Regional Integration and Trade: A Panel Cointegration Approach to Estimating the Gravity Model

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ABSTRACT

Using a panel data set of bilateral export flows from 12 EU countries to 20 OECD trading partners over the period 1992-2003, a panel cointegration approach to estimating the gravity model is adopted to test for the significance of European regional integration. A comparison of the results indicates that a positive and significant coefficient estimate of the EU dummy variable is found for both the pooled OLS (POLS) estimator and the dynamic OLS (DOLS) estimator. The results, however, diverge once fixed effects are admitted into the model. The least squares dummy variable (LSDV) estimator suggests a small positive effect of EU integration on trade. In contrast, the dynamic LSDV (DLSDV) estimator indicates that regional integration has a larger beneficial effect on trade. The results highlight the fundamental importance of properly accounting for endogeneity when evaluating trade policy effects.

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I. INTRODUCTION

The proliferation of regional trade agreements (RTAs) in the 1990s prompted a renewal of interest in studying the trade effects of regional integration. Since the creation of the World Trade Organisation (WTO) in January 1995, some 250 RTAs have been notified to the WTO. Taking into account the number of RTAs which are in force but have not been notified, those signed but not yet in force, those currently being negotiated and those in the proposal stage, almost 400 RTAs are scheduled to be implemented by 2010.

The effect of regionalism on trade has been extensively evaluated within a gravity model framework (Sapir, 2001). Most studies of regional integration in Europe find a small, positive and significant effect of RTAs on trade although a neutral or even a negative effect also feature among the empirical findings. The mixed results may be due to a number of factors such as the time-period under study or the sample of countries considered. For example, the findings of Aitken (1973) indicate differing results depending on the time-frame. In estimating a gravity model as a cross-section for each year over the period 1951-1967, Aitken (1973) finds the trade effects of the dummy variables denoting the European Economic Community (EEC) and the European Free Trade Association (EFTA) are consistent with theoretical predictions. In other words, the trade preference coefficients are initially negative and insignificant in the pre-integration period, change sign during the integration phase and increase in magnitude with the progression of time, eventually becoming positive and significant.

The effects of European regionalism on trade can also depend on the number of countries in the sample. Based on a panel data set of 61 countries over the period 1980 to 2003, the findings of Bussière *et al.* (2005) indicate that the EU dummy coefficient is positive and significant using POLS, but is negative and insignificant for the fixed effects (FE) estimator. In conducting a number of robustness checks on the results, the EU dummy remains insignificant for a sub-sample of years starting in 1993, but becomes positive and significant for the FE estimator only when using a sub-sample of OECD countries.

Several approaches have been used to assess the importance of regional integration within a gravity model framework: whereas early studies tended to use cross-sectional methods or a series of cross-sections (Aitken, 1973), panel methods dominate more recent studies. Bayoumi and Eichengreen (1998), for example, continue with the theme of the trade effects of the EEC and EFTA using a first-difference equation of the gravity model among the industrialised countries over the period 1956-1992. The effect of European regional integration has also been examined across a variety of fixed effects estimators (Stack, 2009). Using a similar approach, Cheng and Wall (2005) extend the sample size to consider the trade effects of additional regional blocks while Bussière *et al*. (2005) expand the analysis across several panel estimators, including pooled OLS (POLS), dynamic OLS (DOLS), the fixed effects (FE) and the random effects (RE) estimators.

Many of the empirical findings, however, are likely to suffer from endogeneity bias because one or more of the explanatory variables are correlated with the equation's error term (Bun and Klaassen, 2007). One source of endogeneity bias arises when a relevant explanatory variable is excluded from the gravity model. If an excluded variable is correlated with an included regressor, then the latter is endogenous. In the context of cross sectional regressions, efforts to counter omitted variable bias have typically taken the form of augmenting the gravity specification with relevant explanatory variables in line with theoretical underpinnings – for example, GDP per capita (Bergstrand, 1989). With the additional dimensions of panel data sets, an alternative approach to the omitted variable bias problem has emerged in the form of controlling for omitted unobservable factors across countries through the use of fixed effects, or equivalently, the least squares dummy variable (LSDV) estimator. Yet, while the LSDV estimator controls for correlation between the fixed effects and the included regressors, it does not control for an additional source of endogeneity bias that arises from the joint determination of the dependent variable and the explanatory variables. Frankel and Romer (1999) have previously highlighted the bi-directional nature of causality between trade and GDP. The dynamic OLS (DOLS) estimator, by allowing the equation's error term to be correlated with the leads and lags of the changes in the non-stationary regressors, can be used to account for the possible reverse causality between trade and GDP. Generalising the DOLS estimator to include fixed effects gives the dynamic LSDV (DLSDV) estimator.

This paper examines the trade effect of regionalism in Europe using a panel cointegration approach to estimating the gravity model of bilateral export flows from 12 EU countries to 20 OECD trading partners for the years 1992-2003. The trade effect of European regional integration is estimated using a binary-coded EU dummy variable, which captures the accession of Austria, Finland and Sweden in 1995 when the EU-12 became the EU-15. Applying the dynamic LSDV (DLSDV) estimator to the gravity model accounts for two potential sources of endogeneity bias: omitted variable bias and simultaneity bias. A panel cointegration approach to estimating the gravity model also guards against the spurious regression problem.

Focusing on the effect of EU enlargement, a comparison of the results across the estimators can be summarised as follows. First, POLS and DOLS indicate a positive and significant coefficient of the EU dummy. Second, the results diverge substantially once fixed effects are admitted into the model. The LSDV estimator suggests a small positive effect of EU integration on trade. In contrast, the DLSDV estimator indicates that EU enlargement has a larger beneficial effect on trade. The results suggest the importance of controlling for both omitted variable bias and simultaneity bias.

The layout of this paper is as follows. Section II introduces the gravity model of new trade theory (NTT) determinants and outlines the main theoretical underpinnings of the model. The estimation strategy and data are also provided in this section. Section III discusses the results, focusing mainly on the sensitivity of the trade effect of EU integration to the estimator used. Section IV concludes.

II. MODEL SPECIFICATION AND DATA

The gravity model specification of bilateral exports is expressed as follows:

$$EXP_i{}^tj = n + a>j + 0^t + YG>ij + P_1TGDPt + faSGDP_i{}^t{}_j$$
$$+ fcDGDPPC_{\,t}j + faEU_{\,t}j + e_{t\,ij} \qquad (1)$$

where *EXPj* are the bilateral export flows from 12 EU countries to 20 OECD partner countries, expressed in US dollars at constant 2000 prices; total GDP is a measure of the overall country size, given by the natural logarithm (ln) of the sum of GDP for both countries, in constant 2000 US dollars, $TGDP_i{}^tj = ln(GDP_i^t + GDP_j^t)$; the similarity of size index for each country-pair is obtained from the two countries' shares of GDP, $SGDP_i{}^tj = \ln\{1 - [GDPi/(GDP_i^t + GDP_j^t)]^2 - [GDP_j^t/(GDP_i^t + GDP_j^t)]^2\}$, also in log form; and the absolute difference in the logged values of GDP per capita income levels, in constant 2000 US dollars, is a measure of relative factor endowments, given by

$DGDPPC_{ij}^{t} = |\ln GDPPC_i^t - \ln GDPPC_j^t|$.

The binary-coded EU dummy variable takes the value of one when both countries are members of the EU, otherwise it is zero. The designated values hold for member countries throughout the sample period; for Austria, Finland, and Sweden, values of unity are assigned only after gaining official membership of the EU in 1995. Hence, the EU dummy coefficient captures the trade effect of the fourth round of EU enlargement in 1995. The random error term is denoted by $s\backslash$.

Equation (1) follows the new trade theory developed by Helpman and Krugman (1985). As a starting point, they return to the factor proportions theory, also known as the Heckscher-Ohlin model (Heckscher, 1919; Ohlin, 1933), which explains trade patterns in terms of relative factor abundance. Specifically, capital abundant countries - specialising in the production of goods in which they are relatively well endowed - will export capital-intensive goods and will import labour-intensive goods. The converse also holds true for labour abundant countries.

In recognition of the faltering ability of the Heckscher-Ohlin model - primarily a supply oriented theory - to explain the disproportionately high volume of trade between the developed countries, Linder (1961) proposed a demand based theory which explains trade in terms of the similarity of demand characteristics between trading partners. If the aggregated preferences for goods by the importing country j are similar to the consumption patterns of the exporting country i, then country j will develop industries that are similar to country i. The resulting exchange of certain goods between certain countries will depend on the continued production of and demand for similar but differentiated goods. In combining the supply side and demand side theories of trade within a Heckscher–Ohlin–Chamberlain–Linder framework, Bergstrand (1989) identifies separate roles for GDP and per capita GDP.

Building on Linder's hypothesis, Gruber and Vernon (1970) append the absolute difference between the two countries' per capita incomes to the standard gravity equation as a way of capturing differences in consumption patterns. A negative coefficient, suggesting trade is positively related to countries with similar consumption patterns and therefore similar per capita incomes indicates support for the Linder hypothesis. A positive coefficient can be interpreted as evidence in favour of the factor proportions theory.

Helpman and Krugman (1985) observe from the data that trade between the industrialised countries is better explained by similarities rather than differences in relative factor endowments. Put in another way, the substantial rise of two-way trade in goods of similar factor intensity cannot be explained by the constant returns to scale, perfectly competitive assumptions of the Heckscher–Ohlin model.

Helpman and Krugman (1985) also introduce preferences for differentiated goods into the Dixit–Stiglitz (1977) model of monopolistic competition in which each firm produces a unique variety of goods under increasing returns to scale. On the demand side, the Dixit–Stiglitz 'love of variety' approach means that consumers demand all available varieties in equal quantities. On the production side, increasing returns to scale involves the production of only a limited number of varieties so that in equilibrium, consumers' tastes for variety are proportional to the number of varieties produced. Given that demand for foreign varieties is proportional to the size of the market, trade in similar but differentiated goods implies trade occurs between similar countries. In a multi-country world, a version of the gravity model is derived in which trade depends on the similarities of country size.

In empirically estimating the model of new trade theory (NTT) determinants, Helpman (1987) specifies the share of intra-industry trade as a function of the summed value of the trading partners' sizes, a measure of relative country size and a proxy for relative factor endowments. Based on the evidence for fourteen industrialised countries estimated as a cross section for every year from 1970 to 1981, the role of relative country size in trade patterns is confirmed. In essence, equation (1) modifies the cross sectional specification by Helpman (1987) to a panel data setting.

Specifically, equation (1) includes four sets of dummy variables to control for the nature of heterogeneous trading relations. The main effects consist of country-specific effects for both the exporting country, $y_{,}$, and the importing country, a_{j}, as well as time-specific dummies, 0^{f}, which account for common shocks affecting all countries in the sample. The main effects are also known as the triple-indexed specification of the gravity model, as proposed by Mátyás (1997). Hummels and Levinsohn (1995) assert that factors such as border trade, seasonal trade, cultural ties, and trade restrictions, which vary across country-pairs and hence are unique to each country-pair, can be modelled as a country-pair fixed effect, $ycoy$. Advocating the inclusion of the country-pair fixed effects in the gravity model, Egger and Pfaffermayr (2003) combine the specific effects from both models in one.

In attaching these sets of dummies to an otherwise OLS estimator, the LSDV estimator accounts for the nature of heterogeneous trading relations between the countries in the sample. By accounting for the unobservable omitted variables, the LSDV estimator alleviates the problem of endogeneity arising from possible correlation between the fixed effects and the included regressors. Two remaining issues are of concern.

First, an analysis of the data properties of the gravity model variables has largely been ignored despite the recently developing literature on panel unit root tests and panel cointegration tests. In a time-series setting, Granger and Newbold (1973) deem the results to be 'spurious' if traditional linear methods are applied to non-stationary data. Macroeconomic series in a panel setting, just like their time-series counterparts, are likely to be non-stationary. In this regard, the panel unit root test by Im *et al.* (2003) and the Pedroni (1999) tests for cointegration are used to check if the (time-varying) gravity model variables are non-stationary and are cointegrated.

Second, the LSDV estimator does not control for endogeneity arising from the simultaneous determination of trade and the GDP-related variables. By allowing the equation's error term to be correlated with the leads and lags of the changes in the non-stationary regressors, the DOLS estimator can be used to relieve this source of endogeneity bias. In a panel setting, Mark and Sul (2003) include a symmetric number of leads and lags of the first differences of the potentially endogenous right-hand side variables in a money demand equation. Generalising the model to accommodate fixed effects, the DOLS estimator can more accurately be described as the DLSDV estimator (Mark and Sul, 2003).

In the context of the gravity model of trade, a two-stage approach is adopted to estimate equation (1). Following Mark and Sul (2003), the first stage regression applies the DLSDV estimator which includes two past values and two future values of the first differences of the $I(1)$ cointegrated explanatory variables, $wij =(Ax_{i}^{t}{}_{j-p},..Ax_{i}^{t}j,...Ax_{i}^{t}{}_{j+p})$, where $w_{i}^{t}j$ is a vector of variables containing p_{ij} leads and lags of $Ax_{i}^{t}j$. Estimating the cointegrating vector forms a balanced regression equation. In the second stage, the estimated coefficients from the first stage are substituted into equation (1) and the remaining model parameters are estimated (Bun and Klaassen, 2007). This approach comes with a caveat: the estimates from a two-stage approach are liable to incur a loss of efficiency, although Bun and Klaassen (2007) use a similar two-stage approach to estimate the trade effect of the euro.

In line with the traditional cross-sectional estimation of the gravity model, the POLS and the DOLS specifications explicitly include several time-invariant variables:

$$EXP_{i}^{t}j = \boldsymbol{a} + \hat{}TGDP_{i}^{t}j + A_{2}SGDP_{ij} + A_{3}DGDPPCij + A_{4}DIST_{ij} + A_{5}ADJ_{ij} + A_{6}LANG_{ij} + A_{7}EU_{ij} + \boldsymbol{ju}_{t}j \quad (2)$$

where the additional variables in the traditional model comprise geographic distance, $DIST_{ij}$, measured in kilometres between the capital cities of the exporting and the importing countries; a dummy variable denoting adjoining land borders, ADJ_{ij}, and a dummy variable for a common language, $LANG_{ij}$, as a proxy for cultural and historical links between trading partners. All non-dummy variables are estimated in logarithms.

The reference group of countries in the panel comprise bilateral export flows from 12 EU countries (Austria, Belgium-Luxembourg, Denmark, Finland, France, Germany, Italy, the Netherlands, Spain, Sweden, Switzerland and the United Kingdom) to 20 OECD trading partners (Austria, Belgium-Luxembourg, Canada, Denmark, Finland, France, Germany, Greece, Ireland, Italy, Japan, Korea, the Netherlands, Norway, Portugal, Spain, Sweden, Switzerland, the United Kingdom and the United States) over the period 1992-2003, with Belgium and Luxembourg treated as a single country.[2]

The data sources are as follows. Nominal export flow data, denominated in US dollars, are from the International Monetary Fund's (IMF) *Direction of Trade Statistics* and are expressed in real terms based on US producer prices (2000 = 100), sourced from the IMF's *International Financial Statistics*. Data on Gross Domestic Product (GDP) and GDP per capita at constant 2000 US dollars are sourced from the World Bank's (WB) *World Development Indicators*. The time-invariant variables are sourced from the CEPII.[1] The summary statistics of the data are given in Table 1.

[Insert Table 1 here]

III. EMPIRICAL RESULTS

Drawing on the developing literature on panel unit root tests and panel cointegration tests, the data properties of the gravity model variables are first checked before estimating the gravity model. Several panel unit root tests are available: analogous to the time-series unit root tests, the panel versions differ in terms of the null hypothesis of stationarity or non-stationarity. Panel variants also depend on whether the data set is balanced and whether heterogeneity and cross sectional dependence are allowed. Table 2 reports the panel unit root tests by Im *et al.* (2003). The results indicate that all variables are integrated of order one, $I(1)$, with the exception of exports, which depends on whether a deterministic trend is included in the equation.

[Insert Table 2 here]

The Pedroni (1999) tests for cointegration are presented in Table 3. The (within) panel statistics consist of a variance ratio test (panel v), the panel versions of the Phillips and Perron (1988) $\boldsymbol{p}$-statistic (panel $\boldsymbol{p}$) and t statistic (panel PP) and the augmented Dickey-Fuller (ADF, 1979) t statistic (panel ADF). The group statistics allow for heterogeneity of the long-run coefficients. In other words, individual intercepts and / or individual linear trends can be accommodated in the equation. With only one exception, the seven tests indicate that the null hypothesis of no cointegration is rejected at the 5 per cent significance level. Accordingly, the DOLS (and DLSDV) estimator is appropriate to estimate the cointegrating vector.

[Insert Table 3 here]

Table 4 presents the results for the gravity model of new trade theory determinants using a number of estimators. The DOLS estimator of the cointegrating vector controls for endogeneity arising from the joint determination of exports and the $I(1)$ explanatory variables. The DLSDV estimator additionally controls for endogeneity due to omitted variable bias. The DOLS and DLSDV estimates are compared with their static counterparts - POLS and LSDV. Note that the effects of the time-invariant variables are subsumed into the unit-specific effects and hence are not estimated by the LSDV and DLSDV estimators.

[Insert Table 4 here]

Regarding the parameter estimates in Table 4, the coefficient signs accord with theoretical predictions. In terms of the GDP-related variables – total GDP and the similarity of GDP index – the positive and significant coefficient estimates across the estimators support the new trade theory that economic size and relative size matters for trade. Although the LSDV and DLSDV magnitudes of total GDP seem rather high, these results are not uncommon in the literature (see, for example, Egger and Pfaffermayr, 2004). Comparing the GDP coefficient estimates for LSDV and DLSDV with POLS and DOLS indicates the importance of controlling for heterogeneity bias. In terms of the absolute difference in income per head, the negative and significant coefficient estimate by DOLS supports the Linder hypothesis that the similarity of demand characteristics between the OECD countries will increase trade. In the NTT literature, this coefficient is interpreted in terms of similar factor endowments. This relation, however, does not hold for the remaining estimators.

Of primary interest is the size and significance of the EU dummy coefficient. The trade-enhancing effect of EU enlargement is confirmed across all specifications. Comparing the POLS and DOLS results, a positive and significant coefficient of the EU dummy variable is confirmed, a not surprising result because the EU dummy coefficient is unlikely to be affected when the potential simultaneity between exports and the $I(1)$ explanatory variables are taken into account.

The results diverge substantially once fixed effects are admitted into the model. Whereas the LSDV estimator suggests a small positive effect of EU integration on trade, the DLSDV estimator indicates that EU integration has a large beneficial effect on trade – with the coefficient on the EU dummy more than twice the size when compared with the coefficients from the DOLS or POLS estimators. Note that if the second-stage estimates are instead generated from a regression based on the predicted values, rather than the substituted values from the first stage, the large positive and significant coefficient on the EU dummy is confirmed (the estimated coefficient is 0.59 and the test statistic of 8.51). The results indicate the importance of controlling for two sources of endogeneity: endogeneity due to the correlation between the omitted unobservable factors and the included regressors and endogeneity due to the simultaneous determination of exports and the $I(1)$ explanatory variables in the gravity model. This suggests that the effect of EU membership on trade is perhaps greater than previous studies which do not fully adjust for potential endogeneity.

IV. CONCLUSIONS

With the rising number of regional trade agreements, especially since the mid-1990s, the effect of RTAs on trade flows has received much attention. The expected positive effects on trade of RTAs between signatory countries are usually captured by dummy variables within a gravity model framework (Greenaway and Milner, 2002). The widespread use of the gravity model stems from its empirical success in explaining trade patterns, its simplicity and its versatility in application. Several approaches characterise the gravity model of trade. From its inception in the 1960s as an empirical model, it has traditionally been estimated as a cross sectional or pooled regression, sometimes for a series of cross sections or for data averaged over several years and, more recently, using panel estimators. Not all empirical results, however, are reliable as they may suffer from endogeneity bias due to the exclusion of relevant explanatory variables – either inadvertently or because of difficulties in observing and quantifying these variables.

Assigning theoretical foundations to additional relevant explanatory variables in a cross sectional context and allowing for fixed effects in a panel context comprise the main strands in the gravity literature to counter the problem of endogeneity bias arising from omitted variables. The LSDV estimator, however, does not control for endogeneity arising from the joint determination of exports and the GDP explanatory variables in the gravity model. Using a panel cointegration approach, the gravity model of NTT determinants is estimated by DLSDV, which accounts for two sources of endogeneity: endogeneity due to omitted variables and endogeneity arising from the simultaneity between exports and the $I(1)$ cointegrating gravity model variables. The panel cointegration approach to estimating the gravity model also guards against the spurious regression problem.

A degree of variation in the results suggests that heterogeneity is an important aspect of gravity modelling. This is mainly borne out by the GDP coefficient estimates: the LSDV and DLSDV estimates yield much higher coefficient estimates than POLS and DOLS while their associated t statistics are much reduced. Comparing the coefficient estimate of the EU dummy across the estimators, the not insubstantial trade effect according to the DLSDV estimator is more in line with the importance of trade liberalisation within the EU. According to the European Commission (1996) the Internal Market programme brought about the removal of a number of obstacles to trade through mutual reduction including substantial progress towards dismantling technical barriers to trade, the liberalisation of public procurement and the development of simplified internal customs and fiscal controls. In short, the objective of the un-curtailed movement of goods between member states required the dismantling of trade barriers, especially non-trade barriers, with consequential beneficial effects on the volume of intra-EU trade. The results suggest the importance of controlling for both omitted variable bias and simultaneity bias.

Endnotes

[1] Le Centre d'Etudes Prospectives et d'Informations Internationales, available at http://www.cepii.org.

[2] On the suggestion of an anonymous referee, all estimations in Table 4 were carried out using three different groups of countries. The results generated from the first data set of 12 EU countries to 20 OECD countries are reported in Table 4. The second data set drops Switzerland from the group of EU countries. The third data set additionally drops Greece and Portugal from the group of OECD countries. The treatment of Switzerland as an EU country and Greece and Portugal as OECD countries do not substantially alter the results.

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Table 1 Summary Statistics

Variables	Obs	Mean	Std dev	Min	Max
Exports	2709	21.79	1.40	18.31	25.05
Total GDP	2712	27.70	0.95	25.67	30.13
GDP similarity	2712	-1.24	0.61	-3.76	-0.69
GDPpc difference	2712	0.35	0.29	0.00	1.31
Distance	2712	7.37	0.94	5.15	9.28
Adjacency	2712	0.15	0.36	0.00	1.00
Language	2712	0.12	0.33	0.00	1.00
EU	2712	0.56	0.50	0.00	1.00

Table 2 IPS Panel Unit Root Test Results[a,b]

	Variable Levels				First Differences	
Regressors	Constant	No of obs	Constant and trend	No of obs	Constant	No of obs
Exports	-1.23	1935	-2.29**	2150	-2.64**	1935
Total GDP	-0.70	2150	-2.22	2150	-2.25**	1935
GDP similarity	-1.41	2150	-1.88	2150	-2.04**	1935
GDPpc difference	-1.35	2150	-2.11	2150	-2.04**	1935

[a] The *t-bar* statistics are computed for a balanced panel to test the null hypothesis of a unit root against
[d] the alternative that some of the series in the panel are stationary (Im *et al.*, 2003).
[b] The optimal lag length, as chosen by the Bayesian information criterion (BIC), is one for most cases.
** denotes significance at the 5% level; * denotes significance at the 10% level.

Table 3 Pedroni Panel Cointegration Test Results[a]

Equations	Panel v	Panel $\boldsymbol{p}$	Panel PP	Panel ADF	Group $\boldsymbol{p}$	Group PP	Group ADF
(1a)[b]	0.05	13.15**	6.96**	11.98**	18.74**	-5.37**	7.44**
(1b)[b]	-5.61**	18.85**	6.04**	6.11**	23.05**	-11.48**	–3.71**

[a] The test statistics, based on the residuals from the cointegrating panel regression, test the null hypothesis of
[d] no cointegration against the alternative that all series are stationary (Pedroni, 1999).
[b] Equation (1a) allows for heterogeneous intercepts; equation (1b) allows for individual intercepts and
[d] individual linear trends. Specifying two as the maximum lag length, the optimal lag length is chosen by the
[d] Bayesian information criterion (BIC).
** denotes significance at the 5% level; * denotes significance at the 10% level.

Table 4 NTT Gravity Model of Export Flows[a]

Regressors	POLS	LSDV	DOLS[b]	DLSDV[b]
Total GDP	1.50** (110.00)	2.18** (15.21)	1.13** (33.79)	3.02** (11.93)
GDP similarity	0.81** (42.78)	0.91** (10.23)	0.85** (16.07)	0.85** (4.71)
GDPpc difference	-0.04 (-1.11)	-0.03 (-0.33)	-1.33** (-15.50)	0.16 (0.98)
Distance	-0.74** (-53.53)	–	-0.74** (-53.53)	–
Adjacency	0.54** (17.44)	–	0.54** (17.44)	–
Language	0.19** (6.32)	–	0.19** (6.32)	–
EU	0.40** (17.84)	0.06** (4.56)	0.40** (17.84)	0.87** (24.73)
No of obs	2709	2709	2709	2709

[a] The reported test statistics in parentheses are heteroskedasticity robust (White 1980).
[b] The estimated coefficients are based on a two-stage regression. In the first stage, the DOLS estimates for the I(1) cointegrated explanatory variables are generated from a regression that includes two past values and two future values of their first differences. Generalising the DOLS estimator to allow for fixed effects gives the DLSDV estimator (Mark and Sul, 2003). In the second stage, the estimated coefficients from the first stage are substituted into equation (1) and the remaining model parameters are estimated (Bun and Klaassen, 2007).
** denotes significance at the 5% level; * denotes significance at the 10% level.