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Country size and the trade effects of the euro

Harald Badinger · Fritz Breuss

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Abstract This paper investigates whether small countries gain relatively more than large countries from an 'expansion' of their market through the creation of a single currency. The introduction of the euro offers a particularly valuable source to test this hypothesis, which we motivate using the theoretical model by Casella of the year 1996. Our results from a panel data analysis, using both aggregate and disaggregated trade data, point to a statistically significant but quantitatively moderate small country bonus. On average, the euro has led to an improvement of the small euro area's relative export performance by 3–9%.

Keywords Country size · Trade · Euro

JEL classification C33 · F12 · F15

1 Introduction

There is wide agreement that the introduction of the euro has led to an increase in trade of the euro area member states, though the magnitude of the estimates varies considerable across studies. In his comprehensive survey, Baldwin finds that the effect is likely to lie "somewhere between 5 and 15%, with 9% being the best estimate" (Baldwin 2006: 1).

H. Badinger (✉) · F. Breuss
Europainstitut, Department of Economics, Wirtschaftsuniversität Wien,
Vienna, Austria
e-mail: harald.badinger@wu-wien.ac.at

F. Breuss
Austrian Institute of Economic Research (WIFO),
Vienna, Austria

This paper considers whether small countries gained relatively more from the introduction of the euro. Our hypothesis is based on two assumptions: (i) The size of the domestic market is an important determinant of competitiveness. (ii) The introduction of the euro has lead to a reduction in trade costs.

In that case it may be argued that the euro has increased the size of the market that euro area countries can reach with relative ease. This increase is more significant for small countries, whose domestic market is small. As a consequence, the increase in competitiveness is relatively larger for small countries, which are thus favoured by the euro. A theoretical model, formalising this argument, is derived by Casella (1996), who considers the distribution of the gains from enlarging a trade block among its member states in a new-trade theory model with increasing returns and monopolistic competition. As we argue more in detail below, the implications of this model do also apply to the introduction of a single currency.

Moreover, the introduction of the euro offers a particularly valuable source for testing for a small country bonus with respect to the gains in trade from a market expansion. First, the sample of euro area countries is relatively large and there are considerable differences in country size. Second, the 'market expansion' through the euro was sizeable. Third, the 'market expansion' is not only larger for small countries in relative terms (as required theoretically) but also in absolute terms. Fourth, there is high quality data available for trade of the euro area countries, both at the aggregate and disaggregated level.

We use a panel data approach, considering a relative gravity equation where the dependent variable is the ratio of the large to the small country's exports to other euro area countries over the period 1994–2005. The model is estimated using both aggregate trade and disaggregated trade data at the SITC1, SITC2, and SITC3 level.

Overall, our results are supportive to the theoretical predictions by Casella (1996). At the industry level, in a majority of the SITC groups considered, we find that small countries gained more on average. This is confirmed if we aggregate the industry-specific results and also if we estimate the model for aggregate exports. On average over all models, we find that the euro has led to an improvement of the small euro area countries' export performance by some 3–9%. Moreover, there is also evidence that the relative gains of the small countries are larger, the larger the size difference to the large country.

The remainder of the paper is organised as follows. Section 2 reviews the theoretical background and sets up the empirical model. Section 3 presents the estimation results. Section 4 summarises the results and concludes.

2 Theoretical background and empirical model

2.1 Country size and the introduction of the euro

Before we set up the empirical model, we briefly review the theoretical reference model by Casella (1996). The world consists of N countries, part of them belonging to the trade bloc. Markets are characterised by monopolistic competition and increasing returns, allowing firms with a larger domestic market to produce at lower costs. Obstacles to trade are equal to zero at the domestic market, take a positive value within the trade bloc, and are highest for trade with countries outside the trade bloc. Two factors are employed in the production of K different goods: (immobile) skilled labour and (mobile) unskilled labour. The presence of fixed costs implies that each firm specialises in the production of one variety. An equilibrium of this model specifies the prices of all goods, the distribution of low-skilled workers among the countries within the trade bloc, wages and profits such that all markets clear, consumers maximise their utility, firms maximise profits, and no low-skilled workers can benefit from migration within the trade bloc.

What happens, if one or more countries enter the trade bloc? Technically, the changes in equilibrium are triggered by the possibility of migration and changes in consumer prices. But as Casella (1996) argues the main lessons of the model can be read more broadly: enlarging a trade bloc increases the size of the market that a firm can reach with relative ease. This increase will be more significant for firms located in small countries, whose own domestic market is small. This means that the increases in competitiveness are relatively larger for (firms in) small countries, such that the entry of new members in a trade bloc will favour small countries. This conclusion is reached by Casella (1996): 405, proposition 4) both analytically and in a number of numerical simulations.

In fact, the message of this model is very intuitive and general. If country size matters and favours large countries over small countries with respect to export performance, any enlargement of the domestic market will allow the small country to partially offset its initial disadvantage over large countries. In other words, small countries gain more from the enlargement in the sense that they will improve their export performances relative to the large countries.

This theoretical result can be tested by the study of the development of relative sales volumes. Badinger and Breuss (2006) consider the enlargements of the European Community (EC) by Denmark, Ireland, and the United Kingdom in 1973 and Greece in 1981, as well as the free trade agreements between the EC and the members of the European Free Trade Association (EFTA) in the 1970s. The results are largely inconclusive; the authors stress that the mechanism favouring small countries appears to exist, but that for the sample considered, it is partially offset or even dominated by other forces favouring large countries (such as more group ties, higher market power and related terms-of-trade effects, larger absolute endowments with human capital, and a larger product variety).

We will now consider how the model by Casella (1996) applies to the introduction of the euro. Notice, that in the model, joining a trade bloc means nothing else but a reduction of the acceding country's trade costs vis-à-vis all 'old' members of the trade bloc, and simultaneously, a joint reduction of these old members' trade costs vis-à-vis the joining country. Hence, exactly the same reasoning applies to the introduction of the euro. The introduction of the euro increases the size of the market (by all other euro area countries) that a firm can reach with relative ease. This increase will be more significant for firms located in small euro area countries, such that the introduction of the euro should particularly favour small countries.

Generally speaking, the introduction of the euro makes access to other euro area countries easier by reducing trade costs, e.g. by eliminating transaction costs, resulting from the need to exchange currencies or to hedge against exchange rate changes vis-à-vis euro area countries.

Hence, the present paper is placed in the framework of the traditional view that sees the trade effects of the euro as mainly passing through the channel of a reduction in transaction costs. An alternative view, the so-called 'new goods' hypothesis (Baldwin 2006), argues that a single currency reduces the fixed costs of market entry. It is an empirical question, unrelated with country size in principle, whether there are more or less firms in a country, relative to another, which are just below the efficiency threshold and can take advantage of the reduction of fixed costs. As a consequence, it is important to keep in mind that our empirical testing strategy is directed towards capturing asymmetries in the gains from a 'market expansion' with respect to country size, rather than to give a full account of the trade effects of the euro.

A test for asymmetries in the trade effects of the euro with respect to country size is not only of interest in itself. For several reasons, the introduction of the euro offers a particularly suitable case to test the more general hypothesis that small countries can improve their relative export performance as a result of a 'market expansion':

(i) The size of enlargement (of the trading partner against which a reduction of trade costs takes place) is important for the small country bonus to show up in the data. Since intra–euro area trade makes up some 60% of total trade, the introduction of the euro constitutes a sizeable market expansion, larger than any EU enlargement before.
(ii) In the model by Casella (1996), the reason that small countries gain more is that their *relative* market expansion is larger. This is true for the introduction of a single currency as well. In addition, the *absolute* market expansion is greater for small countries here as well, bearing in mind that the 'new' market (to which access has become easier) is the total euro area excluding the respective domestic market (which is smaller for the small country).
(iii) As opposed to previous enlargements of the EC, there is a relatively large sample of member countries within the euro area with significant differences in size. This increases the number of observations, on which the model can be tested.
(iv) Finally, the euro was introduced at a time period, for which comprehensive, high quality data is available. This enables us to test for a small country bonus using both aggregate and disaggregated export data at the SITC1, SITC2, and SITC3 level. This is potentially important, to account for the intra-industry trade setup of the model by Casella (1996).

It is worth emphasising that an assumption underlying our test is that the size of the domestic market matters. Hence, our empirical analysis is in some way also an indirect test of the relevance of market size, which has been called into question by Rose (2006). Moreover, a further important assumption is that the EU (euro area) countries are not fully integrated: if there were a true Single Market in the EU, all countries would have the same ‘domestic’ market; as a consequence, there would be no difference in the relative increase of the euro area countries’ domestic markets and the theoretical reasoning in Casella (1996) would not apply any more. But the EU is still far away from a true Single Market. Apart from legal barriers that still exist in many industries, particularly service industries (see, for example, European Commission (2002)), there are also cultural and language barriers (hindering migration in particular). This is also supported by the results of Chen (2004), who shows that there are still significant border effects on trade flows within the EU. This suggests that there are still sizeable trade costs within the euro area, part of which have been eliminated by introducing the euro.

2.2 The empirical model

Our basic specification follows closely Casella (1996) and Badinger and Breuss (2006). It is based on a simple gravity approach in ratios, relating relative exports (X) of the large and small country to relative GDP, the relative real effective exchange rate (ER) and a euro dummy ($D^{€}$):

$$\ln \frac{X_{L,t}^{€}}{X_{S,t}^{€}} = \alpha + \beta_1 \ln \frac{\mathrm{GDP}_{L,t}}{\mathrm{GDP}_{S,t}} + \beta_2 \ln \frac{\mathrm{ER}_{L,t}}{\mathrm{ER}_{S,t}} + \gamma D_t^{€} + u_t, \tag{1}$$

where $X_{L,t}^{€}$ are exports from the large country L to other euro area countries (excluding the small country S), and $X_{S,t}^{€}$ are exports from the small country S to other euro area countries (excluding the large country L), both in nominal terms[1]; $\mathrm{GDP}_{L,t}$ ($\mathrm{GDP}_{S,t}$) is real GDP of the large country L (small country S); $\mathrm{ER}_{L,t}$ ($\mathrm{ER}_{S,t}$) is the real exchange rate of large (small) country L (S) against the euro area, and $D_t^{€}$ is a euro dummy, taking a value of zero before the introduction of the euro and 1 afterwards). Finally, t is the time index and u_t is a standard error term.

Our sample comprises 10 euro area countries (Belgium and Luxembourg are treated as aggregate) and covers the period 1994–2005. Data on trade flows are from the UN COMTRADE database and were downloaded from the database of the Austrian Institute of Economic Research (WIFO). Data on real GDP (2000 prices and 2000 purchasing power parties (PPPs)) are taken from the OECD Economic Outlook Database. Data on real effective exchange rates against the euro area are from the European Commission (2007) and based on unit labour costs.

Apart from the fact that the specification in ratios follows from the implications of the theoretical model, it has the important advantage that it implicitly controls for shocks affecting small and large euro area countries alike, i.e. shocks which are not systematically related to country size. This is particularly important, since the

[1] Real exports would be preferable from a theoretical perspective, but the proper deflators for the nominal series, i.e., price indices for exports to the euro area, are not available for most of our observations, in particular at the disaggregated level. However, the ratio of the large to the small country’s price level is captured by the constant term, such that only the difference in the change of the large and small country’s price level could affect our estimates. This difference, in turn, is largely determined by factors unrelated to relative country size (e.g. the change in the monetary regime) and can thus be reasonably assumed to be captured by the error term to a large extent without systematically biasing the estimates of our parameter of main interest, i.e. the euro dummy.

introduction of the euro took place at the same time as other important transformations in the world economy, for example the emergence of China and other Asian emerging economies, progress in globalisation or the fact that 10 new countries joined the European Union in 2004.

Equation 1 in ratios is also consistent with simple versions of the gravity equation where time invariant determinants common in gravity equations (such as distance, common border, and common language) are captured by the constant. The parameter γ measures changes in the relative export performance of the large country as a result of the euro; according to the theoretical model we expect a negative value, indicating that the small country gained relatively more in trade with other euro area countries than the large country.

Several comments are in order here: as far as the dependent variable (exports to euro area) is concerned, we impose a 'comparability constraint'. In particular, to ensure that the destination market is the same in the numerator (for the large country L) and in the denominator (for the small country S), we consider only exports to euro area countries other than exports to the large country L and the small country S.[2]

According to the theoretical model by Casella (1996), the improvement in the small country's relative export performance should show up in relative exports to each single euro area destination market. As mentioned above, the most promising testing strategy is using a possibly large destination market. Hence, the comparability constraint follows naturally from the theoretical model by summing up—for each pair of large and small countries—all destination markets in the euro area to which both the large and small country export. This 'comparable' destination market is equal to the whole euro area, excluding the large and the small country, corresponding to the dependent variable used in Eq. 1.[3] Against this background, our empirical model is designed to test for asymmetries in relative export gains from market integration with respect to country size, using the introduction of the euro as 'natural experiment', not to give a full account of the trade effects of the euro (see above).

Notice that this common destination market differs across country pairs L and S. Missing data are a second reason, why this destination market varies across country pairs; if exports from the small country S (or the large country L) to some euro area country are not available for some industry, we excluded them from the exports of the large country L (the small country S) as well.[4] From a theoretical perspective, this is not a problem, since model (1) could in principle be tested for relative exports to a single third country, though the empirical testing strategy is more promising if

[2] Otherwise, the numerator and the denominator would not be directly comparable: the small country's exports to the euro area would include trade with the large country L; the large country's exports to the euro area would include trade with the small country S.

[3] This choice would systematically bias our main results only under the unrealistic scenario that the small (large) country concentrates its export activities (more precisely, the additional export activities triggered by the introduction of the euro) exclusively on the large (small) country destination market.

[4] For aggregate exports and SITC1 level data, this is not relevant; at the SITC2 level some bilateral trade flows are missing, but there are numerous 'holes' in the bilateral trade data at the SITC3 level.

the largest possible destination market is used, i.e. the aggregate euro area with the aforementioned adjustments.[5]

The GDP ratio is included to captures changes in country size, and the relative real effective exchange rate is included to control for other variations in the competitiveness of the small and large country. Our data for the real effective exchange rate is from the quarterly report on price and cost competitiveness of the European Commission (2007); of the various price indices available we opt for unit labour costs, but his choice is not crucial for our main results (i.e. the coefficient of the euro dummy). Notice that an increase in the real exchange rate is associated with a real appreciation vis-à-vis the other euro area countries.

At the time of the introduction of the euro, the euro area was made up by 11 countries, four of which would be typically considered as large (Germany, France, Italy, Spain). What is more relevant in our context is not the absolute but the relative size of the countries, which we simply measure in terms of relative GDP, or alternatively, relative employment. We argue that a country is relatively large to another country if it is of double size in terms of GDP or employment; this appears to be a reasonable threshold, though any choice remains arbitrary to some extent. Since Belgium and Luxembourg have to be treated as aggregate due to data availability, we are left with 10 countries. Forming all ratios of large to small countries, there are 32 of total 45 ratios, whose GDP or employment ratio exceeds the threshold of 2 (see Table 4 in the Appendix).

We go on to set up a panel by pooling Eq. 1 for all 32 ratios of large to small countries. To simplify notation, we denote relative variables (large to small countries) with superscript $^{\mathrm{REL}}$, yielding

$$\ln X_{i,t}^{\mathrm{REL}} = \alpha_i + \beta_1 \ln \mathrm{GDP}_{i,t}^{\mathrm{REL}} + \beta_2 \ln \mathrm{ER}_{i,t}^{\mathrm{REL}} + \gamma_1 D_t^{€} + u_{i,t}. \tag{2}$$

The cross-section dimension i is spanned by the 32 ratios of large to small countries summarised in Table 4 in the Appendix. Regarding the time dimension, we opt for a two-period panel with averages over the period 1994–1998 ('before') and 2001–2005 ('after'). This helps to smooth out short-run shocks and is more appropriate for our goal of estimating medium- to long-run equilibrium effects. Another advantage of this choice is that possible non-stationarity of the time series[6] is not of concern, given the equivalence of fixed effects estimation (in levels) and the first-differenced estimator in a two-period panel.

The effects of the euro have not materialised immediately. We assume that the main transition took place in the years 1999 and 2000. This is a conservative choice; Baldwin (2006) argues that the break happened very quickly, appearing in 1999. By excluding the years 1999 and 2000, we ensure that the estimated effects are not diluted by mixing up the period after the break with the transition period.[7]

[5] The choice of relative trade with all new member states is also motivated by the possibility that when the market expansion occurs, firms might concentrate on one or a subset of all markets if there is a fixed component of trade costs (Badinger and Breuss 2006).

[6] Time series and panel unit root tests are inconclusive, but this uncertainty would shed some doubt on the results if longer time series were used.

[7] Including the years 1999 and 2000 in the period 'after' the break, the results turned out very similar. This supports the view that the transition took place very quickly.

Since we are interested in the average effect of the euro on relative export performance of large to small countries, the parameter γ, which measures the relative gain of the large country, is restricted to be equal across countries.[8] The same is true for the parameters of relative GDP and the relative real exchange rate as usual in gravity equations. Time-invariant variables such as distance, common border, common language, etc. are cross-section-specific and thus captured by cross-section-specific fixed effects. In our two-period setting, the euro-dummy, taking a value of zero 'before' (1994–1998) and a value of one 'after' (2001–2005) can be regarded as a time-specific effect.

Equation 2 is our baseline model. We extend this empirical model to consider another implication that follows from the theoretical model by Casella (1996), namely that the magnitude of the small country bonus depends on the size difference between the large and the small country. This hypothesis can be tested by adding an interaction term between the euro dummy and relative GDP to Eq. 1, yielding:

$$\ln X_{i,t}^{\mathrm{REL}} = \alpha_i + \beta_1 \ln \mathrm{GDP}_{i,t}^{\mathrm{REL}} + \beta_2 \ln \mathrm{ER}_{i,t}^{\mathrm{REL}} + \gamma_1 D_t^{€} + \gamma_2 D_t^{€} \ln \mathrm{GDP}_{i,t}^{\mathrm{REL}} + u_{i,t}. \quad (3)$$

The relative gain of the large country is now given by $\gamma_1 + \gamma_2 \ln \mathrm{GDP}^{\mathrm{REL}}$. This is an interesting extension of earlier studies such as Badinger and Breuss (2006), since it does now only allow for a refined model test, but also serves to identify thresholds of the size differences required to induce a small country bonus.

Finally, two assumptions underlying the theoretical model should be borne in mind. There are increasing returns to scale, and trade is of intra-industry type. While intra-euro area trade may largely be viewed to be of intra-industry type, the existence if increasing returns cannot be taken as granted at the aggregate level. Therefore, we will not only estimate Eq. 1 at the aggregate level, but also at the industry level, in particular for trade disaggregated at the SITC1, SITC2 and SITC3 level.

We use the most comprehensive approach, using data from the UN COMTRADE database. This yields 10 separate panels at the STIC1 level, 62 panels at the SITC2 level, and 246 panels at the SITC3 level. In terms of Eqs. 2 or 3, only the dependent variable changes; the controls remain the same as before. On the one hand, there is no data on value added and real exchange rates at the detailed SITC level used here. On the other hand, using aggregate data can be justified by the fact that for industries delivering intermediates to other industries, it is not only the size of the own sector that matters. Since cycles are not synchronised across industries, however, its parameter becomes difficult to interpret and is of little interest in itself.

Finally, moving down to an industry-specific equation has a further advantage. At the aggregate level, the relative GDP might be endogenous as a result of reverse causality. At a disaggregated level, however, where one single industry contributes only marginally to total value added, trade in a single industry has a negligible GDP effect at best, mitigating this possible endogeneity problem. Given the absence of

[8] Technically, cross-section-specific parameters for $D^{€}$ are not estimable in this setup since they would be perfectly collinear with the fixed effects.

strong and convincing instruments for the GDP ratio, the use of disaggregated data provides an important robustness check for the aggregate analysis.

3 Estimation results

3.1 Results for aggregate trade

3.1.1 Basic model

Table 1 presents the estimation results for Eqs. 2 and 3. Notice that in our two-period panel the fixed effects (FE) estimator is equivalent to the first-differenced (FD) estimator, both with respect to estimation and inference. That is, our estimates can be obtained by a pooled regression of Δ In $X_{i,t}^{\mathrm{REL}}$ on Δ In $\mathrm{GDP}_{i,t}^{\mathrm{REL}}$, Δ In $\mathrm{ER}_{i,t}^{\mathrm{REL}}$, and $\Delta D_t^{€}$ (a constant).

The first column of Table 1 shows the least squares (LS) estimates. The relative GDP is positive as expected with an elasticity around three quarters and highly significant; the real effective exchange rate shows the right sign but is insignificant. The same holds true for the coefficient of the euro dummy: it is negative, pointing to a small country bonus, but not significant at conventional levels.

Table 1 LS and FGLS estimates of Eqs. 2 and 3, aggregate trade

Dependent variables is ln X^{REL}	Eq. 2			Eq. 3	
	LS	$\mathrm{LS}^{\mathrm{HC}}$	FGLS	$\mathrm{LS}^{\mathrm{HC}}$	FGLS
ln $\mathrm{GDP}^{\mathrm{REL}}$	0.765***	0.765***	0.764***	0.753***	0.803***
	(0.156)	(0.116)	(0.026)	(0.101)	(0.043)
ln $\mathrm{ER}^{\mathrm{REL}}$	−0.143	−0.143	−0.073	−0.229*	−0.159**
	(0.232)	(0.111)	(0.063)	(0.119)	(0.068)
$D^{€}$	−2.653	−2.653	−3.231***	7.104	4.793*
	(2.978)	(1.837)	(0.528)	(4.357)	(2.499)
ln $\mathrm{GDP}^{\mathrm{REL}} \times D^{€}$				−6.111**	−5.303***
				(2.569)	(1.403)
Adj. R^2	0.417	0.417	0.413	0.455	0.439
SE	0.134	0.134	0.134	0.129	0.131
N	32	32	32	32	32
T	2	2	2	2	2
No. of obs.	64	64	64	64	64

LS, least squares estimates; $\mathrm{LS}^{\mathrm{HC}}$, fixed effects estimates using asymptotic heteroscedasticity robust standard errors; FGLS, feasible generalised least squares estimates, using cross-section weights

To ensure comparability, the standard error of estimation and the adjusted R^2 always refers to first-differences differenced models and are based on unweighted residuals. The euro dummy is divided by 100, such that the coefficient is to be interpreted in per cent

Notably, there are large differences in the squared standard errors over the cross-sections, ranging from 0.01 to 0.2. As can be confirmed by more formal tests, there is pronounced heteroscedasticity in the error term, which has to be addressed for valid inference. While in a two-period panel, FE and FD estimation produce identical estimates and *standard* inference, this is not true for the robust covariance estimator.[9]

In order to use the right covariance correction, one has to decide which estimator (FD or FE) is the proper one, which depends on the properties of the error term u in Eq. 2: if u is white noise, the FE estimator is efficient; if u it is a random walk, the FD estimator is efficient. Usually the truth will lie somewhere in between, such that the strength of the serial correlation is typically used as guide. In a two-period panel, testing for serial correlation does not appear to be very promising, and theoretical reasoning does not help along. For comparison, the second column of Table 1 shows the results, when the corrected covariance, based on the FE estimates, is used. The standard errors remain fairly large, in particular of the euro dummy, which is the variable of our primary interest.[10]

To improve the efficiency of our estimates, we next apply a weighted least squares approach. This "is a natural route to follow if the robust standard errors of the fixed effects estimator are too large to be useful" (Wooldridge 2002: 276). In the present context, cross-section weights are the obvious choice. In that case, the resulting weighted fixed effects (FE) and first-differences (FD) estimation produce identical estimates and inference: this has the further advantage that it dispenses us from making a choice between (inference based on) FD or FE estimation.

The weighted or feasible generalised least squares (FGLS) estimates of Eq. 2, using cross-section weights are given in the third column of Table 1. It is reassuring that the parameter estimates do not differ dramatically from the least squares approach. At the same time the standard errors of the coefficients shrink considerably, with the consequence that the coefficient of the euro dummy becomes significant at the 1% level. The real effective exchange rate remains insignificant, however.

The goodness of fit hardly differs between the two estimates and is satisfactory with an R^2 of some 40%. In order to ensure comparability, all R^2s and standard errors of regression (SE) reported refer to the original model in first differences and are based on unweighted residuals. Since there is no precise counterpart to the R^2 in the generalised regression model, the values or the GLS estimates should be regarded as purely descriptive.

We now consider the economic significance of the estimates; since the euro dummy is scaled by a factor of 1/100, its coefficient (i.e. effect on relative exports) can be interpreted in per cent. The estimates point to a relative improvement of the small country's export performance by some 3%; this is a quantitatively moderate though non-negligible effect. Moreover, it should be borne in mind that this figure

[9] Compare the corrected covariances for the FE estimator (Wooldridge 2002: 275) and for the FD estimator (Wooldridge 2002: 282).

[10] If the correction is based on the FD residuals, results are similar: p values become smaller as well, though slightly less.

represents the bottom line effect. As argued in Badinger and Breuss (2006), there may also be forces favouring large countries. What our results suggest is that the small country bonus dominates slightly on average. The ceteris paribus effect depicted in the model by Casella (1996) is likely to be higher.

A qualification to the results is that endogeneity as a result of reverse causality from relative exports to relative GDP may bias our estimates. In this case the coefficient of the GDP ratio (i.e. the slope) would be upward biased, the coefficient of the euro dummy (i.e. the constant) would be downward biased. Unfortunately, in the present context there are no convincing, high quality instruments available; any variable affecting GDP is likely to affect trade as well.

3.1.2 Extended model

We go on to test model (3), which postulates that the relative gains in exports are a function of relative size. The fourth column in Table 1 shows the fixed effects estimates with corrected standard errors, column five the FGLS results. Including the interaction of relative GDP with the euro dummy, the fit of the model improves slightly. The parameter estimates for relative GDP and the real exchange rate remain essential unchanged, but the latter becomes significant now as well. In the unweighted regression, the *p* value of the euro dummy ($D^{€}$) improves to 0.110; the interaction term is significant at the 5% level. In the weighted regression both variables are significant at the 10 and 1% level, respectively. They are also jointly significant in both the unweighted regression (*p* value: 0.026) and the weighted regression (*p* value: 0.001).

In the weighted model, the magnitude of the average effect, evaluated at the mean of the GDP ratio is −4.242%, which is in line with the results for the basic model (2). Depending on the size difference, the overall effect ranges from −11.232 to 1.748%. The threshold of the size difference in terms of relative GDP, as of which the small country gains more (i.e. the small country bonus starts to dominate) is 2.5 (in levels). Only 5 of the 32 size ratios of our sample are below this threshold (AT-IE, BE-FI, NL-AT, NL-PT, PT-IE). For all other ratios, the size difference between the large and small country is sufficiently large to yield a negative overall effect.

Summing up, the estimates for aggregate trade suggest that there appears to be a small country bonus; there is also evidence that the relative gain of the small over the large country increases with the size difference. A limitation of the results is that they are not perfectly robust across all models and estimation methods. We now take a closer look and turn to the disaggregated analysis.

3.2 Results for disaggregated trade data

3.2.1 Basic model

Using disaggregated data is an important refinement of the empirical testing strategy: in the model by Casella (1996) trade is of intra-industry type; moreover, for the small country bonus to exist, there must be increasing returns. Finally, as

Table 2 FGLS and LS estimates of model (2) for disaggregated data, overview of results

	Total[a]	Shares[b]			Average (all)[c]		Average (sign.)[c]	
		–	+	0	μ	σ	μ	σ
(a) Weighted estimates								
SITC1	10	50.00	10.00	40.00	−7.297	0.498	−6.699	0.349
SITC2	62	59.68	20.97	19.35	−9.156	0.365	−9.183	0.350
SITC3	246	47.15	32.52	20.33	−5.228	0.304	−5.387	0.293
(b) Unweighted estimates								
SITC1	10	40.00	0.00	60.00	−6.516	1.302	−6.452	0.778
SITC2	62	33.87	14.52	51.61	−9.602	1.360	−8.813	1.182
SITC3	246	31.71	19.51	48.78	−4.863	0.814	−3.979	0.606

[a] Total number of estimates at the respective SITC levels

[b] Share of cases where coefficient of $D^{€}$ is negatively significant, positively significant, and insignificant respectively; significance level: 5%

[c] Trade share weighted averages of all (significant) coefficients; standard deviation calculated assuming that the industry-specific coefficients are independent

outlined above, the disaggregated approach addresses endogeneity concerns. Notice that only the dependent variable (i.e. the export ratio) is replaced by industry data in Eqs. 2 and 3, whereas the control variables (relative GDP and real exchange rate) remain the same as before.

Table 2 summarises the results of the unweighted and weighted estimates of the basic model (2) form a bird eye's perspective.[11] It shows the shares of the positive, negative, and insignificant parameter estimates for the three levels of aggregation. Of course, we cannot expect the small country bonus to dominate always and everywhere. After all, there are many forces determining the pattern of trade flows. What our results again suggest, however, is that country size matters in the case of 'market expansion' and that it appears to dominate in a majority of the cases considered. For all three levels of aggregation and for both the unweighted and weighted estimates, a negatively significant parameter estimate (suggesting a small country bonus) is the most frequent result. This is particularly pronounced at the SITC1 level, but it also holds up at the SITC2 and SITC3 level.

In a next step we check whether the industry-specific results are in line with the aggregate estimates, by summing up the SITC level–specific estimates using the respective trade share in total trade as weights. The implied effects generally exceed those from the estimates for total trade: we arrive at an average aggregate effect of some 7% at the SITC1 level, 9% at the STIC2 level, and some 5% at the SITC3 level. Taken together with the estimates of model (2) and (3) at the aggregate level (see Sect. 3.1), our results suggest that the introduction of the euro has led to an improvement in small euro area countries' relative export performance ranging from some 3 to 9%.

[11] More detailed results for SITC1 and SITC2 levels are given in Table 5 in the Appendix. Detailed results for SITC3 levels are available from the authors on request.

Table 3 FGLS and LS estimates of model (3) for disaggregated data, overview of results

	Total[a]	Share of significant[b]	Distribution of coefficients[c]				Total[d]	
			− −	+ +	+ −	− +	− −	+ +
(a) Weighted estimates								
SITC1	10	60.00	33.33	0.00	66.67	0.00	100.00	0.00
SITC2	62	88.71	27.27	10.91	41.82	20.00	69.09	30.91
SITC3	246	84.96	20.10	11.00	45.93	22.97	66.03	33.97
(b) Unweighted estimates								
SITC1	10	40.00	75.00	0.00	25.00	0.00	100.00	0.00
SITC2	62	53.23	27.27	9.09	51.52	12.12	78.79	21.21
SITC3	246	56.91	20.00	14.29	42.86	22.86	62.86	37.14

[a] Total number of estimates at the respective SITC levels [b]Share of cases where coefficient of $D^{€}$ and GDP^{REL} $D^{€}$ are jointly significant; significance level: 5% [c]Distribution of coefficients among possible outcomes; the first sign refers to coefficients of $D^{€}$, second sign to that of the interaction term [d]Total distribution, where the potentially ambiguous cases (+ − and − +), which are unambiguous for our given of GDP ratios, were assigned to the cases − − and + +

3.2.2 Extended model

Both the aggregate estimates and the disaggregated estimates of model (2) point to a small country bonus on average; the aggregate estimates of the extended model (3) also suggest that the magnitude of the size difference is important: according to our aggregate estimates the small country bonus starts to dominate as of a size ratio of 2.5. We now consider this extended Eq. 3 from a more disaggregated perspective.

We proceed as follows: model (3) is estimated at the SITC1, SITC2, SITC3 level. We start by showing in how many of the cases the coefficients of the euro dummy and the interaction of the euro dummy with the GDP ratio are jointly significant. Only then, the effect of the euro on trade can be reasonably regarded to be a function of relative market size.

For the cases, where the joint *p* value (of γ_1 and γ_2 in Eq. 3) points to a significant effect, there are four possible outcomes. Both coefficients can be negative or positive: then there is an unambiguous small or large country bonus. Table 3 shows the respective shares of estimates at the different levels of aggregation; the shares of the cases with a joint negative effect range from 20 to 33%, which is clearly larger than the share of cases where both coefficients are positive.

Alternatively, the coefficients could have the opposite sign; then the effect is ambiguous, depending on relative country size. Table 3 shows the respective shares of the cases where the two coefficients take the opposite sign. For each of these cases, we calculate the threshold for the size ratio, as of which the direction of the effect changes. Fortunately, we find that in no single industry, the threshold is of relevance for our sample: it is always clearly below 2, the smallest size ratio in our sample. In several cases, the threshold is even below 1 which is actually ruled out in a specification of ratios from ‘large to small’. Hence we can sharpen the results by adding the shares with a potentially ambiguous effect, which actually turn out as unambiguous with the data at hand, to the shares where both coefficients show the same sign. The last two columns in Table 3 show the corresponding shares, which strengthen our previous results: in more than two-third of the cases where the relative gains depend on relative size, small countries gained relatively more.

4 Conclusions

This paper tests for asymmetries in the trade effects of the euro with respect to country size. Our empirical analysis is motivated by the new-trade theory model by Casella (1996), which investigates the distributions of the gains from trade bloc enlargement among its member states. We argue that the implications of this model hold up for the introduction of a common currency as well: the intuition is that if country size matters—i.e. if larger countries are more competitive since a large domestic market allows them to produce at lower costs—large countries have a starting advantage. But this also means that any regime shift that induces an increase in market size (or the size of the market that can be reached with relative ease) triggers a catching up effect of the small country, since its relative market expansion is larger. As a consequence, the induced increase in competitiveness is relatively larger for the small country, such that it should be able to improve its export performance relative to the large country.

We use a gravity model in ratios, relating relative exports (of the large and small country to the euro area) to relative GDP and the relative real exchange rate and test for a small country bonus as a result of the euro, using 32 ratios of large to small countries over two time periods: 'before' (1994–1998) and 'after' (2001–2005) the introduction of the euro. The estimation is carried out both for aggregate exports and also at the SITC1, SITC2, and SITC3 industry level.

The overall results are supportive to the theoretical predictions by Casella (1996). This is true both at the aggregate level and at the industry level, where we find that small countries gained more on average in a majority of the SITC groups considered. On average small countries improved their export performance relative to large countries by some 3–9% as a result of the euro. In addition, the magnitude of the relative gain often depends on the size difference between the large and the small country.

A broader reading of the results suggests that country size is an important mechanism shaping economic performance and that a small country bonus exists. However, the transmission channel considered here—i.e. an in increase in relative competitiveness as a result of a market expansion—does not appear to be the only relevant one if there are increasing returns to scale, and mechanisms favouring large countries (such as group ties and network effects) are conceivable as well. A more complete and integrated theoretical framework, which depicts the channels through which country size matters, remains to be developed in future research. Such a theoretical framework would also help to assess not only the net effect of enlarging a trade bloc or introducing a common currency, but also to separately identify the mechanisms at work and their relative importance.

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Appendix

See Tables 4 and 5.

Table 4 Size relationships: large to small countries

Relatively large country *i*	Relatively small country *j*	Relative EMPL (*i* to *j*)	Relative GDP (*i* to *j*)
AT	IE	2.5	2.2
BE	FI	1.8	2.1
	IE	2.5	2.6
DE	AT	9.4	9.1
	BE	9.5	7.7
	ES	2.6	2.5
	FI	16.8	15.8
	IE	23.8	20.2
	NL	4.8	4.6
	PT	7.9	11.2
ES	AT	3.6	3.6
	BE	3.6	3.1
	FI	6.5	6.3
	IE	9.2	8.1
	PT	3.0	4.5
FR	AT	5.8	6.8
	BE	5.8	5.8
	FI	10.3	11.8
	IE	14.5	15.1
	NL	3.0	3.5
	PT	4.8	8.4
IT	AT	5.0	6.3
	BE	5.0	5.4
	FI	9.0	11.1
	IE	12.7	14.2
	NL	2.6	3.2
	PT	4.2	7.9
NL	AT	1.9	2.0
	FI	3.5	3.4
	IE	4.9	4.4
	PT	1.6	2.4
PT	IE	3.0	1.8

Data on Employment (EMPL) and GDP in 1999 (in PPPs) taken from OECD Economic Outlook Database

Table 5 Estimation results for Eq. 2 at SITC1 and SITC2 level for parameter of $D^{€}$

SITC1	Coefficient of $D^{€}$		SITC2	Coefficient of $D^{€}$			Coefficient of $D^{€}$	
	LS	FGLS	SITC2	LS	FGLS	SITC2	LS	FGLS
X0	−23.55***	−25.75***	X01	−9.94	−14.11***	X56	−67.60***	−65.37***
X1	−15.95*	−13.87***	X02	−18.31*	−18.36***	X57	−4.52	−3.04***
X2	1.76	−0.08	X03	11.76	11.58***	X58	−12.05*	−12.75***
X3	−45.65***	−45.93***	X04	−27.91***	−29.31***	X59	10.09**	11.89***
X4	−25.35***	−26.19***	X05	−28.79***	−27.11***	X61	−4.94	−4.47
X5	0.19	0.39	X06	−34.71***	−34.32***	X62	−13.98*	−11.73***
X6	−3.09	−3.81*	X07	6.17	7.29***	X63	1.18	−1.89
X7	−7.43***	−8.28***	X08	−4.96	−9.67***	X64	19.24***	19.11***
X8	4.85	3.75**	X09	−48.81***	−46.45***	X65	−8.45*	−8.17***
X9	1.50	0.76	X11	−14.31**	−13.32***	X66	−5.54	−7.77***
			X12	−43.36	−39.44***	X67	−25.35**	−24.03***
			X21	−9.96	−12.65***	X68	−39.59***	−33.25***
			X22	−52.31***	−51.48***	X69	−4.32	−3.71*
			X23	−51.37***	−49.98***	X71	2.51	4.73*
			X24	−4.73	−11.95***	X72	−13.41***	−13.32***
			X25	39.80***	37.30***	X73	−4.41	−1.90
			X26	−73.57***	−75.27***	X74	−18.20***	−18.41***
			X27	11.97*	4.50	X75	−48.95**	−51.54***
			X28	14.86***	12.52***	X76	19.68***	21.79***
			X29	−2.60	−3.32***	X77	−4.40	−4.45***
			X32	57.43***	58.15***	X78	−16.16***	−15.47***
			X33	−13.43	−13.14***	X79	14.67	14.39***
			X34	−113.15**	−108.62***	X81	−6.17	−4.98***
			X41	−4.96	−5.06**	X82	−17.67***	−19.67***
			X42	−52.77***	−59.99***	X83	23.93***	22.83***
			X43	−11.88	7.25	X84	26.94***	22.45***
			X51	−30.49***	−28.03***	X85	−27.52***	−27.75***
			X52	16.28**	5.39*	X87	5.47*	4.52***
			X53	−51.13***	−52.27***	X88	−5.12	−3.56
			X54	22.04*	30.09***	X89	−1.54	−0.25
			X55	3.40	4.42*	X97	−18.50	−12.64

***, **, * denote significance at the 1, 5, and 10% level, respectively

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