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European Enlargement and Single Market Accession: A Mistreated Issue

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Abstract

From 2004, enlargement of the European Union is expected to bring substantial net economic benefits. Herein lies a weakness, in that practically all empirical studies characterise 'single market' accession using simple ad hoc uniform percentage reductions in trade costs. Employing a modified gravity specification we estimate these costs and derive non-tariff barrier (NTB) equivalents, whilst associated regional impacts are calculated within a computable general equilibrium (CGE) framework. Our results suggest that spatial effects in gravity estimations have a dampening impact on NTBs for eleven of our sixteen sectors, which is reflected at the regional level.

• **JEL Classifications:** F1, F11, F13, F15

• **Key words:** European integration, Single market, NTBs, Gravity modelling, Spatial effects, CGE modelling

I. Introduction

From its inception to present day, the European Union (EU) has expanded from

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6 to 15 member states with a concurrent rise in total population from 185 to 375 million. Further plans to extend the European project began in earnest in 1993 at the European Council meeting in Copenhagen, where EU leaders set out detailed economic, political and legislative guidelines on institutional reform, human rights and the protection of minorities. Not surprisingly, this has slowed the pace of EU integration considerably,[1] although the successful conclusion to the Copenhagen negotiations in December 2002 and the signing in Athens of the Accession Treaty in April 2003, promise further expansion of the EU to as many as twenty-seven member states.[2] By far the largest customs union in existence, it is expected to bring greater political and economic harmonisation and stability, the widening of free trade in Europe and greater investment opportunities.

In the intervening time period, there has been a burgeoning of applied trade studies examining the impacts of European integration. One notable feature of this specific literature has been the change in methodology between earlier and later studies, where the majority of earlier studies apply partial equilibrium (Brenton and Gros, 1993; Tyers, 1993; Anderson and Tyers, 1995; Tangermann, 1996). With developments in computational facility and multi-region database syndicates, the vast majority of recent work favours the computable general equilibrium (CGE) approach. The advantage of the latter is that it accurately captures and assesses interaction across sectors and member countries, clearly a key component of any free trade agreement.[3] An additional feature of this empirical trade literature is the richness of contexts pertaining to EU enlargement, which have been examined.[4]

That the largest body of this work (Hertel *et al.*, 1997, Herok and Lotze, 1998; Liapis and Tsigas, 1998, Bach *et al.*, 2000; Frandsen *et al.*, 2000) has focused on the welfare impacts of extending EU agricultural support to the Central and

[1]Having formally applied in 1987, Turkey still faces further delays on its membership.

[2]The ‘first wave’ in 2004 introduces eight members from the Central and Eastern European Countries (CEECs - Czech Republic, Estonia, Hungary, Latvia, Lithuania, Poland, Slovakia and Slovenia) and two new Mediterranean members (Cyprus and Malta). In 2007, Bulgaria and Romania are set to join.

[3]CGE is not without its drawbacks. Model results depend on ‘borrowed’ substitution elasticity estimates, which may be out of date, or ‘best guess’ values. Equally, assumptions relating to factor mobility and model closure greatly influence model predictions.

[4]We endeavour to provide a brief overview of the key areas of EU enlargement treated within the empirical trade literature. However, by our own admission we do not discuss the issue of EMU due to the degree of behavioural complexity in characterising financial markets and associated data limitations in applied trade models resulting in a paucity of studies.

Eastern European Countries (CEECs) is due to a number of factors. Firstly, agriculture in the CEECs accounts for significantly greater land area, contribution to GDP and share of total employment compared with the EU (Ingham and Ingham, 2002).[5] Secondly, the Europe Agreements ratified in 1993 initially left the exact process of integrating these largely agricultural economies undecided.[6] Finally, with the Common Agricultural Policy (CAP) accounting for nearly half of the EU budget, there has been considerable debate on the issue of extending the CAP to the candidate countries whilst maintaining realistic ceiling limits on agricultural support.

A further body of work examines the issue of ‘transition’. Traditional comparative static CGE characterisations are not well suited to modelling the gradual implementation of, and adjustment to, EU common policies. Accordingly, a number of authors (Baldwin *et al.*, 1997, Francois, 1998; Vaittinen, 2002, Heijdra *et al.*, 2002) employ a dynamic CGE treatment to address the impact of temporal considerations (i.e., capital accumulation, investment ownership, productivity growth) on regional welfare. For example, Baldwin *et al.* (1997) investigate the extent to which institutional harmonisation lowers the degree of investment risk in the CEECs, whereas Francois (1998) examines scale effects in non-agricultural sectors with the gradual removal of trade barriers.

A number of studies (Bauer and Zimmerman, 1999; Boeri and Brucker, 2002) focus on the impact of enlargement on labour migration. With significant income differentials between the EU and the CEECs, a degree of labour reallocation is expected, with Austria and Germany facing the greatest possible influx (Heijdra *et al.*, 2002). However, most estimates (European Commission, 2001) suggest that this effect is likely to be modest, with a lower band of around 70,000 workers migrating per annum ranging up to 380,000 immigrants per annum.[7] Notwithstanding, a number of empirical trade studies (Frandsen *et al.*, 2000; Lejour *et al.*, 2001; Vaittenen, 2002) incorporate migration projections into their CGE experiments when examining the costs of accession.

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[5]As an example, Romania and Poland account for 69.2 per cent and 39.9 per cent of the *total* EU15 farming population respectively (EC, 2002)

[6]The Europe Agreements of the 1990s ensured that all non-agricultural trade between the EU15 and the CEECs was tariff free by 2002. Formal negotiations on agricultural trade were not opened until 1999 and 2002 for CEEC and Mediterranean members respectively.

[7]Putting these figures into context, the European Commission (2001) estimates that total annual immigration in the EU in recent times has been around 800,000, with around 300,000 being asylum seekers.

Finally, there is the issue of extending the single market to acceding countries. More specifically, it is anticipated that trade gains will accrue to both the EU and the CEECs with a dismantling of administrative and technical barriers pertaining to product standards, border controls and rules of origin as well as the reduction in trade related risk.[8] A problem arises, however, in attempting to 'quantify' the impacts of non-tariff barriers (NTBs) due to their inherent complexity in design. Indeed, this constitutes a significant weakness in the quantitative trade literature, where the standard approach is to characterise single market access employing an *ad hoc* uniform percentage reduction in trade costs on all EU-CEEC trade.[9]

In recent years, a relatively small but growing literature is developing estimating NTB equivalents on merchandise and services trade using frequency[10] (Hoekman, 1995; Swann *et al.*, 1996), price based[11] (Deardorff and Stern, 1998) and quantity based[12] (Francois and Hoekman, 1999; Anderson and Wincoop, 2001; Park, 2002) methods of measurement. To our knowledge, the only published work examining regional trade and welfare implications of NTBs in the context of European integration is that of Lejour *et al.* (2001), who challenge the standard *ad hoc* treatment. The authors maintain that given the pervasiveness and variation in sectoral NTBs in extra-EU trade (OECD, 1997), the *ad hoc* treatment of such transaction costs and their concomitant impact on trade and economic growth is seriously misrepresented.[13]

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[8]With the democracies of many eastern countries considered to be less stable, insurance often does not cover the flow of goods from west to east (Lejour *et al*., 2001). Brenton and Gros (2001) provide a full discussion of technical NTBs in the EU.

[9]Trade cost reductions are characterised by falls in c.i.f. import prices relative to f.o.b. export prices. Harrison *et al.* (1996), Baldwin *et al.* (1997) and Vaittenen (2002) all assume a 10 per cent reduction in trade costs, with Keuschnigg *et al.*, (2002) employing a lower arbitrary trade cost reduction estimate of 5 per cent.

[10]Using surveys, coverage ratios are developed based on an examination of the proportion of each country's bilateral trade links affected by NTB restrictions. These ratios are subsequently used to calculate tariff equivalents (see Hoekman, 1995).

[11]Price based measures (where data is available) derive estimates of NTBs based on differences between domestic and foreign prices.

[12]Based on econometric models of trade determination: Heckscher-Ohlin model (trade based on comparative advantage); Helpman-Krugman model (trade based on product differentiation); gravity modelling (trade motivated (primarily) by proximity and relative size). NTBs are approximated either from the residuals of the regression or from dummy variable estimates.

[13]Indeed, the context of this research is even more pertinent given the focus in previous trade rounds on tariff barrier reductions, whilst NTBs in many countries have remained unchallenged.

Thus, Lejour *et al.* (op.cit.) employ an ordinary least squares (OLS) gravity specification to estimate potential bilateral trade between countries at the sectoral level employing explanatory data on distance, per capita GDP, bilateral export and import protection and an EU-dummy which assumes a value of unity for current EU members.[14] Their key finding is that for 10 of the chosen 16 industries, the EU-dummy is statistically significant and positive, suggesting that *'bilateral trade (for that industry) is systematically higher if two countries are both members of the EU'* (p.15, Lejour *et al.*, 2001). Furthermore, they suggest that the removal of single market NTBs could increase 'potential' trade by an order of magnitude of between 37 per cent (Machinery and Equipment) and 249 per cent (Agriculture). The study then employs these estimated trade differentials to examine the elimination of single market transaction costs on trade and real GDP by calibrating tariff equivalents into the benchmark Global Trade Analysis Project (GTAP)[15] database characterised as iceberg costs (Samuelson, 1954).[16]

II. Aims and Objectives

In this paper, our main aim is to revisit the gravity specification employed in Lejour *et al.* (op.cit.). Whilst undoubtedly representing a major step forwards in helping to quantify some of the 'true' costs of accession, we hypothesise that they may misrepresent the impact of single market accession in their gravity specification due to the absence of spatial effects. Thus, employing spatial econometrics procedures, we apply the same CGE dataset and aggregation as Lejour *et al.* (op.cit.) to ascertain the degree of bias on gravity estimates of predicted trade. In the latter part of the study, we implement both spatial effects and non-spatial effects gravity estimates into a CGE model as NTB equivalents and examine the differential impacts on trade and welfare.

[14]The study uses 1997 bilateral data from version 5 of the Global Trade Analysis Project (GTAP) database (Dimaranan and McDougall, 2002)

[15]In version 5, the GTAP database provides a broader coverage of regions (66) and commodity sectors (57), with accompanying domestic support and protection data calibrated to the benchmark year of 1997 (Dimaranan and McDougall, 2002).

[16]The concept of an iceberg cost was developed by Samuelson (1954), who suggested that some fraction of a commodity can be conceived of as 'melting' away as a necessary cost of transportation over a unit of distance. This construct is equally applicable to other forms of trade costs such as NTBs, which inhibit the 'effective' flow of goods and services from one region to another.

An attempt to comprehensively model additional enlargement considerations such as the impacts of agricultural support, transition mechanisms and migration is beyond the scope of this paper. Rather, the objective of this research is to contribute to the current paucity of trade cost estimates currently available to modellers investigating this largely mistreated enlargement issue. Thus, the remainder of the paper is as follows: In section III, we provide a discussion and motivation of our gravity specification including estimates of predicted trade using non-spatial effects (NSE) and spatial effects (SE) model treatments. Section IV examines the trade and welfare implications of these specifications within a CGE model context. Section V concludes.

III. The Gravity Model

The gravity model belongs to the class of empirical models concerned with the determinants of interaction. Inspired by the law of universal gravity in physics, according to which attraction is greater between larger and closer positioned bodies, this model stresses that trade increases in proportion with size and proximity of the trading partners. Namely, a vector of bilateral trade flows (exports, imports or total trade) $\boldsymbol{F}_{ij}$ is modelled as:

$$F_{ij} = X\beta + \varepsilon \quad \varepsilon \sim N(0, \sigma^2) \tag{1}$$

where $\boldsymbol{X}$ is a vector of (logs of) explanatory variables, and ε a white noise error term.

Whilst a number of variations in the definition of the vector $\boldsymbol{X}$ are present in the literature, gravity techniques have been criticised due to the apparent absence of any linkage with established economic theory. In response, certain authors have linked the standard gravity specification with the theory of differentiated products (Helpman and Krugman, 1985), whilst others have derived gravity specifications based on classical theories of trade (Deardorff, 1998; Grossman, 1998), increasing returns to scale (Evenett and Keller, 1998) and geographical theory of interregional trade (Asilis and Rivera-Batiz, 1994).

For the purpose of our comparative analysis we chose the standard gravity treatment as in Lejour *et al.* (2001), using the Bergstrand (1989) specification. Here bilateral trade flows are modelled as a function of both income (GDP_i, GDP_j) and income per capita (gdp_i, gdp_j) in the trading partner countries as well as the distance between them ($DIST_{ij}$). Like Lejour *et al.* (p.10) to these explanatory variables we add two dummy variables: one on EU membership ($DUMMY_{EU}$) and one on adjacency ($DUMMY_{AD}$). The estimated parameter on the EU membership dummy (β_i) will enable us to compute potential trade as exp(β_i). Our explained variable is bilateral exports, for which we retain a vector of explanatory variables of the form:

$$X_{ij} = (GDP_i, GDP_j, gdp_i, gdp_j, DIST_{ij}, DUMMY_{EU}, EUMMY_{AD}) \tag{2}$$

$$DUMMY_{EU} = \begin{cases} 1 & EU15 \\ 0 & otherwise \end{cases}$$

$$DUMMY_{AD} = \begin{cases} 1 & adjacent\ \ partners \\ 0 & otherwise \end{cases}$$

With the exception of the dummy variables, each element of $\boldsymbol{X}$ is defined as log of the relevant data.[17]

A. Trade and spatial effects

Traditionally, this model is estimated using ordinary least squares (OLS) on a spatial cross section of data. Lejour *et al.* (op.cit.) also follow this procedure in their empirical evaluation of trade effects from the enlargement of the European Union. However, as Anselin (1998) explains, spatial data is characterised by the presence of spatial effects, namely spatial dependence (caused by various degrees of spatial aggregation, spatial externalities and spillover effects) and spatial structure or heteroskedasticity. In the presence of such effects traditional econometric techniques cease to be applicable, since spatial effects do impact upon the properties of the traditional estimators and statistical tests. If location matters empirically, the data in the sample will indicate the presence of spatial effects: dependence and heterogeneity. When such effects are ignored, standard econometric techniques produce inefficient and, given the implicit mis-specification, biased estimates (Anselin and Griffith, 1988). Instead, the appropriate technique is that of spatial econometrics.

Furthermore, for the particular case of the gravity model of trade, Porojan (2001)

[17]Observations on trade flows of the form F_{ii} have been given a value of one in the levels, which means that they turned into zeros in the log specification.

finds that when the inherent spatial effects are explicitly taken into account in modelling bilateral trade flows, the magnitude of the estimated parameters changes considerably. For aggregated data on bilateral trade flows she finds that the traditional specification is incomplete, as it omits the inclusion of a spatial lag of the dependent variable. More specifically, the lag of the explained variable captures an important part of the spatial effect, traditionally proxied by the distance variable. As Fotheringham and Webber (1980) comment, in the presence of spatial autocorrelation, the estimated parameter on the distance variable captures both "a "true" friction of distance effect" (p.34) and a measure of the map pattern. Moreover, the spatial lag also captures the effects accounted for by some of the dummy variables included in expanded formulation of the basic model (e.g., regional trading bloc membership, adjacency etc.).

Our aim here is to estimate a gravity model of trade that incorporates the information about spatial effects contained in the data and to use this framework as the starting point in evaluating *ex ante* the trade and welfare effects from the enlargement of the EU towards the CEECs. For this purpose, we propose a revision of the empirical formulation in equation (1) as follows:

$$F_{ij} = \rho WF_{ij} + X\beta + \varepsilon \tag{3}$$

where $\boldsymbol{WF}_{ij}$ is the spatially lagged dependent variable; ε is a potentially heteroskedastic error term and ρ the spatial autocorrelation coefficient, measuring the degree of linear dependence between $\boldsymbol{F}_{ij}$ and a weighted sum of neighbouring countries' exports. By neighbours in this context we mean immediately contiguous countries. In order to explore the robustness of the spatial formulation we estimate the model with and without the adjacency dummy. In other words, the vector of explanatory variables becomes:

$$X_{ij} = (GDP_i, GDP_j, gdp_i, gdp_j, DIST_{ij}, DUMMY_{EU}, WF_{ij}) \tag{4}$$

for model A and

$$X_{ij} = (GDP_i, GDP_j, gdp_i, gdp_j, DIST_{ij}, DUMMY_{EU}, DUMMY_{AD}, WF_{ij}) \tag{5}$$

for model B.

B. Data

Geographically, the empirical analysis covers the world economy. Apart for Belgium and Luxembourg, which are grouped together, there is one observation for each EU member state, Norway is entered separately from the rest of the EFTA countries, while Poland and Hungary are entered separately from the remaining eight accession states that are grouped as one entry for Central and Eastern Europe; the Russian Federation, USA, Canada, Japan, Australia, New Zealand and the rest of the world are each entered as individual observations.[18]

Data on income and population come from the World Development Indicators published by the World Bank (2002). The per capita GDP of the exporting (importing) countries (GDP_i, GDP_j) and the f.o.b. bilateral trade price values from the GTAP database (Dimaranan and McDougall, 2002) are measured in 1997-dollar values. The observations for distance ($DIST_{ij}$) measure the great circle between capital cities, in miles. The contiguity matrix contains non-zero values for pairs of countries that share a land border or are separated by a small body of water. The information is from http://intrepid.mgmt.purdue.edu/Trade.Resources/Data/Gravity/.

C. Gravity Results

The information reported in Table 1 summarises the statistical properties of the estimated models in the traditional specification (columns 1 to 5) alongside the proposed alternative (columns 6 to 15), by sector. Our OLS estimates are systematically different from the ones reported by Lejour *et al.* (op.cit.), where for agriculture and food sectors in particular the disparities are considerable. Moreover, in 5 of the 16 sectors, their OLS estimations show insignificance at 5 per cent, while our results show 5 per cent significance in all but one of the sectors. There is no immediately obvious explanation for these disparities save for the fact that income and population data are taken from different sources.[19]

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[18]The sector and region aggregation in our gravity estimations follow Lejour *et al.*, (op.cit.): Agriculture (agric), food processing (Foodpro), raw materials (RawMat), textiles and leather (TL), non metallic minerals (NMM), energy intensive products (EIP), other manufacturing (OthMan), metals (metals), fabricated metal products (FMP), machinery and equipment (ME), electronic equipment (EE), transport equipment (TE), trade services (TS), transport and communication (TC), financial services (FS), other services (OthServs). Note that such sector definitions must be sufficiently wide, where a lack of comparative advantage in narrowly defined sectors (e.g., apples) result in zero intra-industry trade.

[19]We employ World Bank data rather than GTAP and the United Nations respectively.

Table 1. Testing for spatial effects

	Lejour formulation (OLS)					Spatial-effects specification (ML) Model A					Spatial-effects specification (ML) Model B				
	Spatial dependence		Spatial hetero. (c)	AIC	SBC	Spatial dependence		Spatial hetero. (f)	AIC	SBC	Spatial dependence		Spatial hetero.	AIC	SBC
	Error (a)	Lag (b)				Error (d)	Lag (e)				Error (a)	Lag (b)			
Sector	[1]	[2]	[3]	[4]	[5]	[6]	[7]	[8]	[9]	[10]	[11]	[12]	[13]	[14]	[15]
Agric.	52.872 (0.000)*	4.459 (0.035)**	214.712 (0.000)*	2073	2109	0.758 (0.384)	3.629 (0.057)	2.542 (0.111)	2101	2137	9.956 (0.002)*	0.033 (0.855)	2.450 (0.117)	2075	2116
Foodpro.	26.585 (0.001)*	2.279 (0.131)	184.958 (0.000)*	2063	2099	7.664 (0.006)*	4.658 (0.03)**	0.879 (0.348)	2090	2126	4.209 (0.040)**	0.095 (0.758)	0.815 (0.367)	2065	2105
Raw mat.	12.416 (0.133)	4.576 (0.032)**	286.740 (0.000)*	2258	2288	0.165 (0.684)	1.463 (0.227)	1.219 (0.269)	2269	2305	10.209 (0.001)*	-0.009 (-1.00)	1.089 (0.297)	2254	2294
TL	22.245 (0.004)*	3.998 (0.045)**	188.669 (0.000)*	2010	2046	5.311 (0.021)	6.379 (0.011)**	2.751 (0.097)	2034	2069	4.857 (0.027)**	0.601 (0.438)	2.313 (0.128)	2011	2052
NMM	16.801 (0.032)**	1.129 (0.288)	211.112 (0.000)*	1901	1937	25.421 (0.000)*	0.354 (0.552)	1.859 (0.173)	1941	1977	0.549 (0.459)	2.351 (0.125)	1.268 (0.260)	1900	1941
EIP	17.494 (0.025)**	0.401 (0.526)	191.448 (0.000)*	2107	2143	15.542 (0.000)*	0.164 (0.685)	0.194 (0.659)	2136	2173	2.032 (0.154)	2.176 (0.140)	0.059 (0.808)	2106	2147
OthMan.	25.289 (0.001)*	0.511 (0.475)	195.413 (0.000)*	2068	2104	14.451 (0.000)*	0.077 (0.782)	0.264 (0.607)	2099	2135	1.867 (0.172)	2.569 (0.109)	0.142 (0.706)	2067	2107
Metals	39.094 (0.000)*	0.344 (0.557)	209.476 (0.000)*	2206	2242	1.770 (0.183)	0.134 (0.715)	4.947 (0.026)**	2231	2268	6.647 (0.009)*	1.461 (0.227)	4.227 (0.039)**	2207	2247
FMP	20.262 (0.009)*	0.536 (0.464)	203.733 (0.000)*	1936	1972	14.287 (0.000)*	3.355 (0.067)	0.863 (0.353)	1977	2013	2.826 (0.093)	0.059 (0.807)	0.487 (0.485)	1938	1979
ME	20.671 (0.008)*	0.271 (0.603)	188.432 (0.000)*	2138	2174	15.847 (0.000)*	0.301 (0.584)	0.003 (0.955)	2204	2168	1.698 (0.193)	1.657 (0.198)	0.014 (0.907)	2138	2179
EE	23.326 (0.003)*	0.039 (0.844)	196.399 (0.000)*	2186	2223	3.474 (0.062)	0.160 (0.689)	0.022 (0883)	2201	2238	3.212 (0.073)	0.881 (0.348)	0.065 (0.799)	2188	2228
TE	24.088 (0.002)*	1.319 (0.251)	228.402 (0.000)*	2120	2156	7.367 (0.007)*	3.450 (0.63)	0.840 (0.359)	2145	2181	2.546 (0.111)	0.057 (0.811)	0.469 (0.493)	2122	2162
TS	43.276 (0.000)*	0.319 (0.572)	197.217 (0.000)*	1845	1881	1.030 (0.310)	0.039 (0.844)	0.085 (0.771)	1862	1899	10.841 (0.001)*	1.379 (0.240)	0.031 (0.860)	1845	1886
TC	34.369 (0.000)*	0.008 (0.927)	208.942 (0.000)*	1929	1965	5.027 (0.025)**	0.007 (0.933)	0.153 (0.696)	1947	1982	5.271 (0.021)**	1.571 (0.210)	0.078 (0.780)	1929	1970
FS	34.675 (0.000)*	0.283 (0.595)	233.356 (0.000)*	1828	1864	0.417 (0.518)	-.0112 (-1.00)	0.380 (0.537)	1845	1881	9.507 (0.002)*	1.394 (0.238)	0.363 (0.547)	1828	1869
OthServ	27.311 (0.001)*	2.779 (0.095)	189.549 (0.000)*	2003	2039	10.072 (0.001)*	1.488 (0.222)	0.0917 (0.762)	2022	2059	4.612 (0.032)**	8.071 (0.004)*	0.017 (0.896)	1996	2037

Notes: The numbers in parentheses are the p-values; the levels of significance of 1 per cent and 5 per cent are indicated, respectively, by * and **. (a) Kelejian-Robinson test, not built on the assumption of normality of the error terms; (b) Robust Lagrangian multiplier diagnostic test; (c) White test; (d) Lagrange mutiplier test; (e) Likelihood ratio test; (f) Spatial Breusch-Pagan test; AIC is the Akaike Information Criterion; SC is the Schwarz Information Criterion.

The maximum likelihood (ML) estimation results are reported for two alternative specifications, in order to allow for an assessment of the robustness of our findings. Model A (columns 6 to 10) is the one in which the adjacency dummy has been replaced by the spatial lag of the explained variable, while Model B (columns 11 to 15) is the specification that includes the spatial lag alongside the adjacency dummy.

To enable comparison between the proposed specifications we report two information criteria (AIC and SBC). This helps us identify the preferred model when there is no substantial difference in the information contained in the diagnostic tests for spatial effects. In other words, for the same degree of spatial effects, the preferred model is the one with the lowest information criterion. The shaded areas correspond to the specification with least residual spatial effects.

We test the null hypothesis of spatial independence against two alternatives: that of spatial error or spatial dependence as nuisance, (in columns 1, 6 and 11) and that of spatial lag or substantive spatial dependence, (in columns 2, 7 and 12). As indicated by the estimated *p*-values for the Lejour *et al.* (op.cit.) specification, for each sector there is evidence of at least one form of spatial dependence. Furthermore, in the case of the OLS residuals, the low probability values for all the sectors indicate the rejection of the null hypothesis of homoskedasticity. However, no clear conclusions can be drawn at this stage about the prevailing spatial effect, since a significant value in this case can mean that either heteroskedasticity or spatial dependence may be present.

We deal with the presence of all these effects through the ML estimation of equation (5). As the results in the table 1 indicate, the incorporation of the spatial lag in the formulation is, overall, appropriate. However, a closer look to the relationship between this variable and the adjacency dummy variable is truly revealing. It appears that the inclusion of the latter in the estimation is not always justified, despite its statistical significance in the OLS estimation. The adjacency dummy has been so far used alongside distance in an attempt to capture the role of location. However, the effect it captures varies, it seems, across sectors.

Our results show that the elimination from the estimation of this dummy improves the statistical properties of the spatial lag model in the case of agriculture, raw materials, metals and some services. On the contrary, the dummy is meaningful for all the sectors that relate to manufactured goods and in the case for the transport and communications sector. In other words, adjacency does not seem to matter for trade in sectors that are traditionally associated with inter-industry trade (e.g. agriculture, raw materials), but it does make a difference for goods specific to intra-industry trade (e.g. manufacturing, machinery and equipment). As far as services are concerned, adjacency appears as meaningful only in those cases where there is the need for shared infrastructure.

In Table 2, we report the estimated potential trade as percentage changes from the parameter on the EU membership dummy. The ML values in bold are our 'best estimate', from the regression with least residual effects that we compare to the OLS values. It appears that the lack of attention to spatial effects leads to the overestimation of expected trade increase for eleven of the sixteen industries. Irrespective of the direction of change, the differences in estimates range between 0.5 per cent and 20.6 per cent of the traditional formulation value.

A comparison of our estimates with those of Lejour *et al.* (op.cit.) reveals that they overestimate trade effects in eight cases. The differences between their traditional estimates of potential trade and those from our spatial specification range between 2.3 per cent (electronic equipment) and 209.34 per cent (agriculture). Furthermore, while they report no increase in trade for six sectors, our results indicate that only raw materials can expect a fall in trade. In the remaining five cases, potential trade increases range between 18.54 per cent

Table 2. Estimated potential trade increase (per cent)

	Non Spatial Effects (NSE)	Spatial Effects (SE)		per cent difference	Lejour *et al.* (2001)
		Model A	Model B		
Agric	39.46	39.66	40.38	0.51	249
Food pro.	50.48	55.04	52.50	4.00	94
Raw mat.	-25.38	-27.01	-25.27	-0.44	0
TL	98.47	105.38	103.42	5.03	134
NMM	87.21	81.98	79.96	-8.31	107
EIP	59.57	54.84	52.08	-12.58	0
OthMan.	67.29	61.35	60.31	-10.38	0
Metals	22.56	18.54	18.82	-17.83	0
FMP	66.18	66.48	65.43	-1.13	56
ME	65.48	61.11	59.02	-9.87	37
EE	81.36	77.76	76.70	-5.73	79
TE	63.97	66.41	65.61	2.56	94
TS	68.36	64.59	63.49	-5.51	113
TC	27.92	24.46	23.98	-14.11	0
FS	23.15	20.00	20.02	-13.53	0
OthServ	49.73	39.46	38.55	-20.66	31

(metals) and 60.31 per cent (other manufacturing).

IV. CGE experiment

In this section we demonstrate the differential impacts of NSE and SE estimates of trade flows on real growth and regional welfare. To conduct this experiment, we employ the GTAP model and accompanying version 5 database (Dimaranan and McDougall, 2002).[20] In the standard GTAP framework, conventional neo-classical behaviour (utility maximisation, cost minimisation) is assumed, private demands are non-homothetic, production is characterised employing a perfectly competitive, constant-returns-to-scale technology, and bilateral trade flows are modelled using the Armington (1969) specification to allow for imperfect substitution between heterogeneous products. Long run neo-classical closure involves the use of a fictitious agent, known as the global bank, which collects global investment funds (savings) and disburses them across regions such that changes in expected rates of return are equalised. Our choice of aggregation is motivated by the non-uniformity of NTBs across sectors and their aggregate impact on the EU and CEECs.[21] For this reason we employ the same sixteen sector disaggregation as in section 3, whilst regions are aggregated into three: the EU, the CEECs and a rest of the world (ROW) region.

A. Calculation and implementation of NTB equivalents

To implement the trade costs associated with the gravity estimates into a CGE model, we first calculate tariff equivalents following Anderson and Wincoop (2001).[22] The derivation of tariff equivalents also requires sectoral elasticity of substitution estimates, which are taken from the GTAP database (Dimaranan and McDougall, 2002). Thus, the size of our NTB estimates can be interpreted as the trade costs from non-membership of the European Union and are presented in Table 3.

[20]The model description here is brief. For a fully detailed discussion of the model see Hertel (1997).

[21]We are not suggesting that these are the definitive cost differentials from EU accession, since we have not incorporated macro projection shocks, migration effects, CAP domestic support payments, dynamic investment theory or scale economies. Our aim is to illustrate the impact on accession costs from NTBs under both SE and NSE specifications.

[22]To calculate NTB estimates, the log error (i.e., log difference between actual and predicted trade) terms in equation (3) are taken to be indicative of non-tariff trade barriers.

Table 3. Estimated Non-tariff Barriers (per cent)

			Lejour et al. (2001)
	NSE	SE	NSE
Agric	7.4	7.5	17.7
Food pro.	9.1	9.4	11.7
Raw mat.	0.0	0.0	0.0
TL	10.6	11.0	14.5
NMM	11.8	11.0	13.1
EIP	13.1	11.7	0.0
OthMan.	11.0	10.1	0.0
Metals	3.7	3.1	0.0
FMP	9.5	9.4	8.0
ME	9.4	8.6	5.6
EE	11.2	10.7	10.0
TE	4.9	5.0	11.4
TS	14.7	14.0	17.2
TC	6.7	5.8	0.0
FS	5.6	4.9	0.0
OthServs	10.9	8.9	6.5

In accord with our NSE and SE trade predictions in Table 2, for eleven of the sixteen sectors, spatial effects have a dampening impact on NTB estimates. Interestingly, we find that service sector NTBs (with the exception of TS) are relatively low compared with merchandise trade, a result supported by Francois and Hoekman (1999). Comparing with Lejour *et al.* (*op. cit.*), there are similar NTB values in some sectors (FMP, EE), although significant differences exist elsewhere,[23] which we speculate is attributed to differences in source data (income and population) and borrowed elasticity of substitution estimates.[24] Indeed, these factors may explain the large variation in 'quantity based' estimates of NTBs within the literature (Francois, 1999; Francois and Hoekman, 1999; Anderson and Wincoop, 2001; Park, 2002).[25]

In the standard GTAP treatment, NTB trade costs are not incorporated explicitly within the database. To simulate their removal without altering the benchmark data,

[23]In six of their sectors, EU dummies are insignificant, resulting in zero NTB estimates

[24]Intuitively, the greater the elasticity of substitution parameter, the smaller the NTB estimate for a given gravity residual trade estimate.

[25]Furthermore, Park (2002) also notes in his results that NTB estimates do not appear to be correlated with economic development, whilst Hoekman (1995), using frequency measures, reports the opposite result.

we follow the approach employed in Hertel *et al.*, (2001) and Francois (2003) who distinguish between 'observed' and 'effective' prices and quantities of trade.[26] Thus, the 'effective' import price (PMS^E) of good i from exporting region r to importing region s is a function of the observed import price (PMS^O) divided by an exogenous technical coefficient (AMS), which captures changes in bilateral trade efficiency such as removal of NTBs:

$$PMS^E_{i,r,s} = PMS^o_{i,r,s} / AMS_{i,r,s} \tag{6}$$

Increases in AMS capture reductions in trade costs by reducing the effective price of good i in importing region s from a given exporter r. Since efficiency enhancement (i.e., NTB removal) reduces trade costs, in true iceberg fashion, it also increases the effective quantity of export goods from region r. Thus, in the GTAP model, the effective quantity of exports is the product of observed exports and the technical coefficient:

$$QXS^E_{i,r,s} = QXS^o_{i,r,s} \times AMS_{i,r,s} \tag{7}$$

Note, that since the effective and observed *values* are identical, there are no changes in producer revenues and therefore recalibration of the benchmark database is not necessary.

B. CGE Results

We run three model scenarios in which we examine the trade and welfare impacts of accession to the single market. In the baseline scenario (BL), we simulate the removal of all formal (i.e., tariff) trade barriers between the EU and the CEECs. Additionally, with accession to a customs union, we extend the common external tariff (CET) to the CEECs. The second and third simulations employ the same shocks as the BL, whilst including import augmenting technical change shocks to capture the trade costs associated with the removal of EU-CEEC bilateral NTBs by sector associated with NSE and SE gravity estimates respectively. The results show the impacts of the BL, with NSE and SE outcomes presented as residual differences from the BL. Our general observation supports similar findings in Lejour *et al.* (op. cit.) in that incremental trade and welfare

[26] A full description of the exact implementation of bilateral import augmenting technical change is provided in Hertel *et al.* (2001).

impacts from NTB removal are considerable. Furthermore, we find that trade diversion, resource reallocation and welfare effects from European Integration are biased upwards when not accounting for SE.[27]

Referring to the GTAP data, approximately 60 per cent of CEEC imports are from the EU, whilst only 3 per cent of EU imports come from the CEEC.[28] Thus, in the BL scenario, reciprocal import tariff eliminations between the EU/CEEC have a significant trade diversionary effect. Furthermore, a *lowering* of CEEC import tariffs to the ROW from adoption of the EU's CET has an even greater trade diversionary impact, where 81 per cent of the change in the BL CEEC deficit is due to trade with the ROW (Table 4). Encompassing the impacts of single market accession (i.e., NTB removal) reinforces the trade trends recorded in the BL, where significant real income increases in the CEECs (see discussion below) and greater trade openness creates further CEEC imports. Compared to the BL, the CEEC trade balance deteriorates by \$21.349 and \$20.361 billion (Table 4) under

Table 4. Sectoral and Regional Trade Balances

	Baseline			NSE vs. Baseline			SE vs. Baseline		
	EU	CEEC	ROW	EU	CEEC	ROW	EU	CEEC	ROW
Agric	453	-1205	406	242	-980	544	252	-945	502
FoodPro	-480	141	-275	1303	-2784	1249	1222	-2606	1147
RawMat	-158	-80	208	41	-189	140	15	-150	127
TL	-825	2383	-1869	-71	1510	-1653	-242	2145	-2121
NMM	383	-878	404	247	-723	375	269	-732	369
EIP	739	-1794	874	240	-775	375	321	-952	485
OthMan	744	-2218	1312	117	-1342	1007	197	-1427	1028
Metals	163	-1111	880	180	-1541	1375	216	-1581	1384
FMP	862	-1417	488	664	-1120	384	639	-1067	357
ME	3176	-6888	3503	1148	-4289	2961	1256	-4372	2946
EE	-334	-266	542	-794	680	60	-718	586	79
TE	-2208	1651	211	-1300	-1603	2753	-1353	-1269	2468
TS	-23	-701	724	5	-757	752	12	-729	717
TC	853	-1904	3534	282	-2153	3442	288	-2118	3355
FS	132	-730	599	208	-913	705	198	-882	684
OthServ	108	-3596	3488	586	-4369	3783	478	-4262	3785
Total	3586	-18612	15026	3097	-21349	18252	3051	-20361	17310

[27]This is due to the fact that the EU membership dummy captures some of the spatial effects in the absence of the spatial lag of the explained variable.

[28]Intra-EU trade dominates the EU's trade flows.

NSE and SE scenarios respectively. Moreover, compared to the SE specification, we estimate that the NSE scenario overstates the trade deficit (surplus) to the CEEC (EU) by $0.998 billion ($0.046 billion) or 0.34 per cent (0.00 per cent) of GDP.

With Armington preferences, the elimination/reduction of tariff barriers between EU/CEEC trading partners[29] in the BL leads to large allocative efficiency (AE) improvements[30] as primary resources are moved from highly subsidised agri-food sectors into services, manufacturing and (for CEECs only) capital goods production.[31] The AE resource shift is strengthened by additional NTB shocks, where greater trade openness between the EU and the CEECs encourages further specialisation. Compared with the EU, additional allocative impacts under NSE and SE scenarios are much greater for the CEECs given the strong pattern of trade with the EU, whilst comparing between NSE and SE simulations, the latter reduces AE estimates for the EU (CEEC) by $0.059 ($0.131) billion. Similarly, with the additional impact of NTB removal on capital goods (Cap - see Table 5) production in the CEEC there are further welfare improvements, whilst relative to the NSE simulation, SE estimates reduce CEEC Cap welfare gains by only $0.052 billion.[32]

On single market accession, real growth (GDP) improves for both the EU and CEECs, where for the EU the improvement is only slight (0.11 per cent - Table 5) under both specifications, whilst corresponding estimates for the CEEC (largely from output increases in ‘TS’, ‘Othserv’ and capital goods production) are more marked (4.68 per cent and 4.43 per cent). Comparing between SE and NSE simulations, real growth for the CEECs falls by 0.25 per cent under conditions with SE. The equivalent estimate for the EU is negligible. Comparing our growth

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[29]Relative to other activities, the agri-food sectors have considerably higher import tariffs in both the CEECs and the EU.

[30]For a full discussion of each of the welfare decomposition effects in Table 5, see McDougall (2003). In GTAP, the reallocation of existing resources (allocative effect) is calculated by changes in ‘real’ tax revenues. Thus, a reduced agricultural import tariff, for example, would lower the level of activity in a relatively more highly subsidised sector. *Ceteris paribus*, as resources are reallocated away from activities with a lower marginal value product (i.e., agriculture) to those sectors with higher marginal value product, allocative efficiency increases.

[31]In the CEEC, there are falls of 2.8 per cent (NSE) and 2.4 per cent (SE) in agro-food output compared with the baseline (not shown) where agro-food production accounts for 15.5 per cent of total CEEC production (Dimaranan and McDougall, 2002).

[32]Cap is the money metric value of investment (net of depreciation) in each region.

[33]Using the same GTAP version 5 data, Lejour *et al.* (2001) report similarly slight increases in EU real growth (0.1 per cent) due to the small share of CEEC imports in EU trade.

Table 5. Welfare Decomposition* and Macro Indicators**

	Baseline			NSE vs. Baseline			SE vs. Baseline		
	EU	CEEC	ROW	EU	CEEC	ROW	EU	CEEC	ROW
PCRI per cent	0.01	3.45	-0.03	0.10	8.74	-0.05	0.09	8.35	-0.04
GDP per cent	0.01	1.39	0.00	0.11	4.68	-0.01	0.11	4.43	-0.01
EV	419.8	8645.9	-5133.6	6676.2	22746.7	-8305.5	6271.9	21726.1	-8000.5
Of which:									
AE	904.3	4138.1	-1028.6	1085.2	3569.3	-1431.5	1026.0	3438.2	-1396.4
ToT	-340.0	3838.5	-3567.0	-1691.9	6471.5	-5224.6	-1703.4	6277.3	-4997.8
Tech	0.0	0.0	0.0	7746.9	10730.4	0.0	7397.9	10087.3	0.0
Cap	-144.6	669.2	-538.0	-464.0	1975.4	-1649.4	-448.5	1923.3	-1606.3

*see McDougall (2003) for a full mathematical explanation of the decomposition of EV.
**All figures are US$ 1997 millions unless otherwise stated. All percentages are relative to the baseline index.

estimates with Lejour *et al.* (op.cit.) reveals a similar result for the EU,[33] whilst they estimate lower average CEEC growth of 2.7 per cent per annum, which may be partly due to the reduced frequency of NTBs across sectors. A further effect of increasing GDP in the CEEC is that it bids up the reward on mobile factors (labour and capital), resulting in terms of trade (ToT) gains (Table 5), whilst the residual fall in ToT from SE (relative to the NSE scenario) is $0.194 billion.[34]

In terms of aggregate welfare (Table 5), the removal of NTBs under NSE (SE) conditions result in further real income (equivalent variation - EV)[35] gains to the EU and CEEC of $6.676 ($6.272) billion and $22.747 ($21.726) billion respectively compared with the BL, whilst the ROW experiences a negligible welfare fall. Importantly, the size of the CEEC EV gain is equivalent to an 8-9 per cent increase in per capita real income (PCRI -Table 5) across both NSE and SE specifications, whilst the EU's PCRI estimate is of much smaller magnitude. Comparing with the NSE simulation, the *reduction* in EU and CEEC EV (PCRI) under SE is $0.404 billion (0.01 per cent) and $1.021 billion (0.39 per cent) respectively. As expected, welfare improvements relative to the BL are dominated by technical efficiency (Tech) gains from the removal of NTBs on bilateral trade between the CEEC and the EU.[36] Moreover, technical change accounts for 86 per centand 63 per cent of the residual welfare effect for the EU and CEECs

[34]The ToT is simply the change in the real (money metric) values of exports minus imports for each region. The terms of trade are welfare improving if this difference is positive.

[35]The welfare estimates are recorded at a 1997 base price index. A sensitivity analysis of these results is conducted by variation of the trade elasticity and derived NTB estimates.

respectively, when comparing between NSE and SE scenarios.

V. Conclusions

In this paper we combine both gravity and CGE specifications to re-examine the notion of single market access in the policy context of impending European Enlargement. We follow the quantity based technique approach of Lejour *et al.* (2001) in reassessing the importance of NTBs on trade flows, real growth and real income changes. Moreover, based on previous evidence from the gravity literature, we modify the gravity specification in Lejour *et al.* (op.cit.) to assess the importance of spatial effects in estimating the impacts of single market accession.

The results concur with Lejour *et al.* (2001) in that there is considerable variation in NTBs across sectors and that their inclusion has a significant additional impact on trade and welfare, which has either been hitherto ignored or incorrectly specified in the applied trade policy literature on EU enlargement. Furthermore, our model results show that the pervasiveness of NTBs is somewhat greater than in Lejour *et al.* (op.cit.), which we suggest may be attributed to differences in source data.[37]

Whilst the specification of spatial effects suggests a systematic overestimation of NTBs for eleven of the sixteen sectors, the magnitude of these differences in NTB estimates between NSE and SE specifications are not substantial. Employing a CGE framework, we incorporate these trade costs and estimate that relative to the NSE scenario, the inclusion of SE reveals EV and real growth reductions of around $1 billion and 0.25 per cent respectively for the CEECs. For the EU the corresponding EV reduction is $0.4 billion, whilst economic growth remains largely

[36]A technical efficiency (Tech) gain is a money metric equivalent of the value of an existing input from improvements in its productivity. Thus, in standard production theory, it is the monetary value of an upward shift in the marginal value product of a factor. In GTAP, the definition of such inputs may be broadened to include primary factors, intermediate inputs, or even inputs (purchases) to final demands. Thus, in the context of this paper, technical efficiency gains (Tech) are entirely attributed to the elimination of trade costs on imports associated with NTBs, or in other words, bilateral trade efficiency. Note also that unlike tariff cuts, there is no loss in revenue to the importing country from removal of NTBs. Indeed, the welfare impacts are unambiguously positive as NTB removal lowers the effective price of goods/services to the importing country. Clearly, the Tech effects are greater for the NSE scenario, as the NTB estimates are larger.

[37]It should also be noted that our estimates are considered to be conservative given the absence of scale effects, capital accumulation and projections shocks on macro variables. The dynamic specification in Lejour *et al.* (2001) includes the latter two specifications.

unchanged.

Given the widespread usage of NTBs in global trade, the need to determine their importance on trade flows, particularly in the context of the ongoing WTO negotiations, becomes evident. However, there is an inherent problem when employing quantity based measures in that NTB values appear to be highly sensitive to the choice of data (if available) sources resulting in significant variations.[38] Notwithstanding, we posit that only through further research of this type may we come closer to deriving central tendency estimates, thereby better informing the policy debate.

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[38]Indeed, the comparison between our results and those of Lejour *et al.* illustrates this point.

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Appendix

Table A. Sensitivity analysis of the Armington Elasticities (s)*

	Baseline			OLS vs. Baseline			ML vs. Baseline		
Double the Armington elasticities (2σ)									
	EU	CEEC	ROW	EU	CEEC	ROW	EU	CEEC	ROW
PCRI per cent	-0.02	4.65	-0.03	0.04	4.88	-0.02	0.03	4.70	-0.02
GDP per cent	0.02	1.56	-0.01	0.06	2.49	0.00	0.06	2.37	0.00
EV	-1357.6	11649.9	-5679.3	2593.1	12827.5	-4044.1	2412.3	12367.0	-3955.2
Half the Armington elasticities (0.5σ)									
	EU	CEEC	ROW	EU	CEEC	ROW	EU	CEEC	ROW
PCRI per cent	0.04	2.20	-0.03	0.27	19.04	-0.12	0.26	18.24	-0.12
GDP per cent	0.01	1.22	0.00	0.22	10.40	-0.02	0.21	9.90	-0.02
EV	2899.7	5498.4	-4717.6	18817.4	47921.5	-22620.2	17867.1	45890.3	-21839.1

*All figures are US$ 1997 millions unless stated. All percentages are relative to the baseline index.

The welfare and macro indicators in Table A show sensitivity to changes in Armington trade elasticities (σ), where increases (reductions) in σ reduce (increase) the estimated NTB trade cost estimates under NSE and SE scenarios (see footnote 24). Despite lower trade elasticities, technical change impacts are greater under 0.5*s*, resulting in larger trade diversion and allocative impacts. Thus, compared with the baseline, EV (GDP) gains to the EU and CEEC under the NSE scenario vary considerably, between \$2.6 (0.06 per cent) and \$12.8 billion (2.49 per cent) respec-tively to \$18.9 (0.22 per cent) and \$47.9 billion (10.49 per cent) respectively. More importantly, PCRI gains to the CEEC range between 4/5 per cent (2σ) to 18/19 per cent (0.5σ). The residual impact on EV from SE (compared with NSE) for each of the EU and CEEC regions ranges between -\$0.18 and -\$0.46 billion respectively to -\$0.95 and -\$2.03 billion respectively.