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Implicit Trade Costs and European Single Market Enlargement

Edwards, Terence Huw

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Implicit Trade Costs and European Single Market Enlargement

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1 Introduction

This paper addresses 'deeper economic integration' [1] - the idea that regional integration, by addressing institutional, financial, regulatory and infrastructure issues using, for example, harmonisation and mutual recognition agreements,[2] can promote trade beyond what can be attained by tariff removal alone. In particular, I analyse the likely impact of the recent accession of several Central and Eastern European Countries (CEECs) to the European Union. To this end, I derive estimates of aggregate border costs, including many of which are not explicit trade barriers.[3] These are inferred by comparing actual trade with that predicted from country size and transport costs. The novel aspect is the use of a fully model-consistent procedure for identifying such costs, by calibrating a multi-country Dixit-Stiglitz general equilibrium model directly upon observed trade flows.

The conclusions are that trade patterns in 1997 are consistent with border costs between the existing EU and accession states of between 0 and 33 per cent. If these barriers were overcome by deeper economic integration, one might expect overall trade between these areas to increase by 50-100 per cent, leading to gains in income of 10-20 per cent for the accession states and small gains for the existing EU members. While the conclusions broadly agree with previous studies, the implied gains are, if anything, somewhat more optimistic.

The layout of the paper is as follows. Section 2 discusses the derivation and economic role of border costs. Section 3 outlines the calibration and general equilibrium methodology, especially the model-consistent calibration methodology, as well as the data used. In section

[1] See Lawrence, 1995.

[2] On mutual recognition, the most comprehensive reference is Maskus and Wilson's (2000) World Bank study.

[3] e.g. the effects of product standards, labelling and such like, and the associated application of testing and border checks.

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4, I present results and compare them with previous studies. Section 5 concludes.

2 Border costs and the gains from the Single Market

Early studies of European integration, e.g. Brown *et al* (1995), concentrated on the removal of tariffs and formal non-tariff barriers (NTBs). These are relatively straightforward to identify, although the precise nature of the simulation model (usually computable general equilibrium (CGE)) will affect estimates of gains and losses. However, most formal barriers between the EU and the CEECs were removed in the mid 1990s by the Europe Agreements. The issue has then moved to the effects of CEEC accession to the Single Market, with its associated mix of regulatory harmonisation and mutual recognition agreements, intended to remove regulatory barriers to trade. Such barriers are hard to quantify, since national regimes impose a complex mixture of technical and administrative costs.[4]

The literature on trade costs has recently been extensively covered by Anderson and Van Wincoop (2004). I concentrate here on aspects pertinent to European enlargement, and to the integration of trade costs into a general equilibrium model. Costs can be divided into explicit tariff and non-tariff barriers and transport costs and the harder-to-identify costs associated with product standards and border controls. These can be estimated by 'bottom-up' or 'top-down' methods. The former rely on surveying firms for technical data, finding estimates of border queues and the like. This is by no means easy, although some studies - e.g. Zahariadis (2002) - do make attempts at such measurement.[5]

[4] The articles in Maskus and Wilson (2000) are a good survey of the limited research carried out so far on the economics of technical barriers to trade. Baldwin's (2000) article in that book summarises the view that these barriers comprise 'regulatory protection'. Edwards (2003) gives a more cautionary view on this.

[5] Zahariadis (2002) looked at EU-Turkish integration, combining data on various costs from Harrison et al (1996), Hoekman and Eby Konan (1998). Total estimated costs on Turkish imports into the EU were below 5 % for most sectors, though there is also a standardisation cost (Harrison et al (1996)) of 1- 2.8 %

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2.1 Estimated gravity models

Studies such as LeJour et al (2001) or the literature surveyed in Anderson and Wincoop (2004) derive costs by inference from trading patterns, using gravity models, on the grounds that 'bottom-up' estimates may miss many of the costs involved. If a pair of countries trades much less than might normally be expected, then we might well infer that there is some cost obstructing that trade. Tariffs, NTBs and transport costs can be deducted, leaving an estimate for the net effect of regulations, currency conversion costs and even the informational costs of finding trade partners where trade has been difficult in the past (see Rauch (1999), Edwards (2006)).

Trade is usually compared to an assumed underlying gravity framework, using equations (in logs) for trade in good i between exporting country, c, and importing country, cc, of the form:

$$X_{i,c,cc} = \alpha_i + \beta_i d_{ic,cc} + \gamma_{1i} Y_c + \gamma_{2i} Y_{cc} + \epsilon_{i,c,cc}, \tag{1}$$

$X_{i,c,cc}$ denotes exports, Y is GDP and d is distance between capitals of c and cc. Theory suggests that trade should be roughly proportional to the product of country sizes and inversely proportional to distance. Gravity models can be empirical or more theory-driven (see Bergstrand (1989), Anderson and Van Wincoop (2003)).

While gravity equations usually work reasonably well for trade between large subsets of countries, there is a clear misfit in the case of the national borders of the importing country. Trade within almost any country substantially exceeds than that with neighbouring countries, even after taking account of distance. This 'missing trade' can be very substantial[6],

on Turkish exporters only,.

[6] Trefler (1995), McCallum (1995).

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while the causes are controversial[7].

Despite their intentions, the EU Single Market and introduction of the Single Currency are far from eliminating home bias across member states. Nevertheless, there are also limited regional bias effects linked to the regional trade bloc border. These are potentially particularly important when we come to analyse the impact of Single Market enlargement. A fuller gravity model could therefore be written (in logs) as:

$$\begin{aligned} X_{i,c,cc} &= \alpha_i + \beta_{1i} D_{EU}^{ijs} + \beta_{2i} d_{c,cc} + \gamma_{1i} Y_c + \gamma_{2i} y_c + \gamma_{3i} Y_{cc} + \gamma_{4i} y_{cc} + \\ &\quad \sum_d \delta_d Dd_{i,c,cc} + \upsilon_{1i} TM_{i,c,cc} + \upsilon_{2i} TE_{i,c,cc} + \epsilon_{i,c,cc} \end{aligned} \tag{2}$$

where Dd is a set of dummies for border effects, with D^{EU} set to 1 if both c and cc are EU members, otherwise set to zero. $TM_{i,c,cc}$ is the tariff on imports of i from c to cc. $TE_{i,c,cc}$ is the export tariff levied by country c on country cc. y_c and y_{cc} represent income per capita, which can also be shown to have significant effects. In the LeJour *et al (2001)* study, estimated trade between EU members in the late 1990s was between 0-250 % higher than that between EU members and the CEECs.

2.1.1 Cost estimation

To estimate border costs, we also need estimates of demand and supply elasticities. Ideally, these should be consistent with the estimated effects of tariffs and formal NTBs. In addition, it is necessary to make an assumption whether border costs are fixed or variable with respect to trade. The standard response is to assume they are 'iceberg' costs, which eat up a fixed

[7] Obstfeld and Rogoff (2000) argue that a combination of border regulatory costs, currency conversion costs, informational costs and under-measurement of transport costs explains much of the difference. Anderson and Van Wincoop (2003) argue that omitted variables and model-inconsistencies mean that McCallum's estimated border effect is vastly overstated.

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proportion $\phi_{g,c,cc}$ of the value of exports from c to cc. For example, Baldwin *et al* (1997) and LeJour *et al* (2001) assume that non-membership of the Single Market imposes an iceberg cost borne in the first instance by the importer. This could be consistent with bureaucratic or testing costs in the limited case where a fixed proportion of goods imported have to be tested, or with 'pure horizontal' regulatory barriers (in the sense that different countries' rules specify different technical specifications, but which have no tangible difference in terms of the quality of the good or service experienced by consumers).[8] Unlike a tariff, an iceberg border cost yields no revenue: consequently its abolition gives a much greater boost to overall incomes.

The above resource cost specification is open to challenge. Many trading costs (e.g. the redesign of a good, or testing a variety just once to meet different standards), may impose a lump-sum cost on importers. If producers are identical, then there will be a threshold level of lump-sum cost of market entry. The resource cost of this may be greater or less than that of an iceberg cost, depending upon elasticities and the scale of reduction in observed trade volumes, but numerical analysis suggests that, if entry is seen to have been deterred, the cost of a lump-sum barrier must be high.[9]

The idea that regulatory differences are of the 'pure horizontal' variety is open to criticism (see Edwards, 2003). Different standards may be better suited to the different natonal tastes. Higher standards may raise consumer welfare, though at the expense of producers.

Despite these objections, I continue to use the iceberg cost assumption in this paper, partly for consistency with previous studies and partly due to its relative simplicity of

[8] See, again, Maskus and Wilson (2001) or Edwards (2003) for more detail.

[9] The author's calculations indicate that, for a demand elasticity of 4, the threshold lump-sum entry cost imposes a higher welfare loss than the iceberg trade cost consistent with a halving of trade volumes.

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implementation.

2.2 Specification of the simulation model

The most appropriate simulation tool for major trade changes is usually held to be a multi-country, multi-sector CGE model. The neoclassical Heckscher-Ohlin model framework is not seen as realistic, since it only allows for trade in one direction. The major alternatives are the Armington formulation - a somewhat ad hoc model where producers within a country are perfectly competitive, but different countries' goods are differentiated - and the Dixit-Stiglitz (D-S) formulation, which is explicitly derived from a 'love-of-variety' model of consumer demand, and usually assumes Chamberlinian monopolistic competition in the long run between producers of differentiated varieties. Under many circumstances, both the Armington and the D-S models share many behavioural properties (downward-sloping demand curves, improvements in consumer utility from being able to spread demand across a variety of sources), although the latter can also incorporate price mark-ups and potential gains from capacity rationalisation (see Krugman, 1979, Baldwin and Venables, 1995). Where inputs have a variety effect and where transport costs are high, the D-S formulation can result in agglomeration economies, making the model prone to multiple equilibria.

Of previous simulations of Eastward EU enlargement, LeJour *et al* (2001) used fitted coefficients based upon a gravity model of trade and a multi-country Armington CGE model. There was no guarantee of theoretical consistency between the fitted gravity equations and the simulation model. Baldwin *et al* (1997) utilised a D-S general equilibrium model, but simply assumed that trade between EU members and non-members carried a (fairly arbitrary) 10% iceberg cost. Zahariadis' (2001) single-country on possible Turkish accession utilised more conservative bottom-up estimates of border costs.

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3 Methodology of this study

In common with the 'top-down' studies summarised above, I derive implicit trade costs from observed trade. However, unlike previous work, rather than estimating equations, I derive residual border effects by direct calibration of a theoretical D-S model (see below), which are then fully consistent with the model used for simulation. I calibrate residual border effects for imports and exports between each pair of countries (constructing averages for intra-EU trade by model-consistent CES aggregation). This compares to the more parsimonious set of dummies used in most gravity studies, which constrain many residual border effects to be equal. I also use direct estimates of transport costs from the GTAP project, rather than arc distances. In addition, compared to gravity estimation, more specific account is taken of the importance of relative output prices, calibrating for revealed comparative costs on the basis of a certain set of restrictive assumptions has been made about border effects.[10]

3.1 Derivation of border and comparative production costs

The theoretical relationship between the D-S model and the gravity model is well-established since Bergstrand (1989), and forms the basis for the calibration in this paper. Since the calibration technique is novel, I outline it in detail. The subscript i is dropped throughout this section. I assume goods are consumed in countries $c \in 1...C$, which I also index as cc. Imports of good g into country cc are $Q_{g,cc}$. Total consumer utility in country cc is assumed

[10] In the absence of better information, I have assumed these border costs are symmetrical in both directions between a pair of countries. Note that the assumptions made about relative border effects can potentially affect our picture of the underlying competitiveness of the CECs in different industries - further information on this might help guide future work.

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to reflect the function:

$$U_{cc} = \left[\sum_{c} \sum_{g \in c} \beta((1-\phi_{c,cc})Q_{g,cc})^{(\sigma-1)/\sigma} \right]^{\sigma/(\sigma-1)}, \tag{3}$$

where σ is the elasticity of substitution between goods varieties, and $\phi_{c,cc}$ is an iceberg cost. Setting the marginal utility of consumption of g equal to its relative price and rearranging:

$$Q_{g,cc} = U_{cc} \left[\beta(1-\phi_{c,cc})^{(\sigma-1)/\sigma} (\pi_{cc}/P_c(1+\tau_{c,cc})(1+t_{c,cc}) \right]^{\sigma}, \tag{4}$$

where $\tau_{c,cc}$ is the proportionate transport cost and $t_{c,cc}$ is the net contribution of import and export tariffs, subsidies and the tariff equivalents of NTBs. P_c is the selling price of goods from country c at the point of export, while π_{cc} is an aggregate consumer price index for cc.

Next, rewrite (4) in terms of observable variables. The nominal value of exports from c to cc, $E_{c,cc}$ is the number of goods varieties produced in country c, n_c, times sales per good, $Q_{g,cc}(g \in c)$ times the export price P_c, upscaled by $(1+\tau_{c,cc})$ to take account of the transport cost . U_{cc} equals total expenditure in cc, Y_{cc} divided by the aggregate price index π_{cc}. n_c equals output X_c, divided by the turnover of a 'representative' firm, T_c. Hence

$$E_{c,cc} = \beta(1-\phi_{c,cc})^{(\sigma-1)} X_c Y_{cc} T_c^{-1} P_c^{1-\sigma} \pi_{cc}^{-1} (1+\tau_{c,cc})^{1-\sigma} (1+t_{c,cc})^{-\sigma} \tag{5}$$

For $cc = c$ we can replace $E_{c,cc}$ with H_{cc} (home use). For H_{cc}, $\tau_{cc,cc} = t_{cc,cc} = 0$. This

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means that, rearranging (5), and dividing by the version for H_{cc} gives us:

$$E_{c,cc}/H_{cc} = (1-\phi_{c,cc})/(1-\phi_{cc,cc}))^{(\sigma-1)}(X_c/X_{cc})(T_{cc}/T_c)(P_c/P_{cc})^{1-\sigma}(1+\tau_{c,cc})^{1-\sigma}(1+t_{c,cc})^{-\sigma} \tag{6}$$

We can rearrange this to put $(1-\phi_{c,cc})$ on the left hand side, and if we assume $\phi_{c,cc} = 0$ for $c = cc$, we can simplify somewhat:

$$(1-\phi_{c,cc}) = \{(E_{c,cc}/H_{cc})(X_{cc}/X_c)(T_c/T_{cc})(P_{cc}/P_c)^{1-\sigma}(1+\tau_{c,cc})^{\sigma-1}(1+t_{c,cc})\}^{1/(\sigma-1)}. \tag{7}$$

An interesting result is found if we multiply together these expressions for trade in both directions between a pair of countries, c and cc, since a lot of terms can then be eliminated:

$$(1-\phi_{c,cc})(1-\phi_{cc,c}) = \langle\sqrt{\tilde{E}_{c,cc}\tilde{E}_{cc,c}}|\sqrt{H_cH_{cc}}\rangle^{2/(1-\sigma)}, \tag{8}$$

where the tilde represents adjustment for tariffs, NTBs and transport costs. If the geometric average volume of trade between a pair of countries, once tariffs and transport costs have been corrected for, is significantly smaller than that of home-based consumption in the two countries, then there must be residual border costs present. Assuming residual border trade costs are the same in each direction, then

$$\phi_{c,cc} = 1 - \langle\sqrt{\tilde{E}_{c,cc}\tilde{E}_{cc,c}}|\sqrt{H_cH_{cc}}\rangle^{1/(\sigma-1)}. \tag{9}$$

Once an estimated value for the elasticity of substitution, σ has been chosen, all the other terms on the right hand side of (8) are given, so that, for given observed output, consumption and trade, the higher the value of the trade cost, $\phi_{c,cc}$, the lower will be the implicit trade cost in the other direction, $\phi_{cc,c}$. We can therefore use data on observed trade

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flows a) between existing EU member states and b) between existing and future member states (as well as that between pairs of future member states) to infer the cost-equivalence of assumed regulatory barriers to trade.

3.2 The model for simulations

Simulations on the removal of these trade costs are carried out using a multi-country static CGE model, as outlined in Appendix 1. Goods are produced using a Cobb-Douglas aggregate of intermediate inputs and 4 primary factors: unskilled labour, skilled labour, capital and land. Land is fixed sectorally. Both types of labour are mobile between sectors, but not internationally. For capital, I investigate two variants, one where it is fixed in total within a country, and one where it is internationally mobile.

Intermediate inputs and final consumption goods are CES aggregates of home production and imports from various sources. The elasticity of substitution between different sources of a good is set at 4 in all sectors.[11] This lies at the lower end of elasticity estimates surveyed by Anderson and Van Wincoop (2004), which vary from 4 to 5 up to around 10. However, it is more consistent with the elasticities traditionally used in Armington-based general equilibrium models. A key factor may be time-scale (in this model I am interested in medium-run simulations, where perhaps long-run elasticities would be higher).

There are also iceberg transport costs, iceberg unspecified trade costs (see above) and tariffs, as well as taxes/subsidies on output and use of a commodity.

Firms are imperfectly competitive, and charge markups dependent on their market shares.Treatment of the number of firms within an industry and country is an issue here.

[11] The love of variety characteristic of the Dixit-Stiglitz model requires the substitution elasticity $\sigma > 1$. Note that the original Dixit-Stiglitz (1977) paper was written in terms of a substitution parameter, $\rho = (\sigma - 1)/\sigma$, which correspondingly has to lie in the range between zero and unity.

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Many D-S models assume that the number of firms is endogenous. Trade liberalisation leads to a general shakeout of capacity (see Krugman, 1979). The small loss of consumer variety from the shakeout is offset by a larger gain from allowing firms to reap economies of scale (see Baldwin and Venables, 1995). However, endogenised firm numbers are really a long-run assumption, since fixed costs may not be avoidable in the short- or medium-run. For this reason, I retain a 'medium-run' formulation, with a fixed number of firms in each country/industry.

The top level of the consumption function uses a Cobb-Douglas structure.

3.3 Data

I use the GTAP version 5 database, which has harmonised trade and input-output data for regions across the world in 1997. I aggregate data into 8 goods[12] and 10 regions[13], chosen for their relevance to the issue of enlargement[14].

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[12] **Goods**
AG agriculture, forestry and fishing
OP other primary
FP food processing
IS iron and steel
TX textiles
MH heavy manufacturing
ML light manufacturing
SV services

[13] **Regions***
PLD Poland
HUN Hungary
OCEC Other CEECs (Cz Rep, Slovakia, Slovenia, Romania, Bulgaria)
UK United Kingdom
GER Germany
OEUN Other EU Northern
OEUS Other EU Southern (Italy, Spain, Portugal, Greece)
FSU Former Soviet Union
ODX Other OECD excluding EU and CECs
LDC rest of the world (mostly less developed countries)
*note GTAP version 5 has only 3 CEEC regions.

[14] Due to data limitations, I am unable to carry out simulations on the precise accession list of 2004. The other CEEC region comprises the Czech Republic, Slovakia, Slovenia, Romania and Bulgaria. The latter

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For **trade and protection** I use 4 principal data series from GTAP for these countries and regions:exports at market (i.e. domestic) prices (VXMD), exports at world prices (VXWD), imports at world prices (VIWS) and imports at market prices (ie sales prices in the importing country before indirect tax) (VIMS). Trade volumes, transport costs and tariffs are derived from these series.[15]

4 Results

4.1 Border costs

In 1997, imports from the CEECs into the EU faced sizeable barriers in agriculture and food processing, but formal barriers elsewhere had been removed under the Europe Agreements. CES weighted averages of the barriers facing CEEC exports to the EU varied between 10 and 31 per cent for agriculture, while for food processing they were 25-54 per cent. Even after taking account of these formal trade barriers, there is still a considerable shortfall compared to intra-EU trade.

Table 1 shows calibrated comparative costs and country bias. In this case, average 'excess' bias on EU-CEEC trade is assumed to be the same in both directions. The first column shows calibrated production costs relative to the EU. This suggests the CEECs

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two are not on the 2005 EU accession list, whereas the 3 Baltic States, as well as Cyprus and Malta, are.

[15] *VIWS* - VXWD is the transport cost margin.
VXWD - *VXMD* is net export tax/subsidy, plus the GTAP estimates of the tariff equivalent of some quantitative trade restrictions whose revenue accrues to the exporting country.
VIMS - *VIWS* is net import tax/subsidy and the tariff equivalent of remaining NTBs.
Correction is made for some data errors in GTAP V5. I have removed tariffs on trade between the EU and CEECs other than in agriculture and food processing.

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are low-cost producers compared to the EU in almost all industries, especially services[16], agriculture, and light and heavy manufactures. Hungary is low-cost in textiles, while the OCEC region is high-cost in iron and steel.

Table 1 *Calibrated relative production prices and iceberg cost of home/country bias*

POLAND Industry	Relative Price	Intra-EU Home Bias	EU v Poland	Poland v EU
AG	-0.41	0.68	0.08	0.08
OP	-0.21	0.50	0.20	0.20
FP	-0.35	0.68	-0.05	-0.05
TEX	-0.30	0.55	0.09	0.09
IS	-0.01	0.56	0.16	0.16
MH	-0.40	0.59	0.14	0.14
ML	-0.41	0.53	0.17	0.17
SV	-0.38	0.82	0.06	0.06
HUNGARY Industry	**Relative Price**	**Intra-EU Home Bias**	**EU v Hungary**	**Hungary v EU**
AG	-0.35	0.68	0.10	0.10
OP	-0.50	0.50	0.33	0.33
FP	-0.41	0.68	0.05	0.05
TEX	-0.35	0.55	0.06	0.06
IS	-0.14	0.56	0.19	0.19
MH	-0.45	0.59	0.14	0.14
ML	-0.39	0.53	0.09	0.09
SV	-0.45	0.82	0.06	0.06
OTHER CEECs Industry	**Relative price**	**Intra-EU Home bias**	**EU v OCEC**	**OCEC v EU**
AG	-0.36	0.68	0.09	0.09
OP	-0.16	0.50	0.30	0.30
FP	-0.41	0.68	0.06	0.06
TEX	-0.20	0.55	0.08	0.08
IS	0.24	0.56	0.13	0.13
MH	-0.31	0.59	0.11	0.11
ML	-0.34	0.53	0.13	0.13
SV	-0.36	0.82	0.04	0.04

The second column is average calibrated home bias between EU states, which is far from having been eliminated by the Single Market. The remaining two columns show

[16] Comparative costs in services would, of course, be expected to be lower in poorer countries (see Balassa, 1964). However, it seems that, at least for Poland, the low relative costs apply to all sectors. Only for the Other CEEC region does there seem to be clear evidence supporting the Balassa-Samuelson relationship.

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average calibrated iceberg costs of trade in both directions on trade between the EU and CEECs, assuming they are symmetrical [17]. These vary from slightly negative (for Polish food processing only) to around 15% for Polish manufactures, 10-13% for other CEEC manufactures and 9-14 per cent for Hungarian manufactures. For agriculture they are around 7-10%. The key assumption is that Single Market entry can remove these costs.

4.2 Enlargement simulations

Table 2 (below) shows the effects on consumer welfare in each region resulting from (1) customs union (removal of the tariffs on agriculture and foodstuffs and harmonisation of external tariffs with those of the EU) and (2) assumed abolition of iceberg unspecified trading costs, ϕ_i , when countries join the Single Market. Customs union has only small welfare effects, though these generally benefit the accession states by 0-2$\frac{1}{2}$% while having no significant effect on existing EU members. The former effect is not surprising given the fact that most tariffs have already been abolished, while the latter reflects the small size of the CEEC economies relative to the existing EU.

Under (2) the trade between the EU and CEEC is increased to reflect the supposed removal of trade costs following Single Market accession. Since it is assumed these are real resource costs, all countries can gain, including outsiders. The biggest beneficiaries are the CEEC countries, where welfare rises by 10-20% compared to 1997 base. Gains to the existing EU members are typically around $\frac{1}{2}$%. Even the poorer EU countries in the South experience gains of 0.4%, with expansion outweighing the costs of cheap-wage competition. The Former Soviet Union and LDCs also see small gains, so that trade diversion effects are

[17] If costs were asymmetric, then equation (8) would imply that, if border costs were lower in one direction than in Table 1, they would have to be higher in the other direction.

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outweighed for them by the effects of the overall expansion of the EU and CEEC economies.

Table 2	*Summary of results - change on 1997 base, calculated consumer utility*			
	1.EU-CEC customs union		2. CEEC trade shares shift in line with intra-EU trade	
	a) National capital stocks fixed %	b) Capital mobile internationally %	a) National captal stocks fixed %	b) Capital mobile internationally %
Poland	1.9	2.4	15.3	19.4
Hungary	0.2	0.2	14.6	17.6
Other CEC	1.0	1.2	11.5	13.3
UK	-0.0	0.0	0.2	0.1
Germany	0.0	0.0	0.6	0.7
Other EU North	0.0	0.0	0.4	0.4
Other EU South	0.0	0.0	0.4	0.4
EU total	0.0	0.0	0.4	0.4
Europe total	0.1	0.1	0.9	1.1
Former Soviet Union	0.1	0.1	0.0	0.1
Other OECD	0.0	0.0	0.0	0.0
LDCs	0.0	-0.0	0.0	0.0
Global total	0.0	0.0	0.3	0.3

Table 3 shows the change in trade volumes: these are typically of the order 50-100% between the EU countries and CECs on accession.

Table 3	*Changes in trade volumes with trade share shifts and mobile capital assumed*		
Total trade volumes	Before	After	% change
Poland to EU	4.98	9.12	+ 83%
Hungary to EU	2.62	4.34	+ 65%
Other CEC to EU	6.05	9.81	+ 62%
EU to Poland	1.88	3.77	+100%
EU to Hungary	1.45	2.20	+ 51%
EU to Other CEC	3.56	5.50	+ 55%

To summarise some further results[18] :

1. Output gains are spread widely across all industries in the CEEC region, though the biggest gains are to agriculture, food products and manufactures. Within the EU there

[18] Full details and tables are available in Edwards (2004).

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appear to be few losers.

2. Prices in the EU generally fall as a result of the saving in costs of inputs (the unskilled wage in Germany is set to 1 in this model, to act as a numeraire). However in the CEEC countries - especially Poland - output prices generally rise towards EU levels.

3. Relative skilled/unskilled wages do not change greatly in any country, though there are sizeable gains to both types of labour in Poland in particular. The lack of distributional changes between types of labour may partly be because a fixed factor (land) in two sectors absorbs much of the effects of changes in output prices.[19]

4.3 Comparison with other studies

4.3.1 Border costs

The calibrated residual border costs vary between 7 and 15 per cent of total cost of goods traded - which suggest they are roughly twice as large as implied by 'bottom-up' estimates such as Harrison et al (1996) or Zahariadis, 2002. I suggest this represents a general discrepancy between gravity models and attempts to quantify the effects of observable barriers.[20] Possible reasons are that different regulatory regimes involve more inconvenience and uncertainty to trading firms than simple cost estimates imply, or that there may be fixed costs involved which have not properly been modelled, or alternatively that trade costs are magnified by the presence of informational barriers (see Edwards, 2006).

[19] See Edwards and Whalley (2006).

[20] However, a higher trade elasticity, as suggested by, for example, Harrigan (1993), could reduce the implicit border costs consistent with a particular observed trade pattern.

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4.3.2 Enlargement simulation results

Baldwin *et al*'s work (1997) used a relatively sophisticated D-S formulation, and also incorporated estimates of the impact of the Common Agricultural Policy and of structural and regional assistance, as well as capital mobility. However, for trade barriers they simply assumed a 10% across-the-board iceberg cost (which exceeds bottom-up estimates, but is smaller than the implicit costs for many sectors in this study), as well as a capital 'risk premium'. The LeJour et al study (2001) applies a detailed (but not strictly model-consistent) gravity model estimation to a more conventional Armington multi-country CGE model.

The two previous studies both found significant welfare and trade gains from EU enlargement. Baldwin *et al*'s (1997) simulation results, based on an assumed 10% iceberg cost on trade between the EU and CEECs, are shown in Table 4 (below). Le Jour *et al* (2001) also find substantial benefits for the accession countries, particularly Poland, though not as sizeable as in Baldwin *et al* (1997). This is not surprising since the former use an Armington model, which does not model all the benefits which a D-S model captures. Both studies agreed that enlargement involves few costs for existing EU members, though LeJour *et al* (2001) imply France may have lost slightly. The study in this paper finds GDP gains to Poland of around 20% of GDP, to Hungary of nearly 18% and just over 13% for the other CEEC countries, with small gains for the existing EU countries. These estimates exceed those in LeJour et al (2001), but are roughly in line with Baldwin et al's (1997) figures. The difference may largely reflect the greater gains from trade in a Dixit-Stiglitz compared to an Armington framework, with significant pro-competitive and variety gains to utility.

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Table 4: *Comparison with other studies. Real income per cent change*

	Baldwin et al 1997		LeJour et al 2001	
	Conservative	Less conservative	Custom union	Single market entry
CEEC7	2.5	18.8	1.3	5.3
EU15	0.2	0.2	0.0	0.1
EFTA 3	0.1	0.1	N/A	N/A
Other OECD	N/A	N/A	0.0	0.0
Former Sov Union	0.3	0.6	0.0	0.0

4.4 Comparison with actual experience: the case of Poland.

Direct comparison of the counterfactual simulations of a comparative static model with actual country experience is not simple. Accession to the EU Single Market is a lengthy process, requiring adaptation of trade barriers, laws, standards and macroeconomic policies over a number of years, as well as adjustment by firms and consumers. Consequently, even though the official EU accession date for the Poland was 2005, it is by no means easy to establish precisely when adjustment began or will end. In the meantime, global prices and technology have changed, while the CEECs are also readjusting to a market economy and a more transparent political system - a process assisted by, but not entirely dependent upon EU accession.

Looking at the period between 1997 and 2004 (just prior to official accession), Poland's GDP grew by around 29% (or 3.7% per annum)[21], much faster than the Eurozone as a whole. According to the Polish Ministry of Economic Affairs and Labour, Poland's exports more than doubled, rising as from 20% to 33.7% of GDP,[22] with the growth being spread widely across commodities (as our model would indicate). Imports grew less rapidly in percentage terms. The EU accounted for 78% of Poland's exports and 68% of imports in

[21] Source: Polish National Statistical Office, http://www.stat.gov.pl./dane_spol-gosp/finanse_pod_gosp/Rachunki_kwartalne_pkb_latach_1995-2004/tabela38.xls.

[22] Polish Ministry of Economic Affairs and Labour: Poland 2005. Report-Foreign Trade. Table 3 and Charts 3-4.

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2004.

A tentative conclusion would be that the 80-100% surge in Polish-EU trade predicted by the model has effectively happened in anticipation of accession (2004 saw particularly rapid trade growth).[23] The timing of this surge should not be seen as surprising, given that formal trade barriers (except in agriculture and food products) were removed in the mid-1990s, while implementation of the various EU regulations and standards has been a gradual process. The degree to which Poland's rapid GDP growth can be attributed to rising trade with the EU would require much more detailed study: if one assumes that there are up-front costs in changing a country's regulatory regime, and that developing products and market ties to new countries also involves search and learning-by-doing,[24] then, the long-run welfare gains could take longer to emerge than the increase in trade.

5 Summary and Conclusions

This paper addresses the potential benefits of deeper integration of the CEECs into the EU's Single Market, associated with the 2005 accession. I assume that different regulatory and currency regimes pose a significant barrier to trade, proxied by an 'iceberg'-type border cost, whose removal is potentially relatively cheap. Such barriers are estimated by comparing the trade volumes between countries which are already members of the Single Market in 1997 with those which were not. This involves assumptions about the nature and specification of the barriers imposed by different regulatory regimes, and the underlying structure of the economy. With these assumptions, and using a Dixit-Stiglitz type general equilibrium

[23] Some of the trade growth observed would, of course, reflect underlying steady-state economic growth.

[24] Rauch's (1999) work on networks and trade, in particular, would indicate this kind of learning process is involved.

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structure, I calibrate directly for implicit trade costs - so avoiding the questions of model consistency which apply to previous work.

Based upon this approach, trade between the EU and accession states in 1997 fell well short of its potential, as judged by inter-EU trade patterns. Consequently, entry to the Single Market could be seen as potentially raising trade between the accession states and existing EU by 50-100 % compared to 1997, with trade between Poland and the EU rising particularly fast. Unlike purely gravity-based studies, the general equilibrium approach in this paper is able to derive estimates of associated GDP gains: for the EU's new members from Central and Eastern Europe, these are of the order of 13-20 per cent from entry into the Single Market and abolition of remaining tariff barriers. I do not look at the effects of agricultural or regional subsidies. These cost estimates are somewhat larger than those of Le Jour *et al*'s (2001) model, which included fewer competitive and variety effects. Hence, the study can be viewed as giving a bullish interpretation of the trade effects of 'deep integration' of the accession states, although some other potential benefits from institutional reforms are omitted.[25]

A quick comparison with Poland's actual experience since 1997 that the sizeable increase in predicted trade has largely taken place in the years prior to actual accession. However, there may be ongoing welfare benefits as firms and consumers adjust to membership.

[25] On this point, Piazolo's (2001, Chapter D) estimates suggest that an improvement in institutional quality by one third, as measured by the EBRD index, would increase the level of GDP by at least one tenth purely due to the greater efficiency of resource use estimate with our CGE model. The total increase in GDP in some of the institutionally more backward states, allowing for additional investment over time, could be 20 to 30 percent.

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Appendix 1: General equilibrium model (GEMEE).

Notes on the structure of the model:

The model is based on an imperfectly competitive structure, using a Dixit-Stiglitz framework.[26] In this paper I have used the simpler version of the model, where the number of goods produced within each country, c, and industry, i, $n_{c,i}$, is fixed. Each good is produced by one firm and denoted g. However, unlike many Armington models, it does allow for monopolistic markups. I also allow capital to flow between countries.

Production of goods.

Each firm combines labour, land and capital using a Cobb-Douglas function to form a value added input: i.e.

$$VA_g = \theta_{c,i}(LU_g^{\beta u_{c,i}} LS_g^{\beta s_{c,i}})^{(1-\beta k_{c,i}-\beta d_{c,i})} K_g^{\beta k_{c,i}} Dg^{\beta d_{c,i}}, \tag{A1}$$

where VA is value added (quantity), K is capital, D is land which is sectorally fixed. θ, βk and βd are scale and share parameters. Labour is a Cobb-Douglas aggregate of unskilled labour, LU, and skilled labour, LS, βu and βs are share parameters.

All firms g within i in a given country, c, are identical. I normalise $\theta_{c,i} = 1$. In equilibrium,

[26] Dixit and Stiglitz (1977).

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$$
\begin{aligned}
LU_{c,i} &= VA_{c,i}PV_{c,i}\beta u_{c,i}(1-\beta k_{c,i}-\beta d_{ci})/WU_c, \\
LS_{c,i} &= VA_{c,i}PV_{c,i}\beta s_{c,i}(1-\beta k_{c,i}-\beta d_{c,i})/WS_c, \\
K_{c,i} &= VA_{c,i}PV_{c,i}\beta k_{c,i}/R_{c,i}, \\
D_{c,i} &= VA_{c,i}PV_{c,i}\beta d_{c,i}/LDP_{c,i},
\end{aligned}
\tag{A2}
$$

where WU, WS, R and LDP are factor rents.

The price of value added,

$$
PV_{c,i} = (WU_cLU_{c,i} + WS_cLS_{c,i} + R_cK_{c,i} + LDP_{c,i}D_{c,i})/VA_{c,i}. \tag{A3}
$$

Higher level of production function.

Output of i, $Y_{c,i}$, is a Cobb-Douglas aggregate of intermediate inputs II of other goods, ii, and value added, VA:

$$
Y_{c,i} = \Omega_{c,i}VA_{c,i}^{\alpha v_{c,i}} \prod_{ii} II_{c,ii,i}^{\alpha I_{c,ii,i}}. \tag{A4}
$$

Assuming cost-minimisation, with PU and PY denoting input and output prices,

$$
II_{c,ii,i} = \alpha I_{c,i}Y_{c,i}PY_{c,i}/PU_{c,ii,i}, \text{ and} \tag{A5}
$$

$$
VA_{c,i} = \alpha v_{c,i}Y_{c,i}PY_{c,i}/PV_{c,i}. \tag{A6}
$$

Marginal cost, PPY, is easily calculated from the cost of inputs per unit output:

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$$PPY_{c,ii} = (VA_{c,ii}PV_{c,ii} + \sum_i II_{c,i,ii}PU_{c,i})/Y_{c,ii}. \tag{A7}$$

The marginal per unit price including tax and subsidies:

$$PY_{c,ii} = PPY_{c,ii}(1 + OUTTAX_{c,ii}) - SUBSIDY_{c,ii}/Y_{c,ii}. \tag{A8}$$

Trade and the aggregation of goods.

I use a two-stage nested utility function. Total demand for industry bundle i in c is a Dixit-Stiglitz aggregate $TU_{c,i}$:

$$TU_{c,i} = \left(\sum_{g \in i} \gamma_{g,c} U_{g,c}^{\rho} \right)^{1/\rho}, \tag{A9}$$

where $U_{g,c}$ is use of g in c and γ is a parameter reflecting compatibility and home bias in consumption. The substitution parameter $\rho = (\sigma - 1)/\sigma$, where σ is the elasticity of substitution between g in i.

If γ depends only on country of origin, cc, country of use, c, and industry, i, then we sum, first, the various varieties $g \in (cc \cap i)$, produced in each country cc, and then sum across countries:

$$TU_{c,i} = \left(\sum_{cc} \sum_{g \in (cc \cap i)} \gamma_{cc,c,i} U_{g,c,i}^{\rho} \right)^{1/\rho}. \tag{A10}$$

If all firms within an industry/country are identical in size, then we can write

$$TU_{cc,i} = \left(\sum_{c} n_{ci} \gamma_{i,c,cc} \left(QU_{i,c,cc}/n_{c,i} \right)^{\rho} \right)^{1/\rho}. \tag{A11}$$

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Total expenditure in country cc on goods in industry i:

$$VU_{cc,i} = \sum_{c} QU_{i,c,cc} PUU_{i,c,cc}. \tag{A12}$$

The price PU of the aggregate bundle TU:

$$PU_{cc,i} = VU_{cc,i}/TU_{cc,i}. \tag{A13}$$

Consumption (top level of the nested utility function).

Utility UT is a Cobb-Douglas aggregate across i of consumption CN_i :

$$UT_c = \prod_{i} CN_{i,c}^{\beta c_{i,c}}. \tag{A14}$$

$$CN_{i,c} = \beta c_{i,c} CE_c / PU_{c,i}. \tag{A15}$$

Competition and pricing.

Within export markets, it is assumed that a firm has a very small market share and so its own-price elasticity is σ. By contrast, in the home market, the firm's market share $S_{g,c}$ is assumed to be significant, so the firm's price elasticity

$$\eta h_{c,i} = \sigma + (1/n_{c,i})(1 - SM_{c,i})(1 - \sigma), \tag{A16}$$

where, if HU denotes consumption from domestic suppliers and $PT_{i,c,cc}$ is the selling price,

$$SM_{c,i} = 1 - HU_{c,i} PT_{i,c,c} / VU_{c,i}. \tag{A17}$$

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The overall own price elasticity is a weighted average from home and export markets:

$$\eta o_{c,i} = \eta h_{c,i}(HU_{c,i}/Y_{c,i}) + \sigma(Y_{c,i} - HU_{c,i}/Y_{c,i}). \tag{A18}$$

Monopolistic competition markups: the firm marks up production costs by a proportion

$$MM_{c,i} = 1/(1 - (1/\eta o_{c,i})) - 1. \tag{A19}$$

The price of good g including monopoly markups is therefore:

$$PM_{c,i} = PY_{c,i}(1 + MM_{c,i}). \tag{A20}$$

Transport costs

Transport costs are proportional to value, so the price including transport,

$$PTR_{i,c,cc} = PM_{c,i}(1 + Tmarginc_{i,c,cc}). \tag{A21}$$

This is an iceberg cost, so, if $X_{i,c,cc}$ is the quantity of i leaving country c for country cc, the amount which arrives in country cc is:

$$M_{i,c,cc} = X_{i,c,cc}/(1 + Tmargin_{i,c,cc}). \tag{A22}$$

Tariffs

Tariffs are expressed as a percentage rate, so the price including tariffs is

$$PT_{i,c,cc} = PTR_{i,c,cc}(1 + tariff_{i,c,cc}/100). \tag{A23}$$

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The consumer price, $PUU_{i,c,cc}$, also includes a proportional tax on use:

$$PUU_{i,c,cc} = PT_{i,c,cc}(1 + USETAX_{cc,i}). \tag{A24}$$

Exports

Consumption (final and intermediate) in country cc of good i produced in country c is

$$QU_{i,c,cc} = \{X_{i,c,cc}/(1 + Tmargin_{i,c,cc}) \text{ if } cc \neq c \text{ or } HU_{i,c} \text{ if } cc = c\}. \tag{A25}$$

Sales shares

$$QU_{i,c,cc} = TU_{cc,i} n_{c,i} (\gamma_{i,c,cc} PUU_{i,c,cc}/PU_{cc,i})^{1/(1-\rho)}. \tag{A26}$$

Aggregate consumer price

The total value of expenditure on good i in country c is

$$VU_{cc,i} = \sum_c QU_{i,c,cc} PUU_{i,c,cc}. \tag{A27}$$

Factor markets

Both types of labour are immobile between countries, but mobile between industries. The wage clears each labour market, so that

$$\begin{aligned} \overline{LU}_c &= \sum_i LU_{c,i}, \\ \overline{LS}_c &= \sum_i LS_{c,i}. \end{aligned} \tag{A28}$$

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Capital is fully mobile between industries, and may or not be mobile between countries:

$$\overline{K}_c + KM_c = \sum_i Ki_{c,i}. \tag{A29}$$

Where KM_c is non-zero (so that there are international transfers of capital) the global total of KM is set to zero.

$$\sum_c KM_c = 0. \tag{A30}$$

The rate of return on capital in each industry is equated to the national rate of return, RB_c:

$$R_{c,i} = RB_c. \tag{A31}$$

Where capital is allowed to move internationally,

$$RB_c = RB_{ODX}. \tag{A32}$$

Land is sectorally immobile, so

$$LD_{c,i} = \overline{LD}_{c,i}. \tag{A33}$$

Variety of goods

For sensitivity analysis, the fixed firm numbers version of the model assumes the total number of firms in each country is fixed:

$$n_{c,i} = \overline{n}_{c,i}. \tag{A34}$$

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National accounts

Home use of goods, $HU_{c,i}$,equals total production less exports:

$$HU_{c,i} = Y_{c,i} - \sum_{cc} X_{i,c,cc}. \tag{A35}$$

Total use of good i in country c produced in country cc equals home use, where $c = cc$. Otherwise it equals imports.

Use tax is an ad valorem tax on all use of i in country c, giving revenue

$$TUY_c = \left(\sum_i HU_{c,i} PT_{i,cc} + \left(\sum_{cc} PT_{i,cc,c} EX_{i,cc,c} / (1 + tmargin_{i,cc,c}) \right) \right) (1 + u\,setax_{c,i}). \tag{A36}$$

Output tax, OT, is a tax per unit value of output of an industry above.

Total consumer expenditure in country c,

$$\begin{aligned} CE_c \;=\; & \sum_i VA_{c,i} PV_{c,i} + \sum_i Y_{c,i} PY_{c,i} MM_{c,i} \\ & + \sum cc \sum_i (EX_{i,cc,c} PM_{cc,i} TR_{i,cc,c})/100) \\ & + \sum_i OT_{c,i} \left(VA_{c,i} PW_{c,i} + \sum_{ii} II_{c,ii,i} PU_{c,ii} \right) \\ & + TUY_c - TSUBY_c - BOT_c - KM_c RB_c. \end{aligned} \tag{A37}$$

The Balance of Trade, BOT_c, (including long-term net capital payments) is fixed:

$$BOT_c = \sum_i \sum_{cc} EX_{i,c,cc} PM_{c,i} - \sum_{cc} EX_{i,cc,c} PM_{cc,i} - KM_c RB_c. \tag{A38}$$

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Key assumed parameter values: Demand side:

The top level utility function is Cobb-Douglas in functional form (so the elasticity of substitution between consumption of the produce of each industry, i, is unity). Share parameters for each product class are calibrated from value shares in total expenditure.

The lower level utility function has an elasticity of substitution between goods g in industry i of σ. This is assumed to equal 4 in all industries.

Supply side: technology is assumed to be Cobb-Douglas, so elasticities of substitution between inputs are unity, and share parameters can be directly calibrated from total costs (once monopoly profit has been subtracted). **Firm sizes** are equal within each industry across countries. Iron and Steel and Heavy Manufacture are seen as the least competitive industries (1 and 3 firms respectively in our smallest region, Hungary), followed by Other Primary, Light Manufacturing, Textiles and Food Processing (4-6 firms per industry in Hungary). Services and agriculture have much smaller firm sizes.

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