# Impact of the 5th EU Enlargement on ASEAN

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## Abstract

This article aims at quantifying the impact of the EU fifth enlargement (to ten East and Central European Countries), on third countries, with a specific focus on ASEAN. The impact is assessed at several levels: macroeconomic, regional welfare and structural change. Using a refined standard GTAP model, and data covering 11 regions and 35 industries, we envisage 3 scenarios of integration with scenario 3 assuming the removal of tariffs, NTBs as well as the inclusion of technical progress through spillover effects. Results are obtained at a macro as well as a meso economic level. With regard to the results by industry, this study explores the effects arising from the elimination of the estimated tariff equivalents of non-tariff barriers in services industries at a disaggregated level, an avenue that has rarely – if at all – been explored before. The results suggest that deeper economic integration between the EU-15 and the CEECs-10 leads to overall negative effects, albeit marginal, for ASEAN. Particularly, the terms of trade effects play an important role as a major source of welfare loss. However, when broken down into the industries, ASEAN can nevertheless expect some gains, in leather, textile, clothing, but also in chemicals, transport equipment, business services and air transport.

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## 1. Introduction

The Association of South East Asian Nations (ASEAN) comprises ten South East Asian countries *i.e*. Brunei, Cambodia, Indonesia, Malaysia, Myanmar, Laos, the Philippines, Singapore, Thailand and Vietnam. The EU-ASEAN relationship was initiated in 1980 under the EC-ASEAN Co-operation Agreement. The ASEAN is an important partner of the EU in both economic and political terms. This can be evidenced from the 2001 European Commission's Communication on "Europe and Asia: A Strategic Framework for Enhanced Partnership", which identified ASEAN as an EU key economic and political partner and which emphasised its importance as a locomotive for overall relations between Europe and Asia (COM, 2001). More recently, ASEAN has been identified by the EU Commission as one of the few key partners in the formulation of a new generation of bilateral agreements with a number of emerging (and more mature Asian) economies (CEC, 2006 and 2007).

In terms of economic relations, the EU was the second largest export market for merchandise trade (10.5 percent of ASEAN's total exports) of ASEAN behind Japan (12.2 percent) in 2004 (ASEAN, 2006). However, when trade in services is taken into account, the EU is the first partner for external trade of ASEAN (Dimaranan, 2001). The main trading commodities between the two entities are heavily skewed towards manufacturing products, especially machinery transport equipment, as well as chemicals and related products. On the investment front, the EU is the largest source of inward foreign direct investment (FDI) in ASEAN (accounting for more than 7,000 million USD in 2003).

The 5$^{th}$ EU enlargement incorporated Central and Eastern European Countries (CEECs-10) into the incumbent states (EU-15).[1] Given that the EU-15 is a crucial trade partner for the ASEAN, and that the patterns of trade between these two entities is similar to the trade between the accession countries and the incumbent states, a substantial trade impact of the EU enlargement on the ASEAN countries is inevitable. Most of the literature in the area focuses on the impact of the enlargement on both the EU-15 and CEECs-10. Studies relating to the impact of the enlargement on third countries are rare. Therefore this study quantifies the sectoral impact of enlargement focusing on ASEAN countries using a refined standard GTAP model. The study covers the impact on the patterns of sectoral output and the economic welfare. The data, drawn from the GTAP database version 6, are aggregated into 11 regions x

[1] In the remainder of the article, the CEECs-10 encompass the Czech Republic, Cyprus, Estonia, Hungary, Latvia, Lithuania, Malta, Poland, Slovakia and Slovenia.

35 sectors (8 agricultural sectors, 2 non-agricultural primary, 14 manufacturing industries, and 11 services industries).

Generally, the computable general equilibrium (CGE) model gives underestimated predictions of the impact of trade liberalization if productivity growth effects are not taken into account (Kehoe, 2003; Itakura *et al.*, 2003). In addition, the static CGE model contends that capital accumulation effects are ignored in the framework. Therefore, in order to obtain more accurate results, this study takes both productivity effects and capital accumulation effects into account.

The obstacles to trade can be classified into two categories *i.e.* tariff barriers (TBs) and non-tariff barriers (NTBs). The NTBs refer to a wide range of barriers that distort trade in goods and services. Following the categorization by Deardorff and Stern (1997), we can refer to the first category as one covering quantitative restrictions and similar specific limitations such as import quotas. The second group is related to non-tariff charges and related policies affecting imports such as antidumping duties, and advanced deposit requirements. The third group concerns the government's participation in trade such as government procurement policies. The fourth group rests on customs procedures and administrative practices such as customs clearance procedures. The last group deals with technical barriers to trade, of which a clear example is the health and sanitary regulations and quality standard requirements. The need to adapt product design and to satisfy to multiple testing and certification procedures can entail significant costs for the producers of exporting commodities. Hence, a substantial reduction in trade volumes can be expected due to the presence of NTBs.

When the case of the EU-15 and CEECs-10 is scrutinized, trade between these two entities is unconstrained by tariff barriers, especially in the manufacturing sector. Hence, the NTBs seem to play a significant role as the determinants of trade patterns. Therefore, the eliminations of NTBs due to the EU enlargement are taken into account in this study.

The only work studying the impact of enlargement on Asian countries is that by Lee and van der Mensbrugghe (2004). However, our research differs from the study by Lee and van der Mensbrugghe (2004) in three major ways. First, while the reduction in iceberg trade costs (NTBs) between the EU-15 and the CEECs-10 in their study is arbitrarily assumed to be equal to 2.5 per cent and 5 per cent, we estimate the sizes of the shocks by using the gravity equation and we calculate the NTBs' tariff equivalents. In addition, studying the impact of enlargement through NTBs eliminations, Lejour *et al.* (2004) also used a gravity equation to

estimate the size of shocks. Nonetheless, our study differs to their work by using bi-directional NTBs eliminations between the EU-15 and the CEECs-10.

Second, Lee and van der Mensbrugghe (2004) arbitrarily assumed that productivity growth effects from trade liberalization are a function of an export-output ratio, but our paper takes productivity growth effects into account based upon econometric evidence which indicates that technology is transfered from the EU15 into the CEECs-10 via two main channels *i.e.* imports and foreign direct investment (FDI) (Uprasen, 2006). Technology transfer via imports is endogenized into the standard GTAP model by refining the framework of van Meiji and van Tongeren (1999), while productivity growth through technology transfer via FDI is assumed as being an exogenous variable. In this study, technology is assumed to transfer from the EU-15 to the CEECs-10 only. In the other regions, we assume no changes in productivity, due to lack of data for productivity estimations. Nevertheless, even though our study refines the model of van Meiji and van Tongeren (1999) for taking technology transfer into account, however, unlike van Meiji and van Tongeren (1999) who assume that technology transfer from source to destination country exists in the same industry, we also assume that technology can be transferred across industries, since the statistics show that the first three major importing commodities by the CEECs-10 from the EU-15 (*i.e*. machinery equipment, motor vehicles and parts, and electrical equipment) are highly interconnected to other industries since they are used as inputs in the production process.

Third, while the studies by Lee and van der Mensbrugghe (2004) and by Lejour *et al.* (2004) related to 15 and 16 industries respectively, our study is conducted for 35 industries. This higher level of disaggregation gives a more comprehensive understanding of the impact of enlargement.

The main objective of the study is therefore to quantify the impact of the 5$^{th}$ enlargement of the EU on ASEAN by taking into account the effects derived from NTBs elimination between the EU-15 and the CEECs-10. Technology spillovers from the EU-15 into the CEECs-10 are also endogenised by refining the standard GTAP model. The impact will be studied at both the sectoral and country levels. The study focuses on changes in trade, sectoral outputs, and welfare.

There are two mains tasks to be completed in this study; first, the estimation of NTBs and second, the model simulations. These can be described as follows.

Measuring NTBs is a arduous task, because of the heterogeneity of policy instruments and a lack of systematic data. A unifying and well accepted approach to measure NTBs does not exist. Among the methodologies for quantifying NTBs, three approaches are often used, *i.e*. inventory-based frequency measures, price-wedge methods, and quantity-based econometric methods (Ferrantino, 2006). Since the data for the first two methods are not always readily available for all products and countries of interest, the quantity-based approach is adopted in this study. The NTBs can be estimated by using the gravity equations method (Anderson and Wincoop, 2003).

To be able to predict the impact of the EU enlargement on ASEAN at the sectoral level, the multi-sector and multi-region computable general equilibrium (CGE) is the most suitable framework since it accounts for the interaction effects of all markets in the economy. The Global Trade Analysis Project (GTAP) model (Hertel, 1997) is refined in this study.

This paper comprises six sections. The first section replaces the quantitative work into its specific context, while section two describes the previous quantitative studies on the EU enlargement. Sections three and four illustrate the research methodologies, *i.e*. the gravity equation and the CGE model respectively. Section five presents the simulation findings and the paper is concluded in section six.

## 2. A CGE Model and the 5$^{th}$ EU Enlargement

The impact of the 5$^{th}$ enlargement has been the object of many studies. Most studies quantify the effects of enlargement by using the Computable General Equilibrium (CGE, AGE) frameworks. Based on the studies which focus on the incumbent states and the accession countries, some implications can be drawn from the simulation results. First, the gains from enlargement, in both incumbent states and accession countries, are positive net gains. This indicates that trade creation effects dominate trade diversion effects. Nonetheless, the gains in the accession countries are much higher than in the incumbent states; for example Bchir *et al*.. (2003) find that the welfare of Hungary increases by 2.62 per cent while it increases only by 0.05 per cent in the euro zone. According to Lejour *et al*. (2001), the growth in the volume of GDP increases by 5.3 per cent in the CEECs countries while it increases only by 0.1 per cent in the EU-15.

Second, some studies take the dynamic effects into account which lead to additional gains. For example, when economies of scales (EOS) are incorporated, the welfare gains in the

CEECs increase from 3.8 per cent to 4.5 per cent (Brown *et al.*, 1995). François (1998) shows that once capital accumulation effects have been taken into account, the real income of the new accession countries increases from 1 per cent to 9.7 per cent. This outcome is in line with Baldwin *et al.* (1997) who found that the real income in the CEEC countries increases by 18.8 per cent, which comes from the rise in capital stock by 68 per cent in the accession countries after the enlargement.

Third, with regard to the role of productivity effects, Lotze (1998) introduced an exogenous technical progress variable through technology transfer *via* FDI to the CEECs after the enlargement. He assumes that the firms in the accession countries experiment an exogenous increase of 10 per cent of TFP through FDI. His results indicate that the cumulative GDP of the CEECs increases by 3 per cent through technology transfer *via* FDI after the enlargement.

However, studies focusing on third countries are scarce. The only study on the impact of the EU enlargement on Asian countries is the one by Lee and Mensbrugghe (2004). Technical progress through exports is arbitrarily assumed in their study, and ASEAN countries as well as the other Asian countries are found to be the losers from the enlargement. It is worth noting that the previous studies did not pay attention to the impact of the enlargement on service industries. Therefore, the services sector is generally aggregated into between one and three sub-sectors. Moreover, the elimination of non-tariff barriers between the incumbent states and the accession countries are modelled by assuming the reduction of ice berg trade costs and using arbitrary figures; for example, Baldwin *et al.* (1997) and Lee and Mensbrugghe (2004) arbitrarily assume that the enlargement leads to the reduction in ice berg trade costs by 5,10, and 15 percent respectively according to the various scenarios. Although Lejour *et al.* (2001) used the gravity equation to estimate the size of the shock due to the reduction of non-tariff barriers, there are only four service sectors in their study. Therefore, the effects from the elimination of the estimated tariff equivalents of non-tariff barriers in services industries at a disaggregated level have not been explored explicitly in the various studies on the impact of the 5$^{th}$ enlargement so far.

## 3. The Gravity Equation

### 3.1. Theoretical Foundations

The gravity model of trade in international economics predicts bilateral trade flows between trade partners based on their economic sizes and distance, or transportation costs, between two countries. Transposing Newton's Law of Gravitation to the field of international economics, Tinbergen developed the first gravity model in 1962 (Tinbergen, 1962), on the

basis of work performed by Isard (1954). Being one of the empirically successful achievements in the field of international economics, the model works well when bilateral trade is regressed on GDP. However, the model lacks a concrete theoretical foundation, although attempts have been made in this direction. For example, Anderson (1979) was the first to develop a theory, and this was subsequently followed by Bergstrand (1985, 1989). They posited the theoretical ground for the gravity equation based on product differentiation and on a constant elasticity of substitution (CES) utility function. Deardorff (1998) also contributed to these ideas by showing that the gravity equation can be derived, not only based upon the Heckscher-Ohlin model, but also upon a product differentiation approach. More recently, Anderson and van Wincoop (2003), by imposing the clearing condition and the symmetry in trade costs between two trade partners into the gravity model, derived a theoretically based log-linear gravity equation, as stated in equation (1) below:

$$\ln x_{ij} = \alpha + \ln y_i + \ln y_j + (1-\sigma)\ln \tau_{ij} + (\sigma - 1)\ln p_i + (\sigma - 1)\ln p_j \qquad (1)$$

Where, $x_{ij}$ = bilateral trade flows between countries i and j

$y_i, y_j$ = gross domestic product (GDP) of country i and j respectively

$\sigma$ = constant elasticity of substitution between all commodities

$p_i, p_j$ = composite price indices in country i and j respectively

$\tau_{ij}$ = iceberg trade costs

Equation (1) indicates that the volume of trade flows between two trade partners is determined by the size of two economies (represented by GDP), the difference in price levels, the iceberg trade costs, and the value of a constant elasticity of substitution between all commodities.

The iceberg trade costs are defined as equation (2).

$$\tau_{ij} = d_{ij}.t_{ij} \qquad (2)$$

In log form, this becomes:

$$\ln \tau_{ij} = \rho \ln d_{ij} + \ln t_{ij} \qquad (3)$$

Where, $\rho$ = estimated parameter

$d_{ij}$ = transportation costs, which are proxied by distance

$t_{ij}$ = unobservable trade costs, such as technical standards, health and safety costs, red tape procedures, etc.

The empirical results from the econometric estimation of equation (1) can be used to calculate for the tariff equivalents of NTBs. There are two approaches to do so. First, the hidden NTBs trade costs are modeled by adding a dummy variable into equation (1) (McCallum, 1995;

Anderson and van Wincoop, 2003; Lejour *et al.* (2004); Rose and Stanley, 2005). The estimated parameter from a dummy variable indicates the average tariff equivalent of the trade costs for each pair of trade partners. The second approach is a residual based method (Park, 2002; François *et al*. 2003, Deardorff and Stern, 2004). This approach accounts for all estimated parameters of the gravity equation. After estimating for all parameters, the potential trade flows can be obtained by substituting all necessary data into the estimated gravity equation. The fitted trade flows from the gravity equation are specified as the potential flows. Then, differences between actual and potential trade flows are indicative of trade barriers.

In this study, the residual based approach is adopted. The rationale is to take all estimated parameters into account for calculating the tariff equivalents of NTBs. In addition, this method allows obtaining the bi-directional tariff equivalents of NTBs between each pair of trade partners rather than only one average value of tariff equivalents of NTBs for those countries which can be calculated through the dummy method.

Nonetheless, since the trade costs, which emanate from the residual of the gravity equation, contain both tariff barriers (TBs) and non-tariff barriers (NTBs), thus, in order to get only the tariff equivalents of NTBs, the regression equation is needed to control for imports tariffs and export subsidies. Therefore, equation (1) can be rewritten as follows.

$$\begin{aligned}\ln x_{ij} &= \alpha + \beta_1 \ln y_i + \beta_2 \ln y_j + \beta_3 \ln d_{ij} + \beta_4 \ln p_i + \beta_5 \ln p_j \\ &\quad + \beta_6 tm_j + \beta_7 xs_i + \gamma_i \sum_i z_i + \varepsilon_{ij}\end{aligned} \tag{4}$$

Where,

$x_{ij}$ = export values from country i to country j

$tm_j$ = import tariff (per cent) imposed by importer j

$xs_i$ = export subsidies (per cent) imposed by exporter i

$z_i$ = dummy variable

$\varepsilon_{ij}$ = error term

**3.2. The Empirical Gravity Equation and the Data**

The gravity equation has been modified in particular ways to make the equation able to apply to various situations. For example, cultural similarity and political stability have been incorporated into the gravity equation in the work of Chow and Zietlow (1995). Building on the work of Lovasy (1941), Linder's hypothesis (Linder, 1961) is one of the most important

explanations of the patterns of world trade in differentiated goods. According to the hypothesis, the volume of trade is a function of a country's wealth, which is generally measured by GDP per capita. Thus, the larger the difference in per capita income, the less likely is the trade between the trade partners. This hypothesis has been taken into account in the gravity equation in the works of Péridy (2005), Marques and Metcalf (2005), and Philippidis and Sanjuan (2006, 2007).

However, the Heckscher-Ohlin model plays a significant role on the explanation of trade patterns, especially in the case of homogeneous products. The capital abundant country produces and exports the capital intensive goods, and imports the labor intensive products from the labor abundant country. The reverse case is applied to the labor abundant country. In the real world, there are both homogeneous and differentiated goods, thus the gravity equation in this study takes both the Linder hypothesis and the Heckscher-Ohlin model into account. Equation (4) is refined as follows.

$$\begin{aligned}\ln x_{ij} &= \alpha + \beta_1 \ln gdp_i + \beta_2 \ln gdp_j + \beta_3 \ln dist_{ij} + \beta_4 \ln p_i + \beta_5 \ln p_j \\ &+ \beta_6 tm_j + \beta_7 xs_i + \beta_8 \ln\left(\frac{k}{l}\right)_i + \beta_9 \ln\left(\frac{k}{l}\right)_j + \beta_{10} \ln\left|dpgdp_{ij}\right| \\ &+ \beta_{11} EU + \beta_{12} CEE + \beta_{13} ASEAN + \varepsilon_{ij}\end{aligned} \tag{5}$$

Where,

$x_{ij}$ = imports of country j from country i (mio USD)

$gdp_i, gdp_j$ = GDP of country i and j, respectively (mio USD)

(The data of imports and GDP are taken from GTAP database version 6 (2001))

$dist_{ij}$ = distance between the capital cities of the importing and exporting country (Km), the data are obtained from http://www.indo.com

$p_i, p_j$ = composite price indices in country i and j. They are proxied by the consumer prices index (2000 = 100), the data are compiled from the International Monetary Fund (IMF)

$tm_j$ = import tariffs imposed by importing country j ( percent)

$xs_i$ = exports subsidies imposed by exporting country i ( percent)

(The data of import tariffs and export subsidies are taken from GTAP database V.6)

$(k/l)_i, (k/l)_j$ = capital labor ratio of country i and j, respectively. The data of capital are proxied by VKB (value of beginning capital stocks) from GTAP database V.6 (mio USD), while the data of labor forces are obtained from International Labor Organization (ILO).

$\left|dpgdp_{ij}\right|$ = absolute value of the difference between GDP per capita between country i and j

EU = binary dummy variable for member of the European Union, the value is assigned to 1 if the importing and exporting country are the member of the EU simultaneously, and 0 otherwise.

$CEE$ = binary dummy variable for the member of the new accession countries, the value is assigned to 1 if the importing and exporting country are the member of the CEECS simultaneously, and 0 otherwise.

ASEAN = binary dummy variable for member of ASEAN, the value is assigned to 1 if the importing and exporting country are the member of ASEAN simultaneously, and 0 otherwise.

$\varepsilon_{ij}$ = error term

Equation (5) will be estimated by using the bilateral data of 38 countries (individual member countries of the EU15, CEECS10, Indonesia, Malaysia, Philippines, Singapore, Thailand, Vietnam, China, USA, Japan, South Korea, Taiwan, Hong Kong, and Australia) for 34 industries (as indicated in table 4). This generates 1,406 observations per industry. All cross-section data relate to the year 2001. The regression estimation is conducted under the ordinary least square (OLS) technique. Nonetheless, the OLS standard errors may be biased due to the heteroscedasticity problem from estimation of cross-section data. Hence, the White's covariance matrix estimator will be adopted. However, the least square estimators are still unbiased, consistent, and asymptotically normally distributed.

### 3.3. The Empirical Results

The empirical results of equation (5) are presented in table 1. It is worth noting that even though there are 35 industries in the study, table 1 reports the estimated coefficients for 34 industries only. The dwelling industry is not presented here since there is no cross border trade between any pair of trade partners (implying that the volume of imports and exports is equal to zero). The estimated results show an adequate explanation of bilateral trade by the gravity equation across countries in most industries. The $R^2$ ranges from 0.51 (paddy rice and processed rice, and mineral products) to 0.81 (air transport). Interestingly, six industries from the thirty-four industries show a value of $R^2$ ranging from 0.51 to 0.58; these are: crops and plant-based fibers, paddy rice and processed rice, sugar, sugar cane, and sugar beet, vegetable oils and fats, mineral n.e.c., and energy (water, electricity, etc.). Out of these six industries, four produce agricultural products. This indicates that economic variables alone cannot explain well the patterns of trade for these groups of products. This might be explained by

relatively heavy intervention in the agricultural market of the trade partners, especially in the case of the EU.

For all 34 industries, the estimated coefficients of both importer and exporter income (GDP) are positive and statistically significant at the 1 percent level. This implies that on the supply side, higher country income leads to greater availability of commodities to export, while on the demand side the higher country income generates a greater propensity to consume and therefore increases its volume of imports.

The distance, as the proxy of transportation costs, logically has a highly significant (1 percent level) and negative impact on all agricultural and manufacturing products. Nevertheless, the results for the services sectors are mixed. This shows that trade in services is less likely to depend on distance than trade in manufactured goods, owing to the intangible nature of many service activities. Nonetheless and interestingly, the trade volume of air transport is positively correlated with distance. The effects of relative price indicators are mixed, and there is no predictable trend. This could indicate that the consumer price index (CPI) may not be a good proxied variable of composite price indices. The evidence of non-zero import tariffs and export subsidies are also ambiguous with regard to the patterns of trade of agricultural and manufacturing products. Given the nature of cross sectional data, a spurious relationship could be the explanation. Even though many countries impose a high level of import tariffs, such as the EU, they also have a high volume of trade with their partners. The same problem can occur in the case of export subsidies. In addition, these results also emphasize that the role of tariff barriers as the determinants of the patterns of trade is not crucial. Therefore, considering only the elimination of TBs by ignoring the role of NTBs in the study of the EU enlargement is not satisfactory and it might generate miss leading conclusions.

The patterns of trade, based on the Hechscher-Ohlin (H-O) principle, exist in some agricultural and manufacturing sectors. The capital abundant country tends to import more labour intensive goods, while the labor abundant economy acts as the exporter of agricultural products. However, the H-O premise is less likely to be observed in the patterns of trade in the services sector. Actually, this indicates that trade in manufacturing products and services conform mostly to the teachings of the new trade theory, since an imperfectly competitive market, product differentiation, and economies of scale play a significant role on these commodities. However and interestingly, the Linder effect is less likely to be observed in most industries. The estimated results from the dummy variables show that, relatively, the volume of intra-trade in ASEAN is higher than in the case of either the EU1-5 or the CEECs-10.

**Table 1. The Gravity Equation Estimates**

| Industry | Constant | $gdp_i$ | $gdp_j$ | $dist_{ij}$ | $p_i$ | $p_j$ | $TM_j$ | $XS_i$ | $(k/l)_i$ | $(k/l)_j$ | $\lvert dgdpp_{ij} \rvert$ | EU | CEECS | ASEAN | $R^2$ |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| ANIMA | | **0.84**** | **0.92**** | **-0.83**** | **8.76**** | **-9.70**** | **0.02**** | **0.01*** | | **-0.25**** | **-0.08*** | **1.32**** | | **1.27**** | **0.68** |
| | | (0.02) | (0.02) | (0.04) | (1.81) | (1.93) | (0.00) | (0.00) | | (0.04) | (0.04) | (0.15) | | (0.31) | |
| CROP | | **1.20**** | **0.86**** | **-0.89**** | | | **0.01**** | **-0.78**** | | | | | **0.94**** | **1.78**** | **0.53** |
| | | (0.03) | (0.03) | (0.06) | | | (0.00) | (0.06) | | | | | (0.32) | (0.34) | |
| FOOD | | **1.09**** | **0.82**** | **-0.92**** | **-6.55**** | | **0.01**** | **0.27**** | **-0.58**** | | **-0.10**** | **0.89**** | **0.93**** | **1.83**** | **0.71** |
| | | (0.02) | (0.02) | (0.04) | (1.78) | | (0.00) | (0.04) | (0.04) | | (0.03) | (0.15) | (0.24) | (0.26) | |
| MEAT | **-50.07**** | **0.91**** | **0.86**** | **-0.86**** | **16.25**** | **-8.98**** | **0.02**** | **0.19**** | **-0.30**** | | | **1.71**** | | **1.17**** | **0.67** |
| | (13.63) | (0.02) | (0.02) | (0.05) | (2.03) | (1.91) | (0.00) | (0.02) | (0.05) | | | (0.17) | | (0.45) | |
| RICE | | **0.96**** | **0.41**** | **-0.40**** | **-10.43**** | **7.32*** | **0.01**** | **-0.01**** | **-1.28**** | **0.17*** | | **1.80**** | | **2.16**** | **0.51** |
| | | (0.05) | (0.04) | (0.09) | (2.26) | (3.07) | (0.00) | (0.00) | (0.06) | (0.06) | | (0.29) | | (0.48) | |
| SUGAR | | **0.86**** | **0.77**** | **-0.87**** | | | **0.01**** | | **-0.35**** | **-0.23**** | **-0.11*** | **0.63**** | **0.74*** | **1.79**** | **0.57** |
| | | (0.03) | (0.03) | (0.05) | | | (0.00) | | (0.05) | (0.05) | (0.05) | (0.21) | (0.35) | (0.48) | |
| VEGEO | **-46.63**** | **0.94**** | **0.77**** | **-0.83**** | **13.25**** | **-6.61**** | **0.02**** | | **-0.30**** | | **-0.13*** | **0.48*** | | **2.46**** | **0.53** |
| | (15.99) | (0.03) | (0.03) | (0.06) | (2.45) | (2.21) | (0.00) | | (0.05) | | (0.05) | (0.19) | | (0.54) | |
| OAGRI | | **1.07**** | **0.78**** | **-1.05**** | **7.26**** | **-8.19**** | | | **-0.25**** | **-0.02**** | | **0.62**** | | **2.08**** | **0.69** |
| | | (0.02) | (0.02) | (0.04) | (1.83) | (1.87) | | | (0.04) | (0.04) | | (0.14) | | (0.32) | |
| FORFI | **30.87*** | **0.74**** | **0.95**** | **-0.98**** | **0.85**** | **-10.68**** | **0.02**** | | **-0.56**** | **0.01**** | | **0.78**** | | **0.96*** | **0.64** |
| | (12.44) | (0.02) | (0.02) | (0.05) | (1.65) | (1.94) | (0.00) | | (0.03) | (0.04) | | (0.18) | | (0.40) | |
| PRIMA | | **1.13**** | **1.01**** | **-1.37**** | **6.01**** | **-6.50**** | **0.08**** | | **-0.11*** | **-0.17**** | | | | **2.18**** | **0.73** |
| | | (0.03) | (0.02) | (0.04) | (2.16) | (1.84) | (0.01) | | (0.04) | (0.04) | | | | (0.27) | |
| APPAR | **39.27**** | **0.94**** | **0.84**** | **-1.06**** | **-8.32**** | | **0.01**** | **-0.03**** | **-0.77**** | **0.25**** | | | | | **0.74** |
| | (10.87) | (0.02) | (0.02) | (0.04) | (1.64) | | (0.00) | (0.00) | (0.04) | (0.04) | | | | | |
| CHEMI | **-37.64**** | **1.15**** | **0.90**** | **-1.02**** | **6.47**** | | | | | **-0.13**** | **-0.06**** | | **0.61**** | **1.91**** | **0.81** |
| | (10.04) | (0.02) | (0.02) | (0.03) | (1.44) | | | | | (0.04) | (0.03) | | (0.18) | (0.21) | |
| ELECT | | **1.26**** | **0.86**** | **-0.73**** | | | | **0.28**** | | **0.24**** | | **-0.49**** | | **3.17**** | **0.64** |
| | | 0.03 | 0.03 | 0.06 | | | | 0.04 | | 0.06 | | 0.16 | | 0.39 | |
| LEATH | | **1.16**** | **0.88**** | **-1.07**** | | **-4.19*** | | **-0.13**** | **-0.88**** | | | | | | **0.71** |
| | | (0.02) | (0.02) | (0.05) | | (1.82) | | (0.03) | (0.04) | | | | | | |
| MACHI | **-22.79*** | **1.22**** | **0.89**** | **-1.03**** | **3.42*** | | **0.03**** | **1.08**** | **0.18**** | | | **-0.71**** | | **1.95**** | **0.80** |
| | (10.82) | (0.02) | (0.02) | (0.03) | (1.54) | | (0.01) | (0.20) | (0.03) | | | (0.10) | | (0.22) | |
| MANUF | **46.31**** | **1.13**** | **0.87**** | **-0.78**** | **-8.92**** | **-4.62**** | | | **-0.36**** | **0.11**** | | **-0.27**** | | **0.86**** | **0.80** |
| | (9.43) | (0.02) | (0.02) | (0.03) | (1.38) | (1.42) | | | (0.03) | (0.04) | | (0.10) | | (0.27) | |
| METAL | | **1.22**** | **0.91**** | **-1.34**** | | | **0.02**** | | **-0.09*** | | | **-0.56**** | | **1.33**** | **0.78** |
| | | (0.02) | (0.02) | (0.04) | | | (0.01) | | 0.03 | | | (0.11) | | (0.22) | |
| MINEP | | **1.22**** | **0.95**** | **-1.28**** | **4.48**** | **-4.21*** | **0.02*** | | **-0.23**** | | | | **0.72**** | **1.35**** | **0.78** |
| | | (0.02) | (0.02) | (0.04) | (1.73) | (1.73) | (0.00) | | (0.03) | | | | (0.24) | (0.28) | |

**Table 1. (Cont')**

| Industry | Constant | $gdp_i$ | $gdp_j$ | $dist_{ij}$ | $p_i$ | $p_j$ | $TM_j$ | $XS_i$ | $(k/l)_i$ | $(k/l)_j$ | $\lvert dgdpp_{ij} \rvert$ | EU | CEECS | ASEAN | $R^2$ |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| MINER | | **1.04**** | **0.86**** | **-1.10**** | | | **0.15**** | | **-0.41**** | | | **0.52**** | **1.41**** | **2.12**** | **0.51** |
| | | (0.03) | (0.04) | (0.07) | | | (0.04) | | (0.06) | | | (0.18) | (0.31) | (0.37) | |
| MOTOR | **-68.88**** | **1.38**** | **0.90**** | **-1.30**** | **13.70**** | | **0.02**** | **-3.84**** | **0.30**** | **0.20**** | **-0.16**** | **-0.55**** | | **1.24**** | **0.80** |
| | (11.14) | (0.03) | (0.02) | (0.04) | (1.62) | | (0.00) | (0.17) | (0.03) | (0.04) | (0.03) | (0.15) | | (0.29) | |
| PAPER | **-45.83**** | **1.07**** | **0.88**** | **-1.11**** | **10.68**** | **-3.42*** | | | **0.12**** | **-0.15**** | **-0.08*** | **0.24*** | **0.60**** | **1.47**** | **0.77** |
| | 11.65 | 0.02 | 0.02 | 0.04 | 1.74 | 1.62 | | | 0.03 | 0.04 | 0.03 | 0.12 | 0.21 | 0.28 | |
| TEXTI | | **1.09**** | **0.89**** | **-1.30**** | **-5.84**** | | **0.03**** | **-0.03**** | **-0.43**** | | | **-0.31*** | | **0.56*** | **0.77** |
| | | (0.02) | (0.02) | (0.04) | (1.56) | | (0.00) | (0.00) | (0.03) | | | (0.12) | | (0.23) | |
| TRAEQ | **67.57**** | **1.33**** | **0.92**** | **-1.00**** | **-12.84**** | **-5.49*** | **0.02*** | **5.20**** | | **0.24**** | | **-0.45**** | **1.81**** | **1.90**** | **0.70** |
| | (16.06) | (0.03) | (0.03) | (0.06) | (2.35) | (2.37) | (0.01) | (0.49) | | (0.05) | | (0.16) | (0.33) | (0.39) | |
| WOOD | | **0.90**** | **0.97**** | **-1.29**** | | **-3.54*** | | | **-0.55**** | | | | **0.66**** | | **0.70** |
| | | (0.02) | (0.02) | (0.04) | | (1.74) | | | (0.04) | | | | (0.22) | | |
| AIRTR | **64.43**** | **0.68**** | **0.76**** | **0.22**** | **-9.59**** | **-7.78**** | | | **0.26**** | **0.15**** | | **0.39**** | **-0.30**** | **1.35**** | **0.86** |
| | (6.78) | (0.01) | (0.01) | (0.02) | (0.99) | (1.04) | | | (0.02) | (0.02) | | (0.08) | (0.11) | (0.13) | |
| BUSIN | | **0.60**** | **0.75**** | | **-4.22**** | **2.52*** | | | **0.44**** | **0.16**** | | **0.45**** | **-0.82**** | **1.40**** | **0.81** |
| | | (0.01) | (0.01) | | (1.07) | (1.20) | | | (0.02) | (0.03) | | (0.08) | (0.10) | (0.21) | |
| COMMU | | **0.60**** | **0.73**** | **-0.09**** | | **-3.34**** | | | **0.18**** | | | **0.83**** | **-0.61**** | | **0.85** |
| | | (0.01) | (0.01) | (0.02) | | (1.12) | | | (0.02) | | | (0.06) | (0.07) | | |
| CONST | **26.65*** | **0.90**** | **0.79**** | **-0.54**** | | **-11.04**** | | | **-0.12**** | **-0.29**** | | **0.43**** | **-0.82**** | **-1.21**** | **0.68** |
| | (11.59) | (0.02) | (0.02) | (0.04) | | (1.78) | | | (0.04) | (0.04) | | (0.12) | (0.19) | (0.31) | |
| ENERG | **-49.68**** | **0.65**** | **0.72**** | **-0.97**** | **13.38**** | **-4.35*** | | | | **0.14**** | **-0.10*** | | | **-1.05**** | **0.58** |
| | (12.58) | (0.02) | (0.02) | (0.05) | (1.81) | (1.90) | | | | (0.04) | (0.04) | | | (0.32) | |
| FINAN | **32.25**** | **0.70**** | **0.67**** | | **-2.82*** | **-7.32**** | | | **0.24**** | | **0.07**** | **0.79**** | **-0.87**** | **0.86**** | **0.79** |
| | (7.98) | (0.01) | (0.01) | | (1.17) | (1.19) | | | (0.02) | | (0.02) | (0.11) | (0.11) | (0.16) | |
| PUBLI | | **0.68**** | **0.75**** | | **4.35**** | **-6.13**** | | | **0.17**** | | **0.06**** | | | | **0.80** |
| | | (0.01) | (0.01) | | (1.14) | (1.10) | | | (0.02) | | (0.02) | | | | |
| RECRE | **-50.10**** | **0.71**** | **0.76**** | **-0.05*** | **9.33**** | | | | **0.17**** | **0.10**** | | **0.32**** | **-0.37**** | **0.58**** | **0.83** |
| | (6.82) | (0.01) | (0.01) | (0.02) | (0.92) | | | | (0.02) | (0.02) | | (0.08) | (0.11) | (0.13) | |
| TRADE | **31.51**** | **0.68**** | **0.82**** | | **-10.41**** | | | | **0.19**** | | | **0.29**** | **-0.52**** | **0.74**** | **0.81** |
| | (8.83) | (0.01) | (0.01) | | (1.37) | | | | (0.02) | | | (0.09) | (0.11) | (0.24) | |
| OTRAS | **20.26**** | **0.55**** | **0.75**** | | **-3.05**** | **-3.97**** | | | **0.18**** | **0.08**** | | **0.25**** | **-0.35**** | **0.45**** | **0.82** |
| | (6.39) | (0.01) | (0.01) | | (0.93) | (0.97) | | | (0.02) | (0.02) | | (0.08) | (0.10) | (0.14) | |

***Note:*** **, * stands for the 1 percent and 5 percent level of significant, respectively. The standard errors are shown in parentheses. (n= 1406 observations for each industry)

**3.4. Calculations of Tariff Equivalents of NTBs**

There are two approaches to calculate for tariff equivalents of NTBs; one is the dummy variable approach (McCallum, 1995; Anderson and Wincoop, 2003) and the other is the residual approach (Wall, 1999; Park, 2002). Under the latter approach, it is assumed that the difference between actual and potential trade flows of the country implies trade barriers. The potential trade flows can be obtained from the gravity estimation. In other words, according to Anderson and Wincoop (2001), the residual $\varepsilon_{ij}$ in equation (4) and (5) is defined as the log of the actual imports from exporter *i* to importer *j* minus the log of potential imports from gravity prediction; this is shown as follows:

$$\ln x_{ij}^{a} - \ln x_{ij}^{p} = (1-\sigma)\ln t_{ij} \tag{6}$$

Where,

$x_{ij}^{a}$ = actual imports from country *i* to destination country *j*

$x_{ij}^{p}$ = potential imports from country *i* to destination country *j*

$t_{ij}$ = unobservable trade cost

$\sigma$ = constant elasticity of substitution between all commodities

Park (2002) and François *et al*.(2003) assume that in each country there is only single NTB imposed on all trade partners; therefore the tariff equivalent of each region is obtained by summing actual and potential imports over all trade partners. Hence, for country *j*, $X_j^a = \sum_i x_{ij}^a$ , where $i \neq j$, and $X_j^p = \sum_i x_{ij}^p$ , where $i \neq j$. Therefore, equation (6) is transformed into equation (7) as follows:

$$\ln X_j^a - \ln X_j^p = (1-\sigma)\ln t_j \tag{7}$$

By rearranging the terms, equation (7) assumes the following form:

$$\ln\left(\frac{X_j^a}{X_j^p}\right) - \ln t_j = -\sigma \ln t_j \tag{8}$$

The difference between actual and potential imports needs to be normalized relative to the free-trade benchmark; thus the term $\ln t_j$ is substituted by $\ln\left(\frac{X_b^a}{X_b^p}\right)$, where the subscripts a, p, and b stand for actual, potential, and benchmark, respectively. The free-trade benchmark import ratio is selected from the country which has the positive greatest value of the difference between actual and potential imports. Hence, equation (8) is rewritten as follows:

$$\ln\left(\frac{X_j^a}{X_j^p}\right) - \ln\left(\frac{X_b^a}{X_b^p}\right) = -\sigma \ln t_j \tag{9}$$

Equation (9) can be solved for $t_j$ as follows:

$$t_j = \exp\left\{\ln\left(\frac{X_j^a}{X_j^p}\right) - \ln\left(\frac{X_b^a}{X_b^p}\right)\right\}^{-\frac{1}{\sigma}} = \left(\frac{X_j^a / X_j^p}{X_b^a / X_b^p}\right)^{-\frac{1}{\sigma}} \tag{10}$$

However, $t_j$ is the power of the tariff equivalent of NTBs. Hence to obtain the tariff equivalent, we subtract 1 on both sides in equation (10). The tariff equivalent of NTBs of importer j, $(t_j - 1)$, is therefore obtained as equation (11):

$$(t_j - 1) = \left(\frac{X_j^a / X_j^p}{X_b^a / X_b^p}\right)^{-\frac{1}{\sigma}} - 1 \tag{11}$$

Nevertheless, our methodology follows that of Philippidis and Sanjuan (2006, 2007) by focusing on bi-directional tariff equivalents by industry between specific pairs of trade partners. For example, the tariff equivalent in CEECS-10 form the point of view of the EU-15 can be calculated by referring to *j* as the summation of imports of all member countries of the CEECs-10, from each country of the EU15.

The value of the tariff equivalent is very sensitive to the value of the elasticity of substitution, $\sigma$. Park (2002) employed a number of 5.6 for all service industries, while Walsh (2006) used 1.95 for the estimation of NTBs equivalent in the services sector.[2] François *et al*. (2003) adopted a value of elasticity between 1.26 and 1.68 for the different industries. Our study uses the value of elasticity from the GTAP database which are estimated by Hertel *et al.* (2004).

**Table 2: The Tariff Equivalents of NTBs (percent)**

| **Importer**<br>**Exporter** | | **EU15**<br>**CEECs-10** | **CEECs-10**<br>**EU15** |
|---|---|---|---|
| **Industry** | | | |
| ANIMA | Animals products | 56.68 | 65.17 |
| CROP | Crops and plant-based fibers | 507.21 | 365.88 |
| FOOD | Food products | 34.26 | 85.42 |
| MEAT | Meat products | 38.91 | 89.73 |
| RICE | Paddy rice and processed rice | 216.31 | 293.59 |
| SUGAR | Sugar, sugar cane, and sugar beet | 168.25 | 135.80 |
| VEGEO | Vegetable oils and fats | 108.64 | 75.66 |
| OAGRI | Other agricultural products | 110.79 | 127.10 |

[2] See the appendix.

| | | | |
|---|---|---|---|
| FORFI | Forestry and fishing | 63.57 | 92.33 |
| PRIMA | Primary products (coal, oil, gas, etc.) | 80.66 | 94.19 |
| APPAR | Wearing apparel | 35.22 | 38.25 |
| CHEMI | Chemical, rubber, and plastic products | 27.01 | 23.13 |
| ELECT | Electronic equipment | 38.05 | 41.92 |
| LEATH | Leather products | 33.58 | 43.23 |
| MACHI | Machinery and equipments | 13.81 | 11.10 |
| MANUF | Manufacturing products | 3.30 | 22.33 |
| METAL | Metal products | 36.82 | 47.56 |
| MINEP | Mineral products | 58.62 | 65.68 |
| MINER | Mineral n.e.c. | 41.62 | 52.89 |
| MOTOR | Motor vehicles and parts | 44.95 | 51.80 |
| PAPER | Paper products, and publishing | 46.01 | 54.10 |
| TEXTI | Textiles | 42.35 | 38.21 |
| TRAEQ | Transport equipments | 28.61 | 37.13 |
| WOOD | Wood products | 38.92 | 49.54 |
| AIRTR | Air transports | 69.80 | 60.19 |
| BUSIN | Business services | 44.06 | 74.61 |
| COMMU | Communication | 72.18 | 62.12 |
| CONST | Construction | 119.63 | 139.22 |
| ENERG | Energy (water, -electricity, ect.) | 53.21 | 177.20 |
| FINAN | Financial services and insurance | 77.55 | 131.33 |
| PUBLI | Public admin, defence, education, health | 104.82 | 59.65 |
| RECRE | Recreational and other services | 121.29 | 77.01 |
| TRADE | Trade | 104.79 | 84.67 |
| OTRAS | Other transport (water transport, and etcs.) | 6.72 | 45.80 |

The final results relating to the tariff equivalents of NTBs are reported in table 2. As expected, the tariff equivalents of NTBs are generally higher in the case where the EU-15 is the exporter and the CEECs-10 are the importing entity. In terms of their magnitude, these results are in line with those of other studies (tables A1 and A2 in the Appendix).

## 4. The CGE Model

The computable general equilibrium (CGE, AGE) models are useful models for analyzing complex relationship issues such as the macroeconomic impact of a preferential trade agreement since the strong point of the CGE is that it contains the interdependencies among

the sectors and agents in the economy, which partial equilibrium analysis cannot provide. This paper refines the standard GTAP model as the main methodology used here.

### 4.1. The standard GTAP Model

The Global Trade Analysis Project (GTAP) model (Hertel, 1997) is a multi-region and multi-sector static AGE model. The associated GTAP databases - version 6 - comprises 87 regions and 57 sectors. The model is built on the neoclassical economic basis.

There are seven economic agents in the model, *i.e.* regional households, private households, government, producers, global banks, global transportation sector and the rest of the world. The regional households own a fixed endowment with primary factors of production, *i.e.* land, labor and capital. She receives the factor rewards from lending these endowments to the producers. Her preference is specified as an aggregate utility function which allocates regional income in three ways, namely private expenditure, government expenditure and savings. This form of utility function provides the complete indicator for overall regional welfare. Private households and the government spend their income on both domestic and imported goods. Producers produce commodities by combining primary and intermediate inputs together. The intermediate inputs come from both domestic producers and from abroad. The commodities produced are distributed both in domestic and foreign markets. Bilateral exports and imports are distinguished by destination and source region. There are two global sectors in the model, a global banking sector and a global transportation sector. The global banking sector acts as the intermediary between regional savings and investments. Producers, in addition to final commodities, also supply an artificial investment good, which is collected by the global banks and is then distributed to regional households. The global transportation sector delivers products from the source to destination countries so that the *fob* export values at the source are not equal to the *cif* import values at the destination countries.

The equations in the GTAP model can be classified into four broad categories. The first group includes market clearing conditions for all trade goods, endowments, and all household expenditures. The second group relates to the behavioral equations of producers. The production procedures are subject to a separable and constant-return-to-scale production technology. The production function is the combination of the separate nests structures. The nests are combined through elasticities of substitution under the Armington assumption together with a Constant Elasticity of Substitution (CES) function. The third group of equations defines the behavior of household in the model. The overall regional household's behavior is determined by an aggregate Cobb-Douglas utility function which is the

combination among private consumption, government purchases and savings. The last group of equations covers a macroeconomic closure. It presents the link between savings and investment in the model. The GTAP model concerns the allocation of the real resource flows so that money is not modeled obviously. However, it is a saving-driven model. The amount of saving is determined as a certain share of regional income, and investment has to adjust accordingly.

After the global banks sell the homogenous investment goods to the regional households and collect all the regional savings, the global banks will allocate the investment into each region. There are two mechanisms which the global banks can choose for making such investment. The first mechanism is called the *fixed composition approach*. With this approach, the investment will be done under the assumption that the regional composition of global capital stocks does not change. Since the regional composition of global capital stocks does not change after the investment has been done, therefore the regional specific rate of return has to adjust in order to make the regional share of global capital stock unchanged. Thus, within this framework, the rate of return on capital in each region is allowed to differ, after the investment is accomplished. Thus, regional and global net investments move together. The second investment mechanism is referred to as the *rate of return approach*. According to this approach, the global banks will allocate global savings in such a way that all expected regional rates of return change by the same percentage. In other words, the shares of the regional composition of global capital stocks have to adjust in order to allow the changes in the expected rate of return to be equalized across regions, after the investments are established. Either the first or the second approach can be chosen in the study, depending on the objectives and the assumptions of the model.

It is worth noting that due to the nature of the static CGE model, it captures only the reallocation effects of the resources after trade liberalization. The dynamic effects, *i.e*. the accumulation and productivity growth effects are neglected. This could lead to underestimated predictions. Therefore, this paper takes the accumulation effects into account by endogenizing the capital stock of the economy in the model. This can be accomplished by employing the François *et al.* (1996) concept.

### 4.2. Endogenizing technological spillovers into the GTAP model

According to a study on the vehicles of technology spillovers from the EU-15 to the CEECs-10, econometric evidence indicates that technology is transmitted from the EU-15 to the

CEECs-10 through two main vehicles, namely imports and FDI (Uprasen, 2006). Exports play an insignificant role. Therefore, these two main vehicles are taken into account in our framework. Nevertheless, only technology spillovers through imports will be endogenized into the standard GTAP model, while the FDI channel is treated as an exogenous variable, due to the limitations of the static GTAP model.

Technology spillovers via imports are taken into account in the standard GTAP model by refining the concept of spillover from van Meiji and van Tongeren (1999). The spillover equation is presented as follows.

$$aoall(c,d) = \sum_t \left[ \frac{M(c,s,d)}{\sum_i M(i,s,d)} \left( \frac{\sum_i M(i,s,d)}{\sum_r \sum_i M(i,r,d)} \right)^{\lambda} * aoall(c,s) \right] \tag{12}$$

where,

aoall(c,d) = output augmenting technical change in sector c of destination country d

aoall(c,s) = output augmenting technical change in sector c of source country s

M(i,s,d) = imports of tradable commodity i of country d originating from country s

M(i,r,d) = imports of tradable commodity i of country d originating from any region r

M(c,s,d) = imports of spillovers commodity c of destination country d from any source country s

$\lambda$ = productivity elasticity of destination country d with respect to total imports from source country s.

*t* = spillover commodities (machinery and equipment, motor vehicles and parts, and electronic equipment

Equation (12), which we include in our model, indicates that technical progress in industry *c* of the source country *s* can be transferred to sector *c* of the destination country *d* through the import vehicle. In our study, we assume that technology transfer (which emanates from the expected increases in trade volume due to the EU enlargement) exists when the only source and destination of technology spillovers are the EU-15 and the CEECs-10 respectively, due to the lag of information of technology spillovers in the other countries. The magnitude of technology spillovers is equal to the multiplication of the proportion of total imports by the CEECs-10 from the EU-15 (second bracket) and the proportion of imports of spillover commodities to total imports. Among the 35 tradable commodities, only the first three major importing commodities of the CEECs-10 from the EU-15 are assumed to be classified as ‘spillover commodities’ (these are machinery and equipment, motor vehicles and parts, and electronic equipment). The model implicitly assumes that the existing technology transfer rests upon both the embodiment and non-embodiment hypothesis. According to the non-

embodiment hypothesis, imports of spillover commodities *c* by the CEECs-10 from the EU-15 lead to technical progress in industry *c* in the CEECs-10. Nevertheless, statistical evidence from the CEECs-10 shows that these three spillover commodities have high correlations in terms of factor inputs of production; this means that the production of machinery equipment in the CEECs-10 uses a high proportion of machinery equipment, motor vehicles and parts, as well as electronic equipment as factor inputs in the production process. The same applies to the production of motor vehicles and part, and also to electronic equipment. Hence, the embodiment hypothesis is also implicitly assumed in our framework. In other words, while van Meiji and van Tongeren (1999) assume that technology spillovers exist through the direct effect (own effects) under the non-embodiment hypothesis, our framework takes both direct effects and indirect effects (cross effects) into account, based upon the embodiment hypothesis.

The size of shocks in our study are adopted from the empirical estimations by O'Mahony *et al.* (2008) of multi factor productivity (MFP) growth at the sectoral level for the EU-10 (which is the EU-15, minus Ireland, Luxembourg, Sweden, Portugal and Greece). This implies that the values of *aoall* in the source country (EU-15) for MACHI, MOTOR, and ELECT are 0.54, 0.95, and 3.40 respectively. The value of $\lambda$ comes from our empirical estimation on vehicle of technology transfer from the EU-15 to the CEECS-10 and it is equal to 0.147 (Uprasen, 2006).

Due to the constraint on modelling FDI in the standard static GTAP model, the mechanism of technology spillovers through FDI from the EU-15 into the CEECs-10 in our model is assumed exogenously. Nonetheless, the magnitude of technology spillovers is calculated as shown in the following formula:

$$aoall(c,d) = \left( \frac{\sum_r FDI(c,r,d)}{\sum_r \sum_i FDI(i,r,d)} \right) \left( \frac{\sum_i FDI(i,s,d)}{\sum_r \sum_i FDI(i,r,d)} \right)^{\eta} * aoall(c,s) \qquad (13)$$

where,

aoall(c,d) = output augmenting technical change in sector *c* of destination country *d*

aoall(c,s) = output augmenting technical change in sector *c* of source country *s*

FDI(c,r,d) = stock of foreign direct investment of industry *c* (spillovers sector) of destination country *d* from region *r*

FDI(i,r,d) = stock of foreign direct investment of any industry *i* of destination country *d* from region *r*

FDI(i,s,d) = stock of foreign direct investment of any industry *i* of destination country *d* from source country *s*

$\eta$ = productivity elasticity of destination country d with respect to total FDI from source country *s*

Equation (13) states that the magnitude of technology spillovers from the EU-15 to the CEECs-10 is equal to the multiplication of the relative size of industry (first bracket) and the relative size of FDI stock from the EU-15 to the total FDI stock from the world. Unlike technical spillovers via imports, we assume that technology transfer through FDI has a direct effect only. The mechanism of technical spillovers through FDI can occur through many different channels such as an expert from head quarters giving technical advice to workers in a subsidiary, etc. Nevertheless, the exact mechanism of technical spillovers through FDI is beyond the scope of our study.

However, we assume that no cross effects exist in the spillover mechanism through FDI, in the same way they existed through the import vehicle. Among the 35 industries, the statistics of the CEECs-10 show that only two major industries (financial intermediation, and trade and repairs) account for 40 per cent of the stock of FDI from the EU-15. Therefore, we simply assume that technology spillovers *via* the FDI vehicle exist in these two industries only. The size of the effects are also adopted from the empirical estimations of multi factor productivity by O'Mahony *et al.* (2008), *i.e*. the values of *aoall* in the source country (EU-15) for FINAN and TRADE are 0.81 and 0.46 respectively. The value of $\lambda$ also comes from the empirical estimation of Uprasen (2006) and it is equal to 0.03.

### 4.3. Implementation of NTBs in the GTAP Model

The NTBs create trade costs between trade partners. This leads to at least two broad economic effects, *i.e.* shifting in demand and shifting in supply (Roberts *et al.*, 1999). The supply shift effects are highly relevant to technical regulations and sanitary and phytosanitary measures, while the demand shift effects can be identified for any sort of technical regulation. Generally, the NTBs are introduced into the CGE framework under two main approaches, according to Andriamananjara *et al*. (2003). First, the tariff equivalent of NTBs is treated as either the import or export tariff, *i.e.* tms (i,r,s) or txs(i,r,s) which stands for the source-specific change in tax on imports of commodity *i* from region *r* into region *s*, and the destination-specific change in subsidy on exports of goods i from region *r* to region *s*. Second, NTBs are viewed as institutional frictions or 'sand in the wheels' hampering trade. This includes any measures which do not create economic rents, but reduce efficiency, such as customs clearance procedures, technical regulations, sanitary and phytosanitary (SPS) regulations, *etc*. The

removal of these kinds of NTBs can be considered as an import-enhancing technological shock. Based on the first approach, when implementing the shock to *tms* or *txs*, the calculation for welfare effects needs to be corrected carefully since the *tms* and *txs* themselves generate tax revenue in the model. To avoid these difficulties, this paper adopts the second approach for implementing NTBs in the GTAP model. This can be accomplished by following the approach of Hertel *et al.* (2001). According to Hertel *et al.* (2001), the NTBs are taken into account in the GTAP model through the notion of 'effective price' of commodity *i*, imported from country *r*, at domestic prices in destination country *s*, e.g. $PMS^*_{irs}$ (where * stands for effective term).

Let $PMS_{irs}$ represent the observed price; the effective price is defined as equation (14):

$$PMS^*_{irs} = \frac{PMS_{irs}}{AMS_{irs}} \tag{14}$$

Where $AMS_{irs}$ is the augmenting technical change in region *s* due to imports of commodity *i* from region *r*. The elimination in NTBs increases the value of $AMS_{irs}$ which ensures a reduction in the effective domestic price of commodity *i* exported from region *r* to destination country *s*. Thus, the associated 'effective quantity' of exports with this price can be obtained as equation (15):

$$QXS^*_{irs} = QXS_{irs}.AMS_{irs} \tag{15}$$

Equation (14) and (15) are incorporated into the GTAP model by changing them into percentage change forms.

### 4.4. Data Aggregation and Scenario Design

The data for the simulation in our study are obtained from the GTAP database version 6, base year 2001, which comprises 87 regions and 57 sectors. However, there are certain trade-offs between detailed information and computation constraints. Therefore, data aggregation is necessary. In this study, the countries are aggregated into 11 regions, while the commodities are combined into 35 industries. The study focuses on the effects of the EU enlargement on ASEAN as a group (which comprises Indonesia, Malaysia, Philippines, Singapore, Thailand, Vietnam, and the rest of ASEAN). The other regions are chosen accordingly to their importance as the trade partners or as competitors. Table 3 presents the country aggregation.

**Table 3: Geographical Aggregation**

| Model Aggregation | Countries |
|---|---|
| EU-15 | Austria Belgium Denmark Finland France Germany Greece Ireland Italy Luxembourg Netherlands Portugal Spain Sweden UK |
| CEECs-10 | Cyprus Czech Republic Estonia Hungary Latvia Lithuania Malta Poland Slovakia Slovenia |
| ASEAN | Indonesia Malaysia Philippines Singapore Thailand Vietnam and the Rest of ASEAN |
| China | |
| USA | |
| Japan | |
| Hong Kong | |
| Taiwan | |
| South Korea | |
| Australia | |
| Rest of the world | All other countries |

The 57 GTAP industries are aggregated into 35 sectors as illustrated in table 4. However, these 35 industries can be classified into four main categories or sectors: agricultural sector, non-agricultural primary sector, manufacturing sector, and services sector.

**Table 4: Product Aggregation**

| | Industry | Sector | Products |
|---|---|---|---|
| ANIMA | Animals products | Agricultural | Raw milk, dairy products, animals products n.e.c |
| CROP | Crops | Agricultural | Crops and plant-based fibers |
| FOOD | Food products | Agricultural | Food products |
| MEAT | Meat products | Agricultural | Meat products |
| RICE | Rice | Agricultural | Paddy rice and processed rice |
| SUGAR | Sugar | Agricultural | Sugar, sugar cane, and sugar beet |
| VEGEO | Vegetable oils | Agricultural | Vegetable oils and fats |
| OAGRI | Other agricultural products | Agricultural | Wheat, cereal grains n.e.c., etc. |
| FORFI | Forestry and fishing | Primary sector | Forestry and fishing |
| PRIMA | Primary products | Primary sector | Coal, oil, gas, petroleum, coal products |
| APPAR | Wearing apparel | Manufacturing | Clothing, dressing and dyeing of fur |
| CHEMI | Chemical products | Manufacturing | Chemical, rubber, and plastic products |
| ELECT | Electronic equipment | Manufacturing | Computing machinery, radio, television, etc. |
| LEATH | Leather products | Manufacturing | Tanning and dressing of leather; luggage, etc. |
| MACHI | Machinery and equipments | Manufacturing | Electrical machinery&apparatus optical instruments, |
| MANUF | Manufacturing products | Manufacturing | Other Manufacturing: includes recycling |
| METAL | Metal products | Manufacturing | Fabricated & Sheet metal products |
| MINEP | Mineral products | Manufacturing | Non-Metallic Minerals: cement, lime, concrete |
| MINER | Mineral n.e.c. | Manufacturing | Other Mining: mining of metal ores, uranium, gems |
| MOTOR | Motor vehicles and parts | Manufacturing | Motor Vehicles: cars, lorries, trailers and semi-trailers |
| PAPER | Paper products, and publishing | Manufacturing | Publishing, printing and reproduction recorded media |

| | | | |
|---|---|---|---|
| TEXTI | Textiles | Manufacturing | Textiles: textiles and man-made fibers |
| TRAEQ | Transport equipments | Manufacturing | Manufacture of other transport equipment |
| WOOD | Wood products | Manufacturing | Wood and products of wood and cork |
| AIRTR | Air transports | Services | Air transports |
| BUSIN | Business services | Services | Real estate, renting and business activities |
| COMMU | Communication | Services | Communications: post and telecommunications |
| CONST | Construction | Services | Building houses factories offices and roads |
| DWELL | Dwelling | Services | Ownership of dwellings |
| ENERG | Energy | Services | Water, electricity, gas manufacture distribution |
| FINAN | Financial services and insurance | Services | Financial services and insurance |
| PUBLI | public administration and defense | Services | Public admin, defense, education, health |
| RECRE | Recreational services | Services | Recreational services |
| TRADE | Trade | Services | All retail sales; wholesale trade and commission trade |
| OTRAS | Other transport | Services | Water transport, and etc. |

Three scenarios are envisaged in this study. In *Scenario 1*, it is assumed that the EU enlargement implies a full liberalization (100 percent) of tariff barriers in every sector between the EU-15 and the CEECs-10 only, and the CEEs-10 implements the common external tariff. *Scenario 2* is similar to scenario 1, but the elimination of NTBs in all industries between the EU-15 and the CEECs-10 is also taken into account. Finally, *Scenario 3* is similar to scenario 2, but in addition, technical progress from both the imports and FDI vehicles are allowed in the EU-15 and the CEECs-10. Scenario 3 is the most plausible scenario. It is worth noting again that in all of these three scenarios, the accumulation effects are taken into account by endogenizing the capital stock in line with the concept developed by François *et al.* (1996).

## 5. The Simulation Results

The results are presented in tables 5-8. These tables show results in terms of overall macroeconomic impact (table 5), impact in terms of regional welfare (table 6-7) and in terms of structural change (table 8).

### 5.1. Impact on Selected Macroeconomic Variables

Table 5 shows the macroeconomic impact of the enlargement alongside a number of variables such as GDP, terms of trade, capital stock, export volume and import volume, for the EU-15, the CEECs-10, the ASEAN, and a number of other trade partners. The first finding relates to

an inescapable fact which is that deeper economic integration between the EU-15 and the CEECs-10 leads to substantial overall macroeconomic positive effects to these two partners, and to negative effects, albeit more marginal, to some countries in the rest of the world, including ASEAN. This is clearly the case when either scenarios 2 or 3 are taken into account. According to scenario 3, the enlargement generates an additional 1.63 and 5.01 percentage points GDP growth, *i.e.* on top of the growth relating to the base year, for the EU-15 and for the CEECs-10 respectively. This translates also into additional growth for Hong Kong, the RoW, Australia and also for China. ASEAN countries do not seem to benefit from the 5th enlargement, a finding which may strengthen the rationale for concluding an FTA with that specific partner.

**Table 5: Impact on Selected Macroeconomic Variables (percent)**

| Region | GDP | | | Terms of trade | | | Capital stock | | | Export volumes | | | Import volumes | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Experiment** | **1** | **2** | **3** | **1** | **2** | **3** | **1** | **2** | **3** | **1** | **2** | **3** | **1** | **2** | **3** |
| ASEAN | 0.01 | -0.05 | -0.21 | 0.01 | -0.01 | -0.07 | 0 | -0.04 | -0.09 | 0.03 | -0.05 | -1.04 | 0.04 | -0.05 | -1.19 |
| EU-15 | 0.01 | 0.15 | 1.63 | 0.01 | 0 | 0.02 | 0.02 | 0.15 | 1.57 | 0.1 | 0.3 | 1.15 | 0.1 | 0.3 | 1.14 |
| CEECs-10 | -0.32 | 4.08 | 5.01 | -0.5 | 0.26 | 0.33 | 0.11 | 4.23 | 5.15 | 4.81 | 10.79 | 11.24 | 4.34 | 10.16 | 10.66 |
| China | 0.04 | 0 | 0.06 | 0.02 | 0 | 0.07 | 0.01 | 0 | 0.05 | 0.07 | 0.01 | -0.22 | 0.08 | 0.02 | -0.33 |
| USA | 0.01 | -0.01 | -0.02 | 0.01 | -0.01 | -0.07 | 0 | 0 | 0.01 | 0.02 | -0.04 | -0.25 | 0.02 | -0.03 | -0.18 |
| Japan | 0.02 | 0 | -0.22 | 0.01 | 0 | -0.23 | 0 | 0 | -0.03 | 0.02 | -0.02 | -0.39 | 0.02 | -0.02 | -0.41 |
| Hong Kong | 0.03 | 0.04 | 0.35 | 0.01 | 0.02 | 0.16 | 0.02 | 0.02 | 0.27 | 0.02 | 0.02 | 0.12 | 0.02 | 0.02 | 0.14 |
| Korea | 0.02 | -0.01 | -0.33 | 0.01 | 0 | -0.17 | 0.01 | -0.01 | -0.15 | 0.02 | -0.04 | -0.63 | 0.02 | -0.04 | -0.68 |
| Taiwan | 0.02 | -0.01 | -0.33 | 0.01 | -0.01 | -0.15 | 0.01 | -0.01 | -0.17 | 0.02 | -0.04 | -0.93 | 0.02 | -0.04 | -1.04 |
| Australia | -0.09 | -0.11 | 0.12 | -0.07 | -0.1 | 0.05 | -0.04 | -0.05 | 0.1 | -0.08 | -0.13 | 0.01 | -0.08 | -0.13 | 0.01 |
| ROW | 0.04 | -0.15 | 0.13 | 0.02 | -0.02 | 0.07 | 0.06 | -0.27 | -0.03 | 0.08 | -0.1 | 0.06 | 0.09 | -0.15 | 0.02 |

**Source: Authors' calculations based on the GTAP database.**

The table also shows relatively large gains in terms of capital stock, trade volumes and terms of trade in the case of the CEECs-10, the EU-15 and Hong Kong. Again, ASEAN countries experiment a loss under all three variables. These findings are confirmed by the results of table 6.

## 5.2. Impact on Regional Welfare

The impact of EU enlargement on regional welfare is presented in tables 6 and 7.

**Table 6: Impact on Regional Welfare**

| Region | Experiment 1 | | Experiment 2 | | Experiment 3 | |
|---|---|---|---|---|---|---|
| | **Mio USD** | **% of GDP** | **Mio USD** | **% of GDP** | **Mio USD** | **% of GDP** |
| ASEAN | 69 | 0.011 | -162 | -0.026 | -730 | -0.119 |
| EU-15 | 1629 | 0.021 | 8486 | 0.107 | 81470 | 1.027 |
| CEECs-10 | -1472 | -0.406 | 8952 | 2.470 | 10843 | 2.991 |
| China | 207 | 0.018 | 11 | 0.001 | 353 | 0.030 |
| USA | 252 | 0.003 | -175 | -0.002 | -816 | -0.008 |
| Japan | 210 | 0.005 | 13 | 0.000 | -2213 | -0.053 |
| Hong Kong | 24 | 0.015 | 36 | 0.022 | 382 | 0.235 |
| Korea | 48 | 0.011 | -21 | -0.005 | -734 | -0.172 |

| | | | | | | |
|---|---|---|---|---|---|---|
| Taiwan | 24 | 0.008 | -18 | -0.007 | -396 | -0.141 |
| Australia | -103 | -0.029 | -150 | -0.042 | 156 | 0.044 |
| ROW | 2189 | 0.038 | -5467 | -0.096 | 1404 | 0.025 |

**Source: Authors' calculations based on the GTAP database.**

Table 6 shows the impact in terms of regional welfare under the tree different scenarios. Clearly, the most demanding scenario (scenario 3) is the one that brings the highest level of welfare to the two newly integrated regions (the CEECs-10 and the EU-15). Under this scenario, welfare effects are negative for ASEAN, but also for South Korea and Taiwan.

**Table 7: Welfare Decomposition (mio USD)**

| | **Exp. 1** | | | **Exp. 2** | | | **Exp. 3** | | |
|---|---|---|---|---|---|---|---|---|---|
| **Region:** | EU15 | CEE10 | ASEAN | EU15 | CEE10 | ASEAN | EU15 | CEE10 | ASEAN |
| Equivalent Variation (EV) | **1629** | **-1476** | **69** | **8484** | **8961** | **-162** | **81470** | **10853** | **-730** |
| ***EV Decomposition*** | | | | | | | | | |
| a). Allocation effects | 915 | -494 | 14 | 2139 | 944 | -25 | 12389 | 1246 | -74 |
| b). Changes in endowment effects | 455 | 106 | 8 | 2879 | 4131 | -89 | 30037 | 5026 | -194 |
| c). Technical changes effects | 0 | 0 | 0 | 3315 | 3455 | 0 | 37410 | 4023 | 0 |
| *Of which* | | | | | | | | | |
| -NTBs elimination effects | | | | 3315 | 3455 | | 3316 | 3461 | |
| -Spillovers effects | | | | 0 | 0 | | 34094 | 562 | |
| -Other technical changes | | | | 0 | 0 | | 0 | 0 | |
| d). Terms of trade effects | 285 | -912 | 43 | 52 | 436 | -60 | 597 | 555 | -404 |
| e). Changes in saving-investment | -26 | -176 | 4 | 99 | -5 | 12 | 1037 | 3 | -58 |

**Source: Authors' calculations based on the GTAP database.**

The sources of welfare changes can be investigated under a welfare decomposition analysis. Table 7 indicates that the main sources of welfare gains for both the EU15 and the CEE10 are non-tariff eliminations (experiments 2 and 3), and that the gains for the CEE10 are slightly higher than for the EU15 due to the higher nontariff barriers in the new accession countries against the incumbent states. Nevertheless, the technical change effect is the largest source of welfare gains for the EU15 when the productivity effect is taken into account. ASEAN is the loser from the enlargement and the loss comes from the terms of trade effects.

### 5.3. Impact on the Structure of Production

Table 8 gives an insight into structural change as stimulated by the 5$^{th}$ enlargement. For ASEAN, the subject of analysis here, the enlargement leads to a contraction in the production of a number of industries in all three sectors (agriculture, manufacturing and services). Under scenario 3 – the most plausible scenario -, gains for ASEAN as a whole are however noticeable in the following areas: manufacturing in general, and in particular in leather products (+2.37 per cent increase in relation to the production in value terms during the base year), transport equipment (+ 1.45), textile products (+ 1.09), wearing apparel (+ 1.06), and

chemicals (+ 0.73). ASEAN countries would also gain in the services sector. This is the case for business services (+ 0.95) as well as air transport (+ 0.72). One manufacturing industry in the ASEAN countries would stand to lose out in the process; this is motor vehicles, an industry that would expand substantially in the CEECs-10. Again, all the gains for ASEAN are, as expected, substantially less than those accruing to either the CEECs-10 or the EU-15.

Some puzzling results need nevertheless to be noted. According to our results, the CEECS-10 would benefit from a substantial increase in rice production (+ 35.85), to the detriment of ASEAN who would suffer a contraction (- 0.04). These relative increases need obviously to be related to the volume of production. By world standards, the CEECs-10 are only but a marginal producer of rice; according to the GTAP database, their rice production represented in 2001 less than 1 per cent of ASEAN's production in value terms. The principle of *community preference*, although somewhat eroded by the successive reforms of the Common Agricultural Policy, imply greater opportunities for rice producers in the CEECs-10, to the detriment of other traditional rice exporters to the EU, in particular ASEAN. The same remark applies to business services. The production of business services by ASEAN represents barely 5 per cent that of the EU-15. Consequently, a slightly higher expansion of production in this industry in the case of ASEAN translates, when compared with the EU-15, into much smaller gains in volume terms.

**Table 8: Percentage changes in production**

| Industry | Experiment | ASEAN | EU-15 | CEECs-10 | Industry | Experiment | ASEAN | EU-15 | CEECs-10 |
|---|---|---|---|---|---|---|---|---|---|
| ANIMA | **1** | -0.49 | -1.33 | 26.99 | MINER | **1** | 0 | 0.08 | 0.01 |
| | **2** | -0.45 | -1.4 | 27.48 | | **2** | -0.02 | 0.18 | 2.25 |
| | **3** | -0.16 | -1.21 | 27.78 | | **3** | 0.33 | 0.19 | 2.49 |
| CROP | **1** | 0.01 | 0.49 | -2.88 | MOTOR | **1** | 0.01 | 0 | 0.79 |
| | **2** | -0.04 | 0.74 | -6.58 | | **2** | -0.06 | -0.34 | 7.87 |
| | **3** | 0.38 | 0.27 | -6.49 | | **3** | -0.25 | 1.26 | 8.24 |
| FOOD | **1** | -0.15 | 0.03 | 0.1 | PAPER | **1** | 0.02 | 0.09 | -2.19 |
| | **2** | -0.13 | 0.15 | 0.31 | | **2** | 0.01 | 0.16 | -2.74 |
| | **3** | 0.18 | 0.41 | 0.67 | | **3** | 0.55 | 0.33 | -2.03 |
| MEAT | **1** | -0.27 | -0.78 | 10.23 | TEXTI | **1** | -0.15 | 0.14 | -0.58 |
| | **2** | -0.28 | -0.73 | 10.67 | | **2** | -0.23 | 0.18 | 1.24 |
| | **3** | 0.16 | -0.57 | 11.29 | | **3** | 1.09 | -1.02 | 1.21 |
| RICE | **1** | -0.11 | -0.95 | 37.52 | TRAEQ | **1** | -0.04 | 0.06 | -1.12 |
| | **2** | -0.1 | -0.88 | 35.45 | | **2** | 0.01 | -0.09 | 0.4 |
| | **3** | -0.04 | -1.33 | 35.85 | | **3** | 1.45 | -1.6 | 1.19 |
| SUGAR | **1** | -0.14 | -0.46 | 12.04 | WOOD | **1** | 0.09 | 0.2 | -3.28 |
| | **2** | -0.14 | -0.52 | 13.26 | | **2** | -0.07 | -0.04 | -0.97 |
| | **3** | 0.07 | -0.39 | 13.57 | | **3** | 1.19 | -0.02 | -0.14 |
| VEGEO | **1** | -0.11 | 0.11 | 4.63 | AIRTR | **1** | 0.03 | 0.08 | -0.86 |
| | **2** | -0.11 | 0.26 | 4.57 | | **2** | 0.04 | 0.14 | -0.89 |
| | **3** | 0.9 | 0.44 | 4.92 | | **3** | 0.72 | -0.18 | -0.86 |
| OAGRI | **1** | 0 | 0.16 | -0.23 | BUSIN | **1** | 0.01 | 0.03 | -0.76 |
| | **2** | 0 | 0.21 | 0.4 | | **2** | 0.08 | 0.1 | 1.21 |
| | **3** | 0.13 | 0.35 | 0.72 | | **3** | 0.95 | 0.74 | 1.77 |
| FORFI | **1** | 0.01 | 0.07 | -1.11 | COMMU | **1** | 0.02 | 0.02 | -0.49 |
| | **2** | -0.05 | 0.01 | 0.58 | | **2** | 0.03 | 0.08 | 1.36 |
| | **3** | 0.37 | 0.33 | 1.16 | | **3** | 0.34 | 0.54 | 1.83 |
| PRIMA | **1** | -0.01 | 0.07 | 1.98 | CONST | **1** | 0 | 0.02 | -0.08 |
| | **2** | -0.07 | 0.33 | 7 | | **2** | -0.03 | 0.14 | 3.24 |
| | **3** | 0.33 | -0.08 | 6.98 | | **3** | -0.01 | 1.35 | 4.01 |
| APPAR | **1** | -0.07 | 0.11 | 0.38 | DWELL | **1** | 0.01 | 0.02 | -0.5 |
| | **2** | -0.11 | 0.03 | 3.12 | | **2** | -0.03 | 0.14 | 3.59 |
| | **3** | 1.06 | -0.77 | 3.02 | | **3** | -0.11 | 1.45 | 4.34 |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| CHEMI | **1** | -0.01 | 0.08 | -2.73 | ENERG | **1** | 0.01 | 0.03 | -0.2 |
| | **2** | 0 | 0.15 | -3.54 | | **2** | -0.02 | 0.12 | 1.87 |
| | **3** | 0.73 | -0.27 | -3.07 | | **3** | 0.05 | 0.6 | 2.35 |
| ELECT | **1** | 0.05 | -0.15 | 1.42 | FINAN | **1** | 0.01 | 0.02 | -0.43 |
| | **2** | -0.14 | -0.26 | 9.45 | | **2** | 0 | 0.09 | 0.6 |
| | **3** | -4.53 | 10.95 | 9.23 | | **3** | 0.01 | 0.84 | 0.88 |
| LEATH | **1** | 0.52 | 0.19 | -3.88 | PUBLI | **1** | 0 | 0.01 | -0.99 |
| | **2** | 0.4 | 0.39 | -4.08 | | **2** | -0.01 | 0.07 | 1.02 |
| | **3** | 2.37 | -1 | -4.12 | | **3** | 0.06 | 0.63 | 1.41 |
| MACHI | **1** | 0.16 | -0.03 | -1.3 | RECRE | **1** | 0.03 | 0.02 | -0.74 |
| | **2** | 0.21 | 0.01 | -0.98 | | **2** | 0.02 | 0.07 | 2.13 |
| | **3** | 0.45 | 0.95 | -0.04 | | **3** | 0.22 | 0.84 | 2.75 |
| MANUF | **1** | 0.09 | 0.05 | -2.73 | TRADE | **1** | 0.01 | 0.01 | -0.4 |
| | **2** | 0.11 | 0.06 | -1.11 | | **2** | -0.01 | 0.08 | 2.44 |
| | **3** | 0.88 | -0.15 | -0.79 | | **3** | -0.06 | 1.11 | 2.98 |
| METAL | **1** | 0.06 | 0.13 | -3.69 | OTRAS | **1** | 0.1 | 0.1 | -0.38 |
| | **2** | 0.04 | 0.2 | -3.55 | | **2** | 0.18 | 0.2 | 0.6 |
| | **3** | 0.36 | 0.73 | -2.62 | | **3** | 0.59 | 0.47 | 0.93 |
| MINEP | **1** | 0.02 | 0.14 | -3.4 | | | | | |
| | **2** | -0.01 | 0.24 | -3.35 | | | | | |
| | **3** | 0.17 | 0.75 | -2.61 | | | | | |

**Source: Authors' calculations based on the GTAP database.**

## 6. Conclusions

Much has been written on the impact of the EU 5th enlargement on both the EU incumbent states and the new member states, but much less work has been performed on the impact of the enlargement on third countries. By looking at the specific case of ASEAN, this article quantifies this enlargement impact at several levels: macroeconomic, in terms of regional welfare and in terms of structural change. One of the reasons for choosing ASEAN lies in the strength of economic linkages between the EU and ASEAN; this is evidenced by the fact that the EU is the second largest export market for ASEAN's merchandise trade, and the first partner for ASEAN when trade in services is taken into account. Also, ASEAN has been identified by the EU Commission as one of the few key partners in the formulation of a new generation of bilateral agreements.

Using a refined standard GTAP model, this study regroups the data drawn from the GTAP database version 6 into 11 regions x 35 sectors (8 agricultural sectors, 2 non-agricultural primary, 14 manufacturing industries, and 11 services industries). We envisage 3 scenarios of integration between the EU-15 and the CEECs-10. Whereas *Scenario 1* only takes into account a 100 percent reduction of tariff barriers in every industry, *Scenario 2* envisages also the elimination of NTBs in all industries between the EU-15 and the CEECs-10. Under the most stringent scenario, *Scenario 3*, technical progress from both the imports and FDI vehicles are allowed in both the EU-15 and the CEECs-10. All three scenarios assume accumulation effects by endogenizing the capital stock. There are several ways in which the present study differs from previous work on the effects of trade liberalization. First, we take into account the two main vehicles of technology spillovers, namely imports and FDI. Due to

the limitations of the GTAP model, only technology spillovers through imports are endogenized into the standard GTAP model, while the FDI channel is treated as an exogenous variable. Second, since the EU-15 is essentially a service economy and since the CEECs-10 are bound to become more versed into service activities, this study places a special emphasis on the services sector. In doing so, we explore the effects arising from the elimination of the estimated tariff equivalents of non-tariff barriers in services industries at a disaggregated level. This specific research avenue has not been explored explicitly in the various studies on the impact of the 5$^{th}$ enlargement so far.

The results obtained, in particular under scenario 3 – which is the most plausible scenario -, show that deeper economic integration between the EU-15 and the CEECs-10 leads to substantial overall macroeconomic positive effects to these two partners, and to negative effects, albeit more marginal, to some countries in the rest of the world, including ASEAN. The CEECs-10, the EU-15 and Hong Kong gain in terms of capital stock, trade volumes and terms of trade whereas ASEAN countries experiment a loss under all three variables. These results are confirmed with the findings obtained in relation to regional welfare; ASEAN countries benefit from an increased level of general welfare only in the case where the enlargement implies the removal of tariff barriers only. With the removal of NTBs and with technical spillover effects flowing into the CEECs-10, ASEAN countries would suffer a loss in terms of general welfare, especially with regard to the terms of trade when technical changes are taken into account. A result nevertheless is common to other third countries such as South Korea, Taiwan, Japan and the USA.

With regard to the changes in the structure of the production, the 5$^{th}$ enlargement leads to a contraction in ASEAN's production of a number of industries in all three sectors (agriculture, manufacturing and services), in particular in motor vehicles. Gains are however expected for ASEAN in a number of manufacturing areas such as leather products, transport equipment, textile products, wearing apparel and chemicals. In the services sector, the enlargement has a positive impact on the ASEAN countries in a number of areas such as for business services (although starting from a very small base) and air transport. Needless to say, all the gains for ASEAN are substantially less than those accruing to either the CEECs-10 or the EU-15.

There are several ways in which the study can find an appropriate extension. One possible way is by relaxing the assumption of perfect competition across all industries.

**Bibliography**

Anderson, James E. (1979) "A Theoretical Foundation for the Gravity Equation", *American Economic Review*, 69(1), pp. 106-116.

Anderson, James E. and Eric van Wincoop (2001) "Gravity with Gravitas: A Solution to the Border Puzzle", *NBER Working Paper No.8079*

Anderson, James E. and Eric van Wincoop (2003) "Gravity with Gravitas: A Solution to the Border Puzzle", *The American Economic Review*, 93(1), pp.170-192.

Andriamananjara, S.; M. Ferrantino; and M. Tsigas (2003) "Alternative Approaches in Estimating the Economic Effects of Non-Tariff Measures: Results from Newly Quantified Measures", *Office of Economics Working paper No. 2003-12-C*, U.S. International Trade Commission, Washington DC.

ASEAN Statistic Pocketbook (2006), ASEAN Secretariat Unit.

Baldwin, E. Richard, Joseph F. François, and Richard Portes. 1997. "The costs and benefits of eastern enlargement: the impact on the EU and central Europe", *Economic Policy*, 12(24), 127-176.

Bchir, Hedi, Lionel Fontagne, and Paolo Zanghieri. 2003. "The Impact of EU Enlargement on Member States: a CGE Approach", *CEPII Working Paper No.2003-10*.

Bergstrand, J. H. (1985) "The gravity equation in international trade: Some microeconomic foundations and empirical evidence", *Review of Economics and Statistics*, 67, pp. 474-481.

…….(1989) "The generalized gravity equation, monopolistic competition, and the factor-proportions theory in international trade", *Review of Economics and Statistics*, 71, pp. 143-153.

Brown, Drusilla K., Alan V. Deardorff, Simeon D. Djankov, and Robert M. Stern. 1995. "An Economic Assessment of the Integration of Czechoslovakia, Hungary, and Poland into the European Union", *Discussion paper No.380*, School of Public Policy, University of Michigan.

CEC (2006) Global Europe – Competing in the world – A contribution to the EU's Growth and Job Strategy, COM (2006) 567, 4th October, Brussels.

CEC (2007) Global Europe: A Stronger Partnership to deliver Market Access for European Exporters, COM (07) 183 Final, 18 April, Brussels.

CEC (2001) Europe and Asia: A Strategic Framework for Enhanced Partnerships, COM (01) 469, Brussels.

COM (2001) 469 final *"Europe and Asia: A Strategic Framework for Enhanced Partnerships"*, Communication for the commission, Brussels.

Chow, Ming Yu. and D. S. Zietolw (1995) "The Determinants of Bilateral Trade Among Asia-Pacific Countries", *ASEAN Economic Bulletin*, 11(3), pp.298-305.

Deardorff, A. V. (1998) "Determinants of bilateral trade flows: Does gravity work in a neoclassical world", in Frankel, J.A. eds. *The Regionalization of the World Economy*, Chicago, University of Chicago Press.

Deardorff, A. V. and R. M. Stern (1997), "Measurement of Non-Tariff Barriers", *OECD Economics Department Working Papers No. 179*, OECD.

Deardorff, A. V. and R. M. Stern (2004) "Empirical Analysis of Barriers to International Services Transactions and the Consequences of Liberalization", *Discussion paper no. 505*, University of Michigan.

Dimaranan, Betina V. (2001) *"Global Trade, Assistance, and Production: The GTAP 6 Data Base"*, Centre for Global Trade Analysis, Purdue University.

Ferrantino, Michael (2006) "Quantifying the Trade and Economic Effects of Non-Tariff Measures", *OECD Trade Policy Working Papers No. 28*, OECD.

François, Joseph F.; Bradley J. Mcdonald.; and Hakan Nordstrom. 1996. "Liberalization and Capital Accumulation in the GTAP Model", *GTAP Technical Paper No.7*.

François, Joseph F. 1998. "Scale Economies, Imperfect Competition, and the Eastern Expansion of the EU", in Brockmeier *et al* eds., *Economic Transition and the Greening of Policies*, Wissenschaftsverlag Vauk Kiel.

Francois, J. ; H. van Meiji and F. van Tongeren(2003) “Trade Liberalization and Developing Countries under the Doha Round”, *Tinbergen Institute Discussion Paper no. TI 2003-060/2*

François, Joseph F.; Bradley J. Mcdonald.; and Hakan Nordstrom. 1996. “Liberalization and Capital Accumulation in the GTAP Model”, *GTAP Technical Paper No.7*.

Hertel, T. W. (ed) (1997) *Global Trade Analysis: Modelling and Applications*, Cambridge University Press.

Hertel, T. W.;T. Walmsley; and K. Itakura (2001) “Dynamic Effects of the “New Age” Free Trade Agreement Between Japan and Singapore”, *Journal of Economic Integration*, 16, pp. 446-84.

Hertel, T., HUmmels, D., Ivanic, M. and Keeney, R. (2004) “How Confident Can We Be in CGE-Based Assessments of Free Trade Agreements?”, *National Bureau of Economic Research Working Paper Series, No. 1047*, NBER, USA

Itakura, Ken, Thomas W.Hertel, and Jeffrey J.Reimer. 2003. “The Contribution of Productivity Linkages to the General Equilibrium Analysis of Free Trade Agreements”, *GTAP Working Paper No.23*.

Isard, W. (1954) “Location Theory and Trade Theory: Short-Run Analysis”. *Quarterly Journal of Economics*, 68, pp. 305-322.

Kehoe, Timothy J. 2003. “An Evaluation of the Performance of Applied General Equilibrium Models of the Impact of NAFTA”, *Research Department Staff Report No.320*, Federal Reserve Bank of Minneapolis.

Lee, Hiro and Dominique van der Mensbrugghe. 2004. “EU enlargement and its impacts on East Asia”, *Journal of Asian Economics*, 14(6), 843-860.

Lejour, Arjan M., Ruud A. De Mooij, and Richard Nahuis. 2001. “EU Enlargement: Economic Implications for Countries and Industries”, *CESifo Working Paper No.585*.

Lejour, A. M., R. A. de Mooij, and R. Nahuis (2004) "EU Enlargement : Economic Implications for Countries and Industries", in H. Belger and T. Muutos (eds), *Managing European Union Enlargement*, MIT Cambridge.

Linder, Staffan (1961) *An Essay on Trade and Transformation*, New York:Wiley

Lotze, Hermann. 1998. "Integration and Transition on European Agricultural and Food Markets: Policy Reform, European Union Enlargement, and Foreign Direct Investment", *PhD dissertation*, Humboldt University Berlin, Germany.

Lovasy, G. (1941) 'International trade under imperfect competition'. Quarterly Journal of Economics, vol. 55, August, pp. 567–83.

Marques, Helena and Hugh Metcalf (2005) "What Determines Sectoral Trade in the Enlarged EU?", *Review of Development Economics*, 9(2), pp. 197–231.

McCallum, J. (1995) "National Borders Matter: Canada-US Regional Trade Patterns", *American Economic Review*, 85(3), pp. 615-623.

Meiji, Hans van, and Tongeren, Frank van. 1999. "Endogenous International Technology Spilllovers And Biased", Technical Change In The GTAP Model', *GTAP Technical Paper No.15.*

O'Mahony, Mary; Ana Rincon-Aznar, and Catherine Robinson (2008) "Productivity growth in the US and the EU?: A sectoral analysis" *Discussion paper no.DP.307*, National Institute of Economic and Social Research (NIESR).

Park, Soon-Chan (2002), "Measuring Tariff Equivalents in Cross-Border Trade in Services", *KIEP Working paper 02-15*, Korea Institute for International Economic Policy.

Péridy, Nicolas (2005) "The trade effects of the Euro–Mediterranean partnership: what are the lessons for ASEAN countries?", *Journal of Asian Economics*, 16, pp. 125–139.

Philippidis, G. and A.I. Sanjuan (2006) "An Examination of Morocco's Trade Options with the EU", *Journal of African Economies*, 16(2), pp. 259-300.

……(2007), “An Analysis of Mercosur’s Regional Trading Arrangements”, *The World Economy*, 30(3), pp.504-531.

Robert, Donna; Timothy E. Josling; and David Orden (1999) “A Framework for Analyzing Technical Trade Barriers in Agricultural Markets”, *Technical Bulletin No. 1876*, Market and Trade Economics Division, U.S. Department of Agricultural, Washicgton DC.

Rose, A. K. and T. Stanley (2005), “A Meta-analysis of the Effect of Common Currencies on International Trade”, *Journal of Economic Surveys*, 19(3), pp. 347-365.

Tinbergen, J. (1962) Shaping the World Economy: Suggestions for an International Economic Policy, Appendix VI, New York: The Twentieth Century Fund.

Uprasen, Utai (2006) “Technology Transfer in the New Accession Countries”, the paper presented at the European Network of Industrial Policy (EUNIP 9th) International Conference, 20-22 June, University of Limerick, Ireland

Wall, H.J. (1999) “Using the Gravity Model to Estimate the Costs of Protection”, *Federal Reserve Bank of St. Louis Review*, Jan, pp.33-40.

Walsh, Keith, 2006 “Trade in Services: Does Gravity Hold? A Gravity Model Approach to Estimating Barriers to Services Trade”, *IIIS Discussion Paper No.183*, Institute for International Integration Studies, Trinity College and the Irish Research Council for the Humanities and Social Sciences.

# APPENDICES

**Table A1: The Tariff Equivalents of NTBs ( percent)**

| Importer<br>Exporter | EU15<br>EU12 | EU12<br>EU15 |
|---|---|---|
| **Industry** | | |
| Crops | 48.6 | 94.2 |
| Vegetables, fruits and nuts | 115.5 | 53.1 |
| Livestock | 150.2 | 141.1 |
| Other agricultural products | 93.6 | 56.8 |
| Meat | 29.3 | 31.6 |
| Vegetable oils and fats | 83.9 | 35.1 |
| Dairy | 54.9 | 62.6 |
| Sugar | 134.1 | 102.2 |
| Other food products | 99.1 | 89.0 |
| Beverages and tobacco | 242.7 | 314.3 |
| Raw materials | 26.1 | 30.3 |
| Textiles | 29.4 | 24.3 |
| Wearing appliances | 24.4 | 21.8 |
| Wood | 24.2 | 41.0 |
| Paper | 21.2 | 31.9 |
| Chemical | 29.0 | 25.4 |
| Metal | 25.7 | 24.7 |
| Motor | 21.0 | 46.1 |
| Light manufacturing | 10.2 | 20.8 |
| Other manufacturing | 32.4 | 37.9 |
| Utilities | 70.9 | 62.1 |
| Services | 37.7 | 40.1 |

*Source:* Philippidis and Sanjuan (2006, 2007)
*Note:* EU15 is 15 incumbent states, EU12 is the CEECSC10 including Romania and Bulgaria

**Table A2: The Average Import Tariff Equivalents of NTBs (percent) in Services Industries**

| EU15 Importer | Tariff Equivalents (%) | CEECs-10 Importer | Tariff Equivalents (%) |
|---|---|---|---|
| Austria | 74.3 | Czech Republic | 81.8 |
| Denmark | 60.2 | Hungary | 100.1 |
| Finland | 41.0 | Poland | 109.5 |
| France | 64.0 | | |
| Germany | 26.0 | | |
| Greece | 83.9 | | |
| Ireland | 63.9 | | |
| Italy | 75.0 | | |
| Portugal | 69.1 | | |
| Spain | 42.8 | | |
| Sweden | 70.1 | | |

*Source:* Walsh (2006)