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Factors Driving Import Demand in Central and Eastern European EU Member States

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This study presents estimates of country-specific long-run import elasticities for EU Member States from Central and Eastern Europe and for Croatia. Our results confirm (1) the existence of a strong export-import link in most of the countries, (2) the prominent role of fixed investment in determining imports in nearly all countries and (3) with some exceptions, the relatively smaller role of private consumption for imports. Furthermore, this study uses import elasticities to test for economic interlinkages within the EU-27 and provides some indications on the implications of these results for countries with larger external imbalances.

1. Introduction

Research on factors that influence import demand has always been an active area of both theoretical and empirical economic study. This has often been motivated by the issues associated with external imbalances and their culmination into external debt problems. In this respect, appropriate estimates of import demand functions are generally of great interest when considering adequate policy responses.

This study focuses on the EU Member States of Central and Eastern Europe, here abbreviated as CEE-MS. Basically, these include the Czech Republic, Estonia, Hungary, Latvia, Lithuania, Poland, Slovakia and Slovenia, which entered the EU on May 1, 2004, as well as Bulgaria and Romania, which became EU Member States on January 1, 2007. To the extent that it is possible, we also include Croatia, one of the candidate countries negotiating accession to the EU.

Most of the countries under review had non-negligible levels of current account deficits in recent years. However, a look at e.g. the most recent three-year averages reveals quite important differences between these countries (see table 1). In most countries, the deficit in the goods and services balance, i.e. the main component of the current account, contributed substantially to the current account deficit

(Slovakia, Estonia) or even exceeded it and was only to a minor extent offset by a surplus in the other sub-balances (Lithuania, Latvia, Bulgaria, Romania, Croatia). By contrast, in the Czech Republic, Hungary, Poland and Slovenia, a negative income balance was the main source of the current account deficit, while the goods and services balance posted a relatively small deficit (Hungary, Poland, Slovenia) or even a surplus, that was, however, not (yet) sufficiently high to finance the deficit in the income balance (Czech Republic).

Table 1: Development of the Current Account and the Goods and Services Balance in the CEE-MS and Croatia

	Three-year averages			EU Commission Forecast	
	1998-2000	2001-2003	2004-2006	2007e	2008e
Current account balance as a percentage of GDP					
Czech Republic	-3.1	-5.7	-4.1	-2.5	-2.1
Hungary	-7.5	-6.7	-6.6	-3.9	-1.5
Poland	-5.7	-2.5	-2.2	-3.3	-2.9
Slovenia	-2.2	-0.3	-2.8	-3.3	-2.6
Slovakia	-5.1	-7.0	-8.2	-4.2	-2.7
Estonia	-6.0	-8.6	-11.3	-13.6	-11.2
Lithuania	-9.5	-5.3	-7.3	-12.5	-12.9
Latvia	-7.4	-7.0	-14.4	-22.2	-18.9
Bulgaria	-3.5	-4.5	-10.6	-17	-16
Romania	-4.8	-4.6	-8.6	-12.8	-14.5
Croatia	-10.4	-4.3	-6.7	-8.5	-8.1
Goods and services balance as a percentage of GDP					
Czech Republic	-1.8	-2.2	1.1		
Hungary	-2.6	-2.5	-0.9		
Poland	-6.5	-3.1	-1.0		
Slovenia	-3.0	0.3	-0.9		
Slovakia	-5.4	-5.3	-4.0		
Estonia	-5.9	-5.5	-8.6		
Lithuania	-9.3	-5.5	-8.2		
Latvia	-9.7	-10.9	-17.3		
Bulgaria	-3.6	-9.4	-15.5		
Romania	-5.9	-7.0	-10.5		
Croatia	-12.4	-7.1	-7.4		

Note: The current account balances include the small surpluses on the capital account that stem primarily from EU transfers, except for the forecast values given for Croatia.

Source: European Commission Forecast Autumn 2007, Eurostat, national central banks, author's calculations.

In the study of import demand of these countries, which are all catching-up economies, it is of particular interest to examine the extent to which it is demand effects or price and exchange rate effects that drive import demand.
Moreover, within total demand effects, a further question relates to the relative importance of domestic demand versus that of foreign demand (exports). In other words, how strong is the export-import link? With respect to total domestic demand, another distinction can be made between (private) consumption and investment.
Finally, with respect to foreign demand, the question arises to what extent import demand is driven in particular by foreign demand that stems from a country's main trading partner – the EU-15 states, i.e. the EU Member States before the 2004 and 2007 enlargements, or else those EU Member States that joined the euro area before 2007 (euro area 12, EA-12). In other words, how strong is the interlinkage between imports within the EU-27?
A more profound insight into the factors that drive import demand in the CEE-MS may be helpful for understanding the ongoing process of European economic integration. It may also provide some hints for possible policy responses to address large external imbalances.
This study is structured as follows: Section 2 provides a brief survey of papers published on import demand functions. In section 3, we sketch a simple theoretical model that has been used in the literature to derive import demand equations and we present the main variables used to estimate these equations in practical terms. In section 4, we present some stylized facts on total final demand in the CEE-MS, as background information for interpreting the ensuing estimation results. In section 5, we set out the econometric issues involved in estimating import demand functions and explain the chosen econometric framework. Section 6 presents our estimation results, while section 7 briefly summarizes and concludes. The data we use for the CEE-MS import equations, data availability and limitations as well as possible structural breaks in the time series are outlined in the appendix.

2. Literature Survey

Given the quite comprehensive literature dealing with import demand functions, we will only mention a few papers that are often considered milestones in the analysis of import demand. While there are many country-specific papers in which import demand functions are estimated for one particular country, we focus on those that cover several countries, often grouped into developing versus developed countries.
Hoetthaker and Magee (1969) provided an early paper on income and price elasticities in world trade, in which they concluded that the import elasticity with respect to income is lower in developing countries than in developed economies.

Several years later, Goldstein and Khan (1985) of the International Monetary Fund (IMF) published a comprehensive overview on income and price effects in foreign trade, including estimates of price and income elasticities and related policy issues. Their overview includes both theoretical aspects and estimation methodologies. However, the approaches they described for estimating import demand functions are rather traditional, which is in particular attributable to the fact that the paper was written before cointegration analysis was introduced.

Among the studies that were published after the development of cointegration analysis and thus apply an error correction model (ECM), the earliest papers were by Deyak et al. (1993) for Canada, and Clarida (1994) for the U.S.A. (covering the period from 1968 to 1990, based on seasonally adjusted quarterly data), followed by Carone (1996) for the U.S.A., and Amano and Wirjanto (1997) for Canada and the U.S.A. (covering the period from 1960 to 1993, based on quarterly data).

Reinhart (1995) and Senhadji (1997), both of the IMF, applied a similar approach to a larger number of countries. Reinhart used data of 12 developing countries in the period from 1970 to 1991, pooled into regional blocks (3 African, 4 Asian and 5 Latin American countries). Apart from estimating import demand functions, she estimated also the elasticity of these countries' exports with respect to income in developed countries. Comparing such specific import elasticity with respect to income of developed countries (specific in that it is confined to imports from these developing countries) with her estimates of import elasticity with respect to the income in developing countries, she confirmed the results obtained by Hoetthaker and Magee (1969) that this elasticity is higher in developed economies than in developing countries. Senhadji (1997) came to the same conclusion on the basis of a sample comprising 77 countries.

More recently, Harb (2005) estimated a heterogeneous panel of 40 countries with 28 annual observations for each country. The data series start in different years and range from the mid-1960s to the late 1990s. Splitting his panel into developed economies and developing countries, he could only partially confirm the results obtained by Hoetthaker and Magee (1969).

In a narrower country focus, Tsionas and Christopoulos (2004) applied cointegration analysis to four EU countries (UK, FR, IT, NL) and the U.S.A. for the period from 1960 to 1999.

With respect to the CEE-MS, there are some advanced estimations of import demand functions for individual countries, e.g. Benacek et al. (2003) who performed a detailed study on the factors determining the Czech foreign trade balance by looking at both import and export functions at a disaggregated (two-digit NACE) level. In both functions they included several additional explanatory variables, e.g. the inward stock of foreign direct investment, apart from the main activity variable and relative prices. Moreover, they investigated these functions separately for trade with the EU and for trade with non-EU countries, highlighting the strong interdependence of imports from and exports to the EU.

Mroczek and Rubaszek (2004) estimated the volume of Poland's imports from the EU in the period from 1992 to 2002, taking weighted total final demand as the activity variable, while imposing a unity restriction on the income elasticity for the long-run relationship. Fic et al. (2005) present a multi-equation macroeconomic model of the Polish economy (ECMOD), which incorporates a module on the import volumes that includes a trend variable, potential GDP as activity variable (combined with a unity elasticity restriction) and relative import prices adjusted for oil price fluctuations and enhanced by the rate of customs duties in the cointegrating relationship. This model was estimated on the basis of quarterly data for the period from 1995 to 2004.

Benk et al. (2006) present the Hungarian Quarterly Projection Model (NEM), which incorporates an equation for import volumes that includes weighted total final demand (combined with a unity elasticity restriction) and the real effective exchange rate based on relative import prices in the cointegrating relationship.

The British National Institute of Economic and Social Research (NIESR, 2007) estimated import demand functions for the CEE-MS on the basis of quarterly data in the period from 1993 to 2003 by means of a panel that included the Czech Republic, Estonia, Hungary, Poland and Slovenia, in order to build the respective country modules within the institute's General Equilibrium Model (NiGEM).

However, to the best of our knowledge, no systematic estimates of import demand functions have been made for individual CEE-MS (and Croatia) that follow the same methodological approach.

3. Theoretical Background

Reinhart (1995) uses a simple theoretical model which – like that in Clarida (1994) and Amano and Wirjanto (1997) – serves to derive the import demand equation within a utility-maximizing framework. Harb (2005) provides a summary of this model and briefly outlines the differences in the approaches for estimating the import demand function between Reinhart's paper and that of Senhadji (1997).

In a small and open economy, an infinitely-lived representative rational agent consumes a non-traded home good and an imported good, given a stochastic endowment of the home good and the export good at each period t. Thus, the quantities of home good and imported good are chosen such that an infinite utility function, given in a discrete time setting by

$$(1)\quad \underset{\{h_t, m_t\}}{Max} \left\{ \sum_{t=0}^{\infty} \beta^t \left(\alpha \ln \left(h_t \right) + \left(1 - \alpha \right) \ln \left(m_t \right) \right) \right\}$$

with

h … non-traded home good, and

m … imported good (both consumed),
ß … time-preference parameter (<1)

is maximized, subject to the following budget constraint with respect to the external balance

$$(2)\quad A_{t+1}\left(\frac{p_x}{p}\right)_t = q_t + x_t\left(\frac{p_x}{p}\right)_t + (1+r^*)A_t\left(\frac{p_x}{p}\right)_t - h_t - m_t\left(\frac{p_m}{p}\right)_t$$

with
q … non-traded home good, and
x … exported good (both endowment)
px/p … relative export price
pm/p … relative import price
A … total (net) foreign bond (if debt, then A < 0)
r* … world interest rate

and given that the market clearing condition q = h is fulfilled at any time t.

Obviously, one major simplification is inherent in this model: Imports consist of final goods only, while in the real world they include final goods, intermediate goods and raw materials that are used for producing final goods for domestic consumption as well as investment goods and export goods.

The following two first-order conditions with respect to h and m

$$(3)\quad \frac{\alpha}{h_t} = \lambda_t$$

$$(4)\quad \frac{1-\alpha}{m_t} = \left(\frac{p_m}{p}\right)_t \lambda_t$$

yield the following import demand equation:

$$(5)\quad m_t = \frac{((1-\alpha)/\alpha)h_t}{(p_m/p)_t}$$

or, in its log-linear form:

$$(6)\quad \ln(m_t) = c + \ln(h_t) - \ln\left(\frac{p_m}{p}\right)_t$$

Trying to stick strictly to this simplified theoretical model in his empirical estimates for the U.S.A., Clarida (1994) calculates a proxy for the consumption of domestically produced (nondurable) consumer goods as the explanatory variable and uses imports of nondurable consumer goods as a proxy for consumption of imported nondurable goods.
By contrast, in an effort to adjust for the simplification introduced into this model, Senhadji (1997) equates qt + xt (px / p)t to GDP, effectively including public consumption and investment as well. Thus, by taking into account the market clearing condition, h equals GDP minus exports and the following equation results:

$$(7)\quad \ln(m_t) = c + \ln\left(GDP - x_t\left(\frac{p_x}{p}\right)_t\right) - \ln\left(\frac{P_m}{p}\right)_t$$

In a similar import demand equation like (6), Amano and Wirjanto (1997) construct the sum of private real consumption and aggregate real investment as their activity variable, arguing in favor of excluding public consumption, as "aggregate private [domestic] demand is an appropriate index of market demand for imported goods" (Amano and Wirjanto, 1997, p. 467).
Pointing to her "primary interest (…) to employ cointegration analysis to examine the "long-run" steady-state relationships that describe import demand," Reinhart (1997) develops a steady state solution starting from the budget constraint (see equation 2):

$$(8)\quad A\left(\frac{p_x}{p}\right) = q + x\left(\frac{p_x}{p}\right) + (1 + r^*)A\left(\frac{p_x}{p}\right) - h - m\left(\frac{p_m}{p}\right)$$

Taking into account the market clearing condition (q = h) yields the following import demand equation:

$$(9)\quad m = \frac{\left(x(p_x / p) + r^* A(p_x / p)\right)}{(p_m / p)}$$

or, in its log-linear form:

$$(10) \quad \ln(m) = \ln\left(\left(x + r^* A\right)\left(\frac{p_x}{p}\right)\right) - \ln\left(\frac{p_m}{p}\right)$$

Reinhart interprets (x+r*A), i.e. the sum of the endowment of exports plus the (possibly negative) interest income balance, as permanent income within this simplified model. In turn, specifying permanent income for estimation purposes, she takes GDP as a proxy.

In a similar vein, many other authors (for instance Tsionas and Christopoulos (2004)) also use GDP as the main activity variable when estimating import demand functions.

It has to be noted that these versions of import demand functions (i.e. equations 6 and 7, respectively, as well as 10) imply that imports have (1) a positive relationship with the activity variable, (2) a negative relationship with their relative price, and (3) unitary elasticities with respect to these explanatory variables (i.e. 1 and –1, respectively).

While the former version (equation 6) focuses mainly on domestic demand, the latter (equation 10) stresses the importance of foreign demand and the requirement of an equilibrium between exports and imports that takes into account the possible costs of financing (past) external imbalances.

Harb (2005) uses both Senhadji's and Reinhart's specifications for the activity variable and concludes that GDP (as opposed to GDP minus exports) yields a superior performance.

In building the Central and Eastern European country modules of NiGEM, NIESR combined both approaches by using total final demand for performing its panel estimate of import demand functions.

In this study, too, we do not use real total final demand as the main activity variable. However, for the testing equation, we split real total final demand into its main components: real private consumption (C), real gross fixed capital formation ("fixed investment", I), and real exports of goods and services (X). In doing so, we gain a deeper insight into the driving forces of imports of goods and services.

Following the line of Amano and Wirjanto (1997), we thus exclude public consumption from the estimation.

While the model presented above suggests unitary elasticity for both explanatory variables, according to Reinhart (1995) and Harb (2005), there are good reasons why these elasticities may deviate from unity. Among others, they mention the oversimplified nature of the theoretical model, and, related to this, the model assumption that imports consist of final goods only, and also the noise introduced by the use of proxies and measurement errors.

4. Structure of Total Final Demand in CEE-MS and Croatia: Some Stylized Facts

Table 2 shows the share of the main components of total final demand[1] in 2006.

Table 2: Total Final Demand of CEE-MS and Croatia in 2006

Shares in % (excluding change of inventories and statistical dicrepancy)

	Private Consumption	Public Consumption	Fixed Investment	Exports
Czech Republic	28.2	12.5	14.7	44.6
Estonia*	28.8	8.7	20.3	42.2
Lithuania	39.7	10.5	13.9	35.9
Hungary	30.7	12.7	12.5	44.1
Poland	44.4	12.8	14.0	28.8
Slovenia	32.0	11.4	15.3	41.3
Slovakia	30.6	9.7	14.1	45.6
Latvia	27.7	10.4	21.3	40.6
Bulgaria	39.1	9.8	14.8	36.2
Romania	48.2	12.4	17.0	22.4
Croatia*	36.4	13.1	19.4	31.1
EA-12	41.1	14.7	15.3	28.9

*Note: * "Fixed investment" includes change in inventories in case of Estonia (on a seasonally adjusted basis) and Croatia (on a not seasonally adjusted basis).*

Source: Eurostat, author's calculations.

Exports have the largest weight in total final demand in most of the CEE-MS that acceded to the EU on May 1, 2004, with the exception of Lithuania and Poland, where private consumption is the largest component. In Bulgaria, Romania and Croatia, private consumption has the largest weight, too. The structure of total final demand is quite similar in Lithuania, Bulgaria and Croatia. Poland's structure resembles that of the EA-12, while Romania shows a particularly low weight of exports combined with a particularly high weight of private consumption.

The share of fixed investment is considerably lower than that of exports and private consumption, but it is larger than that of public consumption in all countries, with the notable exceptions of Hungary (both are about equal in size).

The lower share of exports in the EA-12 as well as in Poland and Romania (partly) reflects the smaller degree of openness inherent in the larger size of the respective economic area's population and economy. Conversely, it could be expected that comparatively smaller economies would have larger shares of exports in total final

[1] Here, total final demand excludes the statistical discrepancy in all countries and the change of inventories in all countries except for Estonia and Croatia. The shares are calculated on the basis of nominal seasonally and working-day adjusted data in all countries except Bulgaria, Romania and Croatia, for which no seasonally adjusted data were available.

demand. However, the largest export shares are found not in the Baltic countries, but in the Czech Republic, Slovakia and Hungary. In case of the former two countries, this may be partly explained by the still remaining strong economic integration between the economies of these countries. Moreover, in these three countries the sizeable level of the inward stock of foreign direct investment has probably particularly enhanced the role of exports.
From another perspective, a relatively higher share of exports can be expected for catching-up countries, as exports tend to be valued at world market prices (at least when assuming that the law of one price holds for tradables), while non-tradables are usually still valued lower in these economies than tradables that are integrated in the world market.

5. Econometric Issues in Estimating Import Demand Functions

Since we are interested primarily in long-run import elasticities, we build an error correction model (ECM). The ECM includes the long-run cointegration relationship between the dependent variable and the explanatory variables as non-stationary time series in levels.
We perform unit root tests for all the variables taken so as to determine which variables to include in the long-run relationship as nonstationary in levels.
In performing the unit root tests, we follow the testing strategy outlined by Mosconi (1998). This is a three-step strategy that starts with an augmented Dickey-Fuller (ADF) test on the basis of an autoregressive model that includes both a trend and a constant. If the null hypothesis of a unit root can be rejected at the MacKinnon 5% level at this stage and the trend variable is significant, the time series is regarded as trend stationary. If the null hypothesis of a unit root cannot be rejected at the MacKinnon 5% level, a Fischer test is conducted for the joint hypothesis that both a unit root and no trend exist. If this joint hypothesis can be rejected, the time series is regarded as nonstationary (i.e. integrated of order one, I(1)) with a trend (and a constant).
In case that no significant trend can be established, the second step of this strategy consists in an ADF test on the basis of an autoregressive model that includes only a constant. Following the similar decision-tree as before, the time series is considered to be stationary (I(0)) with a constant or nonstationary (I(1)) with a constant. Alternatively, in case that no significant constant has been found, the third step – an ADF test on the autoregressive model without a constant – leads to the time series regarded as stationary (I(0)) without a constant or nonstationary (I(1)) without a constant.
Basically, only variables that are found to be nonstationary in levels (i.e. integrated of order one, I(1)) are then included in the testable cointegration relationship. However, if the null of the ADF test can be rejected at the MacKinnon 5%, but not

at the MacKinnon 10% level, we additionally examine the cointegration relationship including this variable. Moreover, given the economically ambiguous character of statistical trend stationarity, we also examine the cointegration relationship including the variable that was found to be trend stationary.
In designing the test for cointegration, we took account of the possible endogeneity among the variables in the form of a simultaneity bias. Therefore, we employ the dynamic ordinary least squares (DOLS) method (Stock and Watson, 1993) for estimating the cointegrating vector itself, by including lags and leads of the first differences of the explanatory variables. To the extent possible in view of the short time series, the optimal number of lags and leads is determined on the basis of the Schwarz criterion (SC).
Thus, the employed econometric framework consists of the following DOLS model:

$$(11) \qquad y_t = \beta_0 + \beta_1 x_{1,t} + \beta_2 x_{2,t} + \sum_{i=0}^{iopt} \eta_{1,i} dx_{1,t+i} + \sum_{j=1}^{jopt} \theta_{1,j} dx_{1,t-j} + \sum_{i=0}^{iopt} \eta_{2,i} dx_{2,t+i} + \sum_{j=1}^{jopt} \theta_{2,j} dx_{2,t-j} + e_t$$

The residuals resulting from estimating this model for the variables found to be nonstationary are then tested for stationarity by means of an ADF test. For evaluating the t-statistic of this unit root test (with the null hypothesis of a unit root being equivalent to no cointegration), we take not only the asymptotical MacKinnon critical values, but also the critical values corrected for the small sample size according to MacKinnon (1991), which turns out to have a considerable upward effect on these thresholds.
After having established cointegration, we rebuild the DOLS regression in first differences by including the lagged error correction term (ECT) that was derived from the first DOLS regression. This led to the following error correction representation of the DOLS regression:

$$(12) \qquad dy_t = c_0 + \gamma ECT_{t-1} + \delta_1 dx_{1,t-1} + \delta_2 dx_{2,t-1} + e_t$$

In this way, we estimate γ, i.e. the adjustment coefficient in the case of a disequilibrium in levels (as compared with the long-run relationship).

6. Results

The unit root tests on the stationarity of the involved time series show that all GDP components (M, C, I, X) can be considered nonstationary, i.e. I(1).

Table 3: Relative Import Price Level

Results of ADF-tests for unit roots in the time-series in levels

	nsa 2003		**nsa 2007**		**swa 2003**		**swa 2007**	
	1995q1-2003q4		1995q1-2007q2		1995q1-2003q4		1995q1-2007q2	
	p-value	type	p-value	type	p-value	type	p-value	type
Czech Republic (1)	0.0906	I(1)_t	0.0465	TS	0.0292	TS	0.0081	TS
Estonia	0.3732	I(1)	0.015	TS	0.0107	I(0)	0.1046	I(1)
Latvia (2)	0.2711	I(1)	0.1606	I(1)	n.a.	n.a.	0.6079	I(1)
Lithuania	0.3763	I(1)	0.283	I(1)	0.0001	I(0)_c	0.0115	I(0)_c
Hungary	0.1033	I(1)_t	0.0229	TS	0.034	I(0)	0.0275	I(0)
Poland	0.0012	I(0)_c	0.0005	I(0)_c	0.0155	I(0)_c	0.0071	I(0)_c
Slovenia	0.3435	I(1)	0.4574	I(1)	0.2048	I(1)	0.3886	I(1)
Slovakia	0.0747	I(1)_t	0.1094	I(1)_t	0.2778	I(1)	0.0941	I(1)
Bulgaria	0.0628	I(1)_t	0.0827	I(1)_t	n.a.	n.a.	n.a.	n.a.
Bulgaria 97 (3)	n.a.	n.a.	0.1145	I(1)_t	n.a.	n.a.	n.a.	n.a.
Romania (4)	n.a.	n.a.	0.9995	I(1)_c	n.a.	n.a.	n.a.	n.a.
Croatia (5)	n.a.	n.a.	0.3465	I(1)	n.a.	n.a.	n.a.	n.a.

Notes: The relative import price level is defined as the ratio between the import and the GDP price deflator.
swa: seasonally and working day adjusted
nsa: not seasonally (and not working day) adjusted
p-value: MacKinnon p-value type: Resulting type of time-series that the relative import prices are found to be based on the ADF test at the 5% (Mac Kinnon) significance level and on the Fischer-Test with respect to constant (and trend).
TS: trend stationary
I(1): integrated of order 1, i.e. non-stationary; I(1)tc: I(1) with trend and constant; I(1)c: I(1) with constant.
I(0): integrated of order 0, i.e. stationary; I(0)tc: I(0) with trend and constant; I(0)c: I(0) with constant.
(1): swa time-series starts only in 1996q1
(2): swa time-series starts only in 1999q1
(3): based on nsa time-series starting in 1997q3
(4): nsa time-series starts only in 2000q1
(5): nsa time-series starts only in 1997q1

Source: Author's calculations.

However, with respect to the relative import price level, the results are not fully clear cut (see table 3). In several cases, the relative import price level is found to be stationary.[2]

[2] In particular, the relative import price level can be considered stationary in Poland for both types of data (not seasonally adjusted (nsa), and seasonally and working day adjusted (swa) and in both periods (from 1995 to 2003 and from 1995 to 2007). The same is true for Hungary and Lithuania for swa data in both periods, as well as for Estonia for swa data in the first period. Given the large swings in the exchange rate in both directions in Poland and Hungary and the particularly high pass-through of import prices in very

Moreover, the relative import price level was found to be trend stationary in particular in the Czech Republic, but also to some extent in Estonia and Hungary.
Finally, in Slovakia and Bulgaria and partly in the Czech Republic and Estonia, the null of a unit root could not be rejected at the MacKinnon 5% level of statistical significance, but roughly at the 10% level. For these cases, we examined both possible cointegration relationships, including and excluding the relative import price level. Similarly, we applied the same approach to the cases of trend stationary time series.
According to the results of the cointegration test, the share of countries in which the MacKinnon critical values (increased in absolute terms by correcting for the small sample size) is surpassed (in absolute terms) is considerably higher for seasonally adjusted data than for not seasonally adjusted data (see table 4). In the period up to 2007, 5 out of 11 countries surpass the threshold for nsa data, while 7 out of 8 countries exceed it for swa data. This difference is not very surprising, as the DOLS regression includes lags and leads of the explanatory variables in first differences, which are more meaningful in case of seasonally adjusted quarterly data and thus capture possible endogeneity in a better way.
Moreover, for both types of data, a significant cointegration relationship could be established more often in the period up to mid-2007 than in the period up to 2003. While the lengthening of the time series alone might have produced this result, given the smaller increase of the critical values as a result of the small-sample correction, the effect of this change in the size of the critical values is in fact rather small. Looking at the CEE-MS that acceded to the EU on May 1, 2004, the long-run relationship among the main GDP components seems to have strengthened with EU accession. These results confirm the observation that there was no asymmetric shock to aggregate imports that would have been unrelated to the developments in other main components as a result of EU accession.

small and open economies, this result is economically plausible for the time periods considered.

Table 4: Co-Integration of Imports and Main Components of Total Final Demand

		nsa 2003			**nsa 2007**			**swa 2003**			**swa 2007**		
		1995q1-2003q4			1995q1-2007q2			1995q1-2003q4			1995q1-2007q2		
		t-stat	crit 5%	crit 10%	t-stat	crit 5%	crit 10%	t-stat	crit 5%	crit 10%	t-stat	crit 5%	crit 10%
Czech Republic (1)	A	-2.13	-4.85	-4.46	-2.24	-4.71	-4.35	-2.27	-4.95	-4.53	-3.41	-4.73	-4.37
	B	-0.41	-4.45	-4.07	-1.37	-4.33	-3.98	-2.97	-4.48	-4.09	-2.93	-4.35	-4.00
Estonia	A	**-7.41**	-4.95	-4.53	-2.30	-4.79	-4.42				**-4.61**	-4.77	-4.40
	B				**-6.76**	-4.32	-3.98	**-4.19**	-4.42	-4.05	**-4.88**	-4.32	-3.98
Latvia (2)	A	-3.45	-4.84	-4.45	**-4.86**	-4.71	-4.36	n.a.	n.a.	n.a.	**-4.55**	-4.85	-4.46
Lithuania	A	-2.23	-4.84	-4.45	-2.33	-4.71	-4.36						
	B							**-4.07**	-4.43	-4.06	**-4.22**	-4.33	-3.98
Hungary	A	-2.05	-4.88	-4.48	-1.36	-4.72	-4.36						
	B				-2.25	-4.34	-3.99	-3.31	-4.43	-4.06	**-5.00**	-4.33	-3.98
Poland	B	-0.89	-4.47	-4.08	-2.48	-4.34	-3.99	**-7.91**	-4.42	-4.05	**-6.60**	-4.33	-3.98
Slovenia	A	-1.76	-4.88	-4.48	**-8.62**	-4.71	-4.35	**-6.20**	-4.88	-4.48	**-5.22**	-4.71	-4.35
Slovakia	A	**-6.60**	-4.84	-4.45	**-6.85**	-4.71	-4.36	**-4.90**	-4.87	-4.47	**-5.01**	-4.70	-4.35
	B	**-6.75**	-4.43	-4.06	**-7.40**	-4.33	-3.99				**-4.93**	-4.32	-3.98
Bulgaria	A	**-8.23**	-4.87	-4.47	-3.70	-4.73	-4.37	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
	B	-3.10	-4.47	-4.08	-3.45	-4.35	-4.00	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
Bulgaria 97 (3)	A	n.a.	n.a.	n.a.	-2.60	-4.78	-4.41	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
Romania (4)	A	n.a.	n.a.	n.a.	-2.18	-4.93	-4.52	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
Croatia (5)	A	n.a.	n.a.	n.a.	**-6.41**	-4.79	-4.42	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.

Note: A: co-integration relationship includes relative import price
B: co-integration relationship excludes relative import price
crit 5%, crit 10%: critical values corrected for the small sample size according to MacKinnon (1991)
swa: seasonally and working day adjusted
nsa: not seasonally (and not working day) adjusted
Values in bold letters indicate significant co-integration relationship.
(1): swa time-series starts only in 1996q1
(2): swa time-series starts only in 1999q1
(3): based on nsa time-series starting in 1997q3
(4): nsa time-series starts only in 2000q1
(5): nsa time-series starts only in 1997q1

Source: Author's calculations.

The estimated adjustment coefficient is found to be negative in all cases in which a significant cointegration relationship can be established. Thus, any disequilibrium in the lagged long-run relationship, i.e. ECT (–1), induces corrective changes in aggregate imports toward the long-run equilibrium ("ECT acts as attractor"). In fact, this is what is required for the stability of the long-run equilibrium.
The long-run import elasticities that are recovered from the significant cointegration relationships are summarized in table 5.

Table 5: Long-Run Elasticity of Imports with Respect to Main Components of Total Final Demand

Coefficients in bold letters (with corresponding p-values in italic letters below)

		nsa 2003 1995q1-2003q4			**nsa 2007** 1995q1-2007q2			**swa 2003** 1995q1-2003q4			**swa 2007** 1995q1-2007q2		
		C	**I**	**X**	**C**	**I**	**X**	**C**	**I**	**X**	**C**	**I**	**X**
Estonia	A	**-0.03**	**0.35**	**0.77**							**0.22**	**0.24**	**0.67**
		0.89	*0.00*	*0.00*							*0.01*	*0.00*	*0.00*
	B				**0.13**	**0.14**	**0.81**	**0.04**	**0.21**	**0.78**	**0.10**	**0.20**	**0.75**
					0.27	*0.06*	*0.00*	*0.70*	*0.00*	*0.00*	*0.20*	*0.00*	*0.00*
Latvia (1)	A				**0.57**	**0.29**	**0.24**				**0.53**	**0.60**	**-0.22**
					0.00	*0.00*	*0.11*				*0.09*	*0.01*	*0.21*
Lithuania	B							**0.18**	**0.32**	**0.57**	**0.23**	**0.31**	**0.62**
								0.08	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*
Hungary	B										**-0.21**	**0.72**	**0.71**
											0.05	*0.00*	*0.00*
Poland	B							**0.28**	**0.57**	**0.55**	**0.44**	**0.49**	**0.50**
								0.28	*0.00*	*0.00*	*0.04*	*0.00*	*0.00*
Slovenia	A				**-0.10**	**0.21**	**0.80**	**-0.37**	**0.29**	**0.65**	**0.14**	**0.25**	**0.70**
					0.53	*0.00*	*0.00*	*0.51*	*0.04*	*0.00*	*0.54*	*0.00*	*0.00*
Slovakia	A	**0.24**	**0.32**	**0.89**	**1.01**	**0.06**	**0.58**	**0.89**	**0.14**	**0.65**	**1.06**	**0.09**	**0.57**
		0.30	*0.00*	*0.00*	*0.00*	*0.40*	*0.00*	*0.00*	*0.16*	*0.00*	*0.00*	*0.09*	*0.00*
	B	**1.00**	**0.08**	**0.53**	**1.07**	**0.05**	**0.49**				**1.19**	**0.09**	**0.44**
		0.02	*0.53*	*0.00*	*0.00*	*0.50*	*0.00*				*0.00*	*0.11*	*0.00*
Bulgaria	A	**-0.58**	**0.55**	**0.71**									
		0.05	*0.00*	*0.00*									
Croatia (2)	A				**0.50**	**0.66**	**0.09**						
					0.01	*0.00*	*0.10*						

Note: A: co-integration relationship includes relative import price
B: co-integration relationship excludes relative import price
crit 5%, crit 10%: critical values corrected for the small sample size according to MacKinnon (1991)
swa: seasonally and working day adjusted
nsa: not seasonally (and not working day) adjusted
(1): swa time-series starts only in 1999q1
(2): nsa time-series starts only in 1997q1

Source: Author's calculations.

In most countries, the import elasticity with respect to exports was found to be highly significant, and usually also higher than the import elasticity with respect to the other main components of total final demand. This confirms the hypothesis of a significantly strong export-import link in these countries. Apart from the fact that the relatively high share of exports in total final demand supports this result, it is consistent with the observation that each of these countries can be considered a small and open economy that flexibly participates in international trade and division of labor. More specifically, a strong export-import link may be explained – inter alia – by the high stock of export-oriented inward FDI in these countries. It may even partly consist of intra-company trade within transnational corporations. In some cases, the export-import link may reflect a country's role as transit country between the EU-15 and Russia.

However, there are some deviations from this general finding. In Poland (up to 2003), and in Hungary and Slovakia, the import elasticity with respect to exports is clearly significant and high, too, but it is slightly smaller than the import elasticity with respect to fixed investment in Poland and Hungary, and considerably smaller than the import elasticity with respect to private consumption in Slovakia.
A different type of exception is observed in Croatia and Latvia in that the import elasticity with respect to exports on the basis of nsa data is significant only at roughly the 10% level and, in addition, it is relatively small. Moreover, it is insignificant on the basis of swa data for Latvia.
Gross fixed capital formation is found to have generally the second-highest or, in a few cases, as mentioned above, even the highest significant import elasticity impact among the final demand components of these countries, even though its share in total final demand usually ranks only third. In Hungary and Croatia, and partly also in Poland and Latvia, fixed investment is the component with the highest import elasticity, so that exports (Hungary, partly Poland) or consumption (Croatia, partly Latvia) rank second. The notable exception to this pattern is Slovakia, where import elasticity with respect to investment is mostly insignificant or significant only at the 10% level and relatively small.
The import elasticity with respect to private consumption is insignificant in nearly one-half of the established cointegration relationships. Where it is significant, it is generally lower than the import elasticity with respect to both exports and fixed investment, despite the generally relatively large share of private consumption in total final demand. This is certainly not unexpected, given the low income levels of most people that does not allow them to buy large quantities of imported goods or goods with a large import content. The combination of a relatively large share in total demand and a relatively small import elasticity implies that the import content of one (additional) unit of private consumption is far below that of one (additional) unit of fixed investment or exports. However, there are exceptions to this general finding: In Slovakia, Latvia and Croatia, the import elasticity with respect to private consumption is the highest (Slovakia, partly Latvia) or the second-highest (Croatia, partly Latvia) among the demand components' import elasticities.
Summing over these three main components of total final demand yields an import elasticity of total final demand that ranges from 0.6 to 1.7. While the import elasticity is below one only in four cases, Slovakia and Poland showed particularly high import elasticities in all estimations. The median across both types of data and both periods under consideration stood at 1.15. This is close to the result of a panel cointegration for some CEE-MS in the period from 1993 to 2003 (1.24) that was conducted by NIESR (2007) and is used in the NiGEM modules for individual CEE-MS.
Another perspective focuses on import elasticities with respect to the main components of total final demand in particular for countries with larger external imbalances, like Estonia, Lithuania, Latvia, Bulgaria and Croatia.

If these countries show also a high import elasticity with respect to exports (as Estonia, Lithuania and Bulgaria do), it may be quite difficult for them to overcome the gap in the goods and services balance only by increasing exports. At the same time, if countries with large external imbalances display an import elasticity with respect to private consumption that is significant (as our results suggest for most of the above-mentioned countries), this may provide, to some extent, a possible channel for diminishing the gap in the trade balance, even though this elasticity may be smaller than that of other demand components. In fact, in some of the countries concerned this elasticity was found to be even relatively high.

In a final step, we tested for the strength of the economic interlinkages within the EU-27 as measured by CEE-MS import elasticities. The basic idea of this approach is to take into account the asymmetric size relations between the EU-15 (or else EA-12) on the one hand, and the CEE-MS and Croatia on the other. While the former have a large share in the CEE-MSs' total external demand, the reverse is not true. It follows that the total imports of the EU-15 (EA-12) have a decisive impact on the total exports of individual CEE-MS. Hence, we may hypothesize that the total imports of the EU-15 (EA-12) also have a significant indirect influence on total imports of individual CEE-MS, taking into account their generally strong export-import link. To examine this hypothesis, we substitute total exports of individual CEE-MS in the import demand equations of these CEE-MS by total imports of EU-15 (EA-12) that yield testable relationships.

In Estonia, Hungary, Slovakia, Slovenia and Bulgaria, significant cointegration relationships between imports, private consumption, fixed investment and total imports of EU-15 (EA-12) are found. In these cases, the import elasticity with respect to total imports of EU-15 (EA-12) was significant. (As before, some of these cointegration relationships exclude the relative import price level, while some others include it.) This import elasticity is roughly at or above 1 in all cases, with the exception of Slovakia where it is between 0.25 and 0.40. The latter result is also considerably lower than the corresponding import elasticity of private consumption in Slovakia– similar to what is the case in Slovakia when exports are included in the import demand equation.

In general, these results (a strong impact of total EU-15 (EA-12) imports on CEE-MS imports) reflect important economic interlinkages between these country groups within the EU-27 and are indicative of advanced economic integration.

6. Conclusions

In this study we made systematic estimates of long-run import elasticities for individual CEE-MS and Croatia, following the same methodological approach on the basis of two types of quarterly data (not seasonally adjusted and seasonally adjusted) for the periods from 1995 (first quarter) to 2003 (fourth quarter) and 1995 (first quarter) to 2007 (second quarter).

Our results confirm the existence of a strong export-import link in all countries under study with the exception of Croatia and Latvia. This appears to reflect the relatively high share of exports in total final demand, the flexible participation of these small and open economies in international trade and in the international division of labor, the high stock of export-oriented inward FDI in these countries, intra-company trade by transnational corporations and, in some cases, the countries' role as transit countries between the EU-15 and Russia.

Second, we have found confirmation of the prominent role of fixed investment in determining imports in all countries except Slovakia, despite the relatively small share of gross fixed capital formation in these countries' total final demand.

Third, our results show that the role of private consumption in determining import developments is generally smaller than that of exports or fixed investment. However, Slovakia, Croatia and Latvia are exceptions where private consumption has the strongest or second-strongest elasticity impact among these three main components of total final demand.

In countries with larger external imbalances, a strong export-import link (e.g. Estonia, Lithuania and Bulgaria) renders it more difficult to overcome the gap in the goods and services balance by only increasing exports. However, in most of the countries with larger external imbalances, the import elasticity with respect to private consumption has been found to be significant in recent years, which may provide a possible channel for diminishing the gap in the trade balance. This is true in particular for countries where this elasticity was found to be relatively high (e.g. Croatia and Latvia).

We tested for economic interlinkages between the EU-15 (or EA-12) and the CEE-MS within the EU-27 by using total imports of the EU-15 (or EA-12) instead of the individual CEE-MSs' total exports in the estimated import demand equations of these individual countries. In one-half of the countries under study, the impact of total imports of EU-15 (EA-12) on the individual CEE-MSs' imports has been significant and sizeable, which corroborates a high degree of economic integration within the EU-27.

References

Amano, R. A. and T. S. Wirjanto. 1997. Adjustment Costs and Import Demand Behavior: Evidence from Canada and the United States. Journal of International Money and Finance 16(3). 461–476.

Asseery, A. and D. A. Peel. 1991. Estimates of a Traditional Aggregate Import Demand Models for Five Countries. Economics Letters 35(4). 435–439.

Benáček, V., L. Prokop and A. Višek. 2003. Determing Factors of the Czech Foreign Trade Balance: Structural Issues in Trade Creation. CNB working paper 3.

Benk S., Jakab B., Kovács M. A., Pàrkànyi B., Reppa Z. and G. Vadas. 2006. The Hungarian Quarterly Projection Model (NEM). Occasional Papers 60. Budapest: Magyar Nemzeti Bank.

Carone, G. 1996. Modeling the US Demand for Imports Through Cointegration and Error Correction. Journal of Policy Modeling 18. 1–48.

Clarida, R. 1994. Cointegration, Aggregate Consumption and the Demand for Imports: a Structural Econometric Investigation. The American Economic Review 84. 298–308.

Deyak, T. A., Sawyer, W. C. and R. L. Sprinkle. 1993. The Adjustment of Canadian Import Demand to Changes in Income, Prices, and Exchange Rates. Canadian Journal of Economics 26. 890–900.

Fic, T., Kolasa M., Kot A., Murawski K., Rubaszek M. and M. Tarnicka. 2005. ECMOD – Model of the Polish Economy. Materiały I Studia 36. Warsaw: National Bank of Poland.

Goldstein, M. and M. S. Kahn. 1985. Income and Price Effects in Foreign Trade. In R. W. Jones and P. B. (eds). Handbook of International Economics 2.

Harb, N. 2005. Import Demand in Heterogeneous Panel Setting. Applied Economics 37. 2407–2415.

MacKinnon, J. G. 1991. Critical Values for Co-integration Tests. In: R. F. Engle and C.W.J. Granger (eds.). Long-run Economic Relationships. Oxford University Press. 267–276. Cited in: Maddala and Kim. 1998: Unit Roots, Co-integration and Structural Change. Cambridge University Press. 199–201.

Mosconi, R. 1998. MALCOLM version 2.0: The Theory and Practice of Cointegration Analysis in RATS. Cafoscarina.

Mroczek, W. and M. Rubaszek. 2004. Development of the Trade Links between Poland and the European Union in the Years 1992–2002. Materiały I Studia 30. Warsaw: National Bank of Poland.

National Institute of Economic and Social Research (NIESR). 2007. NiGEM V1.07 Equation Manual: Model Equations and NiGEM V3.07 Model Equations. London. United Kingdom.

Phillips, P. C. B. and S. Ouliaris. 1990. Asymptotic Properties of Residual Based Tests for Cointegration. Econometrica 58. 165–193.

Reinhart, C. 1995. Devaluation, Relative Prices, and International Trade: Evidence from Developing Countries. IMF Staff Papers 2.

Senhadji, A. 1998. Time-Series Estimation of Structural Import Demand Eequations: A Cross-Country Analysis. IMF Staff Paper 45(2). 236–268.

Stock, J. H. and M. Watson. 1993. A Simple Estimator of Cointegrating Vectors in Higher Order Integrated systems. Econometrica 61. 783–820.

Tsionas, E. G. and D. K. Christopoulos. 2004. International Evidence on Import Demand, Empirica 31(1). 43–53.

Appendix

Estimating Import Demand Functions for CEE-MS and Croatia: Data Issues

For most CEE-MS and also for Croatia, annual time series are not available for a sufficiently long period. Moreover, if they are available, the fundamental structural break due to the systemic transformation recession in the early 1990s renders any regression across this break very questionable.

Therefore, to have a sufficient number of observations, we have to use quarterly data. For most CEE-MS, both types of data are available – not seasonally adjusted quarterly time series (which are not working day adjusted, either) as well as seasonally and working day adjusted quarterly time series.
More precisely, not seasonally adjusted (nsa) quarterly data are available from EUROSTAT in level form (as chain-linked volumes with the reference year 2000) for

- Estonia (EE) and Slovakia (SK) for the period from 1993q1 to 2007q2;
- Bulgaria (BG), the Czech Republic (CZ), Latvia (LV), Lithuania (LT), Hungary (HU), Poland (PL), Slovenia (SI) for the period from 1995q1 to 2007q2;
- Croatia (HR) for the period from 1997q1 to 2007q2;
- and Romania (RO) for the period from 2000q1 to 2007q2.

Seasonal and working day adjusted (swa) quarterly data are available from EUROSTAT in level form (as chain-linked volumes with the reference year 2000) for

- Estonia (EE), Lithuania (LT), Hungary (HU), Poland (PL), Slovenia (SI), Slovakia (SK) for the period from 1995q1 to 2007q2;
- the Czech Republic (CZ) for the period from 1996q1 to 2007q2;
- and Latvia (LV) for the period from 1999q1 to 2007q2.

For Bulgaria (BG), Romania (RO) and Croatia (HR) swa data were not yet available.
Thus, while in most cases the quarterly time series are long enough to run least-squares regressions, a "small sample correction" for deriving fully appropriate critical values was required in all cases when testing for cointegration.

We performed estimations of import demand functions using both not seasonally adjusted (nsa) data as well as seasonally and working day adjusted (swa) data.

Clearly, the main advantage of using nsa data was that we could derive comparable results also for Bulgaria, Romania and Croatia.

Concerning the choice of the sample, we tried to get a comparable length for nsa and swa data, implying that we had to shorten somewhat the length of the time series available in case of Estonia and Slovakia as well as the Czech Republic. In the case of Bulgaria, we made an additional estimate based on a sample ranging from 1997q3 to 2007q2, given the severe financial crisis in 1996/1997 and the setup of the currency board regime on July 1, 1997.

For the CEE-MS that acceded to the European Union on May 1, 2004, we additionally performed the estimations on the basis of a shorter sample ranging from the start of the time series up to 2003q4, as one might suspect a potential structural break in the countries' external trade relations in the run-up to EU accession.