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Currency unions and trade: A post-EMU reassessment

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A B S T R A C T

In our *European Economic Review* (2002) paper, we used pre-1998 data on countries participating in and leaving currency unions to estimate the effect of currency unions on trade using (then-) conventional gravity models. In this paper, we use a variety of empirical gravity models to estimate the currency union effect on trade and exports, using recent data which includes the European Economic and Monetary Union (EMU). We have three findings. First, our assumption of symmetry between the effects of entering and leaving a currency union seems reasonable in the data. Second, our preferred methodology indicates that EMU has boosted exports by around 50%. While other estimation techniques yield different results, a panel approach with both time-varying country and dyadic fixed effects on a large span of data (across both countries and time) seems to deliver insensitive and reliable results. Third, different currency unions have different trade effects.

1. Introduction

In this paper we estimate the effect of currency unions on trade. More specifically, we estimate this effect using a variety of models and a panel of annual data that covers more than 200 countries between 1948 and 2013. We do so to check the results of our *European Economic Review* (Glick and Rose, 2002) paper as well the rich empirical literature on the trade effects of currency unions that followed.[3] Our 2002 paper used a panel approach to investigate the effect of currency unions

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[3] As of March 2016, our 2002 paper has over 1050 Google Scholar citations, of which twenty have over 100 cites each. Rose and Stanley (2005) did an early meta-study of this literature which included 34 papers, with seven estimating the trade effect of the EMU. Rose (2008) did a follow-up study of 26 papers with EMU effect estimates. Havranek (2010) extended the sample to 61 studies, with 28 on the EMU and 33 on other currency unions. Our own

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on trade using data through 1997. That work involved an assumption, a caveat, and some analysis. In this paper, we examine each.

1.1. Motivation: an assumption, a caveat, and a finding

In this paper, we use a data set that includes fifteen years of data for the Economic and Monetary Union in Europe, hereafter "EMU". We take advantage of this to ask three questions. First, we test whether our earlier assumption of symmetry between currency union entry and exit is justified in the data. The data set of our *EER* (Glick and Rose, 2002) paper included only 16 switches into but 130 switches out of currency unions before 1998. Given the paucity of data on entries into currency union, we explicitly assumed symmetry between entries and exits.[4] We can now check this assumption, since the many entries into EMU give us a non-trivial number of observations of currency union entries.

Our second question is related: do all currency unions have similar trade effects? While we examine a large number of currency unions, we are most interested in whether EMU has a trade effect similar to that of other currency unions; EMU is the largest and most important monetary union. Our *EER* paper included no data on EMU, so we were cautious about the relevance for EMU:

> "Caveats. There are issues associated with the applicability of our results. Since our sample ends before EMU, most of the currency unions involved countries that were either small, poor, or both; our results may therefore be inapplicable to EMU."

The relevance of our original estimate for EMU has been questioned on the grounds that it largely reflects the experiences of small dependent economies in currency unions with large anchor countries. It is unclear how much the experience of the Bahamas, which adopted the dollar as its currency in 1966, applies to the experience of industrial countries such as France and Germany, which jointly adopted the euro. In fact, influential recent papers estimating the trade effects of EMU have generally found smaller effects than our previous estimate of the effect of currency unions.[5] However, most of these studies work with relatively small samples of industrial, mainly European, countries. Further, since many were done shortly after the establishment of the euro, most have relatively short time series.[6] Only a few papers distinguish between the effects of EMUs and other currency unions with a large sample of countries over a long time period, including Frankel (2010) and Eicher and Henn (2011).

Finally, we ask whether the (many) advances in empirical modeling of trade flows since our *EER* (Glick and Rose, 2002) paper are materially relevant to estimating the currency union effect on trade. We worked hard in our earlier work to ensure that our results did not depend strongly on our precise methodology. For instance we wrote (italics added):

> "To summarize: *a number of different panel estimators all* deliver the conclusion that currency union has a strong positive effect on trade. … Our fixed effects estimates indicate that entry into/departure from a currency union leads bilateral trade to approximately double/halve, holding a host of other features constant. This result is not only economically and statistically significant, but seems *relatively robust*…"
>
> "This result is economically large, statistically significant, *and seems insensitive to a number of perturbations in our methodology*."

The last dozen years has seen considerable methodological work in the area, perhaps most importantly the contributions of Anderson and Van Wincoop (2003). The literature has been ably surveyed recently by Head and Mayer (2014); see also Baldwin and Taglioni (2007). We take advantage of this progress by estimating the effect of currency union on trade using newer techniques. We pay particular attention to the effects of selective sampling across time and countries.

To preview our conclusions, we find that: (a) symmetry looks OK; (b) EMU is way different from other currency unions; and (c) while different methodologies deliver different results, there is reasonable evidence that EMU has a strong positive effect in stimulating trade. Our preferred methodology – a panel approach with both dyadic and time-varying exporter and importer fixed effects on a long broad data set – seems defensible and leads us to conclude that EMU has had a substantive effect in expanding European trade.

(*footnote continued*)
review of the literature finds that the number of papers reporting panel estimates with gravity models of the trade effects of currency unions has since grown to over 100.

[4] Indeed, our abstract includes this assumption as well as our chief finding (italics added):

"During this sample a large number of countries left currency unions; they experienced economically and statistically significant declines in bilateral trade, after accounting for other factors. *Assuming symmetry*, we estimate that a pair of countries that starts to use a common currency experiences a near doubling in bilateral trade."

The assumption of symmetry was later repeated in the paper, twice.

[5] By our count, there are now over 50 papers that estimate EMU effects in panel gravity models of trade.

[6] For example, the samples in Bun and Klaassen (2002), Micco et al. (2003), Barr et al. (2003), Faruqee (2004), Clark et al (2004), Baldwin et al. (2005), De Nardis and Vicarelli (2003a, 2003b)– among the most heavily cited papers on the effects of the EMU – all end in 2002 or earlier. Later EMU studies, e.g., De Nardis et al. (2008a, 2008b), Flam and Nordstrom (2006a), Gomes et al. (2006), Serlenga and Shin (2007), Baldwin and Taglioni (2007), Brouwer et al. (2008), Berger and Nitsch (2008), Baldwin et al. (2008), Santos Silva and Tenreyro (2010), and De Sousa (2012), added a few more years, but usually not more countries.

2. Initial methodology and data set

We are interested in estimating the effect of currency unions on aggregated international trade. In our *EER* paper, we estimated a gravity model of international trade which was conventional for the time:

$$\ln(T_{ijt}) = \gamma \mathrm{CU}_{ijt} + \beta Z_{ijt} + \{\delta_t\} + \epsilon_{ijt} \tag{1}$$

where i and j denote countries, t denotes time, and

- T_{ijt} denotes the average nominal value of bilateral trade between i and j at time t,
- CU is unity if i and j use the same currency at time t and 0 otherwise,
- β is a vector of nuisance coefficients,
- Z is a vector of controls,
- $\{\delta\}$ is a mutually exclusive and jointly exhaustive set of year-specific effects,
- ϵ_{ijt} represents the myriad other influences, assumed to be well behaved.

As (Z) controls, we use a standard collection of (13) determinants from the gravity literature: the products of national real GDP and real GDP per capita, the distance between the countries, the product of national land masses, dummy variables for the number of landlocked and island countries in the dyad, and dummy variables if the countries share a common language, land border, regional trade agreement (RTA), and (variants of) colonial heritage.

The coefficient of interest is γ, which represents the partial trade impact of currency union. This effect ignores at least four related phenomena which may affect the impact of currency union on trade: (a) omitted variables, (b) effects of currency union between i and j on other countries through so-called "multilateral resistance" effects; (c) general equilibrium effects on spending and output for all countries; and (d) the homogeneity implicit in treating all currency unions alike. The omitted variable problem is particularly relevant in light of the inherent challenge of including all relevant determinants of bilateral trading relationships. As emphasized by Baldwin (2006a, 2006b) and as we show later, controlling for unobserved factors by the inclusion of country-pair fixed effects has a significant effect on results. Anderson and Van Wincoop (2003), Baier and Bergstrand (2009), and Head and Mayer (2014) analyze multilateral resistance and general equilibrium effects; below, we ascertain the results of controlling for these factors as well. Eicher and Henn (2011) have brought the homogeneity issue to the attention of the field; we also take this issue into account in the analysis that follows.

A large data set provides many degrees of freedom which is useful in a variety of contexts. For instance, fixed effects can be included to control for unobservables; we explore this issue more below. A large data set also allows direct comparison of the effects of individual currency unions, such as the EMU, with others. In order to compare our results with those of the literature, we handle the currency union dummy variable (CU) in three ways. First, we treat all currency unions as identical, combining all together into a single variable. Next, we separate EMU from all other currency unions; the coefficients allow us to test if the trade effects of EMU differ from those of a combination of other unions. Of course, this "catch-all" way of characterizing other currency unions may miss the differences that might exist between the effects for, say members of the African CFA, the East Caribbean Currency Union (ECCU), bilateral currency unions with Australia, France, the UK, etc. Hence, we also report results that break out the effects of non-EMU currency unions separately. In order to do this, we unpack our single non-EMU CU dummy variable into a number of separate currency unions. More particularly, we separate pairs of countries in two multilateral currency unions: (a) the CFA franc zone; and (b) the East Caribbean Currency Union. We also split off dyads in which both countries use: (a) the Australian \$; (b) the British pound; (c) the French Franc (before the Euro was created); (d) the Indian rupee; and (e) the US \$.[7] Each of those currency unions accounts for more than 1000 observations in our sample; we aggregate the remaining (much smaller) currency unions into a single category "others".

We begin by estimating (1) on a data set that includes observations through 2013 for a broad set of countries. We estimate this with ordinary least squares, using standard errors robust to clustering (since dyads [country-pairs] are dependent across years).[8,9]

2.1. The data set

We rely on the *Direction of Trade* data set assembled by the International Monetary Fund (IMF). The data set covers bilateral trade between over 200 IMF country codes between 1948 and 2013 (with gaps). Not all of the areas covered are countries in the conventional sense of the word; colonies (e.g., Gibraltar), territories (e.g., Guam), overseas departments (e.g., Guadeloupe), countries that gained their independence during the sample (e.g., Guinea-Bissau), and so forth are all

[7] As we describe later, our currency union variable does not include bilaterally fixed exchange rates, such as those between the CFA franc and either the French franc or Euro, only those where literally the same currency is used or else currencies are interchangeable between two countries at a 1:1 par for an extended period of time.

[8] This set-up has been strongly criticized by Baldwin and Taglioni (2007), justifiably so in our opinion (with the benefit of 20:10 hindsight). Below, we fix each of the problems noted by Baldwin and Taglioni.

[9] Our fixed-effects standard errors are also robust. We do not claim that currency unions are formed exogenously, nor do we attempt to find instrumental variables to handle any potential endogeneity problem. For the same reason we do not consider matching estimation further, particularly given the sui generis nature of EMU.

Table 1
Pooled panel least squares gravity estimates for bilateral trade.

	EER 2002	New	Disaggregate EMU	Disaggregated CUs
All Currency Unions	1.30 (.13)	.92 (.09)		
All Non-EMU Currency Unions			1.12 (.11)	
EMU			.02 (.08)	.03 (.08)
CFA Franc				1.14 (.17)
ECCU				1.92 (.26)
Aussie $				3.31 (.23)
British £				.66 (.15)
French Franc				.53 (.13)
Indian Rupee				.21 (.51)
US $				.58 (.21)
Other CUs				2.06 (.43)
Observations	219,558	426,953	426,953	426,953
R^2	.64	.67	.67	.67
RMSE	2.02	2.03	2.03	2.03
Years	1948–1997	1948–2013	1948–2013	1948–2013

Regressand: log of bilateral trade. Regressors included but not reported: log distance; log product real GDP; log product real GDP per capita; common language; common land border; regional FTA membership, # landlocked; # islands; log product area; common colonizer; current colony/colonizer; ever colony/colonizer; common country. Intercept and year controls not reported. Standard errors robust to dyadic clustering recorded in parentheses. Annual data for >200 countries.

included; we use the term "country" simply for convenience.[10] Bilateral trade on FOB exports and CIF imports is recorded in U.S. dollars. We create an average value of the nominal value of bilateral trade between a pair of countries by averaging all of the four possible measures potentially available.

To this data set, we add a number of other variables that are necessary to estimate the gravity model. We add population and real GDP (in constant dollars) from *World Development Indicators*, supplemented where necessary by the Penn World Table Mark 7.1, and the IMF's *International Financial Statistics*. We exploit the CIA's *World Factbook* for a number of country-specific variables such as latitude and longitude, land area, landlocked and island status, physically contiguous neighbors, language, colonizers, and dates of independence. The World Trade Organization's website provides data on regional trade agreements.

Finally, we add information on whether the pair of countries was involved in a currency union. By "currency union" we mean essentially that money was interchangeable between the two countries at a 1:1 par for an extended period of time, so that there was no need to convert prices when trading between a pair of countries; EMU is by far the most important contemporary example. Hard fixes (such as those of Hong Kong or Denmark) do not qualify as currency unions under our definition. We take our data from our earlier paper, which relied on the IMF's *Schedule of Par Values* and issues of the IMF's *Annual Report on Exchange Rate Arrangements and Exchange Restrictions*, supplemented with information from of *The Statesman's Yearbook*, and extended through 2013 so that EMU is included. Our definition of currency union is transitive; if dyads x–y, and x–z are in currency unions, then y–z is a currency union. In our sample, less than 2% of the observations involve dyads in a currency union. At the outset, we combine all currency unions together and estimate a single effect on trade; we return to this issue at length below.[11]

3. Results with older (trade) models

We present estimates for (1) in Table 1. For convenience and to provide a basis of comparison, we tabulate the estimates from our *EER* (Glick and Rose, 2002) paper in the extreme left column. In our original paper, we estimated the key coefficient γ at 1.30, with a robust standard error of .13, implying that a pair of countries joined by a common currency trade over three times as much with each other ($e^{1.3} \approx 3.7$), holding other things constant. As shown in the next column to the right, our new data set – extended through 2013 with more than 200,000 extra observations – provides a point estimate of .92 with a (robust) standard error of .09. While this is smaller, it is still statistically and economically substantive ($e^{.92} \approx 2.51$, with a t-ratio exceeding 9).

By far the biggest recent event in monetary unions has been the establishment of the EMU. In the second column from the right of Table 1, we separate the EMU effect from the combined effects of all other currency unions, to dramatic effect.[12] The currency union effect rises somewhat to 1.12, but the more interesting point estimate is that of EMU; the net effect of

[10] The (211) countries are listed in Appendix A available online.
[11] We also took the opportunity to correct an error in the data set of our *EER* (Glick and Rose, 2002) paper having to do with the transitivity of currency unions.
[12] More precisely, the dummy variable EMU_{ijt} equals one if both i and j use the Euro at time t, and zero otherwise. We construct this variable similarly to that of our currency union variable but restrict it to countries that use the Euro, including EMU member countries as well as miscellaneous parts of

Table 2
Dyadic fixed effects gravity estimates for bilateral trade.

	EER 2002	New	Disaggregate EMU	Disaggregated CUs
All Currency Unions	.65 (.05)	.63 (.07)		
All Non-EMU Currency Unions			.75 (.10)	
EMU			.41 (.05)	.41 (.05)
CFA Franc Zone				.72 (.29)
East Caribbean Currency Union				−.24 (.29)
Aussie $				.81 (.37)
British £				.93 (.12)
French Franc				1.00 (.15)
Indian Rupee				1.70 (.55)
US $				.09 (.21)
Other CUs				1.15 (.35)
R^2: Within	.12	.20	.20	.20
Years	1948–1997	1948–2013	1948–2013	1948–2013
Observations	219,558	426,953	426,953	426,953
Country-Pair Fixed Effects	11,178	14,801	14,801	14,801

Regressand: log of bilateral trade. Regressors included but not reported: log product real GDP; log product real GDP per capita; RTA membership, current colony. Fixed dyadic (pair-specific) effects and year effects included but not reported. Robust standard errors in parentheses. Annual data for >200 countries.

EMU membership is essentially nil in both economic and statistical terms. This is the first indication that EMU has a substantively different effect on trade than other monetary unions. The column on the extreme right of Table 1 shows that this result is not affected if we disentangle the non-EMU currency unions; it also shows dramatically different estimates for different currency unions.[13]

The essence of our 2002 paper was to take maximal advantage of currency union status using a panel estimator with fixed dyadic (country-pair) effects, rather than relying simply on the least squares results of Table 1. The motivation for this was stated explicitly in our *EER* 2002 paper and remains relevant:

> "Above and beyond econometric robustness, the fixed effect estimator has one enormous advantage. Since the within estimator exploits variation over time, it answers the policy question of interest, namely the (time series) question 'What is the trade effect of a country joining (or leaving) a currency union?'"

Another advantage is handling the potential endogeneity of currency unions; Head and Mayer (2014) write "Lacking plausible IVs, the most promising approach is to include country-pair fixed effects …". For both reasons, we are uncomfortable with estimates that do not include dyadic fixed effects.

Accordingly, we add (more than 14,000) dyadic fixed effects and re-estimate (1); our (within) results are presented in Table 2. These estimates rely only on time-series variation around dyadic means, and thus account for all country-pair effects, whether observable or not. Since such dyadic effects are plausibly significant in both statistical and economic terms, we consider the within estimates of Table 2 to be much more believable than those of Table 1. As in Table 1, we tabulate results from our earlier paper at the extreme left.

The estimates in Table 2 indicate that the within estimate of γ has changed little with data revisions and extensions, from .65 to .63.[14] However, when we split off the EMU effect, the effect for non-EMU currency unions rises to .75, while the EMU effect is estimated to be large and positive; the point estimate is .41 with a standard error of .05, implying that EMU entry expands trade by ($e^{.41}-1\approx$) 51%. Thus, making the model *more* plausible by only using variation around country-pair averages has *raised* the estimated impact of EMU on trade! Dis-aggregating the non-EMU currency unions does not affect this conclusion, as reported in the column at the extreme right; the evidence continues to indicate considerable heterogeneity across currency unions.

How do our results compare with the literature? The cottage industry has produced estimates of the trade effects of the Euro which are typically smaller.[15] For example, among papers which use dyadic effects and trade as the dependent variable, the estimated γ for EMU is -.001 in Berger and Nitsch (2008), .03 in Baldwin et al. (2004) and Bun and Klassen (2007), .08 in Faruqee (2004), .11 in Micco et. al. (2003), .22 in Serlenga and Shin (2007), and .25 in Barr et al. (2003).[16] However, as mentioned earlier, these studies invariably focus on the effects of the EMU, excluding other currency unions, and use

(*footnote continued*)
France (Guadeloupe, French Guiana, Martinique, St. Pierre & Miquelon, Reunion), Montenegro and Kosovo. Clearly this dummy variable overlaps with our currency union variable.

[13] Understanding the estimates across different currency unions is an interesting topic for future research, but beyond the scope of this paper.

[14] If we restrict our new data set to the same sample period as our original paper, the point estimates remain similar, as the results in the far right column of Table 2 indicate.

[15] Head and Mayer (2014) and Baldwin (2006a, 2006b) provide summaries; see also Baldwin et al. (2008) and Havranek (2010).

[16] Barr et al. (2003) report a similar magnitude coefficient of .21 with IV estimation.

Table 3
Chow tests for bilateral trade.

	Least squares	Dyadic FE
Post-1997 versus all	89. (.00)	134. (.00)
EMU versus all	27. (.00)	10. (.00)

F-tests (*P*-values reported parenthetically) for hypothesis of identical slopes, using regression model (1) with combined currency union variable.

samples that are smaller and shorter than ours, an issue that we will demonstrate below is significant.[17] Moreover, almost all of these papers include time trends for European Union pairs to control for ongoing economic integration among these countries. Including such trends significantly masks the possible euro effect on trade, both before and during the actual implementation of EMU; without trends, the estimated magnitude of the EMU effect rises to .41 in Bun and Klaassen (2007) and .34 in Berger and Nitsch (2008). We attempt to handle this issue below with a more flexible specification.

Limiting the sample to European and industrial countries precludes any direct comparison of the effects of EMU and other currency unions. Accordingly, Frankel (2010) uses a broad sample of countries over the period of 1992–2006, comparable to the time period used by most euro-focused papers. He gets a low EMU estimate of .06 along with a more substantial non-EMU estimate of .58. However, upon extending his sample back to 1948, the estimated effects rise dramatically: to .75 for non-EMU currency unions (hereafter CUs), similar to what we find, and an even higher figure for EMU of .93.[18] Clearly the span of the data set over both time and countries matters, when estimating the trade effects of currency unions; we return to this issue below.[19]

The impression of a post-1997 break in the trade effect is reinforced by the Chow tests tabulated in Table 3. The top row tests the hypothesis of model constancy – identical slopes of γ and $\{\beta\}$ – when one compares the post-1997 period with the entire sample. The null hypothesis of model constancy is grossly inconsistent with the results of both the least squares estimator of Table 1 and the fixed effects estimator of Table 2. The bottom row of Table 3 also finds non-constancy for a narrower hypothesis; EMU observations need to be modeled differently from other currency union observations.

3.1. Symmetry

The results in Tables 1 and 2 are attempts to estimate the steady state effect of currency union on trade, ceteris paribus. A related question is whether the effects of currency union entry and effect are symmetric. In our earlier paper, we had a large number of observations on exits from currency unions but only a small number of entries into currency unions; hence we were forced to assume symmetry between the dynamic trade effects of currency union exit and entry. Since EMU began in 1999, we now have fifteen years of EMU data and can use this to test our assumption of symmetric dynamics. We begin with graphs.

We replace our simple currency union dummy in (1) with lags after both currency union exits and entries and re-estimate our equation; we then use these results to test the hypothesis of equality between the dynamic trade effects after currency union exit with the (opposite signed) effects after entry. We use fourteen lags for obvious reasons, and add a comparable number of leads (before both currency union exit and entry) so as to be able to test for symmetry in the run-up to monetary union exit/entry. That is, we estimate:

$$\ln(T_{ijt}) = \Sigma_k \theta_k \text{CUENTRY}_{ijt-k} + \Sigma_k \varphi_k \text{CUEXIT}_{ijt-k} + \beta Z_{ijt} + \{\delta_t\} + \epsilon_{ijt} \tag{1'}$$

where: CUENTRY_{ijt-k} is 1 if countries *i* and *j* entered a currency union at time *t–k* and 0 otherwise; CUEXIT is defined analogously for exits from current union; and we let *k* run from -14 to 14.

The point estimates of $\{\varphi\}$, estimated with dyadic fixed effects, are portrayed in the upper-left graph of Fig. 1, along with a $+/-$ two standard error band; the lower-left graph presents estimates of $\{\theta\}$. We are interested in checking the comparability between EMU and other currency unions. Accordingly, we divide the CUENTRY dummies into two mutually and jointly exhaustive sets of dummies and graph the coefficients on the right side of the figure.

Most of the results in Fig. 1 seem intuitive. The effect of currency union on trade is substantial, in both economic and statistical terms, before currency union exit. Upon exit, the effect starts to shrink in both economic and statistical terms, though it lingers on even fourteen years after exit. The effect after currency union entry is also striking; there seems to be a positive effect *before* entry, suggesting that the event is anticipated or perhaps endogenous. The statistical effect of currency union entry on trade seems substantial, even long after entry.

[17] Most studies of EMU impact have focused on aggregate trade data. Baldwin, Skudelny, and Taglioni (2003), Flam and Nordstrom (2006b), Baldwin (2006b), Baldwin and di Nino (2006), and Berthou and Fontagne (2008) estimate gravity models using sectoral data, but only for the effects of the euro.

[18] Frankel (2010) includes a EU time trend in his regressions.

[19] In Frankel's (2010) words:

"There appears to be much useful information from including all 60 years of available data in addition to including developing countries in the entire sample, rather than restricting ourselves to post-1992 observations of European or rich countries. … Only by using the entire sample can we uncover large short-term effects, over 100% when using fixed effects estimation. Second, the trade effects in the year before a monetary union formally goes into operation are even larger, and apply equally to EMU as to other monetary unions."

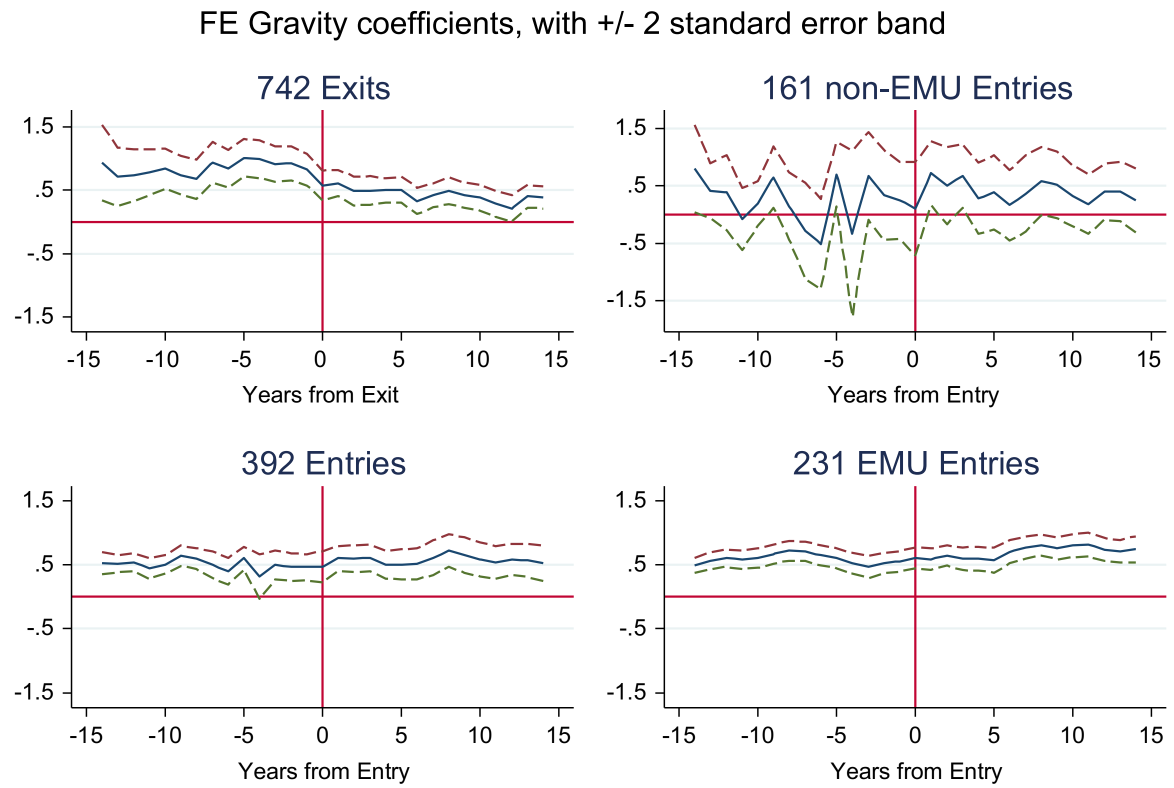

Fig. 1. Effects of currency union transitions on log trade.

Estimates of (1′) allow us to test for symmetry rigorously. We are particularly interested in symmetry between the (dynamic) effects of entry into and exit from currency union. We ask "Does the additional boost to trade after currency union *entry k* years ago equal the reduction in trade after currency union *exit k* years ago?"[20] Since we estimate both leads and lags before entry/exit, we can test for symmetry both *before* and *after* currency entry/exit, as well as both before and after simultaneously. Our *F*-tests are tabulated in Table 4; the different columns present results from our least squares and fixed effects estimators.

Table 4
Symmetry tests for bilateral trade.

Fixed Effects:	Time	Dyadic, Time
After any CU Entry = −After any CU Exit?	2.8 (.00)	1.4 (.15)
Before any CU Entry = −Before any CU Exit?	1.4 (.13)	1.8 (.04)
Both	2.6 (.00)	1.8 (.01)
After non-EMU CU Entry = After EMU Entry?	1.6 (.09)	.8 (.73)
Before non-EMU CU Entry = Before EMU Entry?	1.1 (.39)	1.3 (.17)
Both	1.4 (.07)	1.4 (.07)
After non-EMU CU Exit = −After EMU Entry?	2.1 (.01)	1.1 (.36)

F-tests with *P*-values reported parenthetically, calculated from regressions of log of bilateral trade. Regressors included: 14 leads, 14 lags and contemporaneous values of both (combined) currency union entry and currency union exit; log distance; log product real GDP; log product real GDP per capita; common language; common land border; regional FTA membership, # landlocked; # islands; log product area; common colonizer; current colony/colonizer; ever colony/colonizer; common country. Intercept and year controls not reported. Annual data for > 200 countries, 1948–2013.

The hypothesis of symmetric trade effects of currency union entry/exit works reasonably well for the fixed effect estimator, as indicated by the low *F*-tests. We also present results which compare EMU with other currency unions. EMU

[20] Technically speaking, our joint null is hypothesis is H_0:{$[(\theta_1-\theta_0)=-(\varphi_1-\varphi_0)]$, $[(\theta_2-\theta_0)=-(\varphi_2-\varphi_0)]$, …, $[(\theta_{14}-\theta_0)=-(\varphi_{14}-\varphi_0)]$}.

observations seem to have trade effects which are similar to other currency unions, especially after entry. It is especially striking to us that the fixed effect (FE) estimates are consistent with the hypothesis that the trade effect after EMU entry is symmetric to that after exit from other currency unions; this seems close to validating our original assumption of symmetry. With new data and old methodology, the essence of our earlier work still looks reasonable; the question is whether it stands up to greater econometric scrutiny. We now turn to that question.

4. Results with newer (export) models

We now pursue "theory-consistent estimation" of the gravity equation, closely following the suggestions in the recent survey by Head and Mayer (2014); this technique allows us to address concerns about multilateral resistance and other general equilibrium effects. We rely on the "LSDV" (*L*east *S*quares with time-varying country *D*ummy *V*ariables) technique, which they show works well in many situations. In particular, we estimate:

$$\ln(X_{ijt}) = \gamma \mathrm{CU}_{ijt} + \beta Z_{ijt} + \{\lambda_{it}\} + \{\psi_{jt}\} + \epsilon_{ijt} \tag{2}$$

where:

- X_{ijt} denotes the nominal value of bilateral exports from i to j at time t,
- $\{\lambda_{it}\}$ is a complete set of time-varying exporter dummy variables, and
- $\{\psi_{jt}\}$ is a complete set of time-varying importer dummy variables.

This equation is related to (1), with two substantive differences. First, the equation estimates the effect of currency union on (log) exports rather than trade. Second, it holds constant all country-specific "monadic" phenomena rather than time-invariant dyadic phenomena.[21] Consistently, (2) can only estimate the effect of pair-specific phenomena, like the currency union effect on exports.

The estimate of γ presented at the extreme left column of Table 5 is economically and statistically significant. Roughly comparable to the .63 point *trade* effect of Table 2, the point estimate of the currency union effect on *exports* is .51. This is a large effect in economic ($e^{.51}-1 \approx 67\%$) and statistical terms (the t-ratio exceeds 20). Point estimates for the other bilateral estimates also seem intuitive in sign and size.[22]

Table 5
Panel LS gravity estimates for bilateral exports.

Fixed Effects:	Exporter × year, Importer × year			Exporter × year, Importer × year, dyadic		
	All CUs	Disagg. EMU	Disagg. CUs	All CUs	Disagg. EMU	Disagg. CUs
All Currency Unions	.51 (.02)			.34 (.02)		
All Non-EMU Currency Unions		.76 (.02)			.30 (.03)	
EMU		−.65 (.03)	−.64 (.03)		.43 (.02)	.43 (.02)
CFA Franc Zone			.74 (.03)			.58 (.10)
East Caribbean Currency Union			1.83 (.06)			−1.64 (.11)
Aussie $			1.27 (.10)			.39 (.20)
British £			.26 (.03)			.55 (.03)
French Franc			1.84 (.08)			.87 (.08)
Indian Rupee			.03 (.10)			.52 (.11)
US $			.02 (.05)			−.05 (.06)
Other CUs			1.37 (.06)			−.10 (.06)
Country•Time Fixed Effects	22,438	22,438	22,438	22,438	22,438	22,438
Dyadic Fixed Effects	n/a	n/a	n/a	33,886	33,886	33,886
R^2	.72	.72	.72	.86	.86	.86
RMSE	1.93	1.93	1.93	1.42	1.42	1.42

Regressand: log of bilateral exports. Regressors included but not reported: log distance; common language; common land border; regional FTA membership, common colonizer; current colony/colonizer; ever colony/colonizer; common country. Exporter-year and importer-year controls included not reported. Robust standard errors recorded in parentheses. 879,794 annual observations for > 200 countries, 1948–2013.

The analysis presented above suggests that EMU may have a different trade effect than other currency unions. We split off the effects of EMU in our export model of (2); the estimates are presented immediately to the right in Table 5. Consistent with our earlier results but even more dramatically, the export-stimulating effect of EMU is lower than other currency

[21] These monadic phenomena may be time-invariant (such as land area), or time-varying (such as GDP, or "multilateral resistance" to trade introduced by Anderson and van Wincoop (2003)).

[22] We note in passing that even stronger results characterize the sample restricted to data before 1998, as shown in versions available online.

unions. While other currency unions now seem to raise exports significantly ($e^{.76}-1 \approx$ 114%, with a *t*-ratio of 38), the net effect of EMU on exports is *negative*; the point estimate is −.65 with a standard error of .03. This seems scarcely believable, and dis-aggregating the currency union effects has little consequence.

Baldwin and Taglioni (2007) recommend adding dyadic fixed effects to (2), precisely in the context of estimating the currency union effect on exports.[23] Their reasoning is the same as ours above; dyadic fixed effects are plausibly important, and turn out to be critical empirically. Accordingly, we follow their suggestion on the right-hand side of Table 5. Adding country-pair fixed effects (to the time-varying exporter/importer effects) reduces the combined currency union effect somewhat, though it remains positive and significant. However, the EMU effect is now *positive*; EMU is now estimated to raise exports by an economically significant ($e^{.43}$–1 ≈) 54%, independent of whether one disaggregates currency unions or not. This effect is not only large but significantly different from zero at any confidence level (the *t*-ratio exceeds 20). Thus, the dyadic effects add considerable explanatory power to the exports equation while reversing the negative EMU effect. Indeed, the point estimate of the EMU effect on exports (with dyadic fixed effects) from Table 5 is .43, remarkably similar to the trade effect from Table 2 of .41. Succinctly, making the export model more believable by exploiting only variation around dyadic averages substantially *raises* the estimate of the EMU effect, just as it did with the older trade models.

Our results in Table 5 with dyadic fixed effects deliver an EMU effect which is significantly positive in both the economic and statistical senses. They stand in contrast with the small and insignificant effects estimated by Baldwin and Taglioni (2007) and Baldwin et al. (2008), who use a similar specification with country-year dummies and dyadic fixed effects.[24] We think the main reason is the span of the data set across both countries and time. Baldwin and co-authors work with a small sample of industrial countries which is conventional for the EMU-focused literature; moreover, the twenty-five year span of time is less than half of ours. Table 5 of Baldwin and Taglioni (2007) indicates a total of only 4837 observations, while Baldwin et al. (2008) use even less. Our estimates rely on 879,794 observations over the period 1948–2013; this is consistent with the strong results of Frankel (2010) who uses a broad sample. We will show below that employing a full set of countries consistently delivers a positive and significant EMU result.

Our idea is bolstered by Gil-Pareja et al. (2008), who also employ country-year dummies and dyadic fixed effects, extend the usual sample of industrial countries back to 1950, and find a much higher EMU effect of .57. Eicher and Henn (2011) work with a large sample of countries at five-year intervals over 1950–2000, and emphasize the importance of disaggregating individual currency unions; they break out the effects of the EMU as well as the CFA, ECCU, Pound, Dollar, and other CUs. Eicher and Henn find with this specification that the EMU effect is .54, though it falls to .34 if further controls for European integration are included.[25] Both of these papers support our view that the span of the data across both time and country matter.[26]

In working paper versions of this paper (available online), we also pursue Poisson pseudomaximum likelihood estimation of these models.[27] We take these estimates less seriously, primarily because we have been unable to estimate an appropriate model for a reasonably large panel for purely computational reasons. To us, a plausible methodology to estimate the currency union effect on trade involves panel estimation with dyadic fixed effects. We are reassured by the fact that the old-fashioned trade model and more modern LSDV export model deliver similar results when dyadic fixed effects are included, and await computational advances to be able to estimate the Poisson analogs.[28]

4.1. Symmetry

As with our estimation of old-style gravity models, we are interested in whether the effects of currency union exit are symmetric with those of currency union entry; we are also interested in whether currency unions are all alike, or whether EMU is different. Much as we did above in (1′), we re-estimate our model after adding dynamic currency union entry and

[23] This prevents one from estimating the effects of time-invariant bilateral phenomena (such as distance or language), but does not preclude estimating the effect of currency unions, and is also valuable as a robustness check to control for time-varying omitted dyadic variables.

[24] A number of other EMU-focused and less methodologically pure papers use dyadic fixed effects and (log) exports or imports as the dependent variable, but *without* country-year effects, for samples of industrial countries over periods extending from the early 1980s to the mid-2000s. Like the papers mentioned in the text, their estimated EMU effects are small though positive, ranging from .06 to .14 in Bun and Klaassen (2002), De Nardis and Vicarelli (2003a, 2003b), Brouwer et al., (2008), and Flam and Nordstrom (2006b) to .22 to .33 in Bun and Klaassen (2002), Flam and Nordstrom (2006a), and Flam and Nordstrom (2007).

[25] They also find heterogeneity in the effects of other individual currency unions; more on this in the next section.

[26] We also note our estimates are only half the mean and median of the (37) structural gravity estimates for the common currency effect collected in Table 4 of Head and Mayer (2014), as well as the partial trade impact (PTI) effects that they tabulate in their Table 6.

[27] Santos Silva and Tenreyro (2006) argue that least squares estimates of (1) and (2) may be give biased estimates of true gravity effects because of heteroskedasticity and/or the presence of numerous discarded observations of zero trade. They recommend use of a Poisson pseudo maximum likelihood estimator in these circumstances. Santos Silva and Tenreyro (2010) apply this methodology to a small sample of industrial countries with 6930 observations and find that EMU has a negligible effect on trade.

[28] A recent paper by Mika and Zymek (2016) uses a Poisson pseudo maximum likelihood variant to estimate the effects of EMU and non-EMU currency unions for a full country sample including zero-valued trade observations with both country-year and pair effects over the period 1992–2002. They get estimates of .02 for the EMU and .15 for other currency unions. Their estimates are even lower, -.02 and .02, respectively, if they extend their sample forward to 2013. Since they do not extend their sample backwards in time, their sample period is much shorter than ours. In addition, they include an EU trend in their specification, which we have argued dampens the estimated effect of EMU. More problematic perhaps is that they do not use one-way trade flows as their dependent variable, since they "artificially balance trade flows" by defining their dependent variable as the geometric average of imports and exports and "dropping duplicate observations."

exit effects to our panel regression for exports. Our results are tabulated in Table 6 and indicate that symmetry works quite well.

Fig. 2 is analogous to Fig. 1, but portrays least squares point estimates of $\{\varphi\}$ (in the top-left) and $\{\theta\}$ (in the lower-left) for exports when we include dyadic fixed effects, along with corresponding $+/-$ two standard error bands. As before, we also divide the CUENTRY dummies into EMU and non-EMU dummies, and graph the resulting coefficients on the right side of the figure. The results are intuitive and echo those of Fig. 1; exit from a currency union seems to make exports fall after a lag. More importantly, currency union entry – especially into EMU – leads exports to rise significantly over time. Since country-pair fixed effects may control for important unobserved factors affecting bilateral trade, these results cannot be dismissed lightly.

To summarize, our least squares panel results with time-varying country and dyadic fixed effects, which we consider to be our most plausible econometric model, deliver large positive effects for both the currency union effect on exports and its EMU counterpart. We now ask the question: are all currency union effects on trade alike?

4.2. Disaggregating currency union effects on exports

We now focus on the question "Are the trade effects of all currency unions alike?" Table 7 provides estimates of disaggregated currency union effects on exports, using (2) supplemented with dyadic fixed effects. The top row is repeated

Table 6
Symmetry tests for bilateral exports.

Fixed effects:	Exporter × year, Importer × year	Dyadic, Exporter × year, Importer × year
After any CU Entry = −After any CU Exit?	1.4 (.15)	.8 (.71)
Before any CU Entry = −Before any CU Exit?	.4 (.98)	.8 (.68)
Both	1.0 (.41)	1.0 (.49)
After non-EMU CU Entry = After EMU Entry?	1.8 (.04)	1.3 (.17)
Before non-EMU CU Entry = Before EMU Entry?	.6 (.89)	1.4 (.16)
Both	1.2 (.27)	2.8 (.00)
After non-EMU CU Exit = −After EMU Entry?	5.4 (.00)	.9 (.51)

F-tests with *P*-values reported parenthetically, calculated from regressions of log of bilateral exports. Regressors included: 14 leads, 14 lags and contemporaneous values of both (combined) currency union entry and currency union exit; log distance; common language; common land border; regional FTA membership, common colonizer; current colony/colonizer; ever colony/colonizer; common country. Intercept and year controls not recorded. Annual data for >200 countries.

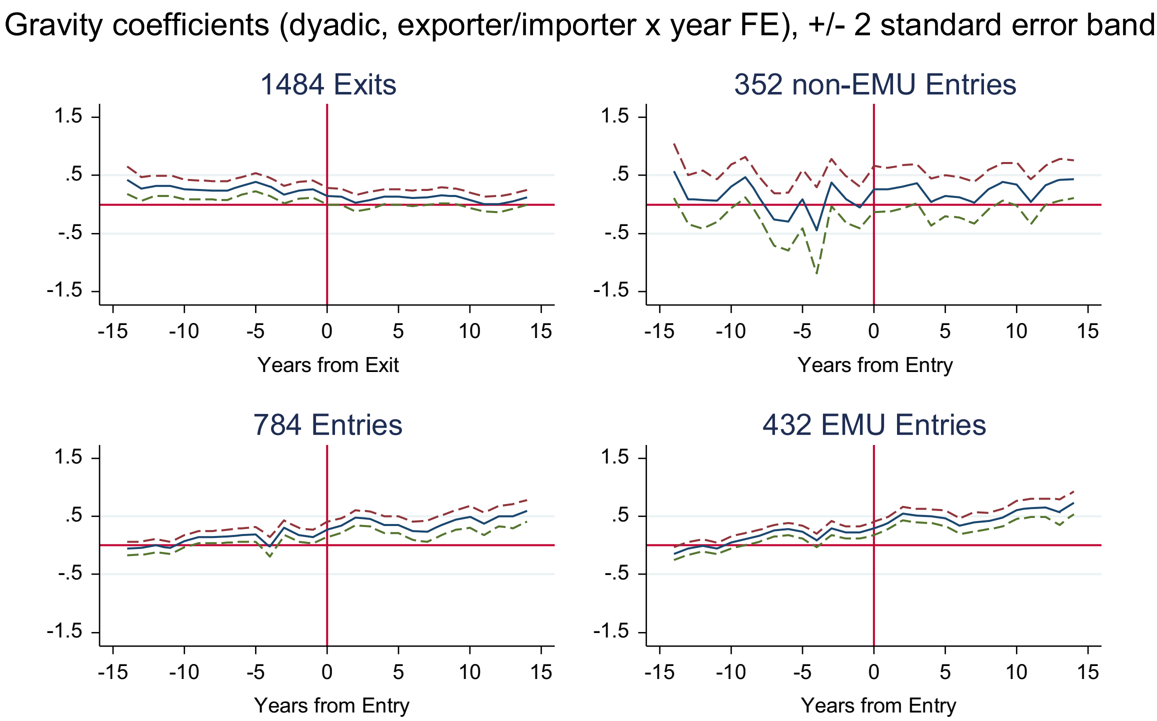

Fig. 2. Effects of currency union transitions on log exports.

Table 7
The Currency Union effect on exports: sensitivity analysis.

	EMU €	CFA Franc	ECCU $	Aussie $	Brit. £	French Franc	Indian Rupee	US $	Other CUs	Equal? (*P*-val)
Default (Table 5)	.43** (.02)	.58** (.10)	−1.64** (.11)	.39 (.20)	.55** (.03)	.87** (.08)	.52** (.11)	−.05 (.06)	−.10 (.06)	.00
Data at Five-Year Intervals	.51** (.05)	1.03** (.23)	−1.69** (.20)	.25 (.48)	.56** (.08)	.95** (.20)	.65** (.25)	−.01 (.14)	−.11 (.14)	.00
No Industrial Countries	1.17** (.14)	.39** (.11)	−1.53** (.14)	.05 (.86)	.36** (.09)	.54 (.18)	.36** (.12)	−.17 (.09)	−.48** (.08)	.00
Larger Countries (GDP > $1 bn)	.42** (.02)	.48** (.11)	−1.88** (.12)	n/a	.55** (.04)	.86** (.08)	.54** (.12)	−.06 (.06)	−.16* (.07)	.00
No Poor Countries (GDP p/c < $1,000)	.45** (.02)	.29 (.18)	−1.51** (.10)	.41* (.20)	.51** (.04)	.99** (.10)	1.19** (.28)	−.12 (.06)	−.25** (.09)	.00
Similarly-sized Countries	.42** (.03)	.35 (.18)	−1.08** (.25)	n/a	.55** (.07)	n/a	−1.23 (.69)	.36** (.12)	.72** (.18)	.00
Drop pre-1960	.45** (.02)	.56** (.10)	−1.46** (.11)	.39* (.20)	.60** (.05)	.63** (.14)	.17 (.16)	−.07 (.07)	.01 (.07)	.00
Drop pre-1980	.47** (.02)	.36 (.22)	n/a	1.40** (.21)	n/a	.00 (.25)	n/a	.08 (.09)	−.78* (.32)	.00
Drop post-1997	n/a	.62** (.11)	−1.34** (.10)	−.09 (.20)	.44** (.04)	1.03** (.09)	.48** (.12)	−.38** (.09)	−.01 (.06)	.00
Drop post-2006	.19** (.03)	.56** (.10)	−1.45** (.10)	.29 (.20)	.51** (.03)	.96** (.08)	.50** (.12)	−.23** (.07)	−.06 (.06)	.00
Drop $>\lvert 2\sigma \rvert$ Residuals	.47** (.02)	.69** (.08)	−1.29** (.09)	.55** (.17)	.55** (.03)	.98** (.07)	.72** (.08)	−.05 (.05)	−.00 (.05)	.00
2004 Cross-Section	−.48** (.12)	2.57** (.24)	5.24** (.28)	2.06* (.99)	1.13 (.86)	n/a	3.17** (.68)	2.00** (.36)	5.36** (.67)	.00
2012 Cross-Section	.79** (.13)	3.06** (.24)	7.52** (.32)	3.23** (.84)	1.18 (1.01)	n/a	3.45** (.95)	1.45** (.40)	4.31** (.96)	.00
Drop Dyadic Fixed Effects	.15** (.03)	2.90** (.03)	4.78** (.06)	3.07** (.12)	.87** (.03)	2.89** (.11)	2.32** (.10)	1.24** (.06)	3.67** (.06)	.00

Coefficients on currency union dummy variables; robust standard errors recorded in parentheses. One (two) asterisk(s) indicate hypothesis of no effect can be rejected at the .05 (.01) significance level. Least squares estimation; regressand is log bilateral exports. Regressors included but not recorded: regional FTA membership; current colony/colonizer; fixed effects for (a) exporter-year, (b) importer-year, and (c) country-pair. Equality test in right-hand column tests hypothesis of equality for all (nine) currency unions. Annual data for > 200 countries, 1948–2013 unless otherwise marked. Other currency unions include those around: Belgian Franc; Portugese Escudo; Pakistan rupee; Jamaican dollar; Mauritius rupee; New Zealand dollar; UAE dirham; Spanish peseta; Denmark krone; Italian lira; South African rand; West African pound; East African shilling; Malaya ringgit; Palestinian pound; and Dutch guilder.

from Table 5; it shows clearly that when the eight major currency unions are split off the aggregate currency union dummy and included separately, results vary widely. Some currency unions have large positive effects (the CFA Franc zone, the British pound zone, and the Indian rupee zone), while many have a small effect, and the ECCU effect is negative. The hypothesis of equal CU effects is strongly rejected, as is apparent with the tabulated *P*-value at the right of the table.

Our results are consistent with those of Eicher and Henn (2011), who stress the importance of breaking out the effects of individual currency unions rather than relying on a single "catch-all" currency union variable. They also find that effects vary greatly across currency union, ranging (in their preferred specification) from as high as .68 for the CFA to .34 for the euro to as low as −.15 for the US dollar zone and −.71 for the ECCU. These relative rankings are comparable to the results we report in Table 7.[29]

Table 7 also provides sensitivity analysis, showing γ estimates for thirteen different perturbations of the basic methodology. In particular, we (a) sample data at five-year intervals instead of annually; (b) drop all industrial countries; (c) drop all small countries (those with GDP less than $1 billion); (d) drop all poor countries (those with GDP per capita less than $1,000); (e) retain only similarly-sized country-pairs (those where national GDP varies by less than a factor of five); (f) drop pre-1960 data; (g) drop pre-1980 data; (h) drop post-1997 data; (i) drop post-2006 data; (j) drop all observations where the residual lies more than two standard deviations from zero; (k,l) provide cross-sectional estimates from 2004 and 2012 (dropping the dyadic fixed effects); and (m) drop the dyadic fixed effects. Despite the nature of this sensitivity analysis, our results are, broadly speaking, quite robust. It is particularly reassuring to us that the EMU coefficients remains significantly positive in both economic and statistical terms with size that varies little from our default estimate of .43, and that the hypothesis of equal currency union effects is consistently rejected. The three final rows are the outliers, demonstrating the importance of using both a panel approach and dyadic fixed effects.

4.3. *The span of the data*

We have repeatedly pointed out that the span of the data set, across both country and time, seems to affect the estimated effect of currency union on trade. We make this issue more concrete in Table 8, which shows how our most important estimate – the effect of EMU on exports, ceteris paribus – varies with the sample. Our default is to estimate Eq. (2) with both exporter/importer-time and dyadic fixed effects, conventional regressors, and disaggregated currency unions (though we only record the estimate for EMU). The top-left cell in Table 8 corresponds precisely to that taken from the extreme-right column of Table 5; the full sample of 879,794 observations delivers an estimate of the effect of EMU on exports of $(\exp e^{.43} - 1 \approx)$ 54%, a large effect that is highly statistically significant (with a robust *t*-ratio exceeding 20). The columns immediately to the right show that beginning the sample later, in either 1985 or 1995, has little effect on this estimate despite the loss of observations. However, the three columns at the right hand of the top row show that ending the sample in 2005 has a substantive effect, reducing the estimate by more than half.

Table 8
Making it vanish: robustness of EMU effect on exports.

	1948–2013	1985–2013	1995–2013	1948–2005	1985–2005	1995–2005
All countries	.43** (.02)	.44** (.02)	.47** (.03)	.18** (.03)	.18** (.03)	.18** (.04)
	[879,794]	[575,373]	[424,230]	[691,074]	[386,653]	[235,510]
Industrial countries plus present/future EU	−.01 (.02)	-.05* (.02)	.04 (.02)	−.09** (.03)	−.16** (.03)	−.07 (.04)
	[73,253]	[38,884]	[26,763]	[61,939]	[27,570]	[15,449]
Upper Income (GDP p/c ≥ $12,736)	.11** (.03)	.14** (.03)	.16** (.03)	−.02 (.04)	−.01 (.04)	−.09* (.04)
	[75,468]	[59,230]	[45,401]	[52,103]	[35,865]	[22,036]
Rich Big (GDP ≥ $10bn, GDP p/c ≥ $10k)	.11** (.02)	.10** (.02)	.10** (.03)	.05 (.03)	.02 (.03)	−.07* (.03)
	[79,240]	[62,099]	[50,367]	[50,200]	[33,059]	[21,327]
OECD	−.03 (.02)	−.03 (.02)	−.03 (.02)	−.06* (.03)	−.08** (.02)	−.08** (.02)
	[25,000]	[16,682]	[12,842]	[18,920]	[10,602]	[6,762]
Present/future EU	−.27** (.02)	−.22** (.02)	−.04 (.02)	−.31** (.04)	−.29** (.03)	−.10** (.03)
	[30,731]	[17,846]	[13,337]	[25,115]	[12,230]	[7,721]

Coefficient on EMU dummy variable; robust standard errors recorded in parentheses; sample size in brackets. One (two) asterisk(s) indicate hypothesis of no effect can be rejected at the .05 (.01) significance level. Least squares estimation; regressand is log bilateral exports. Regressors included but not recorded: regional FTA membership; current colony/colonizer; fixed effects for (a) exporter-year, (b) importer-year, (c) country-pair; and separate dummy variables for currency unions for CFA Franc zone, ECCU, Australian dollar, British pound, French franc, Indian rupee, US dollar, and others (Belgian franc; Portugese escudo; Pakistan rupee; Jamaican dollar; Mauritius rupee; New Zealand dollar; UAE dirham; Spanish peseta; Denmark krone; Italian lira; South African rand; West African pound; East African shilling; Malaya ringgit; Palestinian pound; and Dutch guilder). Annual data for up to > 200 countries, 1948–2013 with restricted samples marked.

[29] Several papers examine the trade effects of a specific currency union, such as the Ireland-UK pound link (e.g. Thom and Walsh, 2002), the CFA (e.g., Levi Yeyati, 2003; De Sousa and Lochard (2005); Tsangarides et al., 2009), the ECCU (e.g. Honohan, 2001; Levy Yeyati, 2003), or the dollar zone (e.g. Klein 2005). Nitsch (2002) also reports results for individual currency unions together, but only in 5-year interval cross sections, not in a pooled panel.

While the effect of later observations on the EMU effect seems large, it is dwarfed by the effects of extra countries. In successive rows, we report the EMU effect for the same (six) periods of time, but reducing the cross-country span in a number of different ways. We consider five different samples of countries: (a) retaining only industrial countries (those with *IFS* country codes below 200) as well as all present and future EU countries (so that, e.g., Croatia is included even before 2013); (b) retaining only upper income countries (defined, á la World Bank, as those with GDP per capita of at least $12,736); (c) retaining only big rich countries (defined as those with GDP per capita of at least $10,000 and total GDP of at least $10 billion); (d) retaining only OECD members; and (e) retaining only present and future EU countries. Reducing the cross-country span of the data leaves what appear to be substantial degrees of freedom, but reduces the estimate of EMU on exports very significantly. Indeed, of the 30 estimates we tabulate which do not use the full set of countries, 21 are negative, 13 of those significantly so! This stands in sharp contrast to the fact that employing a full set of countries always delivers a positive and significant estimate.

We tentatively conclude that a complete set of data, spanning a large number of countries and years, is critical when estimating the effect of currency unions on trade. The results of Table 8 indicate that selective sampling by either country or time seems systematically to reduce or eliminate the otherwise robust effect of EMU on exports, despite the robustness we see in Table 7. Table 8 allows us to reconcile our results with those of the literature, and provide an encompassing explanation of why our stronger, more positive results, are the most plausible.

5. Summary and conclusion

In our *EER* (Glick and Rose, 2002) paper, we concluded that "a pair of countries which joined/left a currency union experienced a near-doubling/halving of bilateral trade." This conclusion was based on (a) an assumption of symmetry between the consequences of currency union exits and entries; (b) a caveat that EMU might be different from other currency unions; and (c) evidence that our results were insensitive to the precise econometric methodology. In this paper, we re-estimate this effect using a variety of models and a panel of annual data that covers more than 200 countries between 1948 and 2013, including fifteen years of EMU. As it turns out, the assumption of symmetry between entry and exit seems reasonable. The fear that prompted our caveat was warranted; EMU seems to be different from other currency unions, and indeed different currency unions have different effects on trade. While different econometric methodologies deliver different results, our preferred methodology (a panel approach which includes country-pair fixed effects on the largest possible span of data across countries and time) leads to the conclusion that EMU has thus far boosted bilateral trade by around 50%.

Appendix A. Supplementary material

Supplementary data associated with this article can be found in the online version at http://dx.doi.org/10.1016/j.euroecorev.2016.03.010.

References

Anderson, James E., Van Wincoop, Eric, 2003. Gravity and ravitas: A Solution to the border puzzle. Am. Econ. Rev. 93 (1), 170–192.
Baier, Scott L., Bergstrand, Jeffrey H., 2009. *Bonus vetus* OLS. J. Int. Econ. 77, 77–85.
Baldwin, Richard, 2006a The Euro's Trade Effects. ECB Working Paper Series No. 594.
Baldwin, Richard, 2006b. In or Out: Does It Make a Difference: An Evidence-Based Analysis of the Trade Effects of the Euro, manuscript. Center for Economic Policy Research.
Baldwin, Richard, Virginia Di Nino, 2006. Euros and Zeros: The Common Currency Effect on Trade in New Goods. NBER Working Paper 12,673.
Baldwin, Richard, Frauke Skudelny, Daria Taglioni, 2005. Trade Effects of the Euro. ECB WP 446.
Baldwin, Richard, Taglioni, Daria, D., 2004. Positive OCA Criteria: Microfoundations for the Rose Effect. Graduate Institute of International Studies, Geneva.
Baldwin, Richard, Taglioni, Daria, 2007. Trade effects of the Euro. J. Econ. Integration 22 (4), 780–818.
Baldwin, Richard, Nino, Virginia Di, Fontagné, Lionel, De Santis, Robert, Taglioni, Daria, 2008. Study on the Impact of the Euro on Trade and foreign direct investment. Eur. Econ. Econ.. (Papers 321).
Barr, David, Breedon, Francis, Miles, David, 2003. Life on the outside: economic conditions and prospects outside Euroland. Econ. Policy 18, 573–613.
Berger, Helge, Nitsch, Volker, 2008. Zooming out: the trade effect of the Euro in historical perspective. J. Int. Money Finance 27 (8), 1244–1260.
Berthou, Antoine, Lionel Fontagne, 2008. The Euro and the Intensive and Extensive Margins of Trade: Evidence from French Firm Level Data. Working Paper, CEPII Research Center.
Brouwer, Jelle, Paap, Richard, Viane, Jean-Marie, 2008. The trade and FDI effects of EMU enlargement. J. Int. Money Finance 27, 188–208.
Bun, Maurice, Klaassen, Franc, 2002. Has the Euro Increased Trade?. University of Amsterdam.
Bun, Maurice, Klaassen, Franc, 2007. The Euro effect on trade is not as large as commonly thought. Oxf. Bull. Econ. Stat. 69, 473–496.
Clark, Peter B., Natalia Tamirisa, and Shang-Jin Wei, Azim Sadikov, Li, Zeng, 2004. Exchange Rate Volatility and Trade Flows—Some New Evidence. IMF Working Paper.
De Nardis, Sergio, De Santis, Roberta, Vicarelli, Claudio, 2008a. The Euro's effects on trade in a dynamic setting. Eur. J. Comp. Econ. 5 (1), 73–85.
De Nardis, Sergio, De Santis, Roberta, Vicarelli, Claudio, 2008b. The Single Currency's Effects on Eurozone Sectoral Trade: Winners and Losers Economics E-Journal 2, 2008-17.
De Nardis, Sergio, Vicarelli, Claudio, 2003a. Currency union and trade: the special case of EMU. Rev. World Econ. 139 (4), 625–649.

De Nardis, Sergio, Vicarelli, Claudio, 2003b. The Impact of Euro on Trade: The (Early) Effect is Not so Large. Institute for Studies and Economic Analyses, Rome.
De Sousa, José, Lochard, Julie, 2005. Do Currency Barriers Solve the Border Effect Puzzle? Evidence from the CFA Franc Zone. Kiel Institute for World Economics.
De Sousa, José, 2012. The Currency Union Effect on Trade is Decreasing over Time. Econ. Lett. 117, 917–920.
Eicher, Theo S., Henn, Christian, 2011. One money, one market: a revised benchmark. Rev. Int. Econ. 19 (3), 419–435.
Faruqee, Hamid, 2004. Measuring the Trade Effects of EMU. IMF Working Paper 04/154.
Flam, Harry, Nordstrom, Hakan, 2006a. Euro Effects on the Intensive and Extensive Margins of Trade. CESifo Working Paper 1881.
Flam, Harry, Nordstrom, Hakan, 2006b. Trade Volume Effects of the Euro: Aggregate and Sector Estimates. Stockholm University, Institute for International Economic Studies Seminar (Paper 746).
Flam, Harry, Nordstrom, Hakan, 2007. The Euro and Single Market Impact on Trade and FDI. Institute for International Economic Studies.
Frankel, Jeffrey, 2010. The Estimated Trade Effects of the Euro. In: Alesina, A., Giavazzi, F. (Eds.), Europe and the Euro, University of Chicago Press, Chicago, pp. 169–212. (Chapter 5).
Gil-Pareja, Salvador, Llorca-Vivero, Rafael, Martınez-Serrano, Jose A., 2008. Trade effects of monetary agreements: evidence for OECD countries. Eur. Econ. Rev. 52 (4), 733–735.
Glick, Reuven, Rose, Andrew K., 2002. Does a currency union affect trade? The time-series evidence. Eur. Econ. Rev. 46 (6), 1125–1151.
Gomes, Tamara, Graham, Chris, Helliwell, John, Kano, Takashi, Murray, John, Schembri, Lawrence, 2006. The Euro and Trade: Is There a Positive Effect?. Bank of Canada.
Havranek, Tomas, 2010. Rose effect and the Euro: is the magic gone? Rev. World Econ. 146, 241–261.
Head, Keith, Mayer, Thierry, 2014. Gravity equations: workhorse, toolkit, and cookbook. Gopinath, G., Helpman, E., Rogoff, K. (Eds.), Handbook of International Economics, vol. 4. , Elsevier, Amsterdam, pp. 131–195.
Honohan, Patrick, 2001. Discussion of Rose (2001) 'Currency Unions and trade: the effect is large. Econ. Policy 33, 457–461.
Klein, Michael W., 2005. Dollarization and trade. J. Int. Money Finance 24 (6), 935–943.
Levi Yeyati, Eduardo, 2003. On the Impact of a common currency on bilateral trade. Econ. Lett. 79 (1), 125–129.
Micco, Alejandro, Stein, Ernesto, Ordonez, Guillermo, 2003. The currency union effect on trade: early evidence on EMU. Econ. Policy 18, 315–336.
Mika, Alina, Zymek, Robert, 2016. Friends Without Benefits? New EMU Members and the 'Euro Effect' on Trade, Manuscript, February.
Nitsch, Volker, 2002. Honey, I shrunk the currency union effect on trade. World Econ. 25, 457–474.
Rose, Andrew K., Stanley, Tom, 2005. A meta-analysis of the effect of common currencies on international trade. J. Econ. Surv. 19, 347–365.
Rose, Andrew, 2008. Is EMU Becoming an Optimum Currency Area? The Evidence on Trade and Business Cycle Synchronization, Manuscript.
Santos Silva, J.M.C., Tenreyro, Silvana, 2006. The log of gravity. Rev. Econ. Stat. 88 (4), 641–658.
Santos Silva, J.M.C., Tenreyro, S., 2010. Currency unions in prospect and retrospect. Annu. Rev. Econ. 2, 51–74.
Serlenga, Laura, Shin, Yongcheol, 2007. Gravity Models of Intra-EU trade: application of the CCEP-HT estimation in heterogeneous panels with unobserved common time-specific factors. J. Appl. Econom. 22 (2), 361–381.
Thom, Rodney, Walsh, Brendan, 2002. The effect of a currency union on trade: lessons from the Irish experience. Eur. Econ. Rev. 46 (6), 1111–1123.
Tsangarides, Charalambos, Ewenczyk, Pierre, Hulej, Michal, Qureshi, Mahvash Saeed, 2009. Are Africa's currency unions good for trade? IMF Staff Pap. 56 (4), 876–918.