in the cointegrating relations. Model 2 allows for a linear trend in each variable but the cointegrationg relations only have intecepts. In Model 3 there are linear trends allowed in all components of the process (see Johansen (1995), pp. 80-83). The box indicates the first time when the null hypothesis is not rejected.

[9] The variables of the model have also been tested for cointegration without the I(0) variable ms in order to exclude the case of building ms the three identified cointegrating relationships with different I(1) variables in the system. These tests justified r=3 according to the trace and r=2 according to the max-eigenvalue statistics each at the 5 and 10 % significance level. Here we would decide for r=2 and not for r=3 because the economic reasoning doesn't give support for a third cointegration relationship.

4.2 MODEL SPECIFICATION

Given the non-stationarity of the variables and the existence of r cointegration vectors, the trade model is estimated in a VECM. I follow the procedure developed by Johansen (1991) and Johansen and Juselius (1994). Performing this approach long-run relations, i.e. cointegration relations, and short-run adjustments can be verified and distinguished. For the analysis the following unrestricted VECM is assumed:

$$\Delta Z_t = \prod * Z_{t-1} + \sum_{i=1}^{k-1} \Gamma_i * \Delta Z_{t-i} + \mu + \varepsilon_t \qquad [3],$$

where Z_t represents a (n x 1) vector of the n endogenous variables ($Z_t = [Z_{t,1} \ldots Z_{t,n}]$) with t = 1993:1, …, 2005:4. ε_t denotes a (n x 1) vector of iid residuals and μ the (n x 1) vector of constants and Δ a difference operator. If the time-series are I(1) and there are r cointegrating relations in the variables Z_t, the (n x n) matrix $\prod$ has to be of reduced rank ($0 < r < n$), i.e. $\prod = \alpha\beta'$, where α and β are (n x r)-dimensional matrices. The cointegration vector $\beta' Z_{t-1}$ represents the long-run cointegrating relations, whereas αZ_t denotes the speed of adjustment moving to the long-run equilibrium. α is known as a loading coefficient. The (n x (k-1)) matrix Γ represents the short run coefficients, where k is the lag order.

For the structural specification of the export system the starting point is a VECM with lag length k=3 and n=6 endogenous variables, namely ex, pex, pex_comp+wexr, ulc, ms and y. In the reduced rank $\prod$ we interpret the r=2 cointegration relations according to the theory as structural long-run relationships of export demand and supply. Thus, the dependent variables are the exports (ex) and the national export price (pex). Following the theoretical remarks above the first cointegration relation is labelled demand (1) and the second supply (2). Accordingly, the cointegration relation has been normalized on the exports and on the export price. Zero restrictions are imposed on the variables ulc in (1) and on y in (2) since they do not have an impact in the structural relationship. The restriction of the just-identified model implies that a change in the ulc does not have a direct long run impact on export demand. For

the demand the export price and the price on world markets is determining. Besides, there can still be short-run effects and surely indirect domestic cost-price effects of ulc via the export price. Therefore the variables in the demand vector are y, pex and (pex_comp+wexr) and ms. Accordingly for (2), y has no direct influence on the long-run export price. Consequently the supply vector of the just-identified model can be described by the predetermined variables ex, (pex_comp+wexr), ulc and ms. The validity of the restriction is tested with a classical χ^2-distributed likelihood ratio test according to Johansen and Juselius (1992).

The just-identified long-run structure of the export system was tested by several hypotheses imposing some overidentifying restrictions using classical likelihood ratio tests being χ^2-distributed under the null as above.[10] The goal is exact identification motivated by economic arguments. First the hypothesis of a long-run export supply that is infinitely price elastic was tested imposing the restriction $\beta_{2,ex}=0$, where the number in the index denotes the cointegration relation (1: demand, 2: supply) and the variable is the parameter under restriction. Although this assumption is often made in the literature, it was rejected here. Another supply side hypothesis of interest is whether Germany is a price transmitter and thus insulated from the competitors price ($\beta_{2,pex\_comp}=0$). As supposed from economic intuition this hypothesis was rejected as well. The interesting question whether the influence of the CEEC is to small to have an impact on Germanys export system is tested via the restriction $\beta_{1,ms}=\beta_{2,ms}=0$. We can reject the hypothesis of no influence stemming from the CEEC to Germany. Besides the hypothesis of no impact of the CEEC on the export demand ($\beta_{2,ms}=0$) could not be rejected. One reason might be that adjustment to the intensified competition goes via the export price.

Imposing zero restrictions on the loading coefficients leads to the question of weak exogeneity. That means the error correction term does not play a role in adjusting to the disequilibrium changes of the cointegration vector under consideration (Johansen (1992b). Again likelihood ratio tests, as described for example in Harris (1995) and Johansen (1992b), showed that

[10] The LR tests of the hypothesis are summarized in table A 2 in the Appendix.

pex_comp can be treated as weakly exogenous. For all other variables the null of weakly exogeneity can be clearly rejected giving support for the assumed cointegrating relations in the case of pex and ex. Regarding the weakly exogeneity restriction of pex_comp we formulate the loading coefficient $\alpha_{pex\_comp,1}=\alpha_{pex\_comp,2}=0$.

4.3 EMPIRICAL RESULTS

The results of the VECM estimation are summarized in table 4. Eight different models have been regressed in order to check the robustness of the results. Due to the small sample problems of the VECM the estimation results were further ensured by a FIML estimation yielding similar results especially regarding the sign and therefore the economic intuition.

Table 4: Estimation results of long-run export demand and supply

Model	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Export demand [1]	cointegration coefficients							
ex	1	1	1	1	1	1	1	1
pex	3,30*	3,32*	0,97*	0,97*	0,14	0,95*	0,96*	0,91*
pex_comp	-0,47	-0,42	-0,99*	-0,99*	0,50*	-0,98*	-0,98*	-1,33*
y	-0,64*	-0,63*	-0,04	-0,05	-0,42*	-0,05	-0,05	0,14*
ms	-	-	-	-	-0,45*	-0,01	-0,00	-
Export supply [2]	cointegration coefficients							
pex	1	1	1	1	1	1	1	1
ex	-0,44*	-0,45*	0,61*	0,55*	-0,66*	0,61*	0,55*	-2,92*
pex_comp	-0,67*	-0,67*	-1,07*	-1,07*	-0,89*	-1,07*	-1,07*	1,48*
ulc	0,78*	0,81*	0,32*	0,37*	1,44*	0,33*	0,39*	-
ppi	-		-	-	-	-	-	1,49*
ms	0,52*	0,53*	0,20*	0,23*	0,76*	0,21*	0,24*	0,27*
fdi	-	0,00	-	0,00	-	-	0,00	-
g	-	-	0,14*	0,14*	-	0,14*	0,14*	0,12*
loading coefficient [1]	-0,16*	-0,12	-1,59*	-1,44*	-0,52*	-1,54*	-1,40*	1,08*
loading coefficient [2]	-0,28*	-0,28*	-0,85*	-0,72*	-0,21*	-0,81*	-0,70*	-0,34*
	Test statistics							
χ^2-LR-test (df)	7,43 (3)	5,79 (3)	2,55 (3)	1,46 (3)	2,71 (2)	2,56 (2)	1,46 (2)	7,49 (3)
Adjusted R^2 [1]	0,77	0,77	0,79	0,79	0,78	0,79	0,79	0,83
Adjusted R^2 [2]	0,41	0,40	0,45	0,44	0,37	0,45	0,44	0,46
AIC	-31,26	-31,18	-31,81	-31,73	-31,36	-31,81	-31,73	-30,1
SC	-27,33	-27,02	-27,64	-27,32	-27,42	-27,64	-27,32	-25,93
* significant at the 5 %-level								

In order to check the robustness of the estimation the exogenous variable g was introduced in the model (3), (4), (6), (7) and (8). The variable g should be a proxy for globalization and accordingly the fact that exports and imports grow stronger than GDP. The variable is calculated as the share of exports in GDP of the whole market. But including this variable yields a seri-

ous problem. The loading coefficient of the export demand equation doesn't show the theoretically required characteristics ($-1<\alpha<0$) and brings up some interpretation problems. The variable FDI is included in the model (2), (4) and (7) in order to control for the fraction of increased market share of the CEEC stemming from amplified trade in intermediates and thus non-competition effect. The share of FDI in GDP is used as a proxy for this part of trade between advanced countries and newly industrializing countries caused by increased outsourcing activities of manufacturing industries. Besides, the variable FDI is never significant in the export supply equation and the estimation results don't differ much from the models without FDI. In model (5) - (7) the restriction $\beta_{2,ms}=0$ is loosed because the LR results are on the border of significance. Regarding the models (1) to (8) we can conclude that the models all show the expected negative sign for the main variable of interest ms. After interpretation of the alternatives, the test statistics and the theoretical requirements mentioned above I decide for model (1).

Model (1) shows a stable long-run relationship for the export demand. The price elasticity of demand is very high (-3,30) and highly significant. This result is kind of surprising although the price elasiticity for manufactured goods is higher than for aggregate exports or nonmanufactures (see Goldstein / Khan (1985), p. 1070). Besides it fits into the assumption of intensified competition and higher substitutability of German exports. The foreign price elasticity has the expected sign but is insignificant. The coefficient of the activity variable is < 1 (0,64) and highly significant. This means that a 1 %-increase in the imports of manufactured goods in the observed market leads to a less strong increase in demand of German goods indicating a loss of market share in the long-run. For the export price function we also obtain a stable long-run relationship with all coefficients being significant. But regarding the ulc the sign does not match theory. An increase in the unit labour cost index leads to a decrease in the ex-

port price.[11] The sign for the competitors export price is the expected. The value of 0,67 means, that a 1 % price increase in the market is not fully shifted into German export prices. One interpretation may be the competition stemming from new entrants in the market of manufactured goods. Since the competitors catch up in quality a price increase of their goods cannot completely be followed by German firms if they want to stay competitive. This is also represented in the negative coefficient of the market share of the CEEC. An increasing market share results in a pressure on German export prices.[12]

The loading coefficients show the direction and speed of adjustment of an endogenous variable when there is an export supply or demand disequilibrium.[13] For the export demand equation we estimate a loading coefficient (-0,16) that is at the border of 5 % significance level and shows the theoretically required sign. An excess demand is stabilized by a falling demand, rising market share of the CEEC and decreasing imports from the market. This result is consistent with economic theory. For the export price adjustment coefficient on the export demand cointegration equation theory expects a positive sign, since rising prices correct for excess demand. But the corresponding adjustment coefficient of the estimation is insignificant. One reason might be sticky prices.

Since the export price equation is of particular interest in this analysis the whole equation results including the short-run dynamic is formulated in [4] showing only the significant parameters for parsimonious reasons (t-values in parenthesis).

$$\Delta pex = \underset{}{-0{,}28}*[pex_{-1} \underset{(-5{,}37)}{-0{,}44}*ex_{-1} \underset{(-6{,}04)}{-0{,}76}*pex\_comp_{-1} + \underset{(-3{,}24)}{0{,}78}*ulc_{-1} + \underset{(6{,}72)}{0{,}52}*ms_{-1} + 3{,}19] -$$

$$\underset{(-2{,}95)}{0{,}46}*\Delta pex_{-1} \underset{(-1{,}66)}{-0{,}24}*\Delta pex_{-2} \underset{(-2{,}53)}{-0{,}19}*\Delta ex_{-1} \underset{(-1{,}89)}{-0{,}11}*\Delta ex_{-2} \underset{(-1{,}86)}{-1{,}07}*\Delta ulc_{-2} \quad [4]$$

Test statistics: LM (1): 30,80 (0,72); LM (4): 29,48 (0,77); Jarque-Bera: 2,62 (0,27); White Test: 8,54 (0,36)

[11] For the VECM, several specifications with different sets of cost/price variables already mentioned in the theoretical model have been tested. The ppi behave similar to the ulc (see model (8)), while the pim was not used for the VECM due to its I(0) property.

[12] The export system was additionally estimated using FIML yielding similar results. This shows the robustness of the negative sign of the ms variable and the < 1 property of the income elasticity of export demand.

[13] The loading coefficients of model (1) are summarized in table A 3 in the Appendix.

The error correction term of the export price equation is -0,28 and highly significant. Thus, the adjustment to the long-run cointegration relationship described above is faster than for the export demand disequilibrium adjusting 28 % of the export price within one quarter. The correction of a supply disequilibrium taking the form of an export price above the long-run level goes via falling prices, falling ulc and rising volumes. This goes in line with economic theory. The affection on market share and the imports is not interpretable in an economically reasonable manner. The short run part became very parsimonious because of the exclusion of insignificant parameters. The dynamics of the lagged periods exhibit jointly declining export prices and exports.

5 CONCLUSION

The CEEC experienced a considerable change in their industries and competitiveness since they abolished communism and opened up to trade. A technological catch up process took place especially in the manufacturing industry changing the specialisation and thus the export pattern caused by new technologies, FDI flows and higher educational attainment. Accordingly, medium-to high-tech exports of already industrialized countries are exposed to the competition stemming from newly industrializing countries offering the same goods in the same markets. This describes the situation of Germany suffering falling export prices in the period of 1993-2005. The assumed competition effect of the CEEC on German export prices became evident applying VECM on manufactured export demand and supply. The competition elasticity of export prices is negative. This means that a one per cent increase of the market share of the CEEC reduces the export price of German manufactured products by 0,52 per cent in the long-run and thus forces German firms to sell goods more cheaply on world markets. Irrespective of any German market share movements this is reducing the welfare effect of selling exports if the import price doesn’t decrease at the same rate. This terms of trade effect is interesting to be analyzed in the future, yet requires an amplified data set in order to

improve the estimation results. But to significantly influence the income of a – though open – large country the terms of trade decline has to be considerably.

Another caveat alongside the small sample size is the rough trade aggregation. A deeper aggregation enables to distinguish more clear-cut between increased market share of the CEEC due to outsourcing or competition effect than does the variable FDI used in this analysis. Data availability for the observed countries especially regarding the corresponding export price variables are the shortcoming for this improvement.

Since the CEEC are well integrated into the international division of labour and the institutional arrangements becoming more efficient being member of the European Monetary Union the process of producing more sophisticated products will be aggravated, particularly in terms of quality. A possible way to insulate Germany from lower cost competition should be to concentrate more on high-technology and innovative products. The fear of decreasing welfare in Germany is for no reason if the specialisation pattern moves according to comparative advantages and Germany allows for outsourcing and off shoring of less competitive industries or steps within a value chain. The forthcoming entry of the CEEC into the European Monetary Union brings up some challenges for Europe due to intensified trade, yet also opportunities to import cheaper intermediate products. Other east European and Asian countries head for the development of the CEEC in a few years. Thus, the changing pattern of specialization never stops and becomes a huge challenge for both, highly developed countries and firms. The ability to adjust will be one of the crucial determinants of competitiveness and ensures the gains from trade.

APPENDIX

Table A 1: Acronyms of Variables and Data description

Acronym	Meaning	Source
ex	log of real exports (SITC 5-8) in €	OECD *Montly Statistics of International Trade*
y	log of real imports (SITC 5-8) from export market in €	OECD *Montly Statistics of International Trade*
pex	log of domestic export unit value index of machinery and transport equipment in €	OECD *Montly Statistics of International Trade*
pex_comp	log of trade-weighted foreign export unit value index of machinery and transport equipment in national currencies	OECD *Montly Statistics of International Trade*
ppi	log of domestic producer price index in €	OECD *Main Economic Indicators*
wexr	log of trade-weighted nominal effective exchange rate index (€/national currencies)	OECD *Montly Statistics of International Trade*
ulc	log of unit labour costs index in manufacturing industry in €	OECD *Main Economic Indicators*
ms	log of market share of CEEC in the export market including GY	OECD *Montly Statistics of International Trade*
fdi	log of inward FDI relative to GDP of the CEEC	OECD *Main Economic Indicators*
g	log of exports (volume) relative to GDP (volume) of the export market	OECD *Main Economic Indicators*

Table A 2: LR results for hypothesis tests

H0	ulc has no impact on export demand, y no impact on export supply	H0	pex is weakly exogenous
LR test	2,71 $\chi^2(2)$	LR test	16,56 $\chi^2(2)$
H0	ms has no impact on export demand	H0	pex_comp is weakly exogenous
LR test	3,81 $\chi^2(1)$	LR test	2,71 $\chi^2(2)$
H0	long-run export supply is infenitely price elastic	H0	ulc is weakly exogenous
LR test	11,71 $\chi^2(1)$	LR test	14,07 $\chi^2(2)$
H0	there is no influence of pex_comp on export supply	H0	ms is weakly exogenous
LR test	8,81 $\chi^2(1)$	LR test	13,15 $\chi^2(2)$
H0	ms has no influecne on Germany	H0	y is weakly exogenous
LR test	24,52 $\chi^2(2)$	LR test	13,23 $\chi^2(2)$
H0	ex is weakly exogenous		
LR test	10,85 $\chi^2(2)$		

Table A 3: Cointegration and loading coefficients of model (1)

cointegrating coefficients							Test Statistics	
	EX(-1)	PEX(-1)	PEX_COMP(-1)	Y(-1)	ULC(-1)	MS(-1)		
EX-demand	1	3,30*	-0,47	-0,64*	0	0	Adj. R-squared EX-demand	0,77
t-value	-	(-3,05)	(0,84)	(9,07)	-	-		
EX-supply	-0,44*	1	-0,67*	0	0,78*	0,52*	Adj. R-squared EX-supply	0,41
t-value	(5,37)	-	(6,04)	-	(-3,24)	(-6,73)		
loading coefficients							LM (1)	30,80 (0,72)
	ΔEX	ΔPEX	ΔPEX_COMP	ΔY	ΔULC	ΔMS	LM (4)	29,48 (0,77)
EX-demand	-0,16*	-0,01	0	-0,31*	-0,01	0,37*	Jarque-Bera	2,62 (0,27)
t-value	(1,65)	(0,42)	-	(5,01)	(1,04)	(-2,39)	White Test	8,54 (0,36)
EX-supply	0,64*	-0,28*	0	0,81*	0,04*	-1,05*	LR test for joint restricitions ($\chi^2(3)$)	7,43 (0,06)
t-value	(-3,05)	(3,85)	-	(-5,31)	(2,37)	(3,12)		(p-values)
* significant at the 5 %-level.								

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