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Isaac Mensah[1]

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Keywords: Gravity model, Bilateral exports, Euro, Poisson estimator.

JEL: F4, F14, F15, F33, C33.

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1 Introduction

Since 2004, the European Union has gained thirteen "new" member countries [1]. Some of these "new" members further deepened their integration in Europe by joining the EMU. Thus, Slovenia joined the EMU in 2007, Malta and Cyprus in 2008, Slovakia in 2009, Estonia in 2011, Latvia in 2014 and Lithuania in 2015[2]. The adoption of the euro allowed these "new" EMU members, which are small and open economies to mitigate the risk of exchange rate fluctuations among themselves and in their trade relationships with other "old" EMU members. Moreover, by using the euro compared to using their independent currencies, they also reduced the severity of exchange rate fluctuations with non-EMU countries.

An investigation of the euro's effect on trade for these "new" EMU member countries is as important as that of the "old" members. However, despite the important role the EMU membership may have played for these countries, existing evidence on the euro's effect on trade is widely focused on the "old" EMU members, and neglects the "new" EMU countries. Moreover, there are a number of EU member countries[3] who are in transit to the EMU and can be considered homogeneous to the "new" EMU members. This implies that from a policy perspective, our analyses and findings can be a good proxy for the EU countries in transit to the EMU.

A consensus among economists is yet to be reached on the euro's effect

[1] Bulgaria, Croatia, Cyprus, Czech Republic, Estonia, Hungary, Latvia, Lithuania, Malta, Poland, Romania, Slovakia and Slovenia.

[2] Throughout the paper, we define as a "new" EMU member, any country from this list.

[3] Poland, Romania, Bulgaria, Croatia, Hungary and Czech Republic.

on trade. Indeed, existing evidence for the "old" EMU members is mixed, by disclosing both positive, negative and insignificant effects of the euro adoption on trade. We then aim at contributing to this strand of literature by providing new evidence on the topic, and in particular, by studying the role the euro played for the "new" EMU members' trade. For this reason, we include in our sample all the member countries of the EMU and allow for the existence of a heterogeneous euro's effect on trade according to the structural characteristics of the "old" and "new" EMU members, by splitting the total euro's effect into that of the "old" and "new" EMU members.

We analyze the euro's effect on trade using a theory-consistent empirical model following existing studies by (Baldwin, 2006; Head and Mayer, 2014; Rose, 2017; Larch et al., 2017). Furthermore, we use the most recent (as at the time of writing) IMF-Direction of Trade (DOT) data spanning 1988 to 2015. We report estimates using the Pseudo Poisson Maximum Likelihood (henceforth, PPML estimator).

We control for both time-varying country-specific and country-pair fixed effects, thus addressing both the "multilateral resistance" and endogeneity issues. As suggested by Santos Silva and Tenreyro (2006 henceforth, SST), the Poisson estimator accommodates zero trade flows, and Larch et al., (2017) provides the algorithm for solving high-dimensional fixed effects using a Poisson estimator. We, thus, report results for the baseline model by focusing on a sample which includes both zero and non-zero trade flows.

After two decades since the introduction of the euro, we believe that there is room for renewed empirical studies. Also, the availability of more recent data and a longer post-euro time span could help in better identifying the euro's effect on trade. In this paper, we argue that empirical studies should pay attention to both the "old" and "new" EMU member countries and compare their experience.

To the best of our knowledge, our paper is one of the few studies that disaggregate the euro's effect by categorizing the effects into "old" and "new" EMU member countries. The other existing recent works (Zymek et al., 2017; Larch et al., 2017; Cislik et al., 2014) exclude Latvia and Lithuania from the EMU estimates. Furthermore, differently, from Cislik, Michalek and Mycielski (2014), we adopt a Poisson model in our empirical strategy.

Anticipating our results, we show a statistically non-significant euro's effect on trade. Our results are consistent with a number of recent studies (Larch et al., 2017; Mika and Zymek, 2017; Ciéslik et al., 2012, 2014) which focus on samples of a larger number of countries. However, disaggregating this effect, we report a relatively large euro's effect on trade of between 49-60 percent for the "new" EMU member. Our results prove robust to a number of sensitivity checks, especially, when we expand the sample by including a larger set of non-EMU countries.

The rest of the paper is as follows; Section 2 reviews the existing literature, Section 3 offers a discussion of our empirical models and methodology, Section 4 presents our results, Section 5 shows some sensitivity analysis and Section 6 concludes.

2 Literature Review

An understanding of how monetary variables, especially exchange rates, influence trade flows has long been pursued by monetary and trade economists. The general consensus by economists on the ambiguous effect of exchange rates volatility on trade shifted the focus of researchers to study the effects of currency unions. Economists' thought of currency unions as having microeconomic benefits but macroeconomic costs (Rose, 2000) was only a theoretical possibility until the creation of the European Monetary Union.

In the wake of the European monetary integration in 1999, Rose (2000) applied a gravity[4] model in order to answer a simple question "What is the currency union effect on international trade". In his cross-sectional study of 186 countries, characterized mainly by poor, small and open economies, Rose (2000) concluded that countries with a common currency trade three times as much than they would have otherwise.

His findings, though interesting, were taken by researchers with a pinch of salt, leading to the revival of the currency union effect literature. This strand of literature also included the analysis of the "euro effect" on trade. Other panel studies (Rose and Glick, 2002; Rose and van Wincoop, 2001 among others) were further developments on the subject and a year after the

[4]Gravity as literately defined in the spirit of Newton's law is directly proportional to the mass of objects (say country i and j) and inversely proportional to the distance between them. Presented mathematically and in economic terms as; $G_{ij} = \frac{GDP_i GDP_j}{Dist_{ij}}$. The specification in Tinbergen (1962) is slightly different, and given below as;

$$G_{ij} = \alpha GDP_i^{\alpha_1} GDP_j^{\alpha_2} Dist_{ij}^{\alpha_3}$$

Thus, G is the bilateral trade flows, GDP represents the mass, Dist is the bilateral geographical distance between countries and the constant parameters α.

publication of Rose (2000), a number of authors [5] identified some theoretical and empirical flaws in his work.

Baldwin (2006) raised three main critiques of the work by Rose (2000): omitted variables, reverse causality and model misspecification. It is worth mentioning that the identification of the currency union's effect in Rose (2000) rests on the exploitation of cross-country heterogeneity. Persson (2001) questioned the validity of Rose's country selection and proposed the use of a "matching strategy" for the sample selection.

By reviewing the euro's effect literature, Baldwin (2006) re-classified errors in the empirical estimation of the gravity model into; gold, bronze and silver medal errors. These errors relate to the wrongful measurement of variables and specification of the gravity model. The gold medal error refers to the omission of relative prices (*multilateral resistance term*) in the empirical estimation, while the bronze medal error relates to the conversion of nominal variables into real variables which turn to over/underestimate variables. The silver medal error concerns the definition of the dependent variable which, preferably, should be represented by bilateral exports. That notwithstanding, there still exist contrasting empirical measurements and specifications of the gravity model even in recent contributions.

By building on the Rose (2000)'s contribution, Micco, Stein, and Ordenez (2003) were the first to study the euro's effect on trade. Moreover, their empirical model was an improvement[6] on earlier contributions, given the updated empirical and theoretical developments in Persson (2001), Ten-

[5] see Persson (2001) and Tenreyro (2001)

[6] For example, they avoided the gold medal mistake by including a measure of relative prices (exchange rates) in their empirical model.

reyro (2001) and Rose and Van Wincoop (2001). By studying 22 developed countries (including 15 European countries) for the period 1992 to 2002, they found a euro's effect on trade of between 8 to 16 percent. Furthermore, they also reported no evidence of trade diversion. Others[7] such as Barr et. al, (2003), Flam and Norstrom (2003) and Berger and Nitsch (2008) using similar estimation methods have reported somewhat similar results.

Prior to their membership in the EMU, all "new" EMU countries, considered in "euro effect" studies, were used as a control sample. However, there are studies which anticipated the EMU integration of some Central and Eastern European Countries (henceforth, CEECs), by considering countries such as Slovenia, Latvia, Estonia etc., as EMU countries prior to their membership. Maliszewska (2004) and Belke and Spies (2008) are a few known ex-ante analysis of the euro's effect on some "new" EMU countries.

By estimating both OLS and panel (FE) models, Maliszewska reported a euro effect in the range of 6-26 percent on trade. Going forward, she assumed that any CEEC joining the euro will have a similar trade effect. Based on this assumption, she made a forecast of the euro's effect for the CEECs yet to join the EMU. Her conclusion from the forecast was that less open economies like Latvia and Lithuania will have a significant increase in trade compared to economies like Estonia and Slovakia who were relatively more opened. Interestingly, the conclusion in Belke and Spies (2008) contrasts with the above findings. Thus, using a Hausman-Taylor approach on a sample of CEECs and OECD countries for the period 1992-2004, they concluded that except for Poland, Latvia and Lithuania, all other CEECs that had joined

[7]See Rose (2017) which list a number of recent contributions.

the EMU would have experienced an increase in trade.

The need for expanding empirical investigations on the “euro effect” by including the analysis of the “new” EMU members became more apparent after Slovenia and other CEECs joined the EMU beginning 2007. Cieślik, Michałek and Mycielski (2014) is one of the few ex-post euro studies of the “euro effect” on the “new” EMU members. In their study, they used a data set similar to that in Rose (2000) for the period 1990-2010. Using a panel (FE) estimator, they concluded that the elimination of exchange rate volatility by joining the Exchange Rate Mechanism (ERM II) resulted in trade expansion for the “new” EMU members. However, their EMU accession did not have any positive euro’s effect on trade.

The conclusion above is consistent with their earlier studies (Cieślik et al., 2012) which considered only Slovenia and Slovakia as the “new” EMU countries. More recently, Mika and Zymek (2017) by adopting both OLS and PPML estimators on a sample of EU and 7 developed countries for the period 1992-2002, found no evidence of a positive euro effect on trade for the “old” EMU countries. The same evidence is corroborated when they expand the sample to include 153 countries for the period 1992-2013. Finally, they found no significant effect for the “new” EMU members either.

Our work differs significantly from most contributions discussed above in terms of the estimator and the empirical specification used. More importantly, this work is related to studies by Mika and Zymek (2017) and Larch et al., (2017) in terms of the estimation methodology used. However, we consider a larger sample of “new” EMU members, investigating a longer post-euro time span in our estimation. In addition, and different from

Zymek et al., (2017), we estimate a euro's effect on bilateral exports among the "old" EMU countries, "new" EMU countries and between the "old" and "new" EMU countries.

3 Data and empirical methodology

In accordance with recent developments in the literature, we specify a gravity model that accounts for recent theoretical contributions in the literature. Tinbergen (1962)'s model forms the basis for gravity model specification. Over time, assumptions made in the formulation of the original theoretical and empirical models have been relaxed following subsequent findings in the literature.

Bergstrand (1989) formulated a demand-side model that deviated from the conventional homogeneous endowment (factors) assumption, thus accounting for the differences in factor endowment. The resulting empirical suggestion is to include GDP per capita in the gravity model specification. Furthermore, Anderson and Van Wincoop (2001), an update on Anderson (1979), introduced the concept of *multilateral resistance term* and suggested the need to relax the homogeneous price assumption due to border effect. This led to the inclusion of relative price variables in the gravity model specification. Recent contributions, in order to account for this effect, include time-varying country-specific fixed effects in the gravity specification.

Our baseline analysis mainly rests on a sample of OECD countries. This is an attempt to focus on a fairly homogeneous group of countries. That notwithstanding, we recognize that OECD countries are differentiated in several factors. Moreover, we also acknowledge the differences between the "old" and "new" EMU countries. To date, there still exist some differences in the institutional setup among member states which lead to the lags in the implementation of euro-wide policies among member states.

The sample of countries under analysis has been found to affect the euro's trade effect disclosed by the empirical analysis. In particular, Rose (2017) argues in favour of using larger samples. However, the inclusion of many smaller countries tends to exacerbate the difference in the estimated effects between estimators (Larch, et al., 2017). Hence, while we decided to focus on a smaller sample[8] of OECD countries, we also show the robustness of our findings by extending the sample to include a larger set of countries. More interesting, by exploiting our baseline sample, we arrive at a conclusion similar to those in Larch et al., (2017) and Mika and Zymek (2017) who used a relatively large sample.

After the publication of Santos Silva and Tenreyro (2006), the Pseudo-Poisson Maximum Likelihood (PPML) estimator has been embraced in the gravity model literature. Indeed, it is consistent in the presence of heteroskedasticity, and it offers a natural treatment for missing bilateral trade flows for which alternative treatments in the literature are found to generate inconsistent estimates of parameters. Finally, with respect to other estimators (like Least Square Dummy Variable (LSDV)), the PPML report non-bias estimates (in terms of magnitude) of dyadic dummies. We avoid Baldwin's gold, silver and bronze medal errors by estimating our gravity model in nom-

[8]see Figure 1 on page 21 of Rose (2017). The literature reflects significant number of small sample studies.

inal terms and with bilateral export trade as the dependent variable. Hence, our PPML gravity specification is the following:

$$\mathrm{X}_{ijt} = exp\Big\{\beta_0 + \beta_1 FTA_{ijt} + \beta_2 EU_{ijt} + \beta_3 EMU_{ijt} + \alpha_{it} + \delta_{jt} + \phi_{ij}\Big\} \times \epsilon_{ijt} \quad (1)$$

The dependent variable is the bilateral exports between country i and j at time t. Free Trade Agreements (henceforth, FTA) is the trade policy dummy indicating whether both countries are/were members of some free trade agreements. Both EU and EMU are the institutional dummies indicating whether both countries are members of the European Union and the European Monetary Union respectively. It is important to emphasize that EMU is the dummy of interest which captures the euro's effect on trade.

EMU is further disaggregated into EMU_{old}, EMU_{new} and EMU_{oldnew}. EMU_{old} takes the value 1 for the pair of "old" EMU countries and 0 otherwise, while EMU_{new} takes value 1 for the pair of "new" EMU countries and 0 otherwise, and EMU_{oldnew} takes value 1 for the pair of "old" and "new" EMU countries and 0 otherwise. α_{it} and δ_{jt} are the time-varying exporter and importer fixed effects (i.e., country-specific time-variant dummies) respectively and ϕ_{ij} captures country-pair fixed effects. Finally, ϵ_{ijt} is the error term.

We also report estimates of an alternative specification where we use countries' GDP and bilateral exchange rates (EX) as controls for multilateral resistance, instead of including exporter-year and importer-year fixed effects, but we include country-pair fixed effects as controls for endogeneity. While we expect the EU dummy to be positive, EMU could be negative or positive reflecting the inconclusiveness of the euro's effect on trade in the literature.

However, when disaggregating the total EMU effect, we expect a larger and positive euro's effect on the "new" EMU members. While the theoretical literature on trade suggests a positive FTA on trade, there exists a large empirical literature that concludes on the positive and negative effects of FTA on trade. Given this inconclusiveness, we are receptive to the outcome of the FTA dummy.

Moreover, regardless of a positive, negative or zero euro's effect on trade, we estimate trade diversion effect by means of the following specification:

$$\mathrm{X}_{ijt} = exp\Big\{\beta_0 + \beta_1 FTA_{ijt} + \beta_2 EU_{ijt} + \beta_3 EMU_{ijt} + \beta_4 DV_{ijt} + \alpha_{it} + \delta_{jt} + \phi_{ij}\Big\} \times \epsilon_{ijt} \quad (2)$$

In equation (2) all variables follow their definition given in equation (1). DV is a dummy which takes 1 for the pair of EMU and non-EMU countries and 0 otherwise. A positive coefficient of the DV dummy implies no evidence of trade diversion while a negative coefficient indicates otherwise. An analysis of trade diversion in the EMU was first done by Micco et. al, (2003). In their work, they found no evidence of trade diversion. We expect similar results as trade (both pre and post-EMU integration) between EMU and non-EMU members have not changed significantly (both EU and non-EU alike), looking at the global pattern of trade. And more so, EU-China trade flows have grown steadily in recent years, showing the EU's sustained interest in external markets.

Data

Our study is focused on all members of the EU, EMU, as well as further OECD and non-OECD countries. The sample includes (38) countries which are: Austria, Belgium, Britain, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Italy, Ireland, Latvia, Hungary, Romania, Bulgaria, Croatia, Iceland, Poland, Luxembourg, Lithuania, Malta, Netherlands, Norway, Portugal, Spain, Slovakia Republic, Slovenia, Sweden, Switzerland, Australia, Canada, New Zealand, Japan, China, India, US. The estimates cover the period from 1988 to 2015. Hence, our analysis is implemented on a balanced panel with a total of 39,368 observations (given by $38 \times 37 \times 28$).

Bilateral trade data are sourced from the International Monetary Fund's (IMF) *Direction of Trade Solution* (DOTS), while data on GDP are from the World Bank's *World Development Indicators* (WDI). Bilateral exporter and importer exchange rates (period averages) data are from the OECD.stat database. For Bulgaria, Cyprus, Croatia, Malta and Romania, we used exchange rates data from the WDI. Finally, trade policy (free-trade agreement) data are from the Mario Larch's Regional Trade Agreements Database in Egger and Larch (2008).

Both EU and EMU dummies are created with particular reference to country's period of membership in the EU and EMU. In this work, countries who were members of the EMU by 2001 are classified as "old" EMU members, while those who gained membership subsequent to 2001 are deemed "new" EMU countries. It is worth noting that among the non-EMU economies we included in the analysis China and India. This reflects their significance in recent international trade flows.

4 Empirical Results and Discussion

Table 1 presents the results of the estimation of equation (1) by adopting the PPML estimator. The models are estimated on the whole sample of 38 countries for the period 1988-2015. We report estimates using bilateral exports (dependent variable) that include both zero and non-zero trade flows. We estimate two baseline specifications. While in Model 1, we treat both "old" and "new" EMU groups as homogeneous, and we estimate a single effect for the whole set of EMU members, in Model 2 we split them between "old" and "new" EMU members and we estimate heterogeneous effects for three different groups of country pairs: "old-old" EMU members, "new-old" EMU members, "new-new" EMU members.

Our estimates are consistent with our expectations in terms of sign and magnitude. From our results, the trade benefits of joining the EMU is small, negative and statistically insignificant with reference to our baseline model [column 3]. When disaggregating the total "euro-effect"[column 4], our results indicate that the euro has been highly beneficial to the "new" EMU members. As indicated by the EMU_{new}, the reported "euro effect" is as high as 49 percent[9] compared to that of the "old" EMU countries (indicated by EMU_{old}), which is negative and statistically insignificant. Interestingly, the "euro effect" on the trade between the "new" and "old" EMU countries

[9]This value is computed by; $[(exp^{\beta} - 1) \times 100]$, where β is the estimated co-efficient of the EMU_{new} dummy.

(indicated by EMU_{oldnew}) though positive, is statistically insignificant.

Our results from the alternative baseline model show a large, positive and statistically significant euro's effect on trade [column 1]. Furthermore, they also show a similar euro's effect on the "old" EMU countries. It is indeed evident that an inadequate specification of the multilateral resistance term in the structural gravity model can bias the estimates of the euro's effect. Thus, time-varying exporter and importer fixed effects are important and should be included in the model specification to account for changes in multilateral resistance (Feenstra, 2004; Baldwin and Taglioni, 2007).

The larger "euro effect" on the "new" EMU countries though interesting, needs further clarification. These countries, prior to their EU integration, were less open to the international market with respect to the "old" EMU members. Thus, their EU membership gave them unlimited access to the larger EU market, providing a possibility for these countries to improve their market institutions. Moreover, their further integration in Europe by joining the EMU gave them further trade advantages in terms of price transparency, mitigation of external price volatility and other frictions related to cross-border trade.

Our results also suggest that the creation of the European single market (EU) had a positive and statistically significant effect on trade. A result consistent with the argument documented in Berger and Nitsch (2008). This is intuitive on the logic that the removal of obstacles to the free movement of goods, capital and labour, in the spirit of transparent and falling prices through competition, are a few rationales for the positive EU trade effect. We also find a positive but insignificant effect of free trade agreements on trade. In recent literature, Larch et al.,(2017) and Zymek et al., (2017) have found a positive, significant but small FTA effect on trade.

Table 1: PPML- Baseline Estimates

	WORLD (38) SAMPLE- BASELINE Dependent Variable: Bilateral Exports			
VARIABLES	**Model 1** [1]	**Model 2** [2]	**Model 1** [3]	**Model 2** [4]
logGDPeGDPm	0.744***	0.748***		
	(0.077)	(0.076)		
logEXe	0.384*	0.381*		
	(0.202)	(0.201)		
logEXm	-0.077	-0.078		
	(0.129)	(0.129)		
FTA	0.014	-0.001	0.065	0.069
	(0.093)	(0.090)	(0.051)	(0.051)
EU	0.218	0.232	0.137**	0.123**
	(0.170)	(0.168)	(0.061)	(0.059)
EMU	0.415***		-0.031	
	(0.105)		(0.060)	
EMU_{old}		0.459***		-0.062
		(0.115)		(0.067)
EMU_{new}		0.353***		0.397**
		(0.118)		(0.156)
EMU_{oldnew}		-0.012		0.114
		(0.233)		(0.072)
Exporter_Year	NO	NO	YES	YES
Importer_Year	NO	NO	YES	YES
Country-pair FE	YES	YES	YES	YES
Year FE	YES	YES	NO	NO
Observations	35,068	35,068	36,026	36,026
R-squared			0.942	0.943

$***$,$**$,$*$ represent 1%, 5% and 10% significant level respectively, standard errors are in brackets. The dependent variable (bilateral exports) include zero and non-zero trade flows.

5 Sensitivity Analysis

As discussed in Rose (2017), the estimated euro's effect on trade is likely to be biased by (i) the number of countries considered (ii) the nature of countries and (iii) the time span covered by the analysis. Moreover, according to Baldwin (2006), due to the major institutional changes in Europe (The Maastricht Treaty) during 1992, the estimates of the "euro effect" is likely to be biased if these changes are not controlled for in the estimation process. Hence, we check the robustness of our results to these issues. Our sensitivity analysis also aims at testing whether there exists any evidence of trade diversion since a currency union can divert trade from high-cost producers (non-union member) to low-cost producers (union member) and vice versa.

Table 2 presents an estimation by restricting the sample to the 28 EU countries for the same period as in Table 1. For easy comparison, we will refer to our main sample as the baseline sample and the sub-sample of 28 EU countries (used for the results in Table 2) as the EU sample. Clearly, the estimated euro's effect on trade in our baseline model though positive is again statistically insignificant. The euro's effect on trade for the "new" EMU members is larger compared to that in Table 1. Moreover, trade between the "new" and "old" EMU countries is also positive and significant at about 17 percent.

Our results seem to contrast the argument that small observations used in estimating the euro's effect are likely to cause underestimation. Thus, our point estimate of the EMU dummy in both the baseline and EU sample falls in the range of those documented in Larch et al., (2017) which used a sample of 200 countries for the period 1948-2013. Other contributions which exploit larger sample of countries (Zymek et al., 2017 and Cie'slik et al., 2012b) have concluded on a statistical insignificant euro's effect on trade.

Table 2: PPML- EU (28) Estimates

	EU (28) SAMPLE			
	Dependent Variable: Bilateral Exports			
VARIABLES	**Model 1**	**Model 2**	**Model 1**	**Model 2**
	[1]	**[2]**	**[3]**	**[4]**
logGDPeGDPm	0.398	0.425		
	(0.291)	(0.288)		
logEXe	0.156**	0.157**		
	(0.078)	(0.078)		
logEXm	0.124**	0.126**		
	(0.060)	(0.059)		
FTA	0.002	-0.014	-0.086	-0.053
	(0.041)	(0.037)	(0.077)	(0.077)
EU	0.236***	0.247***	0.119	0.103
	(0.071)	(0.070)	(0.090)	(0.088)
EMU	0.253***		0.006	
	(0.085)		(0.034)	
EMU_{old}		0.314***		-0.098*
		(0.100)		(0.057)
EMU_{new}		0.383**		0.473***
		(0.161)		(0.131)
EMU_{oldnew}		-0.043		0.160***
		(0.223)		(0.061)
Exporter_Year	NO	NO	YES	YES
Importer_Year	NO	NO	YES	YES
Country-pair FE	YES	YES	YES	YES
Year FE	YES	YES	NO	NO
Observations	18,006	18,006	18,794	18,794
R-squared			0.986	0.986

$***$,$**$,$*$ represent 1%, 5% and 10% significant level respectively, standard errors are in brackets. The dependent variable (bilateral exports) include zero and non-zero trade flows.

Alternatively, the results we get by estimating our model on a sub-sample which includes economies with relatively homogeneous economic size and development are reported in Table 3. We also report in Table 3 results from the estimation of equation (2). There are 30 OECD countries in our sample. Hence, estimating a model of only OECD countries motivate our quest in two dimensions (i) it represents a further robustness check on the "size of the sample" argument and (ii) we are able to estimate the euro's effect assuming that the EMU is composed of only OECD-EMU countries.

Table 3: PPML- OECD (30) Estimates

	Dependent Variable: Bilateral Exports					
	EXCLUDE ZERO OECD (30)		**INCLUDE ZERO OECD (30)**		**INCLUDE ZERO BASELINE**	
VARIABLES	**Model 1 [1]**	**Model 2 [2]**	**Model 1 [3]**	**Model 2 [4]**	**Model 1 [5]**	**Model 2 [6]**
FTA	0.005	0.012	-0.023	-0.014	0.066	0.067
	(0.059)	(0.060)	(0.061)	(0.061)	(0.051)	(0.051)
EU	0.097	0.104	0.070	0.078	0.138**	0.114**
	(0.069)	(0.069)	(0.072)	(0.072)	(0.061)	(0.058)
EMU	-0.162***	0.027	-0.135**	0.109	0.013	
	(0.061)	(0.088)	(0.062)	(0.089)	(0.114)	
EMU_{old}						-0.271*
						(0.157)
EMU_{new}						0.216
						(0.181)
EMU_{oldnew}						-0.018
						(0.079)
DV		0.108*		0.140**	0.024	-0.111
		(0.062)		(0.063)	(0.079)	(0.087)
Exporter_Year	YES	YES	YES	YES	YES	YES
Importer_Year	YES	YES	YES	YES	YES	YES
Country-pair FE	YES	YES	YES	YES	YES	YES
Year FE	NO	NO	NO	NO	NO	NO
Observations	21,985	21,985	22,203	22,203	36,026	36,026
R-squared	0.943	0.943	0.943	0.943	0.942	0.943

∗ ∗ ∗,∗∗,∗ represent 1%, 5% and 10% significant level respectively, standard errors are in brackets.

From Table 3, we report a negative and statistically significant euro's effect on trade. However, the negative effect disappears when we add to the specification, the trade diversion dummy. The coefficient of the trade diversion dummy is positive and significant. Also, using the baseline sample, the diversion effect disappears, thus it is still positive but insignificant. The positive coefficient of the DV dummy indicates that, despite the introduction of the euro, there exists no evidence of trade diversion within the selected OECD countries' sample. Hence, in spite of the monetary union, EMU members have kept intact their trading relationship with non-EMU countries. This finding is very much in line with that reported in Micco et al., (2003). The US, the UK, Japan, Switzerland and more recently China, are still important external markets for most EMU member countries especially Germany.

Do the results from the OECD sample invalidate our previous findings? Looking at Larch et al.,(2017), our answer is certainly "no". Thus, using their larger sample of over 800,000 observations, they documented -0.203, -0.117 and -0.067 euro's effect on trade using the OECD sample in their data for the period 1948-2005, 1985-2005 and 1995-2005 respectively. There is not much difference in their results and those reported in Table 3. It is important to add that the only difference in the estimated EMU dummies in Table 3 and those in Tables 1 and 2 is that, the contributions of Malta, Cyprus and Lithuania are excluded since they are non-OECD countries.

As argued in Baldwin (2006), the institutional changes in Europe in 1992 can bias the estimation of the euro's effect if not properly controlled for in the empirical specification. One of these institutional changes was the removal of EU internal customs that led to the change in the recording system of trade flows in most EU countries. To avoid this problem, we re-estimate the euro's effect for the period 1993-2015. Table 4 presents the results using the Baseline, EU and OECD sample for the period 1993-2015. Clearly, the results in Table 4 are quite consistent with those presented in previous tables. More specifically, we correctly estimated the statistical insignificance of the euro's effect in [Model 1] and [Model 2] using the EU (28) and OECD (30) samples respectively. Moreover, EMU_{new} is also correctly estimated.

Table 4: PPML- Basline, EU (28) and OECD (30) Estimates

	PERIOD: 1993-2015					
	Dependent Variable: $X_{ijt} >= 0$					
	BASELINE		**EU (28) SAMPLE**		**OECD (30) SAMPLE**	
	Model 1	**Model 2**	**Model 1**	**Model 2**	**Model 1**	**Model 2**
	[1]	**[2]**	**[3]**	**[4]**	**[5]**	**[6]**
FTA	0.033	0.040	-0.129	-0.091	-0.024	-0.014
	(0.053)	(0.053)	(0.091)	(0.091)	(0.075)	(0.076)
EU	0.088	0.044	0.054	0.014	0.069	0.071
	(0.073)	(0.070)	(0.125)	(0.120)	(0.098)	(0.099)
EMU	-0.158**		0.007		-0.201**	0.071
	(0.074)		(0.038)		(0.084)	(0.086)
EMU_{old}		-0.226***		-0.131*		
		(0.086)		(0.067)		
EMU_{old}		0.389**		0.475***		
		(0.156)		(0.130)		
EMU_{old}		0.102		0.167***		
		(0.070)		(0.060)		
DV						0.161**
						(0.076)
Exporter_Year	YES	YES	YES	YES	YES	YES
Importer_Year	YES	YES	YES	YES	YES	YES
Country-pair FE	YES	YES	YES	YES	YES	YES
Observations	31,754	31,754	16,964	16,964	19,554	19,554
R-squared	0.949	0.949	0.986	0.986	0.944	0.944

$***$,$**$,$*$ represent 1%, 5% and 10% significant level respectively, standard errors are in brackets.

Finally, as done in both Larch et al., (2017) and Zymek et al., (2017), we estimate our specification using a data similar to that in Rose and Glick (2015). The limitation of using this data is that since the sample ends in 2013, estimates of the EMU effect are likely to exclude the effect of Latvia and Lithuania. That notwithstanding, the estimates as shown in Table B indicate the statistical insignificance of the euro's effect on bilateral exports, but a relatively large EMU_{new} effect as reported in the baseline results. Moreover, as done in Table 3, restricting the sample to the period 1993-2015, the results are again consistent with our baseline results. Using a Panel Fixed Effect(FE) estimator, we again found a larger euro's effect on the "new" EMU members. Furthermore, the evidence of no trade diversion is also upheld. These results are not reported in this current paper.

It is important to state that most of the earlier contributions to the literature (Micco et al., 2003; Berger and Nitsch, 2008; Flam and Norstrom, 2003 among others) prior to (SST, 2006) employed the use of the panel fixed effect estimator. This estimator is based on the *log-linearization* of the gravity model which is sometimes a challenge, especially when there are a lot of zeros or missing bilateral trade flows in the sample. For this reason, this estimator only works on the necessary condition that $X_{ijt}>0$. Moreover, as argued in SST, the FE estimator tend to be unbiased, but inconsistent in the presence of heteroskedasticity.

6 Conclusion

In this paper, we set out to study the euro's effect on trade for both the "old" and "new" EMU members for the period 1988-2015. We estimated a theory-consistent gravity model controlling for both time and country heterogeneity effects. We used the Pseudo Poisson Maximum Likelihood (PPML) estimator, and we conducted a number of robustness checks to test the sensitivity of our results. We found that the euro's effect is statistically insignificant on bilateral exports. Moreover, disaggregating the total euro's effect to that of "new" and "old" EMU members and using the Baseline sample, we found a statistically significant euro's effect of between 42-60 percent on the "new" EMU members. For the "old" EMU members, the euro's effect is for most estimates negative and statistically insignificant.

Our results on the "new" EMU countries contrast with the conclusions of Zymek et al., (2017) and Cieślik et al., (2012b, 2014). However, our general conclusions on the aggregate euro's effect on trade are consistent with (Zymek et al., 2017; Cieślik et al., 2012b, 2014; Larch et al., 2017). Of course, our conclusions add to the list of contributions that contrast the results in Glick and Rose (2016). Consistent with the findings in Micco et. al, (2003), we found no evidence of trade diversion between EMU and non-EMU countries.

Our results reveal increasing bilateral trade flows among the "new" EMU countries following their euro adoption. Nevertheless, in order to extend this conclusion to further "new" EMU members, some caution should be taken. Thus, as far as other CEECs in transit to the EU are concerned, much is required of them in terms of convergences and synchronization of their economies to the EMU average. For the "new" EMU members, the Exchange Rate Mechanism (ERM II) was a good pathway to the convergence of their economies to the "old" EMU members. Currently, countries like Poland, Hungary among others are yet to fully exploit this convergence avenue.

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Appendix

Table A: Summary Statistics

Variables		Mean	Std. Dev.	Min	Max	Obs
Log(Bil.Expts)	overall	19.001	3.046707	2.108425	27.58471	N = 35581
	between		2.880675	7.108208	26.04075	n = 1406
	within		1.010617	7.661089	35.51792	T-bar = 25.3
Log(GDPem)	overall	51.9969	2.72025	43.60304	60.55304	N = 36366
	between		2.530248	45.38641	59.11085	n = 1406
	within		0.9953118	49.06829	55.0281	T-bar = 25.9
Log(EX)	overall	0.6911508	1.733699	-7.094085	5.657703	N = 37777
	between		1.595571	-1.059861	5.084888	n = 1406
	within		0.6503173	-5.343073	2.683069	T-bar = 26.9
FTA	overall	0.2575696	0.4373012	0	1	N = 39368
	between		0.307304	0	1	n = 1406
	within		0.3112256	-0.7067161	1.221855	T = 28
EU	overall	0.2808626	0.4494262	0	1	N = 39368
	between		0.3233576	0	1	n = 1406
	within		0.3122428	-0.4691374	1.17372	T = 28
EMU	overall	0.0843833	0.2779653	0	1	N = 39368
	between		0.1826132	0	0.6071429	n = 1406
	within		0.2096187	-0.5227596	1.048669	T = 28
DV	overall	0.2335907	0.4231201	0	1	N = 39368
	between		0.269745	0	0.6071429	n = 1406
	within		0.3260647	-0.3735521	1.197876	T = 28

Table B: PPML Estimates- Larger Sample

	ROSE-LIKE SAMPLE (206 COUNTRIES)			
	Dependent Variable: Bilateral Export Trade			
	1988-2013		**1993-2013**	
VARIABLES	**Model 1**	**Model 2**	**Model 1**	**Model 2**
	[1]	**[2]**	**[3]**	**[4]**
RTA	-0.100***	-0.100***	-0.079***	-0.079***
	(0.012)	(0.012)	(0.012)	(0.012)
EU	0.337***	0.336***	0.274***	0.272***
	(0.015)	(0.015)	(0.016)	(0.016)
EMU	-0.002		0.010	
	(0.010)		(0.011)	
EMU_{old}		-0.005		0.005
		(0.010)		(0.012)
EMU_{new}		0.365***		0.371***
		(0.083)		(0.082)
EMU_{oldnew}		0.022		0.036
		(0.026)		(0.026)
Exporter_Year	YES	YES	YES	YES
Importer_Year	YES	YES	YES	YES
Country-pair FE	YES	YES	YES	YES
Observations	526,360	526,360	454,945	454,945
R-squared	0.993	0.993	0.994	0.994

$***$, $**$, $*$ represent 1%, 5% and 10% significant level respectively, standard errors in brackets. The dependent variable (bilateral exports) include zero and non-zero trade flows.