Integration of the CEECs in the EU and their Participation in the EMU – A VEO and AGE Analysis*

Lars Wang**
University of Hohenheim
June 20, 2004

Abstract

This study re-assesses the integration of the Central and Eastern European countries (CEECs) in the European Union (EU) and their participation in the Economic and Monetary Union (EMU). It takes new measures for the degree of openness into account. The value-added based economic openness (VEO) model which improves on established economic openness models forms the core of these openness indicators. An applied general equilibrium model is drawn on to simulate the changing level and pattern of trade among the old and the new members of the EU as well as the rest of the world. A shift from the measures of the traditional gross economic openness (GEO) model towards those of the VEO model in the cost-benefit analysis of whether a candidate is in the position to join a single currency area or not leads to a decrease of the realized degree of openness. Thus, net-benefits of a participation of the CEECs in the EMU are lower as the GEO model suggests.

JEL classification: C67, C68, E20, F15, F42

Keywords: degree of openness, value-added approach, exchange rate arrangements, optimum currency areas, computable general equilibrium simulation

---

* First Draft.

** International Economics, Department of Economics, University of Hohenheim, D-70593 Stuttgart, Germany, lawang@uni-hohenheim.de

Table of contents

1. Introduction

This study presents the impact of a changed foundation of the cost-benefit analysis of monetary integration on the assessment of regional integration in the context of the new membership of Central and Eastern European countries (CEECs) in the European Union (EU) and their participation in the Economic and Monetary Union (EMU). A fundamental part of this analysis is the degree of economic openness of a country which plans to join in a single currency area. According to the common perception, a high economic importance of interregional trade, this is a high degree of trade openness, indicates a high level of economic integration between two regions. The costs and the benefits from the pegging of the domestic currency of an economy depend on the degree of economic openness. Costs represent economic stability losses of an economy from joining an exchange rate area. They tend to decrease with the degree of openness. On the other hand, benefits do increase and characterize monetary efficiency gains. When benefits are larger than costs at a break-even degree of economic openness a country should join the other members of a single currency area (Krugman and Obstfeld 2003, pp. 617 ff.).

However, the value of the degree of economic openness in the cost-benefit analysis of monetary integration depends on the operationalization of the economic significance of the trading partners within an integration area of a country. It is at least questionable that established economic openness models appropriately represent the importance of these economies. The linkage between their theoretical foundation and their empirical measures of economic openness is weak because these models do not emphasize the necessary inputs of the traded products (Wang 2003, pp. 6 f.). This would clarify how much income is created by trade in which country. For instance, the regional export ratio (RER) of the gross economic openness (GEO) model can exceed 100 percent which implies a negative value of domestic non-tradeables.[1]

A more appropriate measure of openness should relate the *value added* in the traded goods sector to the gross domestic product. For example, consider a country, which imports intermediate goods of 100 euro. Domestic labor (and perhaps capital) is used to increase their value by 25 percent, resulting in exports of 125 euro. These exports would allow the country to import also final consumer goods of 25 euro. If non-traded goods production (assuming they do not require any imported input) amounts to 100 euro, total value added, or GDP,

[1] This economic openness measure puts regional exports in relation to the gross domestic product within a period of one year to indicate the importance of regional trade at the export side of a country. Furthermore, the regional import ratio measures the significance analogously at the import side.

would amount to 125 euro. Openness as traditionally measured would thus be equal to 80 percent, whereas the share of traded goods in consumption would be only 20 percent. As this set of numbers might actually describe, for instance, the Estonian case one must be extremely careful in using the ratio of exports to gross domestic product as the relevant measure of openness (Pelkmans, Gros and Ferrer 2000, pp. 165ff.).

In contrast to the GEO model, the value-added based economic openness (VEO) model which is developed in this paper overcomes this limitation since it calculates the value added which is induced by regional trade.[2] The VEO model puts emphasize on national and international structures of production and the linkages between them. This leads to an improved theoretical foundation of the empirical indicators and hence enhances their accuracy of measuring the importance of regional trading partners. For example, exports generate less wealth at home as the GEO model suggests because their production includes imports of intermediates. The VEO model is able to quantify this transfer of income abroad. Consequently, the choice of an economic openness model influences the outcomes of the cost-benefit analysis.

This contribution proceeds as follows. In section 2, the value-added based economic openness model is developed. It serves as the theoretical foundation of our new empirical method to assess the economic relevance of regional trade linkages for an economy. Section 3 empirically illustrates the deviations of the degrees of economic openness when they are measured by the value-added based economic openness model instead of the gross economic openness model. Then, section 4 presents a general equilibrium simulation for a potential scenario of trade integration between the CEECs and the EU in the year 2008 where the introduction of the euro in the new members of the EMU might be on the agenda. Subsequently, section 5 empirically outlines the impact of the value-added based economic openness model on the results of the standard cost-benefit analysis of monetary integration and compares them to the outcomes of the well-known standard gross economic openness model. Section 6 concludes and discusses the implications of the outcomes for the introduction of the euro in the new member countries of the EU from Central and Eastern Europe and, more general, for the assessment of international monetary relations and the optimality of exchange rate arrangements between economies.

[2] This kind of induced value added measures the economic performance of trading economic sectors and their supplying sectors of a country. The measures of the VEO model are based on that part of regional trade-induced value added which represents income of production factors in the producer country.

2. Measurement of openness of trade with the VEO model

In section 1, we discussed the potential drawbacks of the usual measures of economic openness. In this context, the question emerges how the analysis of monetary integration can be improved with more appropriate indicators of openness. This question was the motivation for developing the value-added based economic openness (VEO) model in this paper. In any case, an answer should contain a major enhancement of the adequacy of the degree of openness with an eye on its heavy impact on the results of the cost-benefit analysis. In general, one should bear in mind that a high relevance of member countries of an integration area for an economy is associated with a high degree of openness with them.

The gross economic openness (GEO) model as a stylized established economic openness model serves as a basis for the derivation of two measures of economic openness to assess the importance of regional trading partners. At the export side of an economy the indicator is the *regional export ratio* (RER) and at the import side it is the *regional import ratio* (RIR). The RER indicator relates the value of goods and services which is sold by the country under investigation to its trading partners within a region to all the products which the economy produced for final demand purposes within a year. On the other hand, the RIR measures the value of the economy's regional imports as a share of the gross domestic product (GDP). This output-orientation of the gross economic openness model leads to indicators of economic openness which are in clear lack of accuracy. If, for instance, the RER measure displays an empirical value of more than 100 percent then this correctly indicates a high degree of openness. But how good is the theoretical foundation of this empirical indicator? A country that earns more income from exports than from the production of all final goods and services creates a negative income with non-tradeables, according to the GEO model.

In contrast to these traditional indicators of openness, however, our new value-added based economic openness model interprets the significance of countries within a region in an input-oriented way.[3] Within this model, we focus on the income of factors of production that the international trade generates in the producer country. Hence, the measures of economic openness of the VEO model do not take the total value of regional trade into account. The *regional value-added based export ratio* (RVER) and the *regional value-added based import ratio*

[3] The economic openness measures based on the VEO model are derived according to a static multi-regional input-output table which describes national and international economic interconnections by their values and an input-output analysis which links domestic and regional income to international trade. In contrast, indicators of the GEO model are based on the national income account and the current account.

(RVIR) are the corresponding indicators. The RVER relates the domestic value added which is induced by regional exports of the home country to the GDP. Similarly, the RVIR measure compares the regional value added which is induced by regional imports of the home country with the GDP.[4] These indicators of openness clearly incorporate a closer link to their theoretical foundation than those of the GEO model. For example, the RVER cannot exceed 100 percent. This is a clear theoretical achievement of our measure since it is not possible for the home country to use more than all of its production factors to produce goods and services for its regional trading partners in export sectors and their supplying sectors.

2.1 Representation of economic interconnections

Within the value-added based economic openness model, we model economic interdependencies by means of an input-output table which represents them in value terms. This input-output table illustrates that the output of economic sectors are the delivery of intermediate products to domestic sectors as well as to foreign sectors and the supply of goods and services to domestic and foreign final demand. The foreign sectors and the components of foreign final demand are located in economies within a region or outside of the considered region. In addition, economic sectors need input to produce their output. Hence, the VEO model presents the obtainment of intermediates of these sectors from economic sectors at home and abroad. The imported intermediate inputs are split up with respect to the location of the trading partners – within an integration area or as part of the rest of the world. Besides these domestic and imported intermediate products, sectors also require domestic production factors for their production of output.[5]

However, it is important to look at the assumptions which are made for modeling the connections between production output and its input. In general, it is supposed that every sector produces a homogenous product by using a homogenous technology. Hence, there is no necessity to distinguish between products and economic sectors. Furthermore, a proportional relation between total production of a sector and its essential intermediate products is assumed. Returns to scale are presumed to be constant in the production. That is, production coefficients

[4] In the VEO model, the regional imports consist of direct imports of the home country from the integration area and indirect imports of the home country from the rest of the world which imports intermediates from the integration area. Different to this, the GEO model takes only the first part into account.

[5] The depicted economic linkages illustrate that the value-added based economic openness model does not only model an economy but also its intra-regional and extra-regional trading partners. In doing so, the representation of economic interdependencies expands the classical view of Leontief (1936).

are supposed to be independent from the factor input. The final demand is presumed to be exogenously given to allow the determination of the total production of economic sectors. Finally, it is presupposed that a given production of a sector is only achievable by a combination of factors of production. Consequently, possibilities of factor substitution do not exist at all. An efficient input of factors is only achievable if all sectors produce the amount of intermediates which are required for the total production of the economic sector.

We start our illustration of the input-output table of the value-added based economic openness model with a brief description of the output of sectors. The value of the gross output of sector i of region k (X_{ik}) is determined by the value of intermediate products of sector i of region k for all sectors j of region k (X_{ijkk}) and the value of goods and services of sector i of region k for all components e of final demand of region k which includes exports (Y_{iekk}) as

$$(1) \qquad X_{ik} = \sum_{j=1}^{4} X_{ijkk} + \sum_{e=1}^{3} Y_{iekk}, \quad i = 1,2,3,4, \quad k = 1,2,3.$$

Region k consists of home country (1), aggregated integration area (2), or aggregated rest of the world (3). The aggregated integration area represents all regional trading partners of the home country and the aggregated rest of the world includes those economies outside the region. Sector i and sector j symbolize agriculture (1), other primary production (2), manufacturing (3), or services (4). Demand e is that one in the home country (1), in the aggregated integration area (2), or in the aggregated rest of the world (3).

Furthermore, economic sectors are in need of some input to produce some output. The value of the gross output of sector j of region k (X_{jk}) contains the value of delivered domestic intermediate products (X_{ijkk}), the value of imported intermediate products of all sectors i of region l for sector j of region k (X_{ijlk}), and the value of domestic factors of production of all factors g of sector j of region k (W_{gjk}) as

$$(2) \qquad X_{jk} = \sum_{i=1}^{4} X_{ijkk} + \sum_{i=1}^{4} \sum_{l \neq k} X_{ijlk} + \sum_{g=1}^{5} W_{gjk}, \quad j = 1,2,3,4, \quad k = 1,2,3$$

where region l represents home country (1), aggregated integration area (2), or aggregated rest of the world (3). Factor of production g is unskilled labor (1), skilled labor (2), capital (3), land (4), or natural resources (5). Therefore, the value of gross output in equation (1) equals that one in equation (2) because output of production is of the same value as its input

$$(3) \qquad X_{ik} = X_{jk}, \quad i, j = 1,2,3,4, \quad k = 1,2,3.$$

This relation leads to an additional presentation of the link between the gross output and the demand as given in (1). The direct production coefficient of region k (a_{ijk}) gets introduced as

$$(4) \qquad a_{ijk} = \frac{X_{ijkk}}{X_{jk}}, \quad i, j = 1,2,3,4, \quad k = 1,2,3$$

that indicates the value of required intermediate products of sector i of region k for sector j of region k to produce one unit output of sector j of region k. With equation (4) the equation (1) can be transformed into

$$(5) \qquad X_{ik} = \sum_{j=1}^{4} a_{ijk} X_{jk} + \sum_{e=1}^{3} Y_{iekk}, \quad i = 1,2,3,4, \quad k = 1,2,3.$$

Finally, the gross domestic product of region k (Y_k) coincides with the value of domestic primary inputs of region k (W_{gjk}) as

$$(6) \qquad Y_k = \sum_{g=1}^{5} \sum_{j=1}^{4} W_{gjk}, \quad k = 1,2,3.$$

Equations (1) to (6) represent the economic linkages within an economy, within its aggregated trading partners inside and outside an integration area, and between them.

2.2 Modeling the income created by regional trade

Assume that the export sectors of the home country sell goods and services to member countries of an integration area.[6] These exports generate income which equals the value of the exports – the *export-induced value added*. According to equations (2) and (5), intermediate inputs from domestic economic sectors, imported intermediates from sectors inside and outside the integration area, and production factors of the home country are necessary for the production of these exports. Hence, exports do not only create income in the home country but also abroad via imported intermediate inputs. Production structures of export sectors and their supplying sectors reflect the international competitive position of these sectors and, hence, the degree of participation of the economy in the international division of labor. The *export-induced domestic value added* represents the value of required factors of production in the home country whereas the *export-induced international value added* characterizes its demand

[6] This view can be analogously applied to the aggregated integration area and aggregated rest of the world.

of imported intermediate products from the aggregated countries within the integration area or from the aggregated rest of the world.

In order to give a satisfying answer to the question how much income is created at home by exports of the producer country we start with a presentation of the gross output of equation (5) in a compact way.[7] Hence, the vector of values of gross output of region k (x_k) is

$$(7) \qquad x_k = \left(X_{1k}, X_{2k}, X_{3k}, X_{4k}\right)^T, \quad k = 1,2,3.$$

Then, the vector of values of final demand of region k (y_k) is defined as

$$(8) \qquad y_k = \left(\sum_{e=1}^{3} Y_{1ekk}, \sum_{e=1}^{3} Y_{2ekk}, \sum_{e=1}^{3} Y_{3ekk}, \sum_{e=1}^{3} Y_{4ekk}\right)^T, \quad k = 1,2,3.$$

It is followed by the matrix of direct production coefficients of region k (A_k)

$$(9) \qquad A_k = \left(a_{ijk}\right) = \begin{pmatrix} a_{11k} & a_{12k} & a_{13k} & a_{14k} \\ a_{21k} & a_{22k} & a_{23k} & a_{24k} \\ a_{31k} & a_{32k} & a_{33k} & a_{34k} \\ a_{41k} & a_{42k} & a_{43k} & a_{44k} \end{pmatrix}, \quad k = 1,2,3.$$

Now, the gross output of equation (5) can be rewritten as

$$(10) \qquad x_k = A_k x_k + y_k, \quad k = 1,2,3.$$

The next intermediate step links the demanded exports with the required gross output of region k (x_k). It begins with the vector of export values of region k (y_k) which is defined as

$$(11) \qquad y_k = \left(Y_{1lkk}, Y_{2lkk}, Y_{3lkk}, Y_{4lkk}\right)^T, \quad k = 1,2,3, \quad l \notin k.$$ [8]

The identity matrix (B) is

$$(12) \qquad B = \left(b_{rs}\right) = \begin{pmatrix} 1 & 0 & 0 & 0 \\ 0 & 1 & 0 & 0 \\ 0 & 0 & 1 & 0 \\ 0 & 0 & 0 & 1 \end{pmatrix}, \quad b_{rs} = \begin{cases} 1 \text{ for } r = s \\ 0 \text{ for } r \neq s \end{cases}$$

which allows to rearrange equation (10) to

$$(13) \qquad \left(B - A_k\right) x_k = y_k, \quad k = 1,2,3.$$

---

[7] This is named the export-induced domestic value added of region k.

[8] Depending on the focus of the analysis, either economies in one of the regions or all foreign countries which demand exports are taken into account.

As a result, the gross output of region k (x_k) which is required to supply the exports of region k (y_k) is

$$(14) \qquad x_k = \left(B - A_k\right)^{-1} y_k, \quad k = 1,2,3.$$

The term $(B–A_k)^{-1}$ represents the Leontief inverse matrix of region k. Its coefficients indicate the expenditure of sector i of region k for the production of one unit final demand of sector j of region k. Then, the last step connects the gross output of region k (x_k) with the income of factors of production in region k. The production coefficient of production factors (d_{gjk}) is introduced as

$$(15) \qquad d_{gjk} = \frac{W_{gjk}}{X_{jk}}, \quad g = 1,2,\ldots,5, \quad j = 1,2,3,4, \quad k = 1,2,3$$

which indicates the value of factor of production g of region k necessary for the production of one unit output of sector j of region k. Hence, the matrix of production coefficients of production factors of region k (D_k) is

$$(16) \qquad D_k = \left(d_{gjk}\right) = \begin{pmatrix} d_{11k} & d_{12k} & d_{13k} & d_{14k} \\ d_{21k} & d_{22k} & d_{23k} & d_{24k} \\ d_{31k} & d_{32k} & d_{33k} & d_{34k} \\ d_{41k} & d_{42k} & d_{43k} & d_{44k} \\ d_{51k} & d_{52k} & d_{53k} & d_{54k} \end{pmatrix}, \quad k = 1,2,3.$$

This leads us to the vector of values of production factors of region k (q_k). It is defined as

$$(17) \qquad q_k = \left(Q_{1k}, Q_{2k}, Q_{3k}, Q_{4k}, Q_{5k}\right)^{T}, \quad k = 1,2,3.$$

The vector represents the values of factors of production of region k (q_k) for the gross output of region k (x_k) required to supply the demanded export products of region k (y_k)

$$(18) \qquad q_k = D_k x_k, \quad k = 1,2,3,$$

where q_k characterizes the *export-induced domestic value added* of region k.

In the following, the value of imported intermediates which the producer country creates with its exports is of main interest.[9] Our efforts to link the gross output of region k (x_k) with the

[9] This is the value added which exports of the producer country k generate abroad in region l. It is represented by the export-induced international value added of region k in region l.

value of imported intermediates from region *l* starts with the production coefficient of imported intermediate products (c_{ijlk})

$$(19) \qquad c_{ijlk} = \frac{X_{ijlk}}{X_{jk}}, \quad i, j = 1,2,3,4, \quad k = 1,2,3, \quad l \neq k.$$

Here, c_{ijlk} represents the value of intermediate products of sector *i* of region *k* which is required to be imported from region *l* for the production of one unit output of sector *j* of region *k*. The matrix of production coefficients of imported intermediate products of region *k* from region *l* (C_{lk}) is

$$(20) \qquad C_{lk} = \left(c_{ijlk}\right) = \begin{pmatrix} c_{11lk} & c_{12lk} & c_{13lk} & c_{14lk} \\ c_{21lk} & c_{22lk} & c_{23lk} & c_{24lk} \\ c_{31lk} & c_{32lk} & c_{33lk} & c_{34lk} \\ c_{41lk} & c_{42lk} & c_{43lk} & c_{44lk} \end{pmatrix}, \quad k = 1,2,3, \quad l \neq k.$$

This leads to the vector of values of imported intermediate products of region *k* from region *l* (p_{lk}), where

$$(21) \qquad p_{lk} = \left(P_{1lk}, P_{2lk}, P_{3lk}, P_{4lk}\right)^{T}, \quad k = 1,2,3, \quad l \neq k$$

stands for the values of the required imported intermediates of region *k* from region *l* (p_{lk}) for the gross output of region *k* (x_k) to produce the export products of region *k* (y_k)

$$(22) \qquad p_{lk} = C_{lk} x_k, \quad k = 1,2,3, \quad l \neq k.$$

p_{lk} symbolizes the *export-induced international value added* of region *k* in region *l*.

2.3 Construction of indicators of openness

The input-output table and the input-output analysis of the previous sections offer the necessary instruments to develop the indicators of economic openness RVER and RVIR of the value-added based economic openness model. The *regional value-added based export ratio* measure defines the importance of the trading partners within an integration area of a country as the export-induced domestic value added of exports to the integration area (q_1) as share of the gross domestic product (Y_1) in percent as

$$(23) \qquad \begin{aligned} & y_1 = \left(Y_{1211}, Y_{2211}, Y_{3211}, Y_{4211}\right)^{T}, \quad x_1 = \left(B - A_1\right)^{-1} y_1, \quad q_1 = D_1 x_1, \\ & \mathrm{RVER} = \frac{q_1}{Y_1} 100. \end{aligned}$$

In addition, the degree of openness can be calculated by focusing on the import side of a country. In this case, the indicator *regional value-added based import ratio* puts the export-induced regional value added (q_2 and p_{23}) in relation to the GDP (Y_1) in percent as

$$
\begin{aligned}
& y_2 = \left(Y_{1122}, Y_{2122}, Y_{3122}, Y_{4122}\right)^T, \quad x_2 = \left(B - A_2\right)^{-1} y_2, \quad q_2 = D_2 x_2, \\
& y_3 = \left(Y_{1133}, Y_{2133}, Y_{3133}, Y_{4133}\right)^T, \quad x_3 = \left(B - A_3\right)^{-1} y_3, \quad p_{23} = C_{23} x_3, \\
& \mathrm{RVIR} = \frac{q_2}{Y_1} 100 + \frac{p_{23}}{Y_1} 100.
\end{aligned} \tag{24}
$$

The *export-induced regional value added* consists of the income created in the integration area by international trade with the home country. The variable q_2 represents the export-induced domestic value added of the region aggregated integration area of exports to the region home country and p_{23} symbolizes the export-induced international value added of the region aggregated rest of the world in the region aggregated integration area.

3. Realized integration of trade of the CEECs with the European Union

The comparison of the alternative economic openness models in the previous sections has revealed the marked differences in the theoretical underpinnings of their measures of economic openness. The comparative analysis enacted in this section takes a closer look on the significance of the variations of calculated degrees of openness. Even without further analysis, it appears to be quite reasonable to suppose that their importance rises in line with the intensity of participation in the regional division of labor of an economy because a country does not only need domestic factors of production but also demands intermediate products from abroad which are taken into account and excluded in our measures of the VEO model.

3.1 Degrees of openness of member countries of selected integration areas

As a starting point of the empirical analysis we calculate and present the empirical realizations of the degrees of openness of 31 countries according to the different discussed indicators of openness. This includes beside the Central and Eastern European countries also Cyprus and Malta as the new member countries of the European Union which joined the prevailing 15 members of the EU in May 1, 2004. Furthermore, the countries of NAFTA and MERCOSUR are under investigation to increase the sample. We do not include Paraguay in this cross-sectional sample simply because data were not available. The GTAP Data Base Version 5.4 is the source of data (Center for Global Trade Analysis 2003, described in Dimaranan and

McDougall 2002).[10] The latest year for which a complete data set is available is 1997. Table 1 displays the outcomes for the measures of openness of the value-added based economic openness (VEO) model as well as the gross economic openness (GEO) model at the export and import side of the economies. A degree of openness of zero percent of the gross domestic product indicates a closed economy which finds itself in a status of complete autarky. The higher the empirical value is, the more significant are the other member countries of an integration area with respect to their trade relationships for the country under consideration.

[10] Before this data basis was applied to calculate economic integration measures it was transformed to fit the economic openness models introduced in the previous section 2.

Table 1: Realizations of degrees of openness based on the VEO and GEO model, 1997

Percent of GDP, 1997	Export side		Import side	
	RVER	RER	RVIR	RIR
EU				
Austria	17.1	24.4	26.4	29.6
Belgium	25.7	50.1	43.9	49.1
Cyprus	9.5	13.0	22.4	24.7
Czech Republic	24.2	40.1	41.2	46.4
Denmark	17.0	23.0	19.2	21.4
Estonia	32.2	62.3	74.2	82.7
Finland	17.0	23.3	17.7	19.5
France	12.5	15.2	12.6	14.4
Germany	12.7	15.8	12.8	14.9
Greece	7.1	8.3	14.9	16.5
Hungary	22.5	39.2	39.0	43.8
Ireland	30.0	51.0	38.3	42.1
Italy	10.7	14.0	12.0	13.5
Latvia	24.3	45.2	60.1	66.5
Lithuania	17.7	33.4	42.5	47.1
Luxembourg	27.0	52.5	50.3	55.8
Malta	27.4	46.2	73.6	82.0
Netherlands	27.1	43.9	28.6	31.7
Poland	12.3	17.4	24.4	27.4
Portugal	16.4	22.1	26.9	30.2
Slovak Republic	28.9	49.2	47.3	53.1
Slovenia	23.7	39.1	43.2	48.7
Spain	12.9	16.9	15.6	17.6
Sweden	16.8	23.6	20.7	23.2
United Kingdom	11.0	13.7	12.8	14.2
NAFTA				
Canada	19.2	27.1	20.0	22.5
Mexico	17.7	23.2	16.3	18.2
United States	2.2	2.6	2.4	3.3
MERCOSUR				
Argentina	2.4	2.7	2.0	2.2
Brazil	0.8	0.9	1.1	1.2
Paraguay	n.a.	n.a.	n.a.	n.a.
Uruguay	5.7	7.1	8.3	9.0

Source: Center for Global Trade Analysis (2003) and own calculations.

Table 1 reveals that all empirical realizations of the degree of openness indicate a lower importance of the regional trading partners of the countries if they are calculated by value-added based measures of economic openness instead of indicators of the established GEO model. Both economic openness models describe the same economic situation a country faces but the VEO model clearly reveals that exports create less income in the producer country than suggested by the standard GEO model. Export sectors and their supplying sectors demand imported intermediates to produce exports which increase the wealth abroad and not at home.

For example, trade activities of Poland, as a representative of the CEECs, with its 24 neighbors within the European Union are summarized by the degree of openness of the country. Table 1 demonstrates that the results of the alternative measures of openness range between 12.3 and 27.4 percent of the gross domestic product in the year 1997. For Poland, both economic openness models reveal a relatively low level of regional trade openness. The country exports 17.4 percent of all goods and services for the final demand to the European Union (RER). According to the RVER measure, these exports lead to domestic income which amounts to 12.3 percent of the total earnings in Poland. Within the same year, the expense for imports from the region represents a share of 27.4 percent of the national income (RIR). Only 24.4 percent of the income which the domestic factors of production receive is transferred to the other members of the EU since imports include exported intermediates which create income in Poland (RVIR).

The relative positions of the economies according to their degrees of openness could give an additional view on the sample. Hence, Table 2 records the rank order of the four indicators of the study for the year 1997. These rank orders begin with one for the country with the lowest degree of openness, continue with two, three, …, and end up with the total number of countries for the most integrated economy.

Table 2: Rank orders of economies by openness based on the VEO and GEO model

Rank order, 1997	Export side		Rank order, 1997	Import side	
	RVER	RER		RVIR	RIR
Brazil	1	1	Brazil	1	1
United States	2	2	Argentina	2	2
Argentina	3	3	United States	3	3
Uruguay	4	4	Uruguay	4	4
Greece	5	5	Italy	5	5
Cyprus	6	6	United Kingdom	7	6
United Kingdom	8	7	France	6	7
Italy	7	8	Germany	8	8
France	10	9	Greece	9	9
Germany	11	10	Spain	10	10
Spain	12	11	Mexico	11	11
Poland	9	12	Finland	12	12
Portugal	13	13	Denmark	13	13
Denmark	16	14	Canada	14	14
Mexico	19	15	Sweden	15	15
Finland	15	16	Cyprus	16	16
Sweden	14	17	Poland	17	17
Austria	17	18	Austria	18	18
Canada	20	19	Portugal	19	19
Lithuania	18	20	Netherlands	20	20
Slovenia	22	21	Ireland	21	21
Hungary	21	22	Hungary	22	22
Czech Republic	23	23	Czech Republic	23	23
Netherlands	27	24	Lithuania	24	24
Latvia	24	25	Slovenia	25	25
Malta	28	26	Belgium	26	26
Slovak Republic	29	27	Slovak Republic	27	27
Belgium	25	28	Luxembourg	28	28
Ireland	30	29	Latvia	29	29
Luxembourg	26	30	Malta	30	30
Estonia	31	31	Estonia	31	31
Paraguay	n.a.	n.a.	Paraguay	n.a.	n.a.

Source: Center for Global Trade Analysis (2003) and own calculations.

At the export side 71.0 percent of the countries change their positions in response to a shift of the applied measure for calculating the degree of openness and in two out of 31 cases (6.5 percent) this happens at the import side. Changes take place by up to four rank positions which means, for instance, for Mexico (Luxembourg) that the openness of the economy increased (decreased) relative to the other countries under investigation. With respect to the rank order, the value added-based economic openness model leads for the export (import) side to considerably different (similar) outcomes than the gross economic openness model.

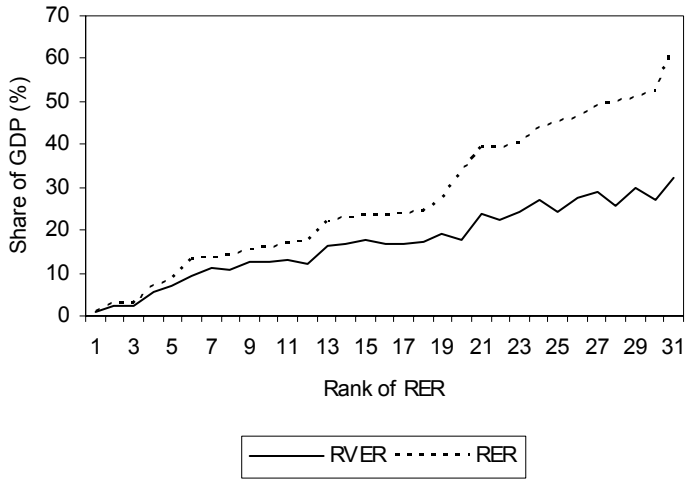
The relative importance of domestic factors of production in relation to imported intermediate products at the export side changes in most cases since the export sectors and their supplying sectors need different combinations of production input to create one unit of output. Coming

back to our previous example Poland, the country creates less income at home with its exports in relation to the other countries under investigation as the GEO model would suggest (rank changes from 12 to 9). At the import side nearly no changes occur due to a shift of the applied measure of openness since imports of a country include a very low fraction of intermediate products exported by the same country. Table 2 indicates that Poland can be regarded as a relatively closed economy – characterized by a rank 9 (RVER) and 12 (RER) at the export side and by the 17th position at the import side of the country (RVIR and RIR).

3.2 Systematic differences between the GEO and VEO model

In the following, we search for systematic disparities between the empirical outcomes if different economic openness models are applied. Moreover, we assess whether these differences might be of relevance for the cost-benefit analysis of monetary integration. As a starting point, we visualize the empirical results gained in the preceding section. Figure 1 gives a brief eye-ball impression of the empirical realizations of the degrees of openness of Table 1, dependent on the method used. The horizontal axis arranges the economies of the sample in an increasing order by their position within the rank order of the RER measure. The vertical axis displays the empirical outcomes of the regional value-added based export ratio and the regional export ratio, respectively.

Figure 1: Degrees of openness at the export side



Source: Center for Global Trade Analysis (2003) and own calculations.

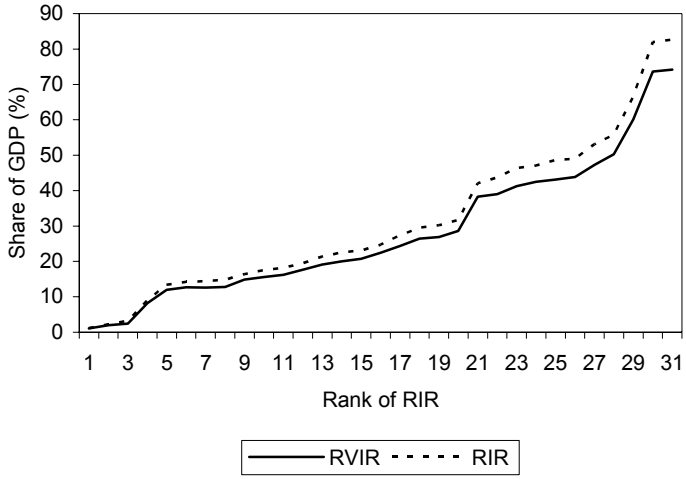
Figure 1 illustrates that, first, the RVER is in all cases lower than the RER. Hence, the VEO model as a rule leads to lower measured degrees of openness as compared to the often applied and still popular GEO model. Let us now again draw attention to the fact that the RVER indi-

cator introduced in this paper cannot exceed 100 percent. Following this concept, it is simply not possible to use all factors of production of an economy to manufacture exclusively export products since input factors earn income for the production of tradeables and non-tradeables. However, in the case of the gross economic openness model, the corresponding RER measure cannot be excluded to be larger than 100 percent. For example, a country can export more goods and services than it produces for final demand when it serves as an international hub for the exchange of goods between other economies. Second, Figure 1 clearly reveals the tendency of the RVER to increase with the RER. This means that the more products the economic sectors of an economy sell to their regional trading partners the more domestic production factors they and their previous supplying economic sectors need for production. The income of these input factors exactly corresponds to the export-induced domestic value added. Third, Figure 1 points out that the spread between the indicators RVER and RER increases with the rank order. This spread reflects the imported intermediate products which a country demands to produce exports as a share of the GDP. An increasing gap between the two measures reveals that a more open economy towards regional trade demands domestic factors of production at a relatively lower magnitude. The more companies sell products on international markets the more firms are confronted with the pressure to reduce costs and the more of them gain experiences through exporting final products which let them include more cost-efficient primary inputs from abroad than those from home.

Fourth, the curve of the regional value-added based export ratio is less steep than the regional export ratio and, thus, the economies reveal smaller differences with respect to their degree of openness when the value-added based economic openness model is applied. This implies that the importance of regional trade is more similar for the countries within an integration area than the GEO model suggests. Fifth, the jitter of the measure of economic openness RVER respectively the emergence of local maxima reflects that some positions of countries within the rank order change due to a shift in the indication of openness. The increasing importance of export-induced imported intermediates products disturbs the rank order.

Figure 2 completes the overview of the Table 1 by focusing on the values of the economic openness measures at the import side of the countries. The horizontal axis of the figure puts the economies in an increasing order of their regional import ratio (RIR) values. From its vertical axis the empirical realizations of the regional value-added based import ratio and the regional import ratio can be read off.

Figure 2: Degrees of openness at the import side



Source: Center for Global Trade Analysis (2003) and own calculations.

Figure 2 reveals that the results for the import side in principle correspond to those for the export side, but at a distinctively lower order. We now proceed to an econometric evaluation of the results via a brief regression analysis. For this purpose, we analyze the indicators of the gross economic openness (GEO) model and the value-added based economic openness (VEO) model with a frequency distribution analysis in Table 3. The standard statistical measures also include the Jarque-Bera test of a normality distribution (Jarque and Bera 1987). As usual, a small probability value leads to a rejection of the null hypothesis that the underlying distribution of the observations is a normal distribution. However, all probability values are far above 0.10 or less. Seen on the whole, thus, Table 3 confirms the previous outcomes.

Table 3: Results of the frequency distribution analysis

Sample 1 31 Observations 31	Export side		Import side	
	RVER	RER	RVIR	RIR
Mean	17.15	27.31	28.09	31.37
Median	16.97	23.31	22.44	24.71
Maximum	32.16	62.35	74.24	82.73
Minimum	0.84	0.94	1.08	1.19
Range	31.32	61.41	73.16	81.54
Standard deviation	8.64	17.02	19.51	21.69
Variation coefficient	0.50	0.62	0.69	0.69
Skewness	-0.15	0.28	0.79	0.79
Kurtosis	2.12	1.97	2.94	2.94
Jarque-Bera	1.10	1.77	3.20	3.19
Probability	0.5759	0.4122	0.2017	0.2029

Source: Center for Global Trade Analysis (2003) and own calculations.

The results of the correlation analysis, as presented in Table 4, validate the first impression gained with respect to Table 2, where rank orders of economies by economic openness are

based on the VEO and GEO model. It characterizes the different rank orders of economies which denote the relative position of the cross-section with respect to the realized degree of openness according to the measures RVER and RER as well as to the RVIR and the RIR indicator. The analysis incorporates the rank order correlation measures developed by Spearman (ρ_R) and Kendall (τ), respectively (Kendall and Dickinson Gibbons 1990).

Table 4: Results of the correlation analysis

Sample 1 31 Observations 31	RER	RIR
RVER	0.980645 (ρ_R)	/
	0.913978 (τ)	/
RVIR	/	0.999597 (ρ_R)
	/	0.995699 (τ)

Source: Center for Global Trade Analysis (2003) and own calculations.

The empirical realizations of ρ_R and τ demonstrate that the positions of economies within the rank order do scarcely change when the VEO model is applied instead of the GEO model to calculate the degrees of openness of the countries under investigation. Exports include a larger share of imported intermediates the more an economy trades with other countries since, for example, experiences in exploiting cost-efficient input sources abroad increase. Positions at the import side do alter even less than those at the export side since the share of exported intermediates in imports is of very low significance.

What additional insights between the relationship of regional trade and induced income can a regression analysis offer (Greene 2002)? It would appear that the following specifications of the regression equations are useful in our context:

(25) $\log \mathrm{RVER}_t = \hat{c}_1 + \hat{c}_2 \log \mathrm{RER}_t + \hat{u}_t, \quad t = 1,2,\ldots,31$ and

(26) $\log \mathrm{RVIR}_t = \hat{c}_1 + \hat{c}_2 \log \mathrm{RIR}_t + \hat{u}_t, \quad t = 1,2,\ldots,31,$

where the index t represents the economy with the number t in the sample. The estimator $\hat{c}_2$ in equation (25) measures the induced percentage change of RVER_t when RER_t increases by one percent. Equation (26) has to be interpreted in an analogous fashion. We apply the ordinary least squares (OLS) method after making sure that the usual assumptions of functionality, of no autocorrelation, normality and homoscedasticity of the residuals are valid for the chosen specifications. Table 5 displays the final estimation results.

Table 5: Results of the regression analysis

Sample 1 31 Observations 31	RER	RIR
RVER	0. 85***	/
RVIR	/	1.01***

Source: Center for Global Trade Analysis (2003) and own calculations.
Note: *** 1 percent significance level

The upper left-hand value of the table supports the result of Figure 1 that the importance of domestic production factors in relation to imported intermediate products to produce goods and services for exports declines with the level of an economy's participation within the international division of labor. An increase of exports in relation to all products for final demand (RER) of 1.0 percent increases according to the gross economic openness model the wealth at home for the same amount. But the elasticity of domestic income of these exports is smaller than 1.0 percent. The exports lead to an increase of only 0.85 percent of income which domestic production factors earn (RVER). The value added of exports at home is lower because a part of the induced wealth is transferred abroad through the payment of imported intermediate products. As a consequence, the value-added based economic openness model is able to quantify the importance of the different sources of production inputs by taking production linkages in the exporting sectors and their supplying sectors into account.

For the import side, the regression analysis estimates an increase of the RVIR of 1.0 percent when the RIR raises 1.0 percent (see the lower right-hand figure of the Table 5). This outcome clearly goes in line with that one of Figure 2, namely that the share of exported intermediates which are manufactured in the imports is at a similar low level for the countries and hence independent of the degree of openness. Table 5a and Table 5b reproduce Table 5 in detail to present all relevant estimation results.

Table 5a: Regression of value-added based economic openness at the export side

Dependent Variable	LOG(RVER)	Sample		1 31
Method	Least Squares	Included observations		31
Variable	**Coefficient**	**Std. Error**	**t-Statistic**	**Prob.**
C	0.076624	0.057073	1.342553	0.1898
LOG(RER)	0.848715	0.018132	46.80827	0.0000
R-squared	0.986937	Mean dependent var		2.620315
Adjusted R-squared	0.986487	S.D. dependent var		0.835381
S.E. of regression	0.097111	Akaike info criterion		-1.763587
Sum squared resid	0.273485	Schwarz criterion		-1.671072
Log likelihood	29.33560	F-statistic		2191.014
Durbin-Watson stat	1.450754	Prob(F-statistic)		0.000000

Source: Center for Global Trade Analysis (2003) and own calculations.

Table 5b: Regression of value-added based economic openness at the import side

Dependent Variable	LOG(RVIR)	Sample		1 31
Method	Least Squares	Included observations		31
Variable	**Coefficient**	**Std. Error**	**t-Statistic**	**Prob.**
C	-0.149462	0.020301	-7.362368	0.0000
LOG(RIR)	1.010703	0.006220	162.5020	0.0000
R-squared	0.998903	Mean dependent var		3.000546
Adjusted R-squared	0.998865	S.D. dependent var		0.996731
S.E. of regression	0.033577	Akaike info criterion		-3.887611
Sum squared resid	0.032695	Schwarz criterion		-3.795095
Log likelihood	62.25797	F-statistic		26406.89
Durbin-Watson stat	2.152136	Prob(F-statistic)		0.000000

Source: Center for Global Trade Analysis (2003) and own calculations.

4. Prospective openness of trade of the CEECs after May 1, 2004

A realistic potential year for the Central and Eastern European countries that joined the European Union and the Economic and Monetary Union in May 1, 2004 where the introduction of the euro in these new members of the EU might be on the agenda is 2008. This section gives a scenario of the economic development of the CEECs and their effect on the economic openness of them.

4.1 The Global Trade Analysis Project model

Applied general equilibrium (AGE) models assume an economic equilibrium that gets distorted by an external shock. Then, they estimate economic effects necessary to come back into a situation of system-wide balance. The Global Trade Analysis Project (GTAP) model is chosen for this study (see Brockmeier 2001, Itakura and Hertel 2000, Hertel 1997, Hertel and

Tsigas 1997) since it is in the economic research a well established simulation system. The GTAP model is a multi-regional multi-sector AGE model. AGE models are members of the class of computable general equilibrium (CGE) models. It is an applied model and not a theoretical one because its focus is on economic policy relevance and not insights about economic key mechanisms. Furthermore, it is a general equilibrium model and not a partial equilibrium model because resources shift among alternative uses, feedback effects among income and expenditure exist, and the GTAP model offers a sound theoretical structure. The model is also a multi-regional and not single-regional one because patterns of specialization and trade among regions exist and international trading partners are not exogenous. In addition, this model consists of accounting equations and relies on value flows. Value flows correspond to real flows crossing markets in the opposite direction. In doing so, the GTAP model describes the economies of the world. It divides the world in several countries and regions, respectively. Hence, every economy is modeled in the same way. The model links all economies by trade flows and thus it is a global model.

How does the GTAP model describe economic relationships within an economy as well as between economies? Inside a country the income of regional households is linked with the spending of private households, government expenditure, and savings. Producers are connected with income and expenditure. Taxes and subsidies are related to the agents. Furthermore, a region is linked with the rest of the world by exports and imports. A global banking sector ties global savings to investments. The linkage of the agents and the world is done through markets where supply equals demand. The underlying equation system of the GTAP model includes two different kinds of equations. Equilibrium relationships ensure that receipts and expenditures of agents are balanced and behavioral relationships specify the agents' behavior of optimization.

The GTAP Data Base and the GTAP behavioral parameters along with the theory of the GTAP model determine simulation results (Dimaranan and McDougall 2002, Gehlhar et al. 1997, pp. 74 ff., Huff et al. 1997, pp. 124 ff.). Version 5.4 of the GTAP Data Base consists of 78 regional economic data bases being linked among each other by bilateral trade, transport, and protection matrices (Center for Global Analysis 2003). The data are value flows being measured in US dollars and effective rates of protection. Regional data bases describe the intersectoral linkages of 57 sectors within each region and these databases are derived from

individual national input-output tables.[11] Endowment commodities of each sector include un-skilled labor, skilled labor, capital, land, and natural resources. Behavioral parameters consist of the agents' elasticity specifications for each region. These are substitution elasticities in consumption and production, demand elasticities of consumers, transformation elasticities which determine the degree of mobility of primary production factors across sectors, and allocation flexibilities of regional investment. An empirical analysis with the GTAP model enhances a theoretical one because it allows estimating the significance of the induced economic consequences. Thus, the empirical investigation offers additional implications for economic policy.

4.2 Simulation design

To simulate the economic effects of an ongoing economic integration of the Central and Eastern European economies with the old member countries of the European Union regions, economic sectors, and production factors are aggregated according to the problem. Table 6 illustrates the aggregations for the model experiment.

Table 6: Aggregations of regions, sectors, and factors for the simulation

Regions	Economic sectors	Production factors
Czech Republic	Food	Capital
Estonia	Other primary production	Un-skilled Labor
Hungary	Manufacturing	Skilled Labor
Latvia	Services	Land
Lithuania		Natural Resources
Poland		
Slovak Republic		
Slovenia		
Rest of EU-25		
Rest of the World		

The table shows that the scenario consists of the eight CEECs that joined the EU in May 1, 2004 and the region "Rest of EU-25" which includes the remaining 17 members of the European Union at its stage of the last enlargement round. All other economies are represented by the region "Rest of the World". Hence, the economic integration between each Central and Eastern European country of interest and all residual countries of the European Union is focused at for the cost-benefit analysis of monetary integration. The economies outside the inte-

[11] Input-output tables link production output of economic sectors with the necessary input of intermediates and production factors.

gration area are taken into account since the economic linkages among the European Union and all other countries cannot be neglected. Because we do not disaggregate the degree of openness in this study, the aggregation of economic sectors and production factors is of minor interest and follows just the standard aggregation of the GTAP model.

The economic growth of the new members of the EU from Central and Eastern Europe represent the shock of the model. As a proxy for economic development the percentage change of their gross domestic product (GDP) is chosen. Alternatives measures of growth are the change of labor use, capital stock, or total factor productivity (TFP). Economic development demands for the production of output the input of resources from the country itself which are intermediate products and production factors as well as from abroad in form of intermediates. With the increase of output income increases and thus demand of domestic and imported goods and services. In addition, production for export rises. Therefore, economic development might have an impact on the economic openness of the CEECs which are still in their transforming process. GDP change is the measure of economic growth in this study since the problem of availability of data. Table 7 reproduces the estimation of the economic growth of the CEECs, the remaining members of the European Union, and the countries outside this integration area between 1998 and 2008. The period starts with 1998 because the base year of the GTAP 5.4 Data Base is 1997 and ends with 2008 as a possible year of the introduction of the euro in these countries.

Table 7: Estimation of economic growth between 1998 and 2008

GDP (percentage change of US$)	1998	1999	2000	2001	2002	2003e	2004e	2005e	2006e	2007e	2008e	'98-'08e
Czech Republic	7.5	-3.4	-6.5	10.4	22.4	8.8	8.8	8.8	8.8	8.8	8.8	117.8
Estonia	13.3	-0.7	-1.1	7.5	17.8	6.8	6.8	6.8	6.8	6.8	6.8	109.3
Hungary	2.9	2.1	-3.0	11.4	26.8	6.7	6.7	6.7	6.7	6.7	6.7	112.6
Latvia	7.9	9.5	7.4	5.5	11.3	5.7	5.7	5.7	5.7	5.7	5.7	108.5
Lithuania	12.1	-0.8	5.8	6.2	15.0	11.6	11.6	11.6	11.6	11.6	11.6	178.4
Poland	6.4	-2.2	1.7	11.8	7.2	8.8	8.8	8.8	8.8	8.8	8.8	110.1
Slovak Republic	4.4	-8.1	-2.3	3.6	15.8	7.1	7.1	7.1	7.1	7.1	7.1	69.9
Slovenia	7.6	2.5	-9.7	3.8	16.7	6.3	6.3	6.3	6.3	6.3	6.3	74.1
Rest of EU-25[e]	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	15.3
Rest of the World[e]	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	15.3

Source: World Bank (2004) and own calculations.
e: estimated

The change of gross domestic product of the Central and Eastern European countries is based on the latest available data which is for the year 2002 (World Bank 2004). The years until the proposed full membership in the Economic and Monetary Union (EMU) of the CEECs in

2008 is estimated on the average growth rate between 1990 and 1995 of the economies which depends on different data availability of the countries. In case of the other members of the EU and those economies outside of it a rough estimation of 1.3 percentage change per year was made which was the case between 1970 and 1990 (McDougall and Tyres 1997, p. 198). The figures in the last column specify the shock of the production output for each country.

The specification of the closure to simulate the economic effects of the shocks is as follows: The split between model exogenous and endogenous variables is necessary to build a solvable equation system of the GTAP model. Exogenous variables are given and do not change by the interplay of the model equations as the endogenous variables. The following changes of variables are exogenous in the specification: population, slack of saving, profit, income, endowment, capital goods, and trade, world price index of primary factors, augmenting technological change, output technological change, factor input technological change, input-neutral shift in utility function, private and government consumption distribution parameters, saving distribution parameter, tax, and output of produced commodities. The latter variable is exogenous because this is the place where the economic development of the countries comes into the model as shocks. Finally, the Johansen approach is used for solving the GTAP model.

4.3 Results and interpretation of the outcomes

The simulation outcomes of the scenario of economic development of the CEECs which became members of the EU in May 1, 2004 presented in the previous section are presented in Table 8. Beside the simulated degrees of openness of the countries with the measures of trade openness of the gross economic openness (GEO) model and the value-added based economic openness (VEO) model for the year 2008 at the right-hand side, the table also displays the corresponding realizations of the year 1997 from Table 1 at the left-hand side.

Table 8: Results of the simulation

Percent of gross domestic product	Pre-simulation (1997)				Post-simulation (2008)			
	Export side		Import side		Export side		Import side	
	RVER	RER	RVIR	RIR	RVER	RER	RVIR	RIR
Czech Republic	24.2	40.1	41.2	46.4	24.1	40.6	42.7	48.4
Estonia	32.2	62.3	74.2	82.7	32.5	65.7	82.1	92.4
Hungary	22.5	39.2	39.0	43.8	21.5	39.4	41.5	46.9
Latvia	24.3	45.2	60.1	66.5	24.1	46.6	65.7	73.4
Lithuania	17.7	33.4	42.5	47.1	16.8	34.6	45.9	51.3
Poland	12.3	17.4	24.4	27.4	11.4	16.3	25.1	28.4
Slovak Republic	28.9	49.2	47.3	53.1	31.0	54.6	51.8	58.7
Slovenia	23.7	39.1	43.2	48.7	23.7	39.5	44.4	50.5

Source: Center for Global Trade Analysis (2003) and own calculations.

Seeing on a whole, the most striking result of Table 8 is that a further integration of trade between the Central and Eastern European countries (CEECs) and the old members of the European Union takes place on a modest additional level in the scenario of 2008 in comparison to the base year 1997. The ongoing transformation process of the CEECs in combination with the continuing integration of in the intra-European working process, for example, in the field of offshore outsourcing, leads to an increase of the significance of imports (RIR and RVIR). The increased importance of exports in relation to all produced final goods and services (RER) is at a lower level as for the import side. Most CEE economies apply less domestic production factors to produce their exports (RVER) since their increasing role as part of the international division of labor in the value-added process of production.

Two groups among the CEECs with a different level of change of their economic openness can be built with the Table 8. Estonia, Hungary, Latvia, Lithuania, and the Slovak Republic increase their degree of openness to up to 11.7 percent between 1997 and 2008. On the other hand, the Czech Republic, Poland, and Slovenia lie behind the others with a rise of the degree of economic openness up to 4.4 percent. In case of Poland which shows the lowest degree of openness among the CEECs as it is the largest economy within this region the importance of exports (RER) decreases by -6.5 percent. The domestic market increases its dominant role for the Polish economy. Table 9 summarizes the changes of the post-simulation degrees of economic openness of the Central and Eastern European economies in relation to the pre-simulation realizations with standard statistical measures.

Table 9: Change of economic openness, post-simulation as percent of pre-simulation

Sample 1 8 Observations 8	Export side		Import side	
	RVER	RER	RVIR	RIR
Mean	-1.2	2.4	6.7	7.6
Maximum	7.5	10.9	10.7	11.7
Minimum	-7.6	-6.5	2.8	3.6
Standard deviation	4.3	4.6	3.0	3.1

Source: Center for Global Trade Analysis (2003) and own calculations.

In addition to Table 8, the table points out that economic openness calculated by the RVIR measure increases less than those realizations of the indicator RIR. The CEECs have to spend less income for imports since the share of exported intermediate products in imports increases.

5. Assessment of the introduction of the euro in the CEECs

In order to round off our analysis, the following section investigates the relevance of the findings for the cost-benefit analysis of monetary integration of the theory of optimum currency areas. This leads to the final interesting question whether differences between the degree of economic openness measured by the different presented models reveal a sufficient magnitude to have a distinct impact on the results of the traditional cost-benefit analysis of monetary integration for the Central and Eastern European countries under investigation.

5.1 The standard framework of analysis of monetary integration

Consider an economy which has to decide about participation in a monetary integration process, for example a single currency area. The economy might derive its choice from the theory of optimum currency areas by applying the regular framework of the cost-benefit analysis of monetary integration (see, for instance, Mundell 1961, Gros and Thygesen 1998, pp. 268 ff.). It has to assess the potential benefits and costs of pegging its currency to a fixed exchange rate area (Krugman and Obstfeld 2003, pp. 617 ff.). The outcome of these considerations strongly depends on the assessment of the degree of openness of the candidate country with the members of a monetary integration area. A high importance of the existing area for the country in question is associated with a high degree of openness of the economies.[12]

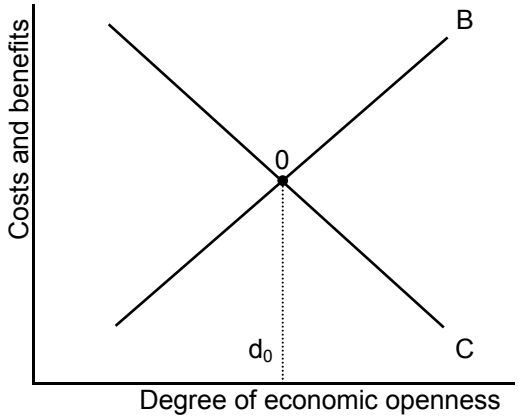
[12] Besides trade, the regional mobility of the factors of production labor and capital is also relevant for an assessment whether one region should integrate with another because it may serve as a shock-absorber.

The potential benefits for an economy of joining a single currency area are commonly perceived to materialize through noticeable gains in efficiency and credibility. The monetary efficiency gain occurs from pegging to a fixed exchange rate area instead of letting the exchange rate float because this tends to lower inflation differences and exchange rate volatility and, hence, transaction costs. The higher the degree of real openness of the economy in question with the existing integration area already is, the more the country in question will benefit from entering the single currency area. The potential costs for the economy from joining the currency area arise mainly through additional instability. Stabilization of output and, thus, also of employment becomes more difficult for the country once the exchange rate does not float anymore vis-à-vis the currency area – the country in question gives up exchange rate and monetary policy to stabilize its economy. Exchange rate policy cannot influence relative prices of domestic and foreign products and monetary policy is not able any more to effect domestic output to adjust to a product demand or supply shock. Hence, the costs to be born by the economy are the lower the higher the degree of economic openness is because, in this case, the economy and the member countries of the integration area are supposed to respond in a similar fashion to shocks.

In most discussions about the Economic and Monetary Union (EMU) it was assumed that the costs of fixing the exchange rate fall with the degree of openness. The same was valid with respect to the benefits because openness was considered to be a good proxy for the exposure to exchange rate risk. Although there have been some important qualifications of the above arguments which disputed the slope of the curves in terms of the sign and the linearity during this debate, one aspect stayed largely undisputed: the outstanding role of trade openness.[13] Figure 3 puts these considerations in a joint diagram which usually serves as a framework to decide whether an economy should peg its currency to a fixed exchange rate area (see, for example, Krugman and Obstfeld 2003, pp. 604 ff., which represents a useful summary of the work originally proposed by Krugman 1990 and De Grauwe 1994).

[13] This statement can be corroborated by referrals to a number of sources. A few examples are given in the following. A correct measurement of the degree of openness with respect to, for example, intra-industrial trade is also of importance in the endogenous approach of optimum currency areas popularized by Frankel and Rose (1998). Furthermore, McKinnon (1963) pushed the argument that the nominal exchange rate becomes a less powerful adjustment instrument if imports account for a large fraction of the gross domestic product since the general price level contains the price for imported goods.

Figure 3: Cost-benefit analysis of a monetary integration



The figure's horizontal axis measures the economic openness of an economy with other countries of a region. Benefits of the monetary efficiency and costs of the loss of economic stability for the country in question are measured by the vertical axis. The realizations of all indicators increase from zero in the origin of the diagram. Curve B displays the relation between the degree of openness of an economy and the benefits from joining the area. B has a positive slope because the benefits of the economy rise as the trade openness with that integration area increases. The curve C reflects the relation between the degree of openness and the costs. Costs decrease the more the country is integrated with the area which leads to a negative slope of C. Figure 3 illustrates that the break-even degree of openness is d_0. It is determined by the intersection of B and C in point 0. When the degree of economic openness equals d_0 the country is indifferent with respect to its decision. With a level higher (lower) than d_0 the country should (not) peg its domestic currency to a fixed exchange rate area. In this case, the potential benefits are (not) high enough to outperform the potential costs for the country in question of joining the integration area.

5.2 Impact of the GEO and VEO model on the cost-benefit analysis

As pointed out in previous section, the degree of economic openness is – independent from its theoretical underpinnings – of high relevance within the cost-benefit framework for answering the question whether an economy should join a fixed exchange rate area or not. A theoretical shift away from the gross economic openness model towards the value-added based economic openness model leads to a systematic difference of the empirical realization of the measured degree of economic openness. The candidate country and the member countries of an integration area appear to be less integrated but at a more similar level (see section 3.2). Table 10 reviews the deviations of the simulated degrees of openness presented in Table 8. It

characterizes the realizations of the applied new openness measures across all investigated Central and Eastern European countries by the mean, maximum, and minimum realizations as a share of the realizations of the old widespread measures as well as their standard deviation.

Table 10: Effects of the VEO model on the degree of economic openness

Sample 1 8 Observations 8	RVER as share of RER in percent	RVIR as share of RIR in percent
Mean	56.3	88.6
Maximum	69.9	89.4
Minimum	48.6	88.0
Standard deviation	6.5	0.5

Source: Center for Global Trade Analysis (2003) and own calculations.

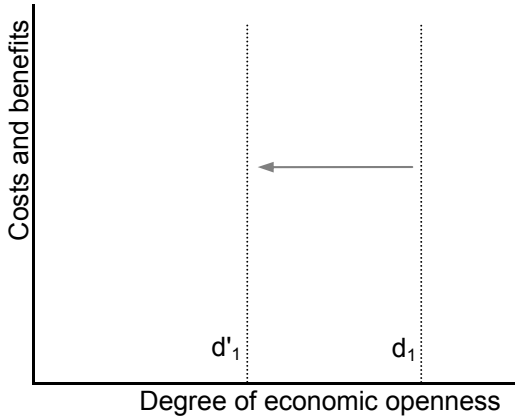
The VEO model calculates at the export (import) side of an economy a degree of economic openness that is up to 51.4 percent (12.0 percent) lower than the value calculated based on the GEO model. This considerable difference can at least theoretically have an impact on the results of the cost-benefit analysis of monetary integration.

According to the value-added based economic openness (VEO) model, the present members of a fixed exchange rate area and the possible participant are less economically integrated with each other than the popular standard gross economic openness (GEO) model suggests. Consequently, the assessment of the realized degree of openness of the country in question is lower as well. Since the measures of the VEO model indicate the significance of regional trading partners by focusing on income in the probable participant as well as the member countries which trade between them creates, the VEO model does not include trade with the rest of the world as the GEO model wrongly does. We argued that the by now well-established gross economic openness model is not able to distinguish whether intermediate products for regional trade are delivered from suppliers within the integration area or outside the region. The GEO model overestimates the regional economic integration because it includes these extra-regional intermediates when an assessment of the trade importance of an integration area for a single pre-in country is on the agenda. This also implies that the GEO model attaches a too high impact of the regional integration on economic variables of the economies within a region. In the following, we will discuss this aspect more deeply. We start this discussion with Figure 4.

Figure 4 illustrates the impact of a shift in the theoretical basis of the concrete degree of openness for an economy which decides to join a monetary integration area. In a very simplified stylized fashion, the diagram demonstrates the move of the currently measured degree of

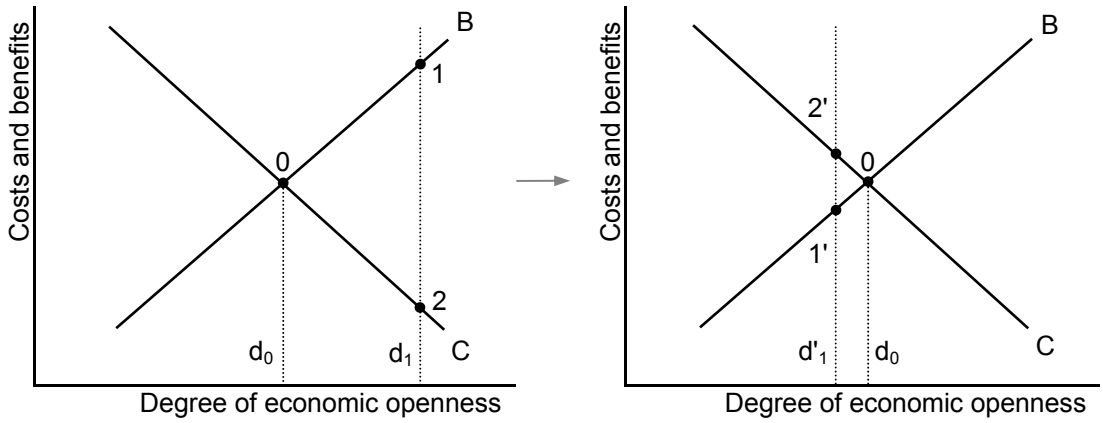
openness from d_1 to the lower level d'_1 when the value-added based economic openness model is applied instead of the gross economic openness model for measuring the significance of economies within a region for the possible participant.

Figure 4: Impact of the VEO model on the realized degree of openness



When the VEO model is applied instead of the gross economic openness model to measure the relevance of regional trade, a reassessment of a candidate's decision to join a fixed exchange rate area might be necessary. Figure 5 illustrates this straightforward outcome.

Figure 5: Impact of the VEO model on the judgment of joining an exchange rate area



(a) Measurement by GEO model (b) Measurement by VEO model

The diagram picks up the country's critical degree of openness d_0 of Figure 3. Figure 5a displays a scenario in which the actual degree of openness d_1 is derived from the gross economic openness model and is higher than its break-even degree of openness represented by d_0. Since the benefits of joining the fixed exchange rate area in point 1 outweigh the costs in point 2, the result of this cost-benefit analysis of monetary integration is a recommendation for the economy to peg its currency to the fixed exchange rate area. On the other hand, Figure 5b draws another conclusion for the same potential candidate which faces an unchanged economic environment. A change of the economic openness model towards the VEO model leads

to an opposite recommendation than before with the GEO model. In this scenario of Figure 5b, the realized degree of openness d'_1 is lower than the break-even degree of openness d_0. The benefits accruing from entering the currency area in point 1' are less than the costs in point 2'. Hence, the economy should not join the fixed exchange rate area. Seen on the whole, thus, outcomes of the cost-benefit analysis of monetary integration based on the value-added based economic openness model might deviate from those analysis results given on the basis of the gross economic openness model. This seems to be a quite important policy conclusion from our derivation of value-added based measures of openness.

Are the differences of the calculated degrees of economic openness between the economic openness models for the new members of the European Union significant enough to have a potential to influence the results of the cost-benefit analysis of monetary integration? Since this study emphasizes the realized degree of openness and not the break-even degree of openness it is difficult to give an answer to this question. The critical levels are necessary to assess the influence of the value-added based economic openness model on the results of the cost-benefit analysis for an economy. Only a sound assessment of the break-even degree of economic openness based on an exact identifications of the cost curve and the benefit curve is able to reveal whether in the concrete economic situation of a country benefits of joining the fixed exchange rate area surpass the costs.

Nevertheless, a closer look at the deviations of actual degree of economic openness should give some preliminary insights. When a country reveals a high actual degree of economic openness according to the GEO model, but a low one if the VEO model is applied, a revision of the recommendation for the economy to peg its currency to the fixed exchange rate area might be highly indicated. As a final overview, Table 11 presents the results of a comparative analysis of realized degrees of economic openness across the Central and Eastern European countries in the year 2008 and the European Union in the composition of the members before the latest enlargement round for the year 1997.

Table 11: Effects of the VEO model on the concrete degree of economic openness

Percent of gross domestic product	Export side			Import side		
	RVER	RER	RVER as share of RER	RVIR	RIR	RVIR as share of RIR
CEEC-8 (2008)						
Mean	23.1	42.1	56.3	49.9	56.3	88.6
Maximum	32.5	65.7	69.9	82.1	92.4	89.4
Minimum	11.4	16.3	48.6	25.1	28.4	88.0
Standard deviation	6.5	13.6	6.5	16.1	18.0	0.5
EU-15 (1997)						
Mean	16.40	25.13	70.97	22.29	25.56	86.98
Maximum	29.28	50.59	85.95	47.33	54.12	88.65
Minimum	6.66	7.75	51.22	11.31	12.99	84.21
Standard deviation	6.82	14.78	10.72	11.67	13.25	1.30

Source: Center for Global Trade Analysis (2003) and own calculations.

The table compares the measured degrees of economic openness calculated by the value-added based economic openness (VEO) model with the values of the gross economic openness (GEO) model for the different countries by standard statistical measures. The CEECs are significantly less open according to the VEO model in comparison to the GEO model on the export side and less strong at the import side. This would mean the net benefits of introducing the euro in these countries would be smaller than suggested by the GEO model. On the other hand, all new members of the European Union except Poland are stronger regionally integrated then the old members of the European Union. If the established members of the euro zone are assumed to show at least moderate net gains from introducing the euro then this could be a very rough hint for the new members that their benefits might outperform the costs. This would speak for a full membership in the Economic and Monetary Union with the year of 2008 when only focus is put on the degree of economic openness.

6. Conclusions

This paper develops a value-added measure for the degree of openness. Additionally, it argues that a change in the theoretical underpinnings of the degree of economic openness towards a more coherent definition potentially leads to a revision of the recommendation for a country to participate in a single currency area. Finally, it delivers empirical estimates of these new openness measures for more than thirty countries.

The standard cost-benefit OCA framework for a judgment whether a candidate country should join a fixed exchange rate area uses the degree of economic openness as an important determinant. If the realized degree of openness is higher than the break-even minimum degree of

openness then the country should move towards entering the fixed exchange rate area. The realized degree of economic openness increases with the intensity of trade among the countries within an integration area.

In general, the degree of economic openness of a specific country is calculated based on an economic openness model which indicates the significance of its trading partners. The most popular economic openness model in this respect is the standard gross economic openness (GEO) model. It puts for an economy the exports to (imports from) the member countries of an integration area in relation to all of its produced goods and services within the period of one year. This representation of the importance of regional trade linkages of the established gross economic openness model is at least questionable because of the poor linkage between the theoretical basis of its empirical economic openness measures. According to the gross economic openness model, a country that earns more income from exports than from the production of all final goods and services creates a negative income with non-tradeables.

The value-added based economic openness model developed in this contribution assures a more accurate and coherent calculation of the degree of openness. This approach does not take the total value of regional trade into account. One such indicator relates the domestic income which is generated by exports of the home country to the region to all products produced within a year. The other measure of openness highlights the share of income in the region which is created by imports of the home country from the region to all produced goods and services of the home country within one year. Imported intermediate products which are manufactured in exports, as well as exported intermediates which are part of imports are unfortunately separated since they do not create income in the producer country.

A change of the theoretical underpinnings of the degree of openness towards the new value-added based economic openness model shows that exports create less income in the producer country than the gross economic openness model suggests. Export sectors and their supplying sectors demand imported intermediates to produce exports which increase the wealth outside the country. Hence, we conclude that the gross economic openness model overestimates the realized degree of economic openness.

If the realized degree of openness becomes lower than even the minimum break-even degree of openness (which is totally possible in the wake of the shift from the gross economic openness model towards the value-added based economic openness model), the recommendation for the candidate country to peg its currency to the fixed exchange rate area might have to be

revised. This paper was not able to finally reveal whether this is actually the case for the European Union because it has its main focus on calculating the actual degrees of economic openness but not the critical ones. Nevertheless, already this very early stage of research indicates that it might be reasonable to think about changing the perspective from an output-oriented towards an input-oriented theoretical view when assessing the importance of trading partners within a region by means of the degree of economic openness. With respect to the degree of economic openness, it might be an option for a full membership of the Central and Eastern countries in the Economic and Monetary Union in the year 2008 and thus participants of the euro zone.

Further research should try to calculate a candidate's minimum break-even degree of economic openness which is derived from costs and benefits of joining a fixed exchange rate area. Its comparison with the actual level of trade within the region would give a further hint whether the country should participate or not. Furthermore, a systematic comparison between the significance of trading partners inside a region and those outside of it could reveal additional insights about the intensity of integration within an integration area with respect to trade. An advanced version of the value-added based economic openness model proposed in this paper could give additional insights in the structure of international trade based on newly developed structural openness measures.

References

Brockmeier, M. (2001), A Graphical Exposition of the GTAP Model, Purdue University, GTAP Technical Paper no. 8, West Lafayette, IN.

Center for Global Trade Analysis (2003), GTAP Data Base Version 5.4, Purdue University, West Lafayette, IN.

De Grauwe, P. (1994), The Economics of Monetary Integration, Oxford University Press, Oxford, 1st and further eds.

Dimaranan, B.V./McDougall, R.A. (eds.) (2002), Global Trade, Assistance, and Production: The GTAP 5 Data Base, Purdue University, West Lafayette, IN.

Frankel, J.A./Rose, A.K. (1998), The Endogeneity of the Optimum Currency Area Criteria, The Economic Journal, vol. 108, pp. 1009–1025.

Gehlhar, M./Gray, D./Hertel, T.W./Huff, K.M./Ianchovichina, E./McDonald, B.J./McDougall, R./Tsigas, M.E./Wigle R. (1997), Overview of the GTAP Data Base, in: *Hertel, T.W. (ed.)*, Global Trade Analysis: Modeling and Applications, Cambridge, MA, pp. 74-123.

Greene, W.H. (2002), Econometric Analysis, 5th ed., Upper Saddle River, NJ.

Gros, D./Thygesen, N. (1998), European Monetary Integration, 2nd ed., Harlow.

Hertel, T.W. (ed.) (1997), Global Trade Analysis: Modeling and Applications, Cambridge, MA.

Hertel, T.W./Tsigas, M.E. (1997), Structure of GTAP, in: *Hertel, T.W. (ed.)*, Global Trade Analysis: Modeling and Applications, Cambridge, MA, pp. 13-73.

Huff, K.M./Hanslow, K./Hertel, T.W./Tsigas, M.E. (1997), GTAP Behavioral Parameters, in: *Hertel, T.W. (ed.)*, Global Trade Analysis: Modeling and Applications, Cambridge, MA, pp. 124-148.

Itakura, K./Hertel, T.W. (2000), A Note On Changes Since GTAP Book Model, Purdue University, West Lafayette, IN.

Jarque, C.M./Bera, A.K. (1987), A Test for Normality of Observations and Regression Residuals, in: International Statistical Review, vol. 55, pp. 163-172.

Kendall, M./Dickinson Gibbons, J. (1990), Rank Correlation Methods, 5th ed., Oxford.

Krugman, P.R. (1990), Policy Problems of a Monetary Union, in: *De Grauwe, P./Papademos, L. (eds.)*, The European Monetary System in the 1990s, Centre for European Policy Studies and Bank of Greece, pp. 48-64.

Krugman, P.R./Obstfeld, M. (2003), International Economics: Theory and Policy, 6th ed., Reading, MA.

Leontief, W.W. (1936), Quantitative Input and Output Relations in the Economic System of the United States, in: Review of Economics and Statistics, vol. 18, no. 3, pp. 105-125.

McDougall, R.A./Dimaranan, B.V. (2002), Guide to the GTAP Data Base, in: *Dimaranan, B.V./McDougall, R.A. (eds.)*, Global Trade, Assistance, and Production: The GTAP 5 Data Base, West Lafayette, IN, pp. 8-1 - 8-18.

McDougall, R./Tyres, R. (1997), Developing Country Expansion and Relative Wages in Industrial Countries, in: *Hertel, T.W. (ed.)*, Global Trade Analysis: Modeling and Applications, Cambridge, MA, pp. 191-211.

McKinnon, R. (1963), Optimum Currency Areas, in: American Economic Review, vol. 53, pp. 717-725.

Mundell, R.A. (1961), A Theory of Optimum Currency Areas, in: American Economic Review, vol. 51, no. 4, pp. 657-665.

Pelkmans, J./Gros, D./Ferrer, J.N. (2000), Long-Run Economic Aspects of the European Union's Eastern Enlargement, Working Document 109 of the Scientific Council for Government Policy, The Hague.

Wang, L. (2003), How Important is International Trade for a Country Really?: A Value-Added Based Approach to Measure Economic Openness, paper for the conference "VIII Conference on International Economics", Spanish Chapter of the International Economics and Finance Society (AEEFI) and University of Castilla-La Mancha (UCLM), Ciudad Real, June 25-27.

World Bank (2004), World Development Indicators 2004, Washington, DC.