estructuraeconòmica
ECONOMÍA APLICADA II

The happy few: cross-country evidence of the euro effect on trade

by

Salvador Gil-Pareja
Rafael Llorca-Vivero
and
José A. Martínez-Serrano

April 2018

Working Papers in Applied Economics

WPAE-2018-03

ECONOMÍA APLICADA II

VNIVERSITAT DE VALÈNCIA

Departamento de Estructura Económica (Economía Aplicada II), Facultad de Economía, Universitat de València
Avda dels Tarongers, s/n, 46022 – Valencia, Spain
Phone +34 96 382 83 49 / Fax +34 96 382 83 54
http://www.estructuraeconomica.es
e-mail: investigacion.estructura@uv.es

ISSN 2172-3036

THE HAPPY FEW:
CROSS-COUNTRY EVIDENCE OF THE EURO EFFECT ON TRADE

Salvador Gil-Pareja*

Rafael Llorca-Vivero

José Antonio Martínez-Serrano

University of Valencia

Abstract

This paper investigates the EMU effect on trade by member country and direction of trade flows. The empirical analysis uses a recent econometric development, which allows us the estimation of gravity equations dealing with heteroskedastic residuals and zero bilateral trade flows on a large span of data (across both countries and periods). Our results, robust to using alternative samples and EU time-trends, suggest that, while there is no evidence of an aggregate EMU effect, some few countries have benefited from sharing the euro. In particular, for Spain and Portugal, this is the case for both exports and import flows. By contrast, the EMU has had a negative effect on import flows in the Netherlands and Malta, while we find a negative impact for exports from Greece.

Key words: EMU, exports, imports, HDFE PPML, gravity equation.

JEL Classification numbers: F14.

1. Introduction

*Corresponding author: Salvador Gil-Pareja, Facultad de Economía, Departamento de Estructura Económica, Av. de los Naranjos s/n, C.P. 46022, Valencia, Spain. Email: sgil@uv.es Tel. 34963828349. Fax 34963828354. Rafael Llorca-Vivero (rllorca@uv.es) and José Antonio Martínez-Serrano (jams@uv.es). The authors acknowledge financial support provided by *Ministerio de Economía, Indsutria y Competitividad* (project ECO2015-68057-R, in part-financed by the European Regional Development Fund) and Generalitat Valenciana (PROMETEOII/2014-053). The usual disclaimer applies.

Since Rose's (2000) path-breaking study, much work has been written on the effect of currency unions on trade. The striking finding reported in that seminal paper, the empirical evidence that sharing a currency union more than triples trade between countries, together with the creation of the euro, has motivated an intense debate on this issue and, in particular, on the effect of the Economic and Monetary Union (EMU) on trade, both in academic and policy making circles.[1] There are more than 50 papers that estimate the effect of EMU on the bilateral trade flows, since it is by far the most important monetary union. The estimates of the EMU effect on trade vary enormously. In a recent paper, Rose (2017) ask why. From both, his meta-regression analysis of 45 papers on the EMU effect on trade and his empirical work using the dataset of Glick and Rose (2016), Rose concludes that including more observations of years and, especially of countries, seems to increase the estimated effect of EMU on trade.[2] Moreover, this author points out that the hypothesis that EMU has no effect on trade does not seem consistent with the literature, reporting an estimate of the export-enhancing effect of EMU of 54% when he uses the full sample of countries and years (211 country codes over the period 1948-2013).[3]

The empirical work on the EMU effect on trade uses different specifications of the gravity equation of international trade. Despite the fact that the empirical literature has progressively improved its theoretical foundations and the econometric specifications to account for potential sources of bias, almost all results rely on gravity equations with serious theoretical and econometric problems. In fact, to date, only two papers (Larch *et*

[1] See Santos Silva and Tenreyro (2010) for a comprehensive review of the earlier empirical literature on the effect of currency unions on trade. More recent papers on this area include Eicher and Henn (2011a), De Souza (2012), Campbell (2013), Roy (2014), Glick and Rose (2016), Larch *el al.* (2017), and Campbell and Chentsov (2017). A review of the EMU effect on trade can be found in Gil-Pareja *et al.* (2008).
[2] Other papers that investigate the EMU effect on trade not included in the meta-analysis by Rose (2017) are Gil-Pareja *et al*. (2003), Esteve-Pérez *et al.* (2011), Eicher and Henn (2011a), Olivero and Yotov (2012), Campbell and Chentsov (2017), Larch *et al.* (2017), Glick (2017), and Mika and Zimek (2018).
[3] This result was previously reported by Glick and Rose (2016).

al., 2017 and Mika and Zimek, 2018) estimate the EMU effect on trade addressing simultaneously for issues related to heteroscedasticity and zeros (with the Poisson Pseudo-maximum Likelihood-PPML- estimator), changes in multilateral resistance terms (with time-varying exporter and importer fixed effects) and unobserved bilateral heterogeneity (with country-pair fixed effects).[4] Computational limitations have conditioned the choice of estimator in previous works. In particular, Mika and Zimek (2018) overcomes the computational problems by restricting their sample to 153 countries over the period 1992-2013 and artificially balancing bilateral trade to include country-time fixed instead of both exporter-time and importer-time fixed effects. More interesting even is the approach followed by Larch *et al.* (2017). They implement an iterative PPML algorithm that specifically addresses the computational burden of the three types of (high-dimensional) fixed effects that need to be estimated in large datasets like that used by Glick and Rose (2016). Both recent works find that the EMU effect on trade vanishes when one mitigates the risk of omitted-variable bias by using a full array of country-time and country-pair fixed effects in a PPML regression (what can be considered as the current "state of the art" in the literature).[5]

This paper benefits from the computational development brought about by Larch *et al*. (2017) to estimate the EMU effect on trade separately for each member country using the PPML estimator with three types of (high-dimensional) fixed effects (exporter-time, importer-time and country-pair), which allows us to obtain unbiased, and theory-

[4] Baltagi *et al.* (2003), Baier and Bergstrand (2007) and Baldwin and Taglioni (2007) motivated and included the three types of fixed effects in the estimation of log-linear gravity equations with ordinary least squares. This is the preferred specification in three recent papers: Glick and Rose (2016), Rose (2017) and Glick (2017). However, Santos Silva and Tenreyro (2006) showed that the traditional log-linearized version of the gravity equation leads to biased coefficients in the presence of heteroskedastic residuals. Evidence in this sense for the effect of currency unions on trade is documented by Santos Silva and Tenreyro (2010).
[5] Dai *et al*. (2014), Bergstrand *et al*. (2015), Anderson and Yotov (2016), Baier *et al*. (2016) and Matoo *et al.* (2017) highlight the importance of taking into account also the internal trade. In spite of the algorithm developed by Larch *et al.* (2017) allows for it without loss of generality, as these authors and most empirical applications do, we do not include within-country trade flows because the unavailability of the required data (in terms of both countries and years) precludes this possibility.

consistent estimates. For each country, we also examine the effect of the EMU on trade taking into account the direction of the trade flows. With this end, we use the same dataset as Glick and Rose (2016) and Larch *et al.* (2017), a large dataset that includes trade flows between more than 200 countries and territories during the period 1948-2013.

To preview our results, we confirm that the finding of a no EMU effect is robust to alternative samples of countries and periods as well as to the use of data for consecutive years or at five-year intervals. However, this consistent result across samples masks heterogeneous effects across member countries. The analysis by country shows robust evidence of a positive effect of EMU on both exports and imports for Spain and Portugal. For Austria and Cyprus we also find a positive effect in all samples, but it disappears when we include a dummy variable specific for the European Union in the regression. By contrast, the EMU has had a negative effect on import flows for the cases of the Netherlands and Malta, while we find a negative impact for exports from Greece.

The rest of the paper is organized as follows. Section 2 presents the methodology. Section 3 describes the data. Section 4 presents and discusses the results. Finally, section 5 concludes.

2. Methodology

We are interested in estimating the effect of the euro on international trade by member country. Towards that end, like the vast majority of previous studies on the trade effects of currency unions we rely on the gravity equation of international trade, which has been used as a workhorse for analysing the determinants of bilateral trade flows for more than 50 years since being introduced by Tinbergen (1962).

Following Baltagi *et al*. (2003), Baier and Bergstrand (2007) and Baldwin and Taglioni (2007), the empirical work on the gravity equation of international trade since

mid-2000s usually includes three types of fixed effects (country-pair fixed effects, exporter-time fixed effects and importer-time fixed effects) in order to deal with two sources of omitted variables bias.[6] As these authors emphasize country-pair fixed effects should be included to control for the impact of any unobserved time-invariant determinant of bilateral trade correlated with the regressors, while country-year fixed effects (for both the exporter and importer countries) should be included to deal with the omission of the theoretical multilateral resistance (price) terms.[7]

Moreover, Santos-Silva and Tenreyro (2006) propose the use of the PPML estimator because it has two interesting properties when compared with the traditional log-linear gravity regression. First, it avoids the statistical problems that arise from the existence of zero bilateral trade flows. As it is well known, the gravity equation in its log-linear specification is not defined for zero trade flows and this problem results in a sample selection bias that can be particularly important in datasets with a large number of trade observations that are zero in levels. Second, and most importantly, the PPML estimator solves econometric problems of both efficiency and consistency that emerge in the likely presence of heteroskedastic residuals.

This paper follows the estimation strategy recently proposed by Larch *et al.* (2017). The advantage of this approach is that it allows us estimating the gravity equation using PPML on a large dataset requiring to compute the three types of high-dimensional fixed effects (exporter-year, importer-year and country-pair) to avoid biased estimates

[6] Baldwin and Taglioni (2007) and Gil-Pareja *et al.* (2008) are among the first that recommend the inclusion of the three types of fixed effects precisely in the context of estimating the euro effect on exports.
[7] In their theoretical foundation of the gravity equation, Anderson and van Wincoop (2003) stand out that bilateral trade flows depend not only on bilateral trade barriers between any two countries (distance, language, adjacency, etc.) but also on trade barriers of each country with the rest of the trading partners (i.e., the multilateral resistance to trade). Exporter-time and importer-time fixed effects also control for changes in GDPs as well as all other country-specific variables.

and misleading inference. In particular, we estimate the following gravity equation with the PPML estimator:

$$X_{ijt} = \exp(\beta_1 EMU_{ijt} + \beta_2 OtherCUs_{ijt} + \beta_3 RTA_{ijt} + \chi_{it} + \lambda_{jt} + \eta_{ij}) + u_{ijt} \qquad (1)$$

where *i* denotes the exporter, *j* denotes the importer and *t* is time. The dependent variable is the value of bilateral export flows (in levels). The set of independent variables includes binary dummy variables for sharing membership in the EMU (EMU_{ijt} equals 1 if both *i* and *j* are EMU members at time *t*, and zero otherwise), sharing non-euro currency unions (*OtherCUs*) and common membership in regional trade agreements (*RTA*). The equation also includes exporter-time fixed effects (χ_{it}), importer-time fixed effects (λ_{jt}) and country-pair fixed effects (η_{ij}). Finally, u_{ijt} denotes the error term. The inclusion of exporter-time and importer-time fixed effects in the gravity equation (1) controls for any exporter specific and importer specific time-variant variable (such as GDPs) as well as all other time-varying country-specific unobservables affecting trade, including the theoretical multilateral resistance terms (Anderson and van Wincoop, 2003). Moreover, country-pair fixed effects capture all bilateral time invariant trade supporting or impeding measures such as distance, contiguity, the use of a common language, etc. In order to examine the impact of the EMU by country and the direction of trade flows the variable of interest in gravity equation (1) will be disaggregated accordingly.

3. Data

This paper uses Glick and Rose (2016)'s dataset properly adapted to the aim of the article.[8] This dataset comprises bilateral trade flows between more than 200 IMF

[8] We gratefully acknowledge Andrew Rose for making these data public. In a previous version of this paper we used a dataset of own elaboration that covered 139 countries over the period 1975-2015. However, we use here Glick and Rose (2016)'s dataset because as concludes Rose (2017) "it seems important to include as much data as possible when estimating the EMU trade effect". In any case, it is worth noting, that all the conclusion of the paper remains unaltered with the use of the cited alternative dataset.

country codes over the period 1948-2013 (with gaps) and a large number of the conventional explanatory variables of the gravity equation of international trade.[9] In particular, the dependent variable in our study (bilateral exports flows in US dollars) comes from *Direction of Trade* dataset (International Monetary Fund). In the set of explanatory variables, we include dummy variables for currency unions and regional trade agreements. Glick and Rose (2016) construct currency union series from the IMF's *Schedule of Par Values* and issues of the IMF's *Annual Report on Exchange Rates Arrangements and Exchange Restrictions*, supplemented with information from the *Statesman's Yearbook*. Following Glick and Rose (2016), we use a transitive definition of currency union. That is, if dyads *x*-*y*, and *x*-*z* are in currency unions, then *y*-*z* is a currency union. Data on regional trade agreements are taken from the World Trade Organization's website.

4. Empirical results

We begin by providing estimations of the average EMU effect on trade using data for different samples (of countries and periods) and considering two frequencies of the data (data for consecutive years and at five-year intervals). Estimation results for the gravity equation (1) considering the world sample of countries (211) over the full sample period (1948-2013) appear in column 1 of Table 1. In line with Larch *et al.* (2017) and Mika and Zymek (2018), the point estimate for the EMU is very close to zero and it is not statistically significant at conventional levels. With respect to the estimated coefficients for the rest of currency unions (*OtherCUs*) and regional trade agreements (*RTA*), we find in both cases a positive and statistically significant coefficient at the 1 per

[9] It is noteworthy that not all areas covered are countries in the conventional sense of the word. The dataset also includes some colonies (e.g. Gibraltar), territories (e.g. Guam) and overseas departments (e.g. Guadeloupe).

cent level of significance. Columns 2 and 3 show the robustness of the result about the lack of an EMU effect using an alternative country sample (OECD+EU) and period of investigation (1983-2013).[10]

Columns 4 to 6 of Table 1 repeat the estimations reported in columns 1 to 3 with data at five-years-intervals. The use of data at intervals is usual in the gravity equation literature of international trade (see, for example, Chen and Wall, 2005; Baier and Bergstrand, 2007; Eicher and Henn, 2011a,b; Kohl, 2014; Dai *et al*.,2014; or Bergstrand *et al.*, 2015), and addresses the concern raised by Chen and Wall (2005, p. 52) who noted that "Fixed-effects estimation is sometimes criticized when applied to data pooled over consecutive years on the grounds that dependent and independent variables cannot fully adjust in a single year's time.". As we can see, the results do not change in any significant way with the use of this kind of data.

Finally, since terms-of-trade changes tend to have lagged effects on trade volumes, in columns 7 and 8 we present the results for the full period and sample of countries including one and two lags, respectively, of the dummy variables *EMU*, *otherCUs*, and *RTA*. For these specifications we report in the table the sum of the estimated coefficients from current and lagged values. We use the data at five-year intervals since they are more appropriate for this kind of analysis. The estimated coefficient for the regional trade agreements raises from 0.185 without lags (column 4) to 0.242 (with one lag) and 0.275 (with two lags). The economic interpretation of the cumulative estimated coefficient with two lags is that -after 10 years- formation of a regional trade agreement increases the level of trade by [exp(0.275)-1]*100= 31.7 per

[10] Similarly to Glick and Rose (2016) and Larch *et al.* (2017), we have considered other alternative country samples and periods of analysis (not reported for brevity). Like in Larch *et al.* (2017) no single subsample leads to a positive and significant effect for the EMU. We have also considered alternative frequencies for the data (three-year and four-year intervals) and the results remain qualitatively unaltered. These results are available from the authors upon request.

cent. In addition to lagged effects of terms-of-trade changes on trade volumes, this result can be explained by the fact that virtually every trade agreement is "phased-in", typically over 10 years (Baier and Bergstrand, 2007). However, for currency unions the results do not change in any significant way with the inclusion of lags. In particular, the point estimate for the EMU remains close to zero and non-statistically significant at conventional levels.

The above results imply that there is no evidence of an EMU effect on trade flows. However, this consistent result across samples may be masking heterogeneous effects among member countries. In order to assess the impact of the euro adoption on trade flows by member country, we re-estimate the gravity equation for each country that shares the euro. Taking the case of Germany as an example, in the regression for this country, we have split the EMU dummy into two dummy variables: *EMUGermany* and *EMUwoGermany*. The first one is a dummy that is unity for trade between Germany and the rest of EMU members for the years that both partners belong to the EMU (and zero otherwise), while the second dummy takes the value of one for all other pairs of EMU countries for the years that both partners belong to the EMU (and zero otherwise).

Columns 1 to 4 of Table 2 present the results for the world sample of countries and four alternative periods: 1948-2013 (full sample period), 1963-2013, 1973-2013 and 1983-2013. To economise on space, we only report the estimated coefficients corresponding to the main parameter of interest in the table (the EMU effect in each country). The results for the four periods consistently suggest that the EMU has had an economically and statistically significant positive effect on trade in the cases of Spain, Portugal, Austria and Cyprus. In particular, according to the results reported in column 1 for the full sample period, the largest impact is found for Cyprus (89.3 per cent), followed by Portugal (51.7 per cent), Spain (33.2 per cent) and Austria (12.4 per cent). Instead, we

find evidence of a negative impact in two countries: The Netherlands (-11.2 per cent) and Malta (-43.3 per cent).

The use of data at five-year intervals (columns 5 to 8 of Table 2) confirm all previous findings. However, it is worth noting that in this case the positive impact for Austria raises to 17 per cent and that the negative point estimate for the Netherlands reaches the statistically significance only at the 10 per cent level.

Next, we go a step further by examining the potential differential impact of the EMU by country according to the direction of the trade flows. To this end, and following with the case of Germany as an example of notation, in the regression for this country the dummy variable *EMUGermany* is split into two: *EMUGermanyX* (1 for Germany exports to other EMU members, and zero otherwise) and *EMUGermanyM* (1 for Germany imports from other EMU members, and zero otherwise). Again, we only report the estimated coefficients of the parameters of interest to save on space. Table 3 presents the results for the same set of sampling periods that are offered in Table 2. Several comments are in order. First, the evidence of positive impact of the EMU on trade for Spain, Portugal and Cyprus appears both in export and import flows. Second, for the case of Austria, import flows are behind the positive effect previously pointed out. The estimated coefficient for *EMUAustriaM* is positive and statistically significant in all regressions whereas the variable *EMUAustriaX*, despite being positive in all cases, only in one of them reaches statistical significance at the 10 per cent level. Third, for the Netherlands and Malta cases, where the estimated coefficient reported in Table 2 is negative, only import flows explain it. Finally, for Greece, when we differentiate between exports and imports we find a negative and statistically significant impact for exports in 7 out of 8 regressions, despite the overall effect is negative but non-statistically significant.

So far, we have controlled in the regressions for membership of countries in regional trade agreements with a single dummy variable that captures the average effect of all regional trade agreements (RTA). Now, we are going to examine how the results are affected when we separate out the effect of the European Union (EU), since members of the EMU are also members of the European Union. It also allows us to test if the trade effects of EU differ from the combined effect of the other regional trade agreements. To this end, we include in the regressions an EU-specific dummy and a dummy for the rest of regional trade agreements (*RTAwoEU*). Panel A of Table 4 present the results for the world sample and Panel B when we confine the sample to EU plus OECD countries. We first provide the results for the average effect of the EMU (column 1). In line with our previous results there is no evidence of a positive effect of euro adoption on trade between EMU countries. Instead, the estimated coefficient for the EU dummy is positive (0.517) and it is statistically larger than the coefficient for the average of the remaining regional trade agreements (0.086). Again, for all currency unions except the EMU, we find a significant positive effect (0.800). In columns 2 to 5 we try to check the robustness of our previous results for those countries with evidence of a positive impact of the euro on trade. As we can see, the positive and statistically significant effect of the EMU on trade remains unaltered for Portugal and Spain. However, the EMU effect for Austria and Cyprus vanishes when the EU effect is split off. The results in panel B, restricting the sample of countries, confirm these findings.

Finally, Table 5 presents the results when we allow for a linear EU-specific trend in bilateral trade flows. This is important because, as argue Micco *et al.* (2003) and Berger and Nitsch (2008), the euro effect may be biased upwards when we do not account for long-term trends in European trade flows as a result of the ongoing economic integration among these countries. From these results, several comments are in order. First, the linear

EU trend is positive and statistically significant at the 1 per cent level for the world sample but insignificant for the EU plus OECD sample. Second, for the world sample (where the EU trend is statistically significant), the inclusion of this variable reduces the magnitude of the EU estimated coefficient. Additionally, it becomes in negative the average EMU effect, although the point estimate (-0.089) only reaches the statistical significance at the 10 per cent level. Evidence of a negative impact of the EMU on trade is also reported by Larch *et al.* (2017) and Mika and Zimek (2018) using the PPML estimator including country-pair and country-time fixed effects. Lastly, and most importantly, the positive effect of EMU on trade for Portugal and Spain remains robust to the inclusion of the linear EU-specific trend in both samples (and also to the inclusion of a quadratic EU trend).[11][12]

5. Conclusions

Much work has been written over the last decade and a half about the EMU effect on trade. Unlike the vast majority of previous research, two recent papers conclude that there is no evidence of a positive effect of the euro adoption, once researchers deal simultaneously with four potential sources of bias: unobserved bilateral heterogeneity, changes in multilateral resistance, zeros in bilateral trade flows and heteroskedastic residuals. The empirical work in this paper is also based on the "state of art" in the gravity equation literature to estimate the EMU effect on trade separately for each member country, which allows us to obtain unbiased, and theory-consistent estimated coefficients.

[11] Following Mika and Zimek (2018), we have also estimated these regressions including additionally a quadratic EU trend. The point estimates for the quadratic EU trend are always very close to zero and not statistically significant at conventional levels. Thus, all our previous conclusions remain unaltered. These results are available from the authors upon request.

[12] It is worth noting that, for those countries that we find a negative effect of the EMU on trade, the inclusion of the EU and the EU trend dummies confirms that finding.

Moreover, we also examine the potential differential effect of the EMU on trade depending on the direction of the trade flows for each country.

Our results using a sample that covers 211 country codes over the period 1948-2013 provide support to the finding of a no EMU effect. This evidence is robust to alternative samples of countries and periods, as well as to the use of data for consecutive years or at five-year intervals. However, this result masks heterogeneous effects across member countries. The analysis by country shows robust evidence of a positive effect of EMU for Spain and Portugal on both exports and imports. For Austria and Cyprus, we also find a positive effect in all samples, but it disappears when we include a dummy variable specific for the European Union in the regression. By contrast, the EMU has had a negative effect on import flows for the cases of the Netherlands and Malta, while we find a negative impact for exports from Greece.

References

Anderson JE, van Wincoop E (2003) Gravity with gravitas: A solution to the border puzzle. American Economic Review 93: 170-192.

Anderson JE, Yotov YV (2016) Terms of trade and global efficiency effects of free trade agreements, 1990-2002. Journal of International Economics 99: 279-298.

Baier SL, Bergstrand JH (2007) Do free trade agreements actually increase members' international trade? Journal of International Economics 71: 72-95.

Baier SL, Yotov YV, Zylkin, T (2016) On the widely differing effects of free trade agreements: Lessons from twenty years of trade integration. CESifo Working Paper No. 6174.

Baldwin R, Taglioni D (2007) Trade effects of the euro: a comparison of estimators. Journal of Economic Integration 22: 780-818.

Baltagi BH, Egger P, Pfaffermayr M (2003) A generalized design for bilateral trade flows models. Economics Letters 80: 391-397.

Berger H, Nistch V (2008) Zooming out: The trade effects of the euro in historical prespective Jorunal of International Money and Finance 27: 1444-60.

Bergstrand JH, Larch M, Yotov YV (2015): "Economic integration agreements, border effects, and distance elasticities in the gravity equation". European Economic Review 78: 307-327.

Campbell, DL (2013) Estimating the impact of currency unions on trade: solving the Glick and Rose puzzle. The World Economy 36:1273-93

Campbell, DL, Chentsov, A (2017) Breaking badly: The currency union effect on trade, CEFIR/NES Working Paper No. 241.

Chen IH, Wall JW (2005) Controlling for heterogeneity in gravity models of trade and integration. Federal Reserve Bank of St. Louis Review 87: 49-63.

Dai M, Yotov YV, Zylkin, T (2014) On the trade-diversion effects of free trade agreements. Economics Letters 122: 321-325.

De Souza J (2012) The currency union effect on trade is decreasing over time. Economics Letters, 117: 917-920.

Eicher TS, Henn Ch (2011a) One money, one market: A revised benchmark. Review of International Economics 19: 419-435.

Eicher TS, Henn Ch (2011b) In search of WTO trade effects: Preferential trade agreements promote trade strongly, but unevenly. Journal of International Economics 83: 137-153.

Esteve-Pérez S, Gil-Pareja S, Llorca-Vivero R, Martínez-Serrano, JA (2011) The impact of the euro of firm export behavior: Does firm size matter? Oxford Economic Papers 63:355-374.

Gil-Pareja S, Llorca-Vivero R, Martínez-Serrano JA (2003) El euro y la integración comercial española: un análisis comparado. Economía Industrial 349-350: 139-146.

Gil-Pareja S, Llorca-Vivero R, Martínez-Serrano JA (2008) Trade effects of monetary agreements: Evidence for OECD countries. European Economic Review 52:733-755.

Glick R (2017) Currency unions and regional trade agreements: EMU and EU effects on trade. Comparative Economic Studies 59:194-209.

Glick R, Rose AK (2016) Currency unions and trade: A post-EMU reassessment. European Economic Review 84:78-91.

Kohl T (2014) Do we really know that trade agreements increase trade? Review of World Economics 150: 443-469.

Larch M, Wanner J, Yotov Y, Zylkin T (2017): The currency Union Effect: A PPML re-assessment with high-dimensional fixed effects, Drexel University Working Paper 2017-07.

Mattoo A, Mulabdic A, Ruta M (2017) Trade creation and trade diversion in deep agreements. Policiy Research Working Paper 8206.

Micco A, Stein E, Ordoñez G. (2003) "The currency union effect on trade: early evidence from EMU" Economic Policy 18: 315-356

Mika A, Zymek R (2018) Friends without benefits? New EMU members and the "euro effect" Journal of International Money and Finance, 83: 75-92.

Olivero MP, Yotov Y (2012) Dynamic gravity: endogenous country size and asset accumulation. Canadian Journal of Economics 45:64-92.

Rose A (2017) Why do estimates of the EMU effect on trade vary so much? Open Economies Review, 28: 1-18.

Roy J (2014) On the robustness of the trade-inducing effects of trade agreements and currency unions. Empirical Economics, 47: 253-304.

Santos Silva JMC, Tenreyro S (2006) The log of gravity. The Review of Economics and Statistics 88: 641-658.

Santos Silva JMC, Tenreyro S (2010) Currency unions in prospect and retrospect, Annual Review of Economics 2:51-74.

Tinbergen J (1962) Shaping the World Economy. Twentieth Century Fund, New York.

Table 1. PPML estimations of the EMU effect on trade

	Data for every year			Data at five-year intervals				
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	1948-2013 World Sample	1948-2013 OECD+EU Sample	1983-2013 World Sample	1948-2013 World Sample	1948-2013 OECD+EU Sample	1983-2013 World Sample	1948-2013 World Sample 1 Lag	1948-2013 World Sample 2 Lags
EMU	-0.002	-0.075	-0.017	0.015	-0.048	0.011	0.019	0.048
	(0.039)	(0.046)	(0.030)	(0.041)	(0.054)	(0.035)	(0.046)	(0.056)
OtherCUs	0.795	1.373	0.022	0.839	1.316	-0.010	0.836	0.857
	(0.112)***	(0.181)***	(0.056)	(0.114)***	(0.179)***	(0.072)	(0.112)***	(0.108)***
RTA	0.199	0.330	0.011	0.185	0.285	0.045	0.242	0.275
	(0.037)***	(0.041)***	(0.038)	(0.035)***	(0.044)***	(0.034)	(0.044)***	(0.050)***
CYFE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
CPFE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	731,826	69,367	524,366	155,951	14,044	117,906	153,152	149,961

Note: The regressand is bilateral exports. Robust standard errors (clustered by country-pairs) are in parentheses.* significant at 10%; ** significant at 5%; *** significant at 1%. CYFE indicates time-varying exporter and importer fixed effects. CPFE indicates country-pair fixed effects. In the specifications with lags (one and two lags) the table reports the sum of the estimated coefficients from current and lagged values for each variable using the "lincom" command in Stata. Coefficient estimates for CYFE, CPFE are not reported for brevity.

Table 2. PPML results of the EMU effect by country. Full sample of countries.

	Data for consecutive years				Data at five-year intervals			
	1948-2013	1963-2013	1973-2013	1983-2013	1948-2013	1963-2013	1973-2013	1983-2013
EMUGermany	-0.022	-0.039	-0.034	-0.020	-0.003	-0.019	-0.022	0.010
	(0.045)	(0.042)	(0.040)	(0.035)	(0.049)	(0.047)	(0.045)	(0.042)
EMUBel-Lux	-0.067	-0.085	-0.071	-0.038	-0.048	-0.067	-0.063	-0.012
	(0.056)	(0.052)*	(0.058)	(0.048)	(0.062)	(0.057)	(0.056)	(0.056)
EMUFrance	0.024	-0.008	0.010	-0.058	0.060	0.027	0.017	0.033
	(0.051)	(0.048)	(0.046)	(0.036)	(0.051)	(0.049)	(0.047)	(0.043)
EMUItaly	-0.021	-0.048	-0.057	-0.062	-0.013	-0.040	-0.053	-0.043
	(0.053)	(0.051)	(0.048)	(0.038)	(0.053)	(0.052)	(0.050)	(0.042)
EMUNetherlands	-0.119	-0.135	-0.127	-0.109	-0.104	-0.118	-0.117	-0.080
	(0.052)**	(0.048)***	(0.047)***	(0.044)**	(0.055)*	(0.052)**	(0.050)**	(0.048)*
EMUIreland	0.033	0.049	0.045	-0.024	-0.034	-0.011	-0.005	-0.054
	(0.210)	(0.213)	(0.213)	(0.205)	(0.203)	(0.207)	(0.209)	(0.202)
EMUGreece	-0.071	-0.080	-0.090	-0.149	-0.046	-0.063	-0.066	-0.014
	(0.105)	(0.101)	(0.095)	(0.079)	(0.121)	(0.115)	(0.111)	(0.099)
EMUSpain	0.286	0.276	0.259	0.133	0.260	0.248	0.231	0.152
	(0.072)***	(0.071)***	(0.067)***	(0.052)***	(0.064)***	(0.063)***	(0.061)***	(0.051)***
EMUPortugal	0.417	0.410	0.361	0.234	0.403	0.397	0.365	0.243
	(0.099)***	(0.095)***	(0.094)***	(0.082)***	(0.106)***	(0.103)***	(0.103)***	(0.099)***
EMUAustria	0.117	0.132	0.151	0.144	0.157	0.167	0.185	0.172
	(0.058)**	(0.057)**	(0.056)***	(0.056)***	(0.062)**	(0.062)***	(0.061)***	(0.063)***
EMUFinland	-0.005	0.029	0.061	0.039	-0.008	0.017	0.047	0.018
	(0.084)	(0.078)	(0.071)	(0.060)	(0.086)	(0.081)	(0.075)	(0.067)
EMUSlovenia	-0.098	-0.082	-0.054	-0.017	-0.015	-0.090	-0.059	-0.015
	(0.079)	(0.078)	(0.076)	(0.075)	(0.100)	(0.099)	(0.098)	(0.097)
EMUCyprus	0.638	0.674	0.706	0.715	0.694	0.739	0.783	0.802
	(0.244)***	(0.242)***	(0.243)***	(0.246)***	(0.283)**	(0.284)***	(0.287)***	(0.296)***
EMUMalta	-0.568	-0.551	-0.548	-0.525	-0.570	-0.544	-0.541	-0.540
	(0.180)***	(0.181)***	(0.178)***	(0.171)***	(0.190)***	(0.191)***	(0.188)***	(0.179)***
EMUSlovakia	0.085	0.102	0.129	0.164	0.132	0.146	0.163	0.187
	(0.119)	(0.120)	(0.122)	(0.125)	(0.109)	(0.109)	(0.111)	(0.113)*
EMUEstonia	-0.017	-0.008	0.008	0.028	0.001	0.012	0.026	0.044
	(0.074)	(0.074)	(0.075)	(0.075)	(0.082)	(0.081)	(0.081)	(0.080)

Note. The table reports the results for separate regressions for each country of the Eurozone. Robust standard errors (clustered by country-pairs) are in parentheses.* significant at 10%; ** significant at 5%; *** significant at 1%. In all regressions the dependent is bilateral exports and the independent variables include, in addition to a dummy to capture the euro effect in each country, a dummy for the rest of countries' euro effect in each case, a dummy for regional trade agreements as well as dummies for exporter and importer country-year fixed effects and country-pair fixed effects. For brevity, we only report the results for the EMU country dummy.

Table 3. PPML results of the EMU effect by country and direction of trade flows. Full sample of countries.

	Data for consecutive years				Data at five-year intervals			
	1948-2013	1963-2013	1973-2013	1983-2013	1948-2013	1963-2013	1973-2013	1983-2013
EMUGermanyX	-0.045 (0.064)	-0.056 (0.059)	-0.052 (0.054)	-0.047 (0.043)	-0.026 (0.068)	-0.037 (0.065)	-0.036 (0.060)	-0.019 (0.051)
EMUGermanyM	0.005 (0.060)	-0.019 (0.057)	-0.012 (0.054)	0.012 (0.050)	0.024 (0.062)	0.002 (0.061)	-0.004 (0.059)	0.045 (0.058)
EMUBel-LuxX	-0.017 (0.078)	-0.042 (0.067)	-0.024 (0.063)	-0.014 (0.064)	0.016 (0.082)	-0.011 (0.072)	-0.005 (0.067)	0.034 (0.068)
EMUBel-LuxM	-0.122 (0.076)	-0.133 (0.074)	-0.121 (0.073)	-0.066 (0.066)	-0.124 (0.080)	-0.134 (0.080)*	-0.133 (0.080)*	-0.072 (0.076)
EMUFranceX	-0.012 (0.066)	-0.034 (0.063)	-0.029 (0.060)	-0.027 (0.052)	0.020 (0.071)	-0.002 (0.069)	-0.009 (0.066)	0.021 (0.064)
EMUFranceM	0.059 (0.075)	0.017 (0.070)	0.008 (0.065)	-0.005 (0.043)	0.099 (0.068)	0.055 (0.064)	0.042 (0.061)	0.045 (0.050)
EMUItalyX	-0.070 (0.062)	-0.091 (0.062)	-0.087 (0.057)	-0.075(0.047)	-0.072 (0.063)	-0.097 (0.062)	-0.101 (0.060)*	-0.066(0.051)
EMUItalyM	0.030 (0.078)	-0.001 (0.076)	-0.024 (0.072)	-0.048 (0.055)	0.051 (0.074)	0.022 (0.073)	-0.001 (0.070)	-0.016 (0.060)
EMUNetherlandsX	0.069 (0.058)	0.033 (0.052)	0.026 (0.047)	0.051 (0.040)	0.096 (0.072)	0.065 (0.067)	0.051 (0.062)	0.088 (0.055)
EMUNetherlandsM	-0.287 (0.070)***	-0.284 (0.068)***	-0.263 (0.064)***	-0.247 (0.060)***	-0.281 (0.072)***	-0.280 (0.071)***	-0.265 (0.068)***	-0.224 (0.065)***
EMUIrelandX	0.076 (0.334)	0.070 (0.340)	0.035 (0.342)	0.069 (0.320)	-0.038 (0.320)	-0.036 (0.328)	-0.059 (0.331)	-0.137 (0.311)
EMUIrelandM	-0.037 (0.089)	0.014 (0.085)	0.060 (0.080)	0.053 (0.093)	-0.027 (0.113)	0.031 (0.105)	0.084 (0.098)	0.087 (0.099)
EMUGreeceX	-0.362 (0.179)**	-0.360 (0.175)**	-0.346 (0.170)**	-0.325 (0.155)**	-0.376 (0.213)**	-0.376 (0.210)*	-0.375 (0.208)*	-0.332 (0.203)
EMUGreeceM	0.047 (0.119)	0.033 (0.114)	0.015 (0.106)	-0.073 (0.084)	0.091 (0.133)	0.067 (0.125)	0.064 (0.118)	-0.020 (0.102)
EMUSpainX	0.239 (0.091)***	0.227 (0.089)***	0.205 (0.083)**	0.098 (0.066)	0.242 (0.092)***	0.227 (0.091)**	0.207 (0.087)**	0.139 (0.071)**
EMUSpainM	0.321 (0.102)***	0.312 (0.100)***	0.299 (0.096)***	0.160 (0.071)**	0.275 (0.084)***	0.265 (0.083)***	0.249 (0.080)***	0.161 (0.067)**
EMUPortugalX	0.448 (0.149)***	0.435 (0.150)***	0.372 (0.151)**	0.235 (0.143)*	0.399 (0.176)**	0.391 (0.176)**	0.346 (0.180)*	0.213 (0.176)
EMUPortugalM	0.396 (0.129)***	0.393 (0.121)***	0.354 (0.118)***	0.233 (0.095)**	0.407 (0.130)***	0.401 (0.121)***	0.378 (0.119)***	0.264 (0.114)**
EMUAustriaX	0.079 (0.089)	0.098 (0.080)	0.109 (0.079)	0.062 (0.076)	0.118 (0.089)	0.130 (0.088)	0.143 (0.087)*	0.102 (0.089)
EMUAustriaM	0.161 (0.068)**	0.172 (0.070)**	0.200 (0.067)***	0.238 (0.067)***	0.203 (0.069)***	0.210 (0.070)***	0.233 (0.068)***	0.252 (0.072)***
EMUFinlandX	-0.012 (0.125)	0.022 (0.114)	0.058 (0.102)	0.043 (0.082)	0.005 (0.126)	0.032 (0.118)	0.067 (0.108)	0.046 (0.091)
EMUFinlandM	0.002 (0.107)	0.037 (0.101)	0.064 (0.093)	0.036 (0.081)	-0.023 (0.109)	0.001 (0.104)	0.025 (0.097)	-0.013 (0.090)
EMUSloveniaX	-0.060 (0.097)	-0.044 (0.095)	-0.017 (0.091)	0.020 (0.087)	-0.057 (0.126)	-0.033 (0.123)	-0.002 (0.120)	0.043 (0.117)
EMUSloveniaM	-0.141 (0.125)	-0.125 (0.124)	-0.096 (0.124)	-0.059 (0.125)	-0.183 (0.155)	-0.158 (0.154)	-0.127 (0.154)	-0.082 (0.154)
EMUCyprusX	0.874 (0.458)*	1.062 (0.398)***	1.200 (0.352)***	1.103 (0.328)***	0.674 (0.476)	0.853 (0.419)**	1.029 (0.363)***	0.997 (0.322)***
EMUCyprusM	0.613 (0.265)***	0.633 (0.263)**	0.655 (0.264)**	0.675 (0.268)**	0.696 (0.313)**	0.725 (0.314)**	0.755 (0.317)***	0.780 (0.328)**
EMUMaltaX	0.050 (0.202)	0.072 (0.201)	0.092 (0.199)	0.166 (0.210)	-0.190 (0.231)	-0.161 (0.229)	-0.146 (0.227)	-0.097 (0.228)
EMUMaltaM	-0.721 (0.211)***	-0.706 (0.212)***	-0.709 (0.207)***	-0.700 (0.194)***	-0.683 (0.233)***	-0.658 (0.235)***	-0.660 (0.231)***	-0.674 (0.216)***
EMUSlovakiaX	0.024 (0.136)	0.040 (0.138)	0.067 (0.141)	0.103 (0.145)	0.011 (0.116)	0.025 (0.117)	0.042 (0.119)	0.066 (0.121)
EMUSlovakiaM	0.148 (0.192)	0.164 (0.194)	0.191 (0.197)	0.227 (0.203)	0.257 (0.176)	0.271 (0.177)	0.289 (0.180)	0.312 (0.183)*
EMUEstoniaX	0.049 (0.112)	0.059 (0.114)	0.073 (0.116)	0.090 (0.120)	0.106 (0.124)	0.116 (0.126)	0.129 (0.127)	0.145 (0.130)
EMUEstoniaM	-0.063 (0.101)	-0.053 (0.101)	-0.037 (0.101)	-0.016 (0.100)	-0.071 (0.103)	-0.059 (0.101)	-0.045 (0.099)	-0.025 (0.096)

Note. The table reports the results for separate regressions for each country of the Eurozone. Robust standard errors (clustered by country-pairs) are in parentheses.* significant at 10%; ** significant at 5%; *** significant at 1%. In all regressions the dependent is bilateral exports. The independent variables include, in addition to two dummies to capture the euro effect in each country by direction of trade flows, a dummy for the rest of countries' euro effect, a dummy for regional trade agreements as well as dummies for exporter and importer country-year fixed effects and country-pair fixed effects. For brevity, we only report the results for the EMU country dummy by direction of trade.

Table 4. PPML results of the EMU and EU effect. Sample period 1948-2013 at five-year intervals.

	Panel A: World Sample				
	(1)	(2)	(3)	(4)	(5)
	Average effect	Portugal	Spain	Austria	Cyprus
EMU	-0.010 (0.041)	0.337 (0.116)***	0.180 (0.062)***	-0.014 (0.068)	0.442 (0.282)
OtherCUs	0.800 (0.111)***	0.797 (0.111)***	0.803 (0.112)***	0.800 (0.111)***	0.800 (0.111)***
EMUwoPortugal		-0.020 (0.041)			
EMUwoSpain			-0.036 (0.042)		
EMUwoAustria				-0.009 (0.042)	
EMUwoCyprus					-0.012 (0.041)
RTAwoEU	0.086 (0.038)**	0.085 (0.038)**	0.087 (0.038)**	0.086 (0.038)**	0.086 (0.038)***
EU	0.517 (0.046)***	0.513 (0.046)***	0.505 (0.046)***	0.517 (0.048)***	0.514 (0.046)***
Observations	155,951	155,951	155,951	155,951	155,951
	Panel B: OECD+EU Sample				
	Average effect	Portugal	Spain	Austria	Cyprus
EMU	-0.053 (0.054)	0.549 (0.111)***	0.218 (0.082)***	0.017 (0.086)	0.193 (0.261)
OtherCUs	1.302 (0.179)***	1.305 (0.179)***	1.308 (0.179)***	1.303 (0.179)***	1.300 (0.179)***
EMUwoPortugal		-0.070 (0.054)			
EMUwoSpain			-0.088 (0.054)		
EMUwoAustria				-0.058 (0.054)	
EMUwoCyprus					-0.054 (0.054)
RTAwoEU	0.178 (0.049)***	0.177 (0.049)***	0.182 (0.049)***	0.178 (0.049)***	0.179 (0.049)***
EU	0.447 (0.062)***	0.442 (0.062)***	0.433 (0.060)***	0.439 (0.065)***	0.445 (0.062)***
Observations	14,044	14,044	14,044	14,044	14,044

Note: The regressand is bilateral exports. Robust standard errors (clustered by country-pairs) are in parentheses.* significant at 10%; ** significant at 5%; *** significant at 1%. The regressions include exporter and importer time-varying fixed effects and country-pair fixed effect.

Table 5. PPML results of the EMU and EU effect including a trend for the EU. Sample period 1948-2013 at five-year intervals.

	Panel A: World Sample				
	(1)	(2)	(3)	(4)	(5)
	Average effect	Portugal	Spain	Austria	Cyprus
EMU	-0.089	0.278	0.119	-0.059	0.375
	(0.049)*	(0.117)**	(0.065)*	(0.074)	(0.282)
OtherCUs	0.811	0.808	0.815	0.812	0.811
	(0.112)***	(0.112)***	(0.112)***	(0.112)***	(0.112)***
EMUwoPortugal		-0.102			
		(0.049)**			
EMUwoSpain			-0.123		
			(0.050)**		
EMUwoAustria				-0.092	
				(0.049)*	
EMUwoCyprus					-0.091
					(0.049)*
RTAwoEU	0.087	0.086	0.087	0.086	0.087
	(0.038)**	(0.038)**	(0.038)**	(0.038)**	(0.038)**
EU	0.224	0.213	0.191	0.219	0.221
	(0.082)***	(0.082)***	(0.079)**	(0.082)***	(0.082)***
EU trend	0.006	0.006	0.007	0.006	0.006
	(0.002)***	(0.002)***	(0.002)***	(0.002)***	(0.002)***
Observations	155,951	155,951	155,951	155,951	155,951
	Panel B: OECD+EU Sample				
	Average effect	Portugal	Spain	Austria	Cyprus
EMU	-0.059	0.543	0.210	0.012	0.187
	(0.060)	(0.112)***	(0.084)**	(0.090)	(0.264)
OtherCUs	1.305	1.309	1.313	1.387	1.303
	(0.179)***	(0.179)***	(0.179)***	(0.179)***	(0.179)***
EMUwoPortugal		-0.078			
		(0.060)			
EMUwoSpain			-0.099		
			(0.060)*		
EMUwoAustria				-0.065	
				(0.060)	
EMUwoCyprus					-0.060
					(0.060)
RTAwoEU	0.178	0.176	0.181	0.179	0.178
	(0.048)***	(0.048)***	(0.048)***	(0.048)***	(0.048)***
EU	0.421	0.405	0.386	0.408	0.419
	(0.100)***	(0.100)***	(0.096)***	(0.101)***	(0.100)***
EU trend	0.001	0.001	0.001	0.001	0.001
	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)
Observations	14,044	14,044	14,044	14,044	14,044

Note: The regressand is bilateral exports. Robust standard errors (clustered by country-pairs) are in parentheses.* significant at 10%; ** significant at 5%; *** significant at 1%. The regressions include exporter and importer time-varying fixed effects and country-pair fixed effect.