

Costa-i-Font, Joan

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Joan Costa-i-Font*

Regional and Institutional Heterogeneity Matters! Revisiting Trade Effects of the Euro

The creation of a single currency is deemed to produce further heterogeneity in regional trade, as regions differ in their exposure to trade with other European countries. It is possible to disentangle two separate effects on bilateral trade, namely the “exchange rate volatility effect” (from exchange rate fixing in 1999) and the pure “common currency effect” (resulting from the issuing of a new currency in 2002). This paper presents an empirical analysis that shows evidence of a regional concentration of currency union effects in a few Spanish regions.

Currency unions can be thought of as “cooperative arrangements” whereby a set of countries irrevocably freeze (or peg) their exchange rates at a constant rate, so as to reduce the uncertainty that comes with volatile exchange rates. To make such an arrangement stable, some currency unions establish a single currency, as is the case in the European Monetary Union (EMU), which is to date the paradigmatic case of a monetary area. A common currency helps to attain two main goals: macroeconomic policy objectives, especially policy credibility and price stability, and a reduction of existing barriers to trade, including transaction, transport and hedging costs and the costs associated with exchange rate variability. This paper attempts to contribute to the understanding of the latter.

A common currency is often seen as a natural complement to a single market and as such can be expected to boost the effects that the single market is argued to have on trade. However, empirical evidence on this question is controversial. A seminal study by Andrew Rose found that monetary unions boost trade by almost 300%, even after controlling for a variety of other characteristics shared among such countries.¹ A number of subsequent contributions² have questioned the magnitude of such an effect.³ More recently, some critics⁴ insist that EMU itself is endogenous to the process of integration, especially among the core economies of Europe. However, more recent work by Frankel⁵ suggests that there is limited empirical evidence to support the endogeneity claim. Two important features missing in this literature are the role of geography and, especially, how monetary unions are institutionally defined.

The importance of the regional dimension has been stressed by Frankel and Rose⁶, whose findings suggest that geography is highly relevant to the make-up of common currency areas⁷ and that one can expect uneven regional trade expansion depending on the areas' relative openness. Furthermore, several studies have found that intra-regional trade is far more important in magnitude than international trade. More specifically, trade within Canada is about 10-20 times greater in volume than that between Canada and the USA.⁸ Whether EMU exerts similar effects at the regional level within European member states remains an open question. Baldwin⁹ finds that

* London School of Economics and Political Science (LSE), London, UK.

- 1 A. Rose: One money, one market: the effect of common currencies on trade, in: *Economic Policy*, Vol. 15, No. 30, 2000, pp. 7-45.
- 2 T. Persson: Currency unions and trade: how large is the treatment effect? In: *Economic Policy*, Vol. 16, No. 33, 2001, pp. 434-448; J. Melitz: North, South and Distance In the Gravity Model, CEPR Discussion Paper Series, No. 5136, 2005.
- 3 For instance, Thom and Walsh found no great decline in Anglo-Irish trade when the Republic of Ireland joined the Eurozone, and evidence from the Irish Currency Board's experience with the British pound displayed no significant effects on bilateral trade. See R. Thom, B. Walsh: Effect of a Common Currency on Trade: Lessons from the Irish Experience, in: *European Economic Review*, Vol. 46, No. 6, 2002, pp. 1111-1123.
- 4 M. Artis: What Do We Now Know About Currency Unions? CEPR Discussion Paper, No. 5677, 2006.
- 5 J. Frankel: The Estimated Trade Effects of the Euro: Why Are They Below Those From Historical Monetary Unions Among Smaller Countries?, LEQS Paper, No. 7, June 2009.
- 6 J. Frankel, A. Rose: An Estimate of the Effect of Currency Unions on Trade and Growth, NBER Working Paper No. 7857, 2000.
- 7 For instance in Spain, regions with large neighbours (Catalonia or the Basque Country and Navarre) exhibited a higher volume of trade with their existing trade partners after the onset of monetary union.
- 8 J. McCallum: National Borders Matter: Canada-U.S. Regional Trade Patterns, in: *American Economic Review*, Vol. 85, 1995, No. 3, pp. 615-662. Hence, a common currency would arguably lead to trade creation as well as deviation to other EMU member states. See A. Micco, E. Stein, G. Ordoñez: The Currency Union Effect on Trade: Early Evidence from EMU, in: *Economic Policy*, Vol. 37, No. 18, 2003, pp. 317-356. Furthermore, the trade effects of EMU are different among the individual countries.
- 9 R. Baldwin: The euro's trade effects, ECB Working Paper No. 594, Frankfurt 2006.

the trade effects of a common currency are the highest for Spain, and some studies show that the impact of exchange rate variability on trade appears to be generally higher in Southern European countries.¹⁰ Hence, a regional analysis drawing from Spanish data seems ideal.

In measuring the effects of a common currency, one should differentiate the effects of reducing exchange rate volatility that could have been attained through a currency board or equivalent mechanisms from the stability and transparency effects that result from a tangible single currency.¹¹ HM Treasury¹² reported that entry into the eurozone would bring the UK a total increase in trade of 50%, though more recent studies have questioned this figure and have argued that exchange rate volatility was only one of several barriers to trade and that reducing it had only moderate effects on trade.¹³ Arguably, these phenomena can be attributed to some degree to intra-country variability resulting from heterogeneous regional common currency effects.

This paper attempts to contribute to the current debate on whether monetary integration has boosted regional bilateral trade between European member states by exploring a relatively ignored source of heterogeneity. Particularly, it examines whether the effects of a common currency were concentrated in a few areas or affected all regions equally, and it examines the sensitivity of trade effects to the various developments that accompany the establishment of a common currency, namely the elimination of exchange rate variability and other transaction costs as well as the transparency effects resulting from the formation of a tangible common currency.

The empirical analysis provides estimates of a set of standard and augmented gravity equations for total trade flows measured as the logarithm of exports and imports¹⁴ as well

as imports and exports separately in order to disentangle the specific effects of a common currency in boosting regional trade.¹⁵ Gravity models are commonly used to account for the influence of transaction costs and distance on economic transactions¹⁶ after ensuring that results are robust by including a battery of checks¹⁷, for example augmenting the standard gravity model, to control for regional specific covariates. Similarly, it examines panel data controls for unobserved heterogeneity and corrects for different sources of endogeneity so as to establish the extent to which the results are robust.

Consistent with evidence suggesting that money illusion may indeed be a real phenomenon¹⁸, this paper estimates the impact of two different common currency effects, namely the effects that result from the reduction of exchange rate variability due to the participation of national currencies in the single currency arrangement, which has effectively been in place since 1999, and the effects of the tangible issue of a single currency for individual use, which eliminated transaction costs of economic activity (beginning in 2002).¹⁹

The basic theoretical underpinnings of this article are introduced below. This is followed by an examination of prior empirical evidence and a description of the database employed. The results are then reported and the trade policy implications explored.

Background

Single Currency and Trade

The main goal of a currency union is to promote economic activity by increasing exchange within the area sharing the same currency. Despite the vast empirical literature, there

10 P. De Grauwe, F. Skudelny: The Impact of EMU on Trade Flows, in: *Weltwirtschaftliches Archiv*, No. 136, 2000, pp. 381-397.

11 The seminal contributions in this area constitute what is known as the optimum currency area approach and help to determine when a currency union is desirable.

12 HM Treasury: UK Membership of the Single Currency – An Assessment of the Five Economic Tests, CM 5776 London, HMSO, June 2003.

13 S. De Nardis, C. Vicarelli: The Impact of the Euro on Trade: The (early) effect is not so large, Working Paper No. 31, ISAE, Rome 2003; H. Berger, V. Nitsch: Zooming Out: The Trade Effect of the Euro in Historical Perspective, CES-ifo Working Paper No. 1435, March 2005; R. Baldwin, F. Skudelny, D. Taglioni: Trade effects of the euro. Evidence from sectoral data, European Central Bank, Working Paper Series 446, 2005. Baldwin et al. draw upon a monopolistic competition model to show that the effect of EMU on trade is non-linear, and whilst trade creating effects range between 108 and 140% in a pooled regression, the estimates fall to a range of 54 to 88% when sector specific data is used.

14 As in R. Baldwin, D. Taglioni: Gravity for Dummies and Dummies for Gravity Equations, Working Paper No. 12516, NBER, Cambridge 2006.

15 Interest in gravity models increased considerably after some models suggested the “death of distance” resulting from the decline of transaction and transport costs due to globalisation. See J.F. Brun, C. Carrère, P. Guillaumont, Jaume de Melo: Has Distance Died? Evidence from a Panel Gravity Model, in: *The World Bank Economic Review*, Vol. 19, No. 1, 2005, pp. 99-120.

16 It is common to find that the elasticity of trade to distance ranges from -0.8 to -1.3. Some studies indicate that globalisation does not necessarily make distance irrelevant. See E. Leamer, J. Levinsohn: International Trade: The Evidence, in: G.M. Grossman, K. Rogoff (eds.): *Handbook of International Economics*, Vol. 3, New York, Elsevier, North Holland 1995.

17 S.J. Evenett, W. Keller: On Theories Explaining the Success of the Gravity Equation, in: *Journal of Political Economy*, Vol. 110, No. 2, 2002, pp. 218-316. Examples of this are corrections for endogeneity and selection biases and the inclusion of a time trend, which is asserted to influence the effect of the distance variable.

18 E. Fehr, J. Tyran: Does money illusion matter?, in: *American Economic Review*, Vol. 91, No. 5, 2001, pp. 1239-1262.

19 Examination of the first years of the monetary union is relevant given that some scepticism has arisen from the fact that the EMU does not seem to have succeeded in creating business-cycle convergence.

is still no general consensus concerning the benefits of currency union for trade and the mechanisms through which these benefits are accrued. Trade influences a country's growth rate by facilitating the transmission of technology across borders. Frankel and Rose's²⁰ findings suggested that a reduction in exchange rate variability increases trade. This result was confirmed in later studies²¹, although there was some debate on the effect of excluding observations from the sample.²² Evidence against the common view that a currency union is a trade-enhancing phenomenon can be found in Fitzsimons et al.²³ Drawing from a gravity model, they found that although Ulster and the Republic of Ireland share a border and use different currencies, trade between the two was greater than predicted.

More sceptical literature includes arguments that a trial period before the introduction of the euro called *Ecco L'Euro*²⁴ could have influenced the results. Alesina and Barro²⁵ argue that the effect of a currency union on trade might have been overestimated as a result of some form of endogeneity. Tenreyro and Barro²⁶, who address the problem of endogeneity by developing a new instrumental variable, found that the effects of currency union were much less significant than those of previous results. However, this is less of an issue in the case of European countries, given that the vast majority of countries that formed EMU joined at the same time (except for Greece, which joined a year later) and the decision to join was based on compliance with a set of well-defined criteria, known as "convergence conditions". Furthermore, Frankel²⁷ provides suggestive evidence to counter endogeneity concerns.²⁸ The use of regional data can further ameliorate

endogeneity constraints, as regions have less specific power to influence monetary policy, especially after the implementation of independent central banking mechanisms in the 1990s.

The Gravity Model Formulation

Gravity models of international trade flows have been widely used as baseline models for estimating the impact of a variety of policies related to regional trading groups, currency unions and various trade distortions.²⁹ Evidence obtained from gravity models makes it possible to measure the trade integration rates of different geographical areas and more generally have been used to select among competing trade theories.³⁰

The formulation that lies behind the gravity equation is that the economic value of an exchange between a pair of countries is a positive function of their combined size and a negative function of their distance (a physical barrier to trade associated with transportation and delivery costs). The objectives of economic (and monetary) integration are in tune with the logic and the variables included in a gravity model: to expand the market dimension and simultaneously reduce – or utterly eliminate – distance.³¹ However, the determinants of bilateral trade flows extend beyond the traditional inverse relationship of the distance between each pair of countries and the direct relationship of their combined economic sizes (GDP, population and GDP per capita). Indeed, a gravity model can be augmented to include additional determinants which act as trade barriers or trade enhancing effects, such as exchange rate variability. Belonging to a common currency seems to have an independent effect, which is not explained by higher price stability but by "credibility enhancing" and the elimination of transaction costs.³²

One way to expand the gravity model is to include variables that make real life different from a hypothetical trade model with no market intervention. Indeed, just as one refers to entry barriers when examining markets, one can refer to trade barriers when dealing with trade. These include transaction and transport costs (which may decrease with economic integration and interdependence or with globalisation in general) and technological devel-

20 J. Frankel, A. Rose: The Endogeneity of the Optimum Currency Area Criteria, in: *Economic Journal*, Vol. 108, 1998, pp. 1009-1025.

21 J. Frankel, A. Rose: Estimating the effect of currency unions on trade and output, in: *Quarterly Journal of Economics*, Vol. 117, No. 2, 2002, pp. 437-466; A. Rose, E. van Wincoop: National Money as a Barrier to International Trade: The Real Case for Currency Union, in: *American Economic Review*, 2001, pp. 386-390; R. Glink, A.K. Rose: Does a Currency Union Affect Trade? The Time Series Evidence, in: *European Economic Review*, Vol. 46, 2002, pp. 1125-1151.

22 T. Persson, op. cit.

23 E. Fitzsimons, V. Hogan, P.J. Neary: Explaining the volume of North-South trade in Ireland: A gravity model approach, in: *Economic and Social Review*, Vol. 30, 1999, No. 4, pp. 381-401.

24 M. Artis, op. cit.

25 A. Alesina, R. Barro: Currency Unions, in: *Quarterly Journal of Economics*, May 2002, pp. 409-436.

26 S. Tenreyro, R. Barro: Economic Effects of Currency Unions, NBER Working Paper, 2003, p. 9435.

27 J. Frankel: The Estimated Trade..., op. cit.

28 The debate on whether a currency union influences economic exchange parallels the debate on the determinants of economic development, which suggests that changes in institutions are likely to impact economic exchange and that income may be explained by institutions rather than by geography or by trade itself. If this is the case, then one might expect an institutional change in the monetary section to determine the intensity of trade.

29 S. Bougheas, P.O. Demetriades, E.L.W. Morgenroth: Infrastructure, Transport Costs and Trade, in: *Journal of International Economics*, Vol. 47, No. 1, 1999, pp. 169-189; P. De Grauwe, F. Skudelny, op. cit.; R. Glink, A.K. Rose, op. cit.

30 R.C. Feenstra, R. Lipsey, C. Bowen: World Trade Flows, 1970-1992, with Production and Tariff Data, NBER Working Paper, No. 5910, 1997.

31 J. Frankel and A. Rose: Is EMU more justifiable ex-post than ex-ante?, *European Economic Review*, Vol. 41, 1997, pp. 753-760.

32 A. Rose, op. cit.

opment. However, the effect of the uncertainty of market equilibrium variables is heterogeneous across geographic areas and more particularly across autonomous regions.

Empirical Analysis

The Data

Data was collected from a variety of official sources in order to obtain reliable estimates with a large time and cross-section range. Much of the data came from the Spanish Chamber of Commerce Council³³, which publishes annual data on the origin and destination of regional trade. Trade was measured using data on bilateral trade flows with other European Union member states. It was measured both separately as imports (M) and exports (X) and as a combined figure (M+X). Data on regional gross domestic products (GDP) was retrieved from the regional accounts section of the Spanish National Statistics Institute (INE). The time frame ranged from 1997, two years before the common currency became operative, to 2004, three years after it became a tangible currency. Aggregate data from Spain, displayed in Figure 1, reveals that even though imports and exports (especially imports) experienced a jump after 1999, the effect did not last very long and the percentage of trade with European Union countries did not increase significantly.

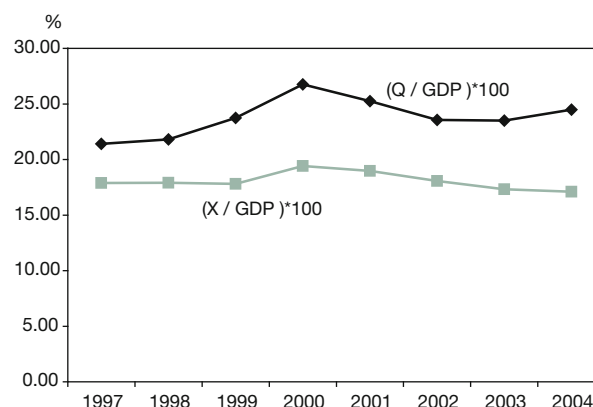
Methods

Consistent with the idea of a gravity model, measures of combined income for each region and country of destination were included as explanatory variables. (Data on the regions of destination within each country were not available.) The measure of distance used was based on Euclidean distance, a combined measurement of the longitude and latitude of the capitals of the Spanish regions and the capitals of the countries with which they traded. The study used the GDP of the exporting country to measure productive capacity, while that of the importing country was used to measure absorptive capacity. Physical distance and country adjacency dummies served as proxies for transportation costs. Population was used as a measure of country size. Larger countries have more diversified production and tend to be more self-sufficient. However, as pointed out by Prewo³⁴, there is an inconsistency in this argument, as larger populations allow for economies of scale which result in higher exports; therefore, the sign of the coefficient of the exporting country should be indeter-

33 SCC: Information Estadística, Spanish Chamber of Commerce Council, 2005.

34 W. Prewo: Determinants of the Trade Pattern among OECD Countries from 1958 to 1974, in: *Jahrbücher für Nationalökonomie und Statistik*, Vol. 193, 1978, pp. 341-358.

Figure 1
Spanish Imports and Exports to the European Union as a Percentage of GDP



minate. In its basic formulation, the gravity equation can be obtained by using logarithms in the following equation:

$$T_{ij} = e^{\beta_1} (Y_i Y_j)^{\beta_2} D_{ij}^{\beta_3} \quad (1)$$

where T_{ij} refers to bilateral trade measured as the log of imports and exports between the region i and the country of origin j , and D_{ij} refers to the distance between i and j .

Table 1 provides the variable definitions. The data contains all the origin/destination pair observations from 17 autonomous regions in Spain to all EU countries from 1997 to 2005. This time period corresponds to the EMU development period, especially with the establishment of the de facto common currency in 1999 and the introduction of the euro in 2002. The years previous to 1997 have not been included in order to isolate the effects of a currency union from other regional and institutional effects that might have influenced regional income, such as decentralisation processes, changes in national governments and trade integration effects resulting from the creation of a single European market.

There is open debate as to how to estimate the gravity model based on “individual” country-pair effects. Matyas³⁵ argues that the correct econometric specification should be the “triple-way model”, where time, exporter and importer effects are specified as fixed and unobservable. Unfortunately, the fixed-effects approach does not allow the estimation of coefficients for time-invariant variables such as distance or common language dummies, though the consistent estimation of such effects is

35 L. Matyas: Proper Econometric Specification of the Gravity Model, in: *The World Economy*, Vol. 20, No. 3, 1997, pp. 363-368.

Table 1
Summary of Statistics

	Definition	Mean	S.E	Source	Expected Effect
Dependent variables					
T_{ij}	Total regional trade (imports and exports) between region i and destination countries j (in logs)	12.131	0.045	A	–
M_{ij}	Regional imports between region i and destination countries j (in logs)	11.286	0.049	A	–
X_{ij}	Regional exports between region i and destination countries j (in logs)	11.274	0.048	A	–
Explanatory variables					
Treatment Variables					
CU_{99}	Effective union currency dummy from 1999 between region i and destination countries j	0.567		–	+
X_{2002}	Material union currency dummy from 2002 between region i and destination countries j	0.384		–	+
Geographical Controls					
$Y_i Y_j$	Regional gross domestic product in logs	12.745	0.025	B	+
$N_i N_j$	Regional population size (in logs)	9.631	0.024	B	+
D_{ij}	Log Euclidean distance between longitude of capital of region i and capitals of destination countries j	2.938	0.014	C	–
border	Dummy variable indicating a border between region i and destination countries j	0.036	0.004	C	+
latitude	Log of latitude of each region	11.342	0.312	C	+

Sources: A: Subdirección General de Aduanas, Camara de Comerç de Catalunya, 2006 (Chamber of Commerce of Catalonia); B: Contabilidad Regional de España, INE, 2006 (Regional accounts, Spanish National Statistics Institute); C: Geographical information toolkit, INE (Spanish National Statistics Institute).

equally important in many situations. Therefore, in order to address this issue properly, it is necessary to employ the Hausman and Taylor instrumental variable estimation technique. Given that other factors such as border effects, institutional effects (such as a currency union) and economic size also influence the decision to trade, the model specified was the following one (logs are missing for simplicity):

$$T_{ij} = \beta_1 + \beta_2 (Y_i Y_j) + \beta_3 D_{ij} + \beta_4 (N_i N_j) + \beta_5 B_{ij} + \sum_k \beta_k Z_{ijk} + \sum \delta_t Time_t + \gamma CU_{ij} + \mu_{ij} \quad (2)$$

$N_i N_j$ refers to the joint population; B_{ij} measures the extent to which each region bordered on Europe; Z_{ijk} measures other controls of bilateral trade; $Time_t$ refers to a time trend; and CU_{ij} refers to the existence of currency union arrangements between the area and the country of origin. This was an attempt to estimate a battery of different empirical specifications for a common currency effect on trade. Trade was measured in logs in Equation 2, and subscripts for time were eliminated for simplicity. Furthermore, the study distinguished between exports (X_{ij}) and imports (M_{ij}), given that the effects associated with the establishment and expansion of a monetary union were likely to be heterogeneous for these variables, especially at the regional level.

Two differently indexed versions of the gravity equation were estimated. In the first, the logarithm of real exports was used as the dependent variable. In the second, the logarithm of total trade was employed. The baseline specification was used to consider the impacts of core explanatory variables such as GDP, population and Euclidean distance (the distance between vectors of latitude and longitude squared). Given that trade across countries that do not have a common currency implies some transaction costs, the effect of a monetary union was included as a dummy representing exchange rate variability to reflect the specific effect of exchange rate risk reduction. In the light of the previous literature, the following research questions were explored.

The Currency Union Effect. This question refers to whether the exposure to a common currency gives rise to an increase in bilateral regional trade and whether such trade effects are regionally homogenous. The value of the currency union was measured using the two definitions outlined in the second research question below. Its value was adequately log normalised so as to obtain the value of the elasticity effect in the gravity equations. The elasticity value was informative of the extent to which exposure to a common currency in each separate autonomous region enhanced bilateral trade with a set of European markets. Evidence from previous work suggested estimates of

Table 2

Gravity Trade Equations of Spanish Regions (Total, Imports and Exports) (OLS)

N= 176

	T_{ij} (Total Trade)		X_{ij} (Exports)		M_{ij} (Imports)	
	Traditional coeff (t-value)	Augmented coeff (t-value)	Traditional coeff (t-value)	Augmented coeff (t-value)	Traditional coeff (t-value)	Augmented coeff (t-value)
CU_{99}	0.45 ^a (5.65)	0.43 ^a (5.69)	0.41 ^a (5.43)	0.42 ^a (4.97)	0.50 ^a (5.87)	0.52 ^a (6.00)
Adj. R ²	135.78	114.95	176.5	143.62	95.05	133.16
F-Test	0.262	0.846	0.07	0.41	8.63 ^a	7.84 ^a
CU_{2002}	0.32 ^a (3.92)	0.30 ^a (3.81)	0.30 ^a (3.42)	0.28 ^a (3.59)	0.34 ^a (3.87)	0.31 ^a (3.64)
Adj. R ²	0.23	0.30	0.24	0.40	0.22	0.26
F-Test	130.40	111.29	1439.20	172.50	126.44	90.96

Notes: Several specifications were made by adding a trend variable, but none proved significant. ^a Significant at 1% level.

300%.³⁶ Later Glink and Rose³⁷ found that trade approximately doubled using aggregate data. Given that this empirical result has been subject to discussion, the empirical magnitude estimated here will be of great interest to researchers and policymakers.

Volatility and Institutional Effects. We have distinguished the effect of the CU_{99} , which refers to the wiping out of exchange rate volatility, from the CU_{2002} , which captures the stability effects of the establishing of a common currency. The tendency in the literature is to believe that the impact of the euro grows over time, so if it is shown that this is not the case, then this would suggest that the common currency has mainly short-term effects.

Robustness. One of the aspects examined in the literature is whether these results are robust to different specifications and to the inclusion of fixed effects that control for potential unobserved heterogeneity. It is also important to establish whether the gravity equation is correctly specified, especially when it is augmented.

The empirical strategy used in this study was to begin initially with the simplest specification possible, a model that estimated the determinants of trade using OLS, that included robust standard errors (to cluster heterogeneity) and that included (though did not report) year controls. It distinguishes between the two definitions of a common currency mentioned in previous sections. Once OLS results were obtained, both the augmented and simple gravity equations were also estimated using generalised least squares (GLS), which took into account the panel

nature of the sample. The intuition behind this strategy is that unobserved heterogeneity may have biased the results, as they only reflected part of the heterogeneity of country pairs and could therefore be prone to omitted-variable bias. The estimated coefficients are then reported at the autonomous region level using random-effects models. Furthermore, in line with a number of previous studies, an additional check was made for robustness. Finally, the set of estimates included fixed effects and the underlying estimates for the reported fixed effects. However, random effects were also used to examine the effect of distance on trade; these were excluded where the fixed-effects model is specified due to collinearity. Finally, given that distance measures “trade barriers”, using a logarithmic specification should adequately exponentially transform the coefficient of each variable.

Results

The estimates from OLS models were reported using the two different definitions of a currency union mentioned above (see Table 2). Consistent with work by Rose³⁸, I find a positive and significant effect exerted by a single currency no matter the definition used, suggesting that the establishment of the euro, as expected, has effectively bolstered trade. The coefficient was larger for imports in comparison to exports, suggesting that, *ceteris paribus*, establishing a common currency was responsible for a larger growth in Spanish regional imports than in its exports. The coefficients of the gravity model did not change significantly when an augmented gravity model was estimated, and the endogeneity test from the Hausman Tests results did not reject the full hypothesis of exo-

³⁶ A. Rose, op. cit.

³⁷ R. Glink and A. Rose, op. cit.

³⁸ A. Rose, op. cit.

Table 3
Currency Union Effects on Total Regional Trade, Imports and Exports by Autonomous Region (Coefficients and Total-effect Estimates) OLS

	[exp(β_{CU1999})-1] *			[exp(β_{CU2002})-1] *		
	T_{ij}	X_{ij}	M_{ij}	T_{ij}	X_{ij}	M_{ij}
Andalusia	0.38	0.28	0.49 ^a	0.28	0.12	0.44 ^b
Aragon	0.90 ^a	0.52	1.32 ^a	0.57 ^b	0.46	0.71 ^b
Asturias	0.59 ^b	0.62	0.48	0.53	0.41	0.50
Balearic Islands	0.18	0.22	0.14	0.12	0.11	0.06
Canary Islands	0.00	0.01	0.03	-0.24	-0.31	-0.21
Cantabria	0.67 ^b	0.91 ^a	0.43	0.50	0.72 ^b	0.30
Castile-La Mancha	0.97 ^a	0.37	1.38 ^a	0.74 ^a	0.37	0.76 ^b
Castile and Leon	0.90 ^b	1.04 ^b	0.76	0.64	0.80 ^b	0.35
Catalonia	0.83 ^a	0.73 ^a	1.12 ^a	0.63 ^a	0.62 ^b	0.69 ^b
Valencia	0.50 ^b	0.40	0.60 ^b	0.33	0.27	0.36
Extremadura	0.89 ^b	0.52	1.84 ^a	0.60	0.40	1.03 ^b
Galicia	0.61 ^b	1.18 ^a	0.33	0.55	0.91 ^a	0.34
Madrid	0.38 ^b	0.52	0.30	0.18	0.36	0.07
Murcia	0.41	0.19	1.23 ^a	0.28	0.14 ^b	0.76 ^b
Navarre	0.37	0.27	1.23 ^b	0.18	0.11	0.48
The Basque Country	0.34	0.48 ^b	1.23	0.21	0.31	0.11
La Rioja	1.26 ^b	1.26 ^a	1.23 ^a	0.77 ^b	0.77 ^b	0.77 ^b

^aSignificant at 1% level. ^bSignificant at 5% level.

*The effect estimates indicate the % change in bilateral trade resulting from the fact that a trade pair (Spanish region + EU13 member state) entered a common currency zone.

geneity of the combined economic mass, with the exception of the effect on imports. However, the coefficients of both the traditional and augmented models did not differ significantly. Besides the standard 1999 definition of a currency union based on fixing exchange rate variability, Table 2 presents a 2002 definition of the currency union and finds that that the effect on trade declined noticeably but remained significant.

On the basis of Table 3 estimates, we compute trade elasticity estimates using the transformed coefficients of the augmented gravity model. The trade elasticity results from the following transformation of the estimated coefficient [-1]. Such elasticities reveal large regional differences. It was possible to group a set of regions including Andalusia, Murcia and Navarre where the common currency only affected exports when the 1999 definition of a currency union was used, namely through wiping out exchange rate volatility rather than via the establishment of a currency union. On the other hand, in another group

Table 4
Gravity Equations for Trade in Spanish Regions (Total, Imports and Exports)

	T_{ij}		X_{ij}		M_{ij}	
	coeff	t-value	coeff	t-value	coeff	t-value
Generalised Least Squares – Random Effects						
CU_{99}	0.18 ^a	7.300	0.149 ^a	5.140	0.249 ^a	6.700
Wald χ^2_7	785.6		574.210		486.160	
CU_{2002}	0.10 ^a	4.4	0.054 ^b	2.020	0.149 ^a	4.300
Wald χ^2_7	785.6		505.580		453.200	
Hausman-Taylor Estimation						
CU_{99}	0.173 ^a	7.210	0.138 ^a	4.790	0.257 ^a	6.910
Wald χ^2_7	800.70		519.50		571.500	
CU_{2002}	0.090 ^a	4.070	0.033 ^a	1.250	0.144 ^a	4.230
Wald χ^2_7	761.78		449.50		442.600	
Generalised Least Squares – Random Effects						
CU_{99}	0.163 ^a	6.450	0.12 ^a	4.01	0.239 ^a	6.150
F-Test (all $u=0$)	249.0		202.360		118.980	
CU_{2002}	0.090 ^a	3.89	0.024 ^a	0.9	0.143 ^a	3.980
F-Test (all $u=0$)	247.4		202.100		118.800	

Notes: Several specifications were made by adding a trend variable, but none proved significant. ^aSignificant at 1% level. ^bSignificant at 5% level.

of regions including Catalonia and la Rioja, the common currency affected both imports and exports with elasticity ranging between 0.62 and 0.77. Finally, there was another group that only showed an increase in exports; this was the case for relatively small regions such as the Basque Country, Extremadura, Cantabria and Valencia. However, once again some of these effects faded away when the 2002 version of monetary union was adopted, which suggests that the overall effect of a currency union has to do mainly with the elimination of exchange rate volatility. When both definitions of a currency union were estimated together, the second definition measuring pure currency union effects was not significant, indicating that the effect of a common currency is primarily due to exchange rate variability effects.

Table 4 reports estimates controlling for unobserved heterogeneity and endogeneity. Importantly, when a cross-section time series was controlled for using panel data, the coefficient for the trade effect resulting from the establishment of a common currency dropped significantly. The coefficient shrank to 0.18 (0.15 for exports and 0.25 for imports). When the 2002 version of monetary union was used, the coefficient fell to 0.1. As before, we re-esti-

mated trade elasticity estimates after controlling for fixed effects. Table 5 reveals that only a few regions showed a significant common currency effect on regional trade. These were Catalonia and the Basque Country (exports) and Madrid, Valencia, Murcia, Castile and La Rioja (imports). This result is not totally unexpected as when fixed effects are introduced into the specification, then variability results only from temporal variation in the data.³⁹ The result attained is not surprising, as these regions are the most trade-oriented regions in Spain, which suggests that a common currency tends to improve bilateral EU trade in more open regions while not having significant effects on other regions. Hence, it does exert an important impact on the economic geography of European countries, though the specific effect on growth and economic activity are beyond the scope of this paper.

Conclusions

This paper has attempted to examine whether the establishment of a common currency triggers bilateral regional trade, both through reductions in exchange rate volatility as well as through reduced transaction costs and increased transparency. The contribution of this paper lies in estimating the effects on regional trade of sharing a common currency with EU countries from 1997-2004. It can be summarised as follows.

First, the effects of a currency union in promoting trade are significant but widely heterogeneous across regions, which reflects the different compositions of regional economic activity. It was found that the formation of a common currency did produce regionally concentrated trade effects in more open regions, which could potentially change the geographic nature of economic activity within Spain by influencing bilateral trade. 70% of Spain's external trade now takes place within the EU, but it is distributed very unevenly among autonomous regions.

Second, the magnitude of the common currency effect tends to shrink over time and the results are primarily due to volatility effects. Indeed, unlike some studies that use a broad definition of "currency union", this study found that establishing a currency union with a single central bank and a tangible currency might well make a difference in promoting trade. A tangible currency lends additional credibility to the stability of these arrangements. Results were sensitive to differences in the model specification. Differences between cross-section and panel data results confirm the existence of a significant omitted variable bias.

39 R. Glink, A. Rose, op. cit.

Table 5

Currency Union Effects on Total Regional Trade, Imports and Exports by Autonomous Region (Coefficients and Total-effect Estimates) GLS-FE

	[exp(β_{CU1999})-1] *			[exp(β_{CU2002})-1] *		
	T_{ij}	X_{ij}	M_{ij}	T_{ij}	X_{ij}	M_{ij}
Andalusia	0.116	0.116	0.073	0.073	0.041	0.083
Aragon	-0.008	-0.068	0.062	-0.030	-0.020	-0.058
Asturias	0.150	0.041	0.297	0.209 ^b	-0.086	0.584 ^a
Balearic Islands	0.185	-0.077	0.477	-0.020	-0.323	0.197
Canary Islands	0.152 ^b	0.448	0.162	-0.086	-0.052	-0.086
Cantabria	0.082	0.162	-0.020	0.130	0.154	0.162
Castile-La Mancha	0.378 ^a	0.020	0.699 ^a	0.361 ^a	0.123	0.405 ^a
Castile and Leon	0.092	0.105	0.010	0.006	0.009	-0.039
Catalonia	0.179 ^a	0.083 ^b	0.553	0.121 ^b	0.098 ^a	0.246
Valencia	0.136 ^a	0.150	0.197 ^a	0.093	0.022	0.197 ^a
Extremadura	0.285 ^b	0.150	0.632 ^b	0.236 ^b	0.272 ^a	0.174 ^b
Galicia	0.283	0.094	0.363	0.450	-0.618	0.323
Madrid	0.166 ^a	0.105	0.197 ^a	0.046	-0.014	0.062
Murcia	0.091	0.041	0.221 ^a	0.011	0.042	-0.068
Navarre	0.105	0.020	0.310 ^b	-0.055	-0.146 ^b	0.116
The Basque Country	0.078 ^b	0.234 ^a	-0.077	0.067	0.104 ^b	0.062
La Rioja	0.538 ^a	0.537 ^a	0.537 ^b	0.456 ^a	0.456 ^a	0.448 ^a

* The effect estimates indicate the % chance in bilateral trade resulting from the fact that a trade pair (Spanish region + EU15 member state) entered a common currency zone. ^a Significant at 1% level. ^b Significant at 5% level.

Two relevant policy implications can be discerned from this study. First, EMU has managed to boost regional trade in the traditional Spanish exporting regions. Second, the effect of a common currency on trade is achieved primarily via the reduction of exchange rate variability, which suggests that a credible arrangement to stabilise the exchange rate would have produced similar results on trade as those of a common currency. Finally, the effects of a common currency on trade are sensitive to alternative specifications, and trade-enhancing effects appear in a range from 45% to 16%. Important avenues for further research include the examination of underlying changes in the destination composition of economic exchange across countries as well as the effect of EMU on non-EMU countries, as discussed in Baldwin.⁴⁰

40 R. Baldwin, op. cit.