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A study of the trade-induced welfare effects of the EMU

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Has the Euro paid off? A study of the trade-induced welfare effects of the EMU

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Abstract

This paper aims to provide policy-relevant insights into the Euro effect. Relying on partial equilibrium estimates using a new dataset that comprises bilateral international and intra-national trade flows of 69 countries during the period 1986-2016, we estimate a general equilibrium gravity model that allows us to quantify the welfare effect of the Euro as well as its impact on consumer prices and producer prices. The results of three counterfactual experiments indicate that the Euro has been successful at increasing welfare for Economic and Monetary Union (EMU) and non-EMU member countries. Our results suggest that a two-speed Euro design would have further increased welfare, albeit its distributional effects within countries, i.e., for consumers and producers. The growth effects of the Euro are mainly driven by trade creation outside the EMU, questioning the cohesiveness of the Euro as an optimum currency area.

Keywords: Euro, trade, welfare, structural gravity, general equilibrium
JEL Classification: F13, F14

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1. Introduction

Stimulated by Rose's (2000) influential article, much work has focused on examining the effect of currency unions on trade. Within this strand of research, the effect of the Economic and Monetary Union (EMU) on trade has attracted particularly great attention among researchers and policymakers given that EMU is, by far, the largest and most important monetary union worldwide.[1] Indeed, the interest on this topic started before the euro creation.[2] Not surprisingly, papers investigating the EMU effect on trade have multiplied since the early 2000s with the availability of post-EMU data (see, for instance, Aristotelous, 2006; Micco, *et al.*, 2003; De Nardis and Vicarelli, 2003; Barr *et al.*, 2003; Gil-Pareja *et al.*, 2003 and 2008; Berger and Nistch, 2008; or more recently, Glick and Rose, 2016; Larch *et al.*, 2018; Mika and Zymek, 2018; Larch *et al.*, 2019; and Esteve-Pérez *et al.*, 2020a). In particular, so far, more than 50 papers have investigated the partial or direct effects of EMU on bilateral trade flows obtaining mixed results.[3] These previous studies do show the initial impact of the EMU on trade flows. However, the extant literature has focused on the trade partial equilibrium effects, neglecting the effects that arise when we consider the changes in prices, incomes, and expenditures prompted by trade costs changes. This paper contributes to this literature by examining the general equilibrium effects of EMU through its impact on trade costs.

The empirical work on the effect of EMU on trade relies on the gravity equation of international trade. In light of the methodological advances and theoretical developments in the gravity equation literature over the last two decades

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[1] In this paper, EMU refers to the third stage of the process of harmonizing the economic and monetary policies among European Union Member States that came into effect on 1 January 1999 by the eleven early joiners of the euro.

[2] Several articles estimate or extrapolate the potential impact of the EMU on trade using pre-EMU data (see, for example, Dell'Ariccia, 1999; De Grauwe and Skudelny, 2000; or Rose and van Wincoop, 2001).

[3] Rose (2017) provides a meta-analysis including 45 studies and a comprehensive review of the literature to date. See Esteve-Pérez *et al.* (2020a) for an overview of more recent studies.

we now know that the vast majority of studies on the EMU effect estimate gravity equations endured theoretical, econometric, and data flaws because of two main reasons. First, computational limitations or difficulties in achieving convergence in the estimations have precluded estimating the gravity equation's econometric specifications simultaneously accounting for all the potential sources of bias pointed out by the specialized literature. These potential biases arise from the unobserved bilateral heterogeneity and the endogeneity of trade policy variables, the omission of the (theoretical) multilateral resistance terms, the heteroskedasticity of the residuals and the existence of zeros in bilateral trade flows.[4] Second, a correct assessment of EMU effect on trade in a structural gravity framework requires the use of data comprising not only international trade flows but also intra-national flows.[5] As pointed out by Larch *et al.* (2018), the non-inclusion of data on intra-national trade flows, in addition to involving a departure from the structural gravity theory of international trade, has prevented researchers from capturing two relevant factors. On the one hand, trade creation effects, that is, the replacement of domestic sales with trade with other EMU countries prompted by the currency union is not properly measured. On the other hand, a proper identification of country-specific EMU effects on trade between EMU members and third countries is not possible when only using international trade flows. In fact, to the best of our knowledge, so far only three papers (Larch *et al.*, 2018; Esteve-Pérez *et al.*, 2020a; and Felbermayr

[4] Two computational advances that have been recently developed allow accounting simultaneously for all cited sources of bias in large datasets. The first one is Tom Zylkin's *ppml_panel_sg* Stata command presented in Larch *et al.* (2019). The second contribution is the *ppmlhdfe* Stata command developed by Correia *et al.* (2019) for fast estimation of (pseudo) Poisson regression models with multiple high dimensional fixed effects. In particular, Larch *et al.* (2019) use the Zylkin's algorithm to overcome Glick and Rose (2016)'s computational problems with PPML (Poisson pseudo-maximum-likelihood) in the estimation of the effect of the EMU on trade using a large dataset that includes only international trade data.

[5] Several studies using the gravity equation demonstrate the importance of accounting for intra-national trade flows (see, for example, Yotov, 2012; Dai *et al.*, 2014; Bergstrand *et al.*, 2015; Anderson and Yotov, 2016; Borchert and Yotov, 2017; Heid *et al.*, 2021; Beverelli *et al.*, 2018; and Baier *et al.*, 2019).

and Steininger, 2019) provide unbiased and theory-consistent estimates of the gravity equation accounting simultaneously for all the sources of bias previously discussed.

Our paper makes the following two contributions to the existing literature on the effect of EMU on trade. First, following all the econometric best practices for the estimation of the gravity equation of international trade compiled by Yotov *et al.* (2016), we re-asses the partial effects of the EMU (both as a whole and for each country) extending in a decade the period considered by Esteve-Pérez *et al.* (2020a) to cover the most recent years. This contribution is valuable by itself because it allows us to grasp a better assessment of such an institutional change that leads to gradual effects on trade. Additionally, it allows considering the years after the financial and debt crisis in 2008 and 2010, respectively. In particular, we use a sample covering 69 countries over the period 1986-2016. Second, we extend the analysis to a general equilibrium framework, which is a natural extension of this literature that allows evaluating the impact of EMU on trade and welfare. This analysis is of interest for academics and further has important policy implications.

In this paper, we add three relevant methodological factors to the discussion of the welfare effects of the Euro. Firstly, this paper uses the GEPPML estimable general equilibrium procedure recently developed by Anderson *et al.* (2018) to perform general equilibrium comparative static analysis of gravity models with the Poisson pseudo-maximum-likelihood (PPML) estimator.[6] This procedure allows us to distinguish between consumer and producer effects, which are relevant to dig deeper into the political economy underneath Europe's monetary integration. Secondly, we explicitly analyse trade creation/diversion effects of the EMU, obtaining

[6] Felbermayr and Steininger (2019) took the first stab at this question using a Caliendo and Parro (2015) computable general equilibrium framework in the spirit of the Ricardian trade model of Eaton and Kortum (2002).

a more accurate measure of its effect both inside and outside the Eurozone. Thirdly, our paper studies both the effect of the level and the change over time of the EMU.

We further span the breadth of the counterfactual analysis by studying the design or phasing in Europe's common currency. In particular, we undertake three general equilibrium counterfactual experiments in order to address three important questions: (i) what are the overall gains from trade of the EMU?; (ii) what are the gains from trade for core EMU countries compared to those obtained by the peripheral member countries?; and, (iii) what are the gains from trade due to trade creation effects with countries outside the Euro area?

To preview our results, we find that EMU has boosted bilateral trade flows between member countries and, especially, between EMU members vis-à-vis non-member countries. Interestingly, the enlargement of the period, including the more recent years significantly raises the effect of EMU on trade. Specifically, the overall trade creation effect of the EMU more than doubles, and the positive effect on trade with third countries is about 50 percent larger when we consider the most recent years of the sample period. Likewise, the analysis of the effect by country reveals an increase in the number of countries for which the EMU has boosted trade between members with respect to Esteve-Pérez *et al.* (2020a), which sample period ended in 2006. Furthermore, the general equilibrium analysis reveals several traits with important policy implications. The results suggest that the EMU had a sizable welfare-enhancing effect on participating countries. This effect is larger among smaller EMU members, where consumers (producers) enjoy lower (higher) prices. The lower bound estimates from our counterfactual analysis suggests that Germany's real GDP would have been about 2.16% lower than it was in 2016 if the Euro had not existed. The results also suggest that the Euro design was a second-best and questions the pro-economic cohesion effect of EMU among Eurozone member countries.

The rest of the paper is organized as follows. Section 2 outlines the methodology and Section 3 describes de dataset used in this paper. Section 4 discusses the empirical results. Finally, section 5 concludes.

2. Methodology: The structural gravity model

2.1 Partial equilibrium analysis

The gravity model is one of the most popular and successful frameworks in international economics. Gravity allows researchers to investigate the determinants of international trade and, in particular, to quantify the partial or direct effects of various types of economic integration agreements on bilateral trade flows. Several contributions since the late 1970s have made the gravity model become a structural model with solid theoretical foundations, making it particularly appropriate for counterfactual analysis.[7] It represents a realistic general equilibrium environment that can be used to capture the possibility that countries are linked and that trade policy changes in one market will unchain ripple effects in the rest of the world (Yotov *et al.*, 2016).

Our empirical strategy begins with the estimation of the partial equilibrium effects of the EMU on international trade flows. Over the last two decades, a number of significant developments in the estimation of the gravity equation allow obtaining unbiased and theory-consistent estimates of international trade determinants.

First, Glick and Rose (2002), Egger and Pfaffermayr (2003), Cheng and Wall (2005) or Baier and Bergstrand (2007) illustrate the importance of both using panel trade data and including time-invariant country-pair fixed effects to account for

[7] Initially the gravity equation lacked theoretical foundations. Anderson (1979) is the first to provide a theoretical basis for the gravity model of international trade. Eaton and Kortum (2002) and Anderson and van Wincoop (2003) offer the two most prominent theoretical foundations of the structural gravity model. For a review of alternative theoretical foundations of the structural gravity model see Head and Mayer (2014) and Yotov *et al.* (2016).

the effect of all-time invariant bilateral trade costs and the endogeneity of trade policy variables.[8] Second, Trefler (2004) and Cheng and Wall (2005) recommend using panel data with intervals instead of data pooled over consecutive years to allow for adjustment in trade flows in response to integration agreements. However, on this issue, recently, Egger *et al.* (2020) challenge the common practice of estimating gravity equations with time interval data and pointe out a series of advantages of using consecutive-year data to capture dynamic-adjustment effects. Third, Baier and Bergstrand (2007) and Baldwin and Taglioni (2007) suggest that, per theory, the gravity equation should also include exporter-time and importer-time fixed effects to control for changes in multilateral resistance terms (Anderson and van Wincoop, 2003).[9] Fourth, Santos Silva and Tenreyro (2006 and 2010) propose to use the Poisson Pseudo-Maximum Likelihood (PPML) estimator to deal with the econometric problems resulting from heteroskedastic residuals and the prevalence of zeros in bilateral trade flows.[10] Fifth, Piermartini and Yotov (2016) also recommend using the PPML estimator because it delivers theory-consistent

[8] Baier and Bergstrand (2007) showed that *ex post* estimation of the partial effects of free trade agreements suffered from endogeneity bias, mainly due to self-selection of country-pairs into agreements (as a result of pre-existing trade levels), and find that this self-selection bias may be substantially reduced when employing pair-specific fixed effects or using first-difference regressions with panel data.

[9] Anderson and van Wincoop (2003) emphasize that gravity model theory implies that bilateral trade flows depend not only on bilateral trade barriers between any two countries but also on trade barriers of each country with the rest of the trading partners (i.e., the multilateral resistance). Failing to control for multilateral resistances produces biased estimates and it is called the "gold medal mistake" by Baldwin and Taglioni (2007).

[10] Despite its wide use in the literature, the log-linear versions of the gravity equation using OLS present two drawbacks. First, it cannot take into account the information contained in zero trade flows since these observations are dropped from the sample with the logarithmic transformation. 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, in the presence of heteroscedasticity (due to Jensen's inequality) the estimates of the log-linear gravity equations with ordinary least squares are not only biased but also inconsistent.

estimates of general equilibrium effects.[11] Last but not least, Yotov (2012), Dai *et al.* (2014), Bergstrand *et al.* (2015) or Heid *et al.* (2021) demonstrate the importance of incorporating intra-national trade flows in structural gravity estimations for several reasons, including consistency with gravity theory.

Despite all the aforementioned advances, the empirical gravity equation has been often estimated with a-theoretical versions of the gravity equation and overlooking some of the critical estimation challenges, which may lead to biased and even inconsistent estimates.[12] In this paper, we take into account all the previously discussed developments in the empirical gravity literature, which currently constitute the "state of the art" in this area of research. In particular, we estimate several specifications of the gravity equation (1) in its multiplicative form (instead of the logarithmic form) with the PPML estimator using data on both international and intra-national trade flows:

$$X_{ij,t} = \exp(\beta_1(BothEMU_{ij,t} \times INTER_{ij}) + \beta_2(OneEMU_{ij,t} \times INTER_{ij}) + \beta_3(nonEMU\_CU_{ij,t} \times INTER_{ij}) + \beta_4(EU_{ij,t} \times INTER_{ij}) + \beta_5(nonEU\_RTA_{ij,t} \times INTER_{ij}) + \beta_6(EUtrend_{ij,t}) + \beta_6(EUtrendsq_{ij,t}) + \chi_{i,t} + \lambda_{j,t} + \eta_{ij}) \times \epsilon_{ij,t} \tag{1}$$

where the dependent variable is the nominal value of bilateral trade flows (in levels) from a country i (exporter) to a country j (importer) at time t. The two variables of central interest in gravity equation (1) are $BothEMU_{ijt} \times INTER_{ijt}$ and

[11] Moreover, it is worth noting that although the PPML estimator is a non-linear estimator, there exist recently developed estimation algorithms that allow fast convergence in the estimation of these models (see Larch *et al.*, 2019 and Correia *et al.*, 2019).

[12] See Yotov *et al.* (2016) or Piermartini and Yotov (2016) for a detailed discussion of the main challenges faced when estimating the gravity model. These authors also provide six recommendations to obtain reliable partial equilibrium estimates within a theoretically-consistent econometric specification, in line with the developments appeared in the literature over the last two decades. This paper follows all these recommendations and some other more recent one.

$OneEMU_{ijt} \times INTER_{ij}$. The first variable is the product of two terms: (i) the bilateral indicator variable $BothEMU_{ijt}$, which takes value one when countries i and j are both EMU members at time t, and zero otherwise; and (ii) a dummy variable, $INTER_{ij}$, which takes value one for international trade flows, and zero otherwise. That is, this interactive variable takes value one when the source and destination countries are different ($i \neq j$), and zero when they are the same country ($i = j$). Hence, $BothEMU_{ijt} \times INTER_{ij}$ takes value one for international trade flows between EMU members and zero otherwise. It is worth noting that the reference group includes intra-national trade flows, which allows capturing potential EMU trade creation effects that arise from the replacement of domestic sales with trade with other EMU member countries. The second variable of interest to capture the EMU effect is an interaction term between $OneEMU_{ijt}$ and the already defined variable $INTER_{ij}$. $OneEMU_{ijt}$ is a binary dummy variable that takes value one if either the importer or the exporter (but not both at once) are EMU members at time t.[13]

The other variables in equation (1) are the same covariates used in the most complete specification in Esteve-Pérez *et al.* (2020a). The variables $nonEMU\_CU_{ijt} \times INTER_{ijt}$, $EU_{ijt} \times INTER_{ijt}$ and $nonEU\_RTA_{ijt} \times INTER_{ijt}$ are three variables that include an interaction with $INTER_{ij}$ to control for membership of both countries of the pair in currency unions other than the EMU ($nonEMU\_CU_{ijt}$), the European Union (EU_{ijt}) and regional trade agreements other than the EU ($nonEU\_RTA_{tij}$), respectively. $EUtrend_{ijt}$ ($EUtrendsq_{ijt}$) is an EU-specific linear (quadratic) trend to account for long-term trends in European Union integration. The equation also includes a set of exporter-time fixed effects ($\chi_{i,t}$), importer-time

[13] Note that the estimate on $OneEMU_{ijt} \times INTER_{ij}$ cannot be identified relying on data that only include international trade flows due to perfect collinearity with the set of exporter-time and importer-time fixed effects.

fixed effects ($\lambda_{j,t}$), and country-pair fixed effects (η_{ij}).[14] Finally, $\epsilon_{ij,t}$ is the error term.

2.1 General equilibrium analysis

The structural gravity framework paves the way for carrying out a general equilibrium analysis that allows evaluating the trade and welfare effects of EMU. We rely on the procedure recently developed by Anderson *et al.* (2018) to perform general equilibrium comparative static analysis of gravity models with the Poisson pseudo-maximum-likelihood (PPML) estimator (henceforth GEPPML). The GEPPML uses a theoretical property that only holds for PPML and allows us to calculate theory-consistent general equilibrium effects of trade policy. Fally (2015) demonstrates that the exporter and importer fixed effects, estimated with PPML, are precisely equal to the multilateral resistances that satisfy the trade's structural gravity equation system.

The GEPPML is a procedure that consists of 3 steps with 2 stages in each one of them.[15] The first step delivers the "baseline" estimates and the "Baseline" GE indexes. This step starts with the estimation of the "baseline" gravity equation using the PPML estimator with exporter and importer fixed effects. However, as Anderson *et al.* (2018) note, the procedure can be implemented with estimates of the trade cost elasticities obtained with any other estimator of choice.[16] The second

[14] It is worth noting that, in addition to accounting for the unobservable (outward and inward) theoretical multilateral resistances, the exporter-time and the importer-time fixed effects also absorb (control for) the exporter and importer size variables in the structural gravity model, as well as all other observable or unobservable exporter-specific and importer-specific time-varying characteristics that may influence trade. Moreover, the bilateral fixed effects control for the impact of any time-invariant determinant of trade, either observed (e.g. bilateral distance, contiguity, common language, etc.) or unobserved. Bilateral fixed effects also address endogeneity concerns of trade policy variables (Baier and Bergstrand, 2007).

[15] The detailed description of the 3-step procedure to obtain the general equilibrium effects of trade policy with the PPML estimator can be found in Anderson *et al.* (2018).

[16] To avoid perfect collinearity one exporter and one importer fixed effect or, alternatively, one fixed effect and the constant must be dropped. Following Anderson *et al.* (2018), we will drop one importer fixed effect and the constant, thus implying that all other fixed effects are identified relative

stage of the first step constructs the multilateral resistance indexes and any other baseline GE indexes of interest (e.g., predicted exports) relying on the estimates of the fixed effects from the "baseline" gravity equation and data on outputs and expenditures.

The second step of the GEPPML procedure delivers the "conditional" gravity estimates and "Conditional" GE indexes. In this step, the term "conditional" means that it allows for changes in inward and outward multilateral resistances in response to changes in trade costs but without taking into account output and expenditure changes. Again, the first stage of the second step estimates the "conditional" gravity equation by PPML, redefining the policy variable(s) of interest to reflect the desired trade policy change (i.e., the counterfactual scenario; for instance, the inexistence of EMU). The second stage constructs the "Conditional" GE indexes with the new fixed effects estimates from the "conditional" gravity and the original data on output and expenditure. Finally, the third step of the GEPPML procedure delivers (also in two stages) the "full endowment" gravity estimates and "Full endowment" GE indexes. The expression "full endowment" in this step means that, in addition to changes in inward and outward multilateral resistances, it also considers changes in output and expenditure.

A remarkable feature of the Anderson *et al.* (2018) procedure relates to its compatibility with standard software packages (e.g., STATA) that allows estimating a constrained Poisson model capable of handling loops. Specifically, in this paper, we examine the EMU's impact on trade and welfare considering three alternative scenarios.

The first counterfactual experiment (CFL 1, henceforth) assesses the trade-induced effects of the EMU on consumer prices, producer prices, and GDP. To that

to that of the dropped fixed effect. Additionally, solving the system of inward and outward multilateral resistance terms requires normalizing one of the multilateral resistance terms.

end, we follow Mayer *et al.* (2019), who suggest that trade-related GE effects of economic integration can be measured by counterfactually removing trade integration gains. Accordingly, CFL 1 poses an alternative multiverse where the only difference with our reference universe is the Euro's suppression. In this alternative scenario, the Euro was never adopted after the Maastricht Treaty in 1992, but the rest of observable and unobservable trade determinants, including borders and distance, remain unchanged. Then, we compute the EMU-enhanced gains from trade by comparing the predicted level of trade costs in CFL 1, that is, where EMU member countries face the same impediments as non-EMU members, with the baseline trade costs.

The first counterfactual is executed by removing the variables *BothEMU* and *OneEMU* and removing its parameters in the counterfactual regression. We first estimate a specification of model 1 that includes all the usual gravity terms for year 2016 to generate our baseline scenario. Since this is a cross-section regression, we control for country-pair heterogeneity with distance, contiguity, and, *INTER* that enter directly in the regression. Hence, the CLF1 scenario is obtained from the estimation of model (1) when *BothEMU* and *OneEMU* are set equal to zero and using information for year 2016. Thus, we get a prediction of a pair of fixed-effects where international borders' effect is the same in its level because the *INTER* (and the rest of the variables) is the same. These predicted fixed-effects are used to generate an alternative set of trade costs for the GE analysis.

This standard procedure, however, might not capture the Euro GE effects fully. The cross-section nature of the GEPPML procedure only allows quantifying the level effects, but not the dynamics related to the change over time of the variables of interest. The proper identification of the effects of trade policy variables requires the use of panel data. We hedge this issue by recovering the coefficients associated to *BothEMU* and *OneEMU* variables from the estimation of the structural gravity equation (1) on the full dataset. Thus, we take advantage of the panel dimension of the data. We use the estimations of gravity equation (1) following all best-practices recommendations to identify the estimated coefficients of EMU and other trade policy variables. The baseline trade costs are then generated with these coefficients instead of the cross-section regression ones. By doing so, we capture both the level and the time variation of the Euro effect on trade.

The second (CFL 2, hereafter) counterfactual poses a policy-relevant experiment, imagining a multiverse where only Germany, Austria, Belgium, Luxemburg, Finland, France and the Netherlands joined the Euro. This is operated by splitting *BothEMU* and *OneEMU* into two sets of variables: EMU's core (the countries that joined in this alternative world) and EMU's periphery (the rest). The counterfactual trade costs are computed by only dropping out the periphery EMU indicators. By doing so, we can quantify the effect of Europe's periphery concerning the core.

In the last scenario (CFL 3, henceforth), we attempt to assess the relative importance of trade creation effects outside the EMU. Initial studies on the effect of the EMU suggested that the Euro would have had a larger impact on trade creation outside the EMU (Lane, 2006). Other authors suggest that core countries, particularly Germany, transfer their economic preferences to the rest of the members (Steinberg and Vermeiren, 2016).

Testing this hypothesis is now relatively straightforward; we need to modify slightly CFL 1 by only removing *OneEMU* in CFL 3. In this case, the variable *BothEMU* appears both in the baseline and counterfactual trade costs.

3. Data

This paper uses a new dataset that carries out an update until 2016 of the balanced panel dataset assembled and provided by Thomas Zylkin for the period

1986-2006. The data include consistently constructed international and intra-national trade flows data on aggregate manufacturing trade for 69 countries over the period 1986-2006.[17] Data on bilateral trade flows over the period 2006-2016 was gathered from the Direction of Trade (DoT) dataset of the IMF. The data were adjusted to match the manufacturing data for 2006 and updated accordingly throughout the rest of the period.

Following the standard procedure in the original dataset, domestic sales have been worked out as the difference between total production and total exports (apparent consumption) of manufacturing products. It is worth noting that in order to ensure consistency between international trade flows and intra-national trade flows, *gross* production values are used to build up intra-national trade flows.[18]

Figure 1 displays the evolution of the share of international trade (both with EMU and non-EMU member countries) an intra-national trade flows of EMU member countries. The smooth trend after 2006 invites us to be rather confident with our data. In addition, for validity and robustness, we also used the trade manufacturing data from International Trade and Production Database for Estimation (ITPD-E) (Borchert *et al.*, 2020). We did not observe significant differences either in the data or in the estimation results when limited to the same period and countries used in this paper. We prefer the combined Zylking+DoT dataset since the

[17] The sample comprises the following countries: Argentina, Australia, Austria, Belgium-Luxembourg, Bolivia, Brazil, Bulgaria, Cameroon, Canada, Chile, China, Colombia, Costa Rica, Cyprus, Denmark, Ecuador, Egypt, Finland, France, Germany, Greece, Hong Kong (China), Hungary, Iceland, India, Indonesia, Iran, Ireland, Israel, Italy, Japan, Jordan, Kenya, Kuwait, Macao (China), Malaysia, Malta, Mauritius, Malawi, Mexico, Morocco, Myanmar, the Netherlands, Nepal, Niger, Nigeria, Norway, Panama, the Philippines, Poland, Portugal, Qatar, Romania, Senegal, Singapore, South Africa, the Republic of Korea, Spain, Sri Lanka, Sweden, Switzerland, Tanzania, Thailand, Trinidad and Tobago, Tunisia, Turkey, Uruguay, the United Kingdom, and the United States.

[18] In the cases where domestic trade difference between total production and total exports was negative (due to accounting in transshipment, we used linear interpolation to complete the data. See Baier *et al.* (2019) for a detailed explanation of the construction of the data.

ITPD-E the time-period for manufacturing trade data is 2000-2014, thus precluding the examination of the effect of the euro for the early joiners.

The solid line in Figure 1 shows that the share of EMU members' aggregate domestic trade decreased throughout the period. The trade share (in this case, imports) with EMU and non-EMU members increased. Interestingly this figure depicts a relative increase of international trade relative to domestic trade in EMU countries.

[FIGURE 1 ABOUT HERE]

In addition to the main variables of interest that aim at capturing trade effects of the Euro, we include dummy variables for other (non-EMU) currency unions and regional trade agreements (UE and non-EU regional trade agreements). Data on currency unions are drawn from Andrew Rose's web page who constructed the currency union series from the IMF's *Schedule of Par Values* and the IMF's *Annual Report on Exchange Rates Arrangements and Exchange Restrictions*, supplemented with information from the *Statesman's Yearbook* available until 2016. Following Glick and Rose (2016), we use a transitive definition of a currency union. If dyads *x-y*, and *x-z* are in currency unions, then *y-z* is a currency union. We use Mario Larch's Regional Trade Agreements Database from Egger and Larch (2008) for regional trade agreements.

4. Empirical results

4.1 Partial equilibrium regressions

We begin by estimating gravity equation (1) using annual data pooled over consecutive years. The results are presented in column 1 of Table 1. We obtain a large positive and highly statistically significant estimate of joining the EMU's partial trade effect. In particular, the point estimate for the variable that captures the effect when both countries in the pair are EMU members is 0.207. This suggests that countries joining the EMU have increased trade among themselves in a 23 percent [(exp(0.207)-1)*100] at the expense of domestic sales.[19] Moreover, we find that EMU membership also leads to greater openness towards non-EMU trading partners. In this case, the estimated coefficient is even larger (0.408), which is in line with the results in previous studies that also use intra-national trade flows.

[TABLE 1 AROUND HERE]

Our choice of using data for consecutive years relies on Egger *et al.* (2020). To make our results comparable to those in previous studies, we re-estimate the specification in column (1) using time-interval data of bilateral trade flows and trade policy variables as a robustness check.[20] The use of data at n-year intervals allows addressing the concern raised by Trefler (2004) and Cheng and Wall (2004) regarding the time required for the dependent and independent variables to adjust to trade policy fluctuations. Similar to Olivero and Yotov (2012), we experiment with alternative time intervals. We consider intervals of two, three, and five years since they allow us to include both the first and the last year of the sample, thus covering the full sample period. The results are reported in columns (2)-(4). Rather interestingly, in all cases the results concerning the estimates of the variables of interest are similar to those reported in column (1). Moreover, the results for the other explanatory variables are broadly consistent with those found with the estimations performed with all available data, that is, data pooled over consecutive years. Therefore, the trade-enhancing effect of the euro is robust to the use of time-interval data. Finally, it is also worth noting that, compared with the effect of

[19] This impact more than doubles that reported by Esteve-Pérez *et al.* (2020a) for the period 1986-2006.

[20] For instance, Cheng and Wall (2005), Baier and Bergstrand (2007), Vicard (2009), Eicher and Henn (2011), Kohl (2014), Limão (2016) and Esteve-Pérez *et al.* (2020b) use data at five-year intervals, whereas Dai *et al.* (2014), Bergstrand *et al.* (2015), Anderson and Yotov (2016), and Gil-Pareja *et al.* (2014 and 2016) use intervals of four years. Alternatively, Trefler (2004) uses three-year intervals. Moreover, Olivero and Yotov (2012) experiment with alternative intervals, and Larch *et al.* (2018) and Esteve-Pérez *et al.* (2020a) perform robustness checks with data at two-year intervals.

EMU found by Esteve-Pérez *et al.* (2020a) for the period 1986-2006, the EMU effect has nearly doubled with the extension of the sample period until 2016. We deepen on this issue next.

The last column of Table 1 presents the results with data pooled over consecutive years but splitting the sample period into two halves: 1999-2007 and 2008-2016. This division of the sample period confirms that the EMU has intensified its trade-enhancing effect over time.[21] In particular, the point estimate rises from 0.152 in the first subperiod to 0.390 in the second, when both countries participate in EMU, and from 0.300 to 0.528, when only one of the countries in the pair is an EMU member. It is important to bear in mind that the second subperiod includes the financial and debt crisis of the Euro. Hence, despite that jolt, we find evidence that the effect of EMU is larger during this subperiod than in the first one, both for trade between members and for trade with non-member countries (relative to internal trade).

Next, to conclude the partial equilibrium analysis, we discuss the results by EMU members to account for the possibility of heterogeneous effects of the euro across member countries. To that end, we follow the strategy initially used by Micco *et al.* (2003) to estimate a separate gravity equation for each EMU country. To illustrate the procedure, let us consider the case of Austria. In this country's regression, we split the EMU dummy (*BothEMU*) into two dummy variables. The first one, *BothEMU(Austria)*, is a dummy that takes the value of one for trade between Austria and the rest of EMU members for the years that both trading partners belong to the EMU (and zero otherwise). The second dummy,

[21] We have also estimated the gravity equation both for each year of the EMU period and splitting the sample period into three equal subperiods. The results are consistent with those reported in column (5) and commented in the text. Specifically, when we split the sample period into three subperiods of equal length, that is, 1999-2004, 2005-2010 and 2011-2016, the point estimates (standard errors in parentheses) for the variable *BothEMU* are 0.109 (0.040), 0.294 (0.044) and 0.445 (0.076), respectively, and for the variable *OneEMU* are 0.253 (0.024), 0.429 (0.032) and 0.558 (0.044), respectively.

BothEMU(-Austria), takes the value of one for all other pairs of EMU countries (i.e., excluding Austria) for the years that both partners belong to the EMU (and zero otherwise).

Similarly, we split the dummy *OneEMU* into two dummies. The first of these dummies that takes the value of one for pairs combining Austria and non-member countries (*OneEMU(Austria))* since 1999 (and zero otherwise). The second dummy takes the value unity for pairs between the rest of EMU countries and third nations (*OneEMU(-Austria))* from the year in which these euro members joined the EMU (and zero otherwise). The rest of the regression variables are identical to those in the gravity equation (1).

[TABLE 2 AROUND HERE]

For the sake of brevity, we only report the estimated coefficients for the two main parameters of interest for each country, that is, following with the example of Austria, for this country we only report the estimated coefficients of the variables *BothEMU(Austria)* and *OneEMU(Austria)*. Column 1 of Table 2 offers the results using data pooled over consecutive years. The estimates indicate the existence of remarkable differences in the effect of EMU on trade across member countries in line with the findings in Esteve-Pérez *et al.* (2020a). However, compared to that study, the extension of the sample period with the inclusion of more recent years leads to an increase in the number of countries that show a positive impact of euro on trade. Specifically, while Esteve-Pérez *et al.* (2020a) find evidence of a positive and statistically significant effect for Austria, Belgium-Luxembourg, Ireland, Portugal and Spain, we further obtain such a trade-enhancing effect for France, Germany, and The Netherlands (three founder members of the European Union) when both trade partners are EMU members. Moreover, it is worth mentioning that the negative and statistically significant impact previously found for Greece over 1986-2006 vanishes with the extension of the sample period. Regarding trade with third countries, the effect is positive and statistically significant at least at the 5 per cent level in all cases except for Finland, Greece and Portugal. The remaining columns of Table 2 confirm the robustness of the results to the use of data at time intervals of two, three and five years.

4.1 General equilibrium experiments

This section relies on general equilibrium analysis to undertake three general equilibrium counterfactual experiments, which allows us to address three important questions. First, we provide an assessment of the overall welfare effect of the adoption of the Euro to its member countries. Second, we examine whether gains from trade differ across countries. Specifically, we analyse whether they are different for core and non-core EMU member countries. Third, we further measure the gains from trade of the euro that accrue to EMU member countries arising from trade creation effects with countries outside the Eurozone.

Before discussing the results, one practical comment is in order. As noted before, the multilateral resistance terms are normalised by setting the multilateral resistance term of a given country equal to one. Anderson *et al.* (2018) suggest two alternative strategies to choose the country used for the normalization procedure: (i) to choose the country with the most reliable data, and (ii) to choose a country that presumably will not be affected much by the counterfactual shock. In line with the first strategy, we set the inward multilateral resistance for USA to be equal to one. In line with the second, we check the robustness of the results choosing Australia as the reference country.[22]

Table 3 reports the results of the first counterfactual experiment CFL1 that estimates the GE effects of the Euro. The columns report the percentage difference between the baseline values (with Euro) and the counterfactual scenario (without Euro) for each country in the sample.

[22] Not reported for brevity, but available from the authors upon request

[TABLE 3 AROUND HERE]

Column 1 of Table 3 highlights that, under the conditional GE scenario, all countries in the sample experience a drop in exports in this alternative world. Further, the EMU member countries experience the largest fall in exports, ranging from -21% to -11% of their respective total exports. These results suggest that the introduction of the EMU generated a significant trade creation effect in non-EMU members.

The conditional GE scenario patterns still hold in the "full endowment" GE effects of the EMU on exports reported in column 2, with some differences. The "full endowment" GE effects are slightly larger (in absolute value), suggesting that producers capture some of the EMU trade-induced gains via higher prices. The results of the change in real GDP reported in column 3 suggest sizeable welfare effects of the EMU. The welfare effects on the real GDP in EMU countries range from 2% in Germany to 6% in Cyprus. In line with the theoretical predictions, smaller countries benefit relatively more from economic integration than larger countries. Further, all other countries in this world would have shaved their GDP by less than a percentage point.

Our results are several orders of magnitude higher than Felbermayr and Steininger's (2019) results, who report a decrease of 0.6% in Germany's real GDP. Interestingly, our results are closer to theirs when we omit the variable $OneEMU$ from the baseline and counterfactual analysis. In such case, Germany's GDP drops off by approximately 1 percent. Using the cross-section estimate of the EMU's effect slightly reduces the fall in GDP. Therefore, our results highlight the relevance of taking into account both the dynamics and trade creation/deviation effects, which we will discuss thoroughly when we carry out our third counterfactual analysis (i.e., CFL3).

Columns 4-6 allow us to quantity the distributional effects of EMU, distinguishing between consumers and producers. As expected, without the Euro, the countries would face higher inward multilateral resistances (IMRs in column (4)), which translate into higher prices for consumers. Countries would also face higher outward multilateral resistances (OMRs in column (5)), which would translate into lower factory-gate prices for producers (relative to the consumers' effects in the USA, the reference country here). The combined effect of lower prices for producers and higher prices for consumers suggests that both agents would have significantly been worse off without the adoption of the Euro.

Figure 2 summarizes our findings graphically. It displays the average change for the world, EMU members and EU members (that do not share the euro) for the variables of interest. The top left (a) panel of Figure 2 depicts the scatter plot of the "full endowment" export growth of column 2 in Table 3. The square green points represent EMU member countries, the circle red points represent non-EMU countries, and within these two categories, the solid points represent EU members. It can be readily seen that all countries are below the 0 line, indicating that all countries would have reduced their exports without the EMU, particularly the global average export fall is of -8.37%.[23] Furthermore, all EMU countries are clustered in the bottom-left area of the figure, indicating the higher gains from the EMU accrue to its members. The fall of their exports (-18.06%) more than triples the ROW average fall (-5.23%). Remarkably, the non-EMU EU countries, represented by the solid red bubbles, also endure a significant reduction in their exports. In fact, the countries in this group are among the non-EMU countries with more expected export loss (-10.04%).

Figure 2 around here

[23] These averages are calculated as a geometric mean, as a more conservative measure of percent averages.

The pattern described in panel (a) of Figure 2 concerning exports is qualitatively similar for the rest of the variables of interest. The trade-induced GE gains due to the EMU differ across our country groups. From highest to lowest gains we get the following ranking: EMU members, non-EMU EU members, and the rest of the world. There are, however, some quantitative differences. The top right (b) panel displays changes in real GDP. The overall impact of the euro is sizeable as a world without the EMU would have involved a 1.02% lower world's GDP. As expected, the EMU members would have been hit the most as shown by the highest negative impact in our counterfactual (-4.15%). To reinforce the relevance of this result, let us use the following example. Considering that the Euro area's GDP growth was of 1.9% in 2016, the non-existence of EMU would have subtracted more than two years of full growth. Equivalently, the average yearly growth rate lost would have been of about 0.25%. The real GDP gain of trade creation to non-EMU EU members is -0.48%, which more than doubles the trade creation effect on the rest of the world, -0.21%.

The bottom panels of Figure 2 summarize the distributional effects for (c) consumers and (d) producers. According to our results, the initial claims of pro-inflationary effects of the adoption of the euro were overstated. Without the Euro, consumer prices in the EMU area would have been 2.09% higher, and 0.11% higher in the non-EMU, but EU member countries. Therefore, the Euro significantly reduced inflation for its members due to cheaper imports. The effect on consumer prices in the rest of the world is practically null, suggesting that their income increase comes from the supply side.

The change in producer prices shown at the bottom right part of Figure 2 (panel d) is unneglectable. Without the EMU-induced export growth, producers would had sold their products domestically at lower prices, -2.14% and this effect gets to -0.37% for non-EMU, but EU member countries. The level of the change in producer prices is similar to that in consumer prices, suggesting that consumers and producers gains from the EMU's economic integration were relatively similar.

The results of our second counterfactual (CFL 2) reported in Table 4 cast a shadow of doubt on the EMU integration process. Interestingly, only the core countries experience a fall in their GDP. To facilitate the interpretation, we turn to the summary of the results of CFL2 in Figure 3, where we can appreciate the clubbing effect of the EMU graphically. As seen in panel (a) of Figure 3, the export of peripheral EMU countries would have been hit the most by paying with Drachmas, Pesetas, and Liras. The rest of the non-EMU EU members would have also experienced a large drop in exports. However, the core EMU members would have increased their exports substantially, between 30% and 40%. The increase in EMU's GDP, 0.21%, reveals that the periphery's gain is higher and could ideally compensate the core's loss. Further, the increase in the real GDP of EU, but non-EMU countries is 0.48%. Therefore, with an appropriate compensation scheme, these results suggest that the *two-speed* Euro may be justified from a trade perspective.

[TABLE 4 AND FIGURE 3 AROUND HERE]

The bottom panels would shed some light on the political-economy mechanisms that would have prevented the creation of a *two-speed* Euro. On the one hand, as shown in panel (c) of Figure 3, consumers in all EMU members (except for Ireland) enjoy lower prices. On the other hand, while the periphery producers relish higher prices than those by the core's, the core manufacturers have experienced a significant fall in their factory gate prices. Trade diversion from non-EMU members might help to understand this situation; EU-non-EMU producers would have incentives to advocate for a two-speed Euro. However, the export-led growth at the core of this alternative universe is mainly consumer-driven. Therefore, both the lobbying power of the core producers (Germany, Austria, Belgium, Luxemburg, Finland, France, and the Netherlands) and the tax-payers' reluctance to transfer rents towards manufacturers would have prevented this alternative timeline of higher overall growth.

[TABLE 5 AND FIGURE 4 AROUND HERE]

As highlighted in the results reported in Table 5 regarding the EMU in our third counterfactual (CFL 3), the trade creation effects outside the EMU dominate the GE effects of the EMU. It is important bear in mind that we found an overall -18.36% lower level of exports for EMU members in the first counterfactual analysis. This percentage was explained by a loss in both within- and outside-EMU exports of EMU member countries. Panel (a) in Figure 4 reveals that most of the EMU-led export growth comes from trade creation outside the EMU of -14.06%. We find the same picture when focusing on GDP growth and consumer and producer prices. For example, the GDP loss related to EMU's trade creation is -3.34%, while the overall effect in CFL1 was -4.15%.

The results of this third experiment suggest that the growth effects of the EMU are mainly driven by macroeconomic and the common exchange rate stability and predictability rather than cohesiveness of the euro area as an optimum currency area in line with Lane's (2006) arguments.

5. Conclusions

This paper examined the Euro effect on trade with structural gravity and trade-induced welfare effects within the estimable general equilibrium framework of GEPPML. The paper aimed to provide policy-relevant insights on the Euro effect on trade and welfare.

The Structural gravity estimates using a new dataset, which extends Zylkin's dataset covering the period 1986-2016, revealed that Euro's effect on trade was more intense during the most recent decade, despite the trade collapse of 2009. The GE analysis uncovered several exciting traits regarding welfare analysis and the

EMU effect. On the methods front, the results suggested that trade creation/deviation and dynamics are essential for quantifying the trade-induced effects of economic integration on welfare.

Our results have some policy implications. Specifically, this study indicates that the Euro has been successful at promoting economic growth and delivering positive welfare effects on consumers and producers within and outside the Eurozone. The main policy message is that the Euro has been a successful experiment in exports and economic growth for consumers and producers within and outside the Euro area. A better design or phasing in the Euro like the two-speed Euro would have led to higher growth. The critical distributional effects, however, would have triggered political-economy forces to prevent this scenario.

Further, trade creation outside the EMU appears to be the primary driver of the GE Euro effects. However, the question whether the Euro is an effective glue for the EMU's economic integration policy merits further research.

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Table 1. EMU effect on trade -PPML using intra-national trade. Sample period 1986-2016

	(1) Consecutive years	(2) 2-year intervals	(3) 3-year intervals	(4) 5-year intervals	(5) Consecutive years
Both in EMU	0.207	0.206	0.195	0.238	
	(0.045)***	(0.045)***	(0.047)***	(0.047)***	
One in EMU	0.408	0.411	0.406	0.457	
	(0.032)***	(0.032)***	(0.034)***	(0.033)***	
Both in EMU 1999-07					0.152
					(0.038)***
Both in EMU 2008-16					0.390
					(0.063)***
One in EMU 1999-07					0.300
					(0.025)***
One in EMU 2008-16					0.528
					(0.041)***
All non-EMU CUs	0.168	0.172	0.231	0.045	0.155
	(0.108)	(0.107)	(0.094)**	(0.115)	(0.113)
EU	0.721	0.685	0.749	0.817	0.679
	(0.104)***	(0.103)***	(0.106)***	(0.102)***	(0.103)***
All non EU RTAs	0.451	0.442	0.450	0.473	0.447
	(0.069)***	(0.069)***	(0.072)***	(0.073)***	(0.069)***
EU trend	0.001	0.002	0.008	0.003	0.015
	(0.007)	(0.007)	(0.007)	(0.006)	(0.006)**
EU trend sq	0.000	0.000	0.000	0.000	0.000
	(0.000)**	(0.000)**	(0.000)	(0.000)**	(0.000)
No. of observations	147487	76042	52234	33198	147487

Notes:
Robust standard errors, clustered by dyad are in parentheses
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$
The regresand is the value of bilateral exports, measured by dyad-year. All regressions include country-pair fixed effects, and exporter- and importer-year fixed effects. Fixed effects are not reported for brevity.
The dataset includes a balanced (annual) panel data covering aggregate manufacturing sector of 69 countries over the period 1986-2016.

Table 2. EMU effect by country: main results. Sample period 1986-2016.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	consecutive years		2-year intervals		3-year intervals		5-year intervals	
	Both in EMU	One in EMU	Both in EMU	One in EMU	Both in EMU	One in EMU	Both in EMU	One in EMU
Auatria	0.187	0.481	0.192	0.486	0.216	0.494	0.288	0.596
	(0.051)***	(0.081)***	(0.052)***	(0.083)***	(0.051)***	(0.085)***	(0.051)***	(0.085)***
Belgium	0.358	0.603	0.356	0.609	0.264	0.501	0.292	0.581
	(0.055)***	(0.051)***	(0.055)***	(0.052)***	(0.059)***	(0.056)***	(0.059)***	(0.055)***
Finland	-0.081	-0.009	-0.087	-0.005	-0.085	-0.021	-0.026	0.017
	(0.055)	(0.083)	(0.058)	(0.083)	(0.062)	(0.082)	(0.060)	(0.082)
France	0.171	0.338	0.175	0.348	0.150	0.333	0.208	0.397
	(0.055)***	(0.050)***	(0.055)***	(0.051)***	(0.055)***	(0.056)***	(0.056)***	(0.046)***
Germany	0.198	0.443	0.193	0.443	0.195	0.448	0.231	0.493
	(0.052)***	(0.055)***	(0.052)***	(0.055)***	(0.055)***	(0.057)***	(0.053)***	(0.057)***
Greece	-0.123	0.075	-0.102	0.075	-0.132	0.135	-0.081	0.096
	(0.098)	(0.072)	(0.100)	(0.073)	(0.100)	(0.088)	(0.109)	(0.097)
Ireland	0.348	0.371	0.304	0.343	0.226	0.288	0.367	0.403
	(0.162)**	(0.171)**	(0.166)*	(0.171)**	(0.147)	(0.172)*	(0.147)**	(0.191)**
Italy	-0.017	0.172	-0.012	0.181	-0.004	0.184	0.029	0.212
	(0.054)	(0.056)***	(0.054)	(0.057)***	(0.055)	(0.057)***	(0.055)	(0.057)***
Nether-lands	0.375	0.668	0.367	0.662	0.467	0.776	0.413	0.751
	(0.049)***	(0.071)***	(0.049)***	(0.072)***	(0.051)***	(0.074)***	(0.051)***	(0.077)***
Portugal	0.245	0.116	0.256	0.152	0.210	0.111	0.354	0.264
	(0.100)**	(0.094)	(0.101)**	(0.088)*	(0.102)**	(0.092)	(0.105)***	(0.090)***
Spain	0.384	0.515	0.378	0.507	0.373	0.509	0.454	0.583
	(0.055)***	(0.065)***	(0.056)***	(0.065)***	(0.056)***	(0.067)***	(0.059)***	(0.068)***
Malta	0.296	0.444	0.180	0.402	0.222	0.328	0.301	0.426
	(0.342)	(0.208)**	(0.274)	(0.179)**	(0.345)	(0.212)	(0.313)	(0.191)**
Cyprus	1.121	0.521	1.265	0.597	0.950	0.446	1.331	0.581
	(0.150)***	(0.102)***	(0.165)***	(0.113)***	(0.162)***	(0.116)***	(0.203)***	(0.128)***
No. of observations	147,487		76,042		52,234		33,198	

Notes:

Robust standard errors, clustered by dyad are in parentheses

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

The estimates reported in each column are obtained from separate regressions (one for each row) for each EMU member country. The regresand in each regression is the value of bilateral exports, measured by dyad-year. The list of independent variables in each regression includes, in addition to two dummies to capture the euro effect for that particular country (Both in EMU and One in EMU), two dummies for the rest of countries' euro effect in each case, a dummy for the EU, a linear EU trend, a quadratic EMU trend, a dummy for other regional trade agreements, a dummy for other currency unions, and dummies for exporter- and importer-year fixed effects and country-pair fixed effects. For brevity and clarity of exposition we only report the EMU estimates for each country. The estimates of the coefficients on all other covariates are available upon request.

Table 3: Counterfactual CF1: No EURO

	Conditional GE	Full Endowment General Equilibrium				
country	% exports	%Δ exports	%Δ real GDP	%Δ IMRs	%Δ OMRs	%Δ price
CYP	-12.63	-14.90	-6.42	3.38	3.94	-3.26
MLT	-19.27	-20.20	-5.58	3.92	2.24	-1.88
AUT	-13.64	-14.98	-5.47	3.01	3.15	-2.62
PRT	-15.09	-16.33	-5.27	2.98	2.92	-2.44
GRC	-19.60	-20.61	-4.99	3.11	2.44	-2.04
FIN	-20.99	-21.83	-4.09	2.34	2.21	-1.85
NLD	-14.67	-15.70	-4.04	1.91	2.63	-2.20
FRA	-17.98	-18.80	-3.65	2.00	2.04	-1.72
ESP	-19.27	-20.01	-3.27	1.68	1.95	-1.64
IRL	-15.72	-16.99	-3.14	0.49	3.20	-2.67
BEL	-16.61	-17.45	-3.05	1.40	2.01	-1.69
ITA	-19.07	-19.81	-2.67	1.00	2.02	-1.70
DEU	-15.93	-16.78	-2.16	0.08	2.48	-2.08
TUN	-8.36	-8.81	-0.80	0.28	0.60	-0.52
CHE	-13.85	-14.52	-0.71	-0.05	0.90	-0.77
DNK	-10.90	-11.45	-0.68	0.12	0.66	-0.56
NER	-4.91	-5.30	-0.64	0.21	0.50	-0.43
ISL	-6.42	-6.80	-0.60	0.20	0.47	-0.40
BGR	-6.75	-7.14	-0.55	0.16	0.46	-0.39
HUN	-9.02	-9.48	-0.52	0.10	0.49	-0.42
POL	-11.08	-11.61	-0.51	0.07	0.52	-0.44
MAR	-7.65	-8.09	-0.49	0.01	0.57	-0.49
SEN	-5.98	-6.30	-0.49	0.20	0.34	-0.29
NOR	-8.01	-8.45	-0.48	0.05	0.50	-0.43
ROM	-7.45	-7.86	-0.46	0.10	0.42	-0.36
CMR	-5.17	-5.52	-0.45	0.10	0.41	-0.35
TZA	-4.53	-4.86	-0.45	0.12	0.39	-0.33
SWE	-8.65	-9.10	-0.38	0.06	0.38	-0.33
JOR	-5.82	-6.17	-0.36	0.10	0.31	-0.26
EGY	-6.62	-7.00	-0.32	0.07	0.30	-0.26
KEN	-5.04	-5.36	-0.30	0.06	0.28	-0.24
MUS	-4.72	-5.03	-0.29	0.05	0.28	-0.24
BOL	-3.17	-3.43	-0.28	0.06	0.26	-0.22
GBR	-12.88	-13.50	-0.25	0.16	0.10	-0.09
TUR	-7.86	-8.30	-0.25	0.03	0.26	-0.22
NPL	-2.49	-2.77	-0.24	-0.02	0.31	-0.27
PAN	-4.19	-4.45	-0.24	0.09	0.17	-0.14

NGA	-6.23	-6.60	-0.23	0.03	0.23	-0.20
ISR	-6.45	-6.84	-0.21	0.01	0.23	-0.20
LKA	-3.61	-3.90	-0.20	-0.02	0.26	-0.22
URY	-3.61	-3.88	-0.19	0.02	0.20	-0.17
ECU	-3.95	-4.22	-0.18	0.03	0.18	-0.16
CRI	-3.69	-3.95	-0.17	-0.00	0.21	-0.18
ZAF	-5.42	-5.78	-0.17	-0.02	0.23	-0.19
COL	-3.97	-4.24	-0.16	0.03	0.16	-0.14
TTO	-4.71	-5.03	-0.15	-0.03	0.22	-0.18
CHL	-4.37	-4.67	-0.15	-0.00	0.17	-0.15
QAT	-4.96	-5.32	-0.14	-0.11	0.29	-0.25
IRN	-5.58	-5.96	-0.14	-0.04	0.21	-0.18
KWT	-5.89	-6.28	-0.13	0.01	0.15	-0.13
MMR	-2.20	-2.45	-0.13	-0.08	0.25	-0.21
CAN	-3.03	-3.24	-0.12	0.02	0.11	-0.10
PHL	-2.90	-3.17	-0.10	-0.08	0.22	-0.19
MEX	-2.90	-3.12	-0.10	0.01	0.10	-0.09
BRA	-5.01	-5.37	-0.08	-0.04	0.15	-0.13
IDN	-3.16	-3.44	-0.08	-0.09	0.20	-0.17
MYS	-2.62	-2.88	-0.08	-0.09	0.20	-0.17
IND	-3.66	-3.98	-0.08	-0.10	0.21	-0.18
AUS	-3.80	-4.11	-0.07	-0.05	0.14	-0.12
THA	-3.02	-3.31	-0.06	-0.11	0.20	-0.17
KOR	-2.94	-3.25	-0.04	-0.16	0.23	-0.19
USA	-5.35	-5.77	-0.04	0.00	0.04	-0.04
JPN	-3.38	-3.71	-0.03	-0.15	0.21	-0.18
CHN	-3.56	-3.92	-0.02	-0.16	0.20	-0.17
SGP	-3.42	-3.77	-0.01	-0.04	0.07	-0.06
HKG	-2.89	-3.21	-0.01	-0.07	0.09	-0.08
MWI	-4.19	-7.91	0.61	-0.41	-0.23	0.20

Table 4: Counterfactual CF2: EURO only CORE

	Conditional GE	Full Endowment General Equilibrium				
country	% exports	%Δ exports	%Δ real GDP	%Δ IMRs	%Δ OMRs	%Δ price
NLD	34.22	30.46	-2.41	-2.99	6.60	-5.33
AUT	41.48	36.72	-2.30	-2.92	6.37	-5.15
BEL	31.82	28.82	-1.89	-3.31	6.34	-5.13
FRA	39.58	36.33	-1.61	-3.33	6.01	-4.88
DEU	36.35	33.50	-0.99	-4.12	6.26	-5.07
FIN	37.77	33.77	-0.94	-3.71	5.68	-4.62
HKG	-2.70	-2.88	0.02	0.10	-0.14	0.12
SGP	-3.36	-3.61	0.02	0.07	-0.11	0.09
CHN	-5.19	-5.52	0.02	0.22	-0.28	0.24
JPN	-4.84	-5.10	0.04	0.20	-0.28	0.24
KOR	-4.46	-4.62	0.05	0.20	-0.29	0.25
USA	-5.41	-5.86	0.05	0.00	-0.06	0.05
THA	-4.37	-4.52	0.08	0.14	-0.25	0.22
IND	-5.06	-5.25	0.10	0.12	-0.26	0.22
AUS	-4.63	-4.86	0.10	0.05	-0.18	0.15
MYS	-3.99	-4.06	0.10	0.10	-0.24	0.20
IDN	-4.49	-4.62	0.11	0.10	-0.24	0.20
BRA	-6.22	-6.57	0.11	0.04	-0.18	0.15
PHL	-4.33	-4.39	0.13	0.09	-0.25	0.22
MEX	-3.78	-3.94	0.13	-0.03	-0.11	0.10
CAN	-4.02	-4.17	0.15	-0.05	-0.12	0.10
MMR	-3.90	-3.83	0.15	0.09	-0.28	0.24
QAT	-7.48	-7.68	0.17	0.11	-0.32	0.28
IRN	-7.19	-7.51	0.17	0.02	-0.23	0.20
KWT	-6.76	-7.13	0.18	-0.05	-0.15	0.13
TTO	-6.60	-6.81	0.19	0.01	-0.23	0.20
CHL	-5.75	-5.96	0.19	-0.03	-0.18	0.16
CRI	-5.59	-5.68	0.21	-0.03	-0.21	0.18
COL	-5.34	-5.51	0.21	-0.07	-0.16	0.14
ZAF	-7.22	-7.48	0.22	-0.01	-0.24	0.21
ECU	-5.51	-5.65	0.23	-0.07	-0.19	0.16
LKA	-5.61	-5.63	0.23	0.00	-0.27	0.24
URY	-5.35	-5.44	0.24	-0.06	-0.21	0.18
NPL	-5.00	-4.81	0.27	0.02	-0.33	0.28
ISR	-8.46	-8.77	0.27	-0.07	-0.23	0.20
NGA	-8.05	-8.31	0.30	-0.10	-0.23	0.20
PAN	-5.60	-5.74	0.30	-0.17	-0.16	0.14

GBR	-11.56	-12.47	0.31	-0.30	-0.01	0.01
TUR	-10.16	-10.52	0.33	-0.10	-0.27	0.23
BOL	-5.62	-5.55	0.33	-0.11	-0.26	0.22
MUS	-6.99	-7.06	0.35	-0.11	-0.27	0.23
KEN	-7.44	-7.51	0.36	-0.12	-0.28	0.24
SWE	-11.28	-11.62	0.38	-0.13	-0.28	0.24
EGY	-9.22	-9.41	0.41	-0.15	-0.29	0.25
POL	-13.30	-13.79	0.43	-0.22	-0.25	0.21
NOR	-11.91	-11.99	0.45	-0.13	-0.37	0.32
JOR	-8.62	-8.71	0.45	-0.20	-0.29	0.25
DNK	-13.96	-14.25	0.50	-0.27	-0.27	0.23
TZA	-8.18	-8.02	0.52	-0.19	-0.38	0.32
ROM	-10.93	-11.03	0.52	-0.20	-0.36	0.31
CMR	-9.11	-8.96	0.53	-0.18	-0.40	0.34
HUN	-12.87	-12.97	0.57	-0.21	-0.42	0.36
MAR	-13.15	-12.98	0.57	-0.06	-0.60	0.52
SEN	-8.92	-8.92	0.60	-0.33	-0.32	0.27
CHE	-18.68	-18.89	0.60	-0.07	-0.62	0.53
ISL	-10.50	-10.35	0.65	-0.30	-0.40	0.34
BGR	-11.37	-11.27	0.66	-0.27	-0.45	0.39
NER	-9.99	-9.62	0.73	-0.31	-0.49	0.42
ITA	-20.58	-21.09	0.74	0.02	-0.88	0.76
ESP	-21.02	-21.37	0.95	-0.17	-0.90	0.78
TUN	-13.77	-13.54	0.96	-0.45	-0.58	0.50
IRL	-27.75	-27.51	1.18	0.40	-1.82	1.58
MWI	-8.79	-11.46	1.75	-0.78	-1.10	0.95
PRT	-24.05	-23.87	1.92	-0.76	-1.32	1.15
MLT	-23.44	-23.40	2.27	-1.38	-0.99	0.86
GRC	-26.19	-26.00	2.42	-1.24	-1.33	1.15
CYP	-31.46	-30.44	3.63	-1.51	-2.35	2.06

Table 5: Counterfactual CF3: No EURO ONE

	Conditional GE	Full Endowment General Equilibrium				
country	% exports	%Δ exports	%Δ real GDP	%Δ IMRs	%Δ OMRs	%Δ price
CYP	-11.58	-13.61	-5.41	2.72	3.42	-2.84
MLT	-15.56	-16.48	-4.54	2.98	2.01	-1.69
AUT	-9.00	-10.27	-4.26	2.15	2.64	-2.20
PRT	-11.47	-12.65	-4.20	2.21	2.49	-2.08
GRC	-16.95	-17.93	-4.17	2.43	2.19	-1.84
FIN	-18.40	-19.22	-3.45	1.83	2.00	-1.68
NLD	-8.58	-9.60	-3.09	1.27	2.21	-1.86
FRA	-11.99	-12.82	-2.83	1.36	1.79	-1.51
ESP	-14.93	-15.67	-2.62	1.20	1.72	-1.45
IRL	-13.69	-14.85	-2.59	0.31	2.74	-2.29
BEL	-9.84	-10.69	-2.32	0.88	1.74	-1.47
ITA	-14.99	-15.72	-2.15	0.69	1.75	-1.47
DEU	-11.88	-12.70	-1.72	-0.01	2.05	-1.72
TUN	-8.57	-9.06	-0.93	0.34	0.70	-0.60
CHE	-14.31	-14.98	-0.82	-0.05	1.03	-0.87
DNK	-11.30	-11.83	-0.77	0.18	0.70	-0.59
NER	-4.93	-5.38	-0.75	0.25	0.59	-0.50
ISL	-6.58	-6.99	-0.71	0.24	0.54	-0.46
BGR	-6.93	-7.35	-0.65	0.19	0.54	-0.46
HUN	-9.39	-9.85	-0.63	0.14	0.58	-0.49
POL	-11.55	-12.06	-0.59	0.12	0.55	-0.47
SEN	-6.19	-6.53	-0.58	0.25	0.39	-0.33
MAR	-7.82	-8.30	-0.58	0.00	0.67	-0.57
NOR	-8.26	-8.71	-0.56	0.07	0.57	-0.49
ROM	-7.72	-8.14	-0.54	0.13	0.48	-0.41
CMR	-5.28	-5.66	-0.53	0.13	0.48	-0.41
TZA	-4.61	-4.97	-0.53	0.14	0.45	-0.39
SWE	-9.02	-9.45	-0.45	0.08	0.44	-0.37
JOR	-6.04	-6.40	-0.43	0.13	0.36	-0.31
EGY	-6.90	-7.27	-0.39	0.09	0.35	-0.30
KEN	-5.23	-5.55	-0.35	0.07	0.33	-0.28
MUS	-4.89	-5.21	-0.34	0.06	0.32	-0.28
BOL	-3.23	-3.51	-0.33	0.08	0.30	-0.26
GBR	-13.75	-14.30	-0.29	0.21	0.09	-0.08
TUR	-8.26	-8.68	-0.29	0.04	0.30	-0.26
NPL	-2.51	-2.82	-0.28	-0.03	0.37	-0.31
PAN	-4.38	-4.64	-0.28	0.12	0.20	-0.17

NGA	-6.53	-6.88	-0.28	0.04	0.27	-0.23
ISR	-6.75	-7.13	-0.25	0.02	0.27	-0.23
LKA	-3.73	-4.03	-0.24	-0.03	0.31	-0.26
URY	-3.75	-4.02	-0.23	0.03	0.24	-0.20
ECU	-4.12	-4.39	-0.22	0.04	0.21	-0.18
CRI	-3.82	-4.08	-0.21	0.00	0.24	-0.20
ZAF	-5.67	-6.01	-0.20	-0.02	0.27	-0.23
COL	-4.15	-4.42	-0.20	0.04	0.19	-0.16
TTO	-4.90	-5.21	-0.18	-0.03	0.25	-0.22
CHL	-4.58	-4.87	-0.18	0.00	0.20	-0.17
QAT	-5.13	-5.49	-0.17	-0.13	0.35	-0.30
IRN	-5.85	-6.21	-0.16	-0.05	0.25	-0.21
KWT	-6.22	-6.59	-0.16	0.01	0.17	-0.15
MMR	-2.24	-2.52	-0.16	-0.10	0.30	-0.25
CAN	-3.17	-3.38	-0.14	0.03	0.13	-0.11
PHL	-3.00	-3.28	-0.12	-0.10	0.26	-0.22
MEX	-3.05	-3.26	-0.11	0.01	0.12	-0.10
BRA	-5.26	-5.60	-0.10	-0.05	0.18	-0.15
IDN	-3.28	-3.57	-0.10	-0.10	0.23	-0.20
MYS	-2.71	-2.97	-0.10	-0.11	0.24	-0.20
IND	-3.82	-4.14	-0.09	-0.12	0.25	-0.21
AUS	-3.99	-4.30	-0.09	-0.06	0.17	-0.15
THA	-3.13	-3.43	-0.07	-0.13	0.24	-0.21
KOR	-3.04	-3.35	-0.05	-0.19	0.27	-0.23
ZZZ	-5.69	-6.09	-0.04	0.00	0.05	-0.04
JPN	-3.51	-3.84	-0.03	-0.18	0.25	-0.21
CHN	-3.70	-4.03	-0.02	-0.19	0.24	-0.21
SGP	-3.65	-3.99	-0.02	-0.06	0.09	-0.07
HKG	-3.09	-3.41	-0.01	-0.08	0.11	-0.10
MWI	-4.19	-7.98	0.52	-0.38	-0.16	0.14

Figure 1: Share of aggregate domestic and international trade of EMU members.

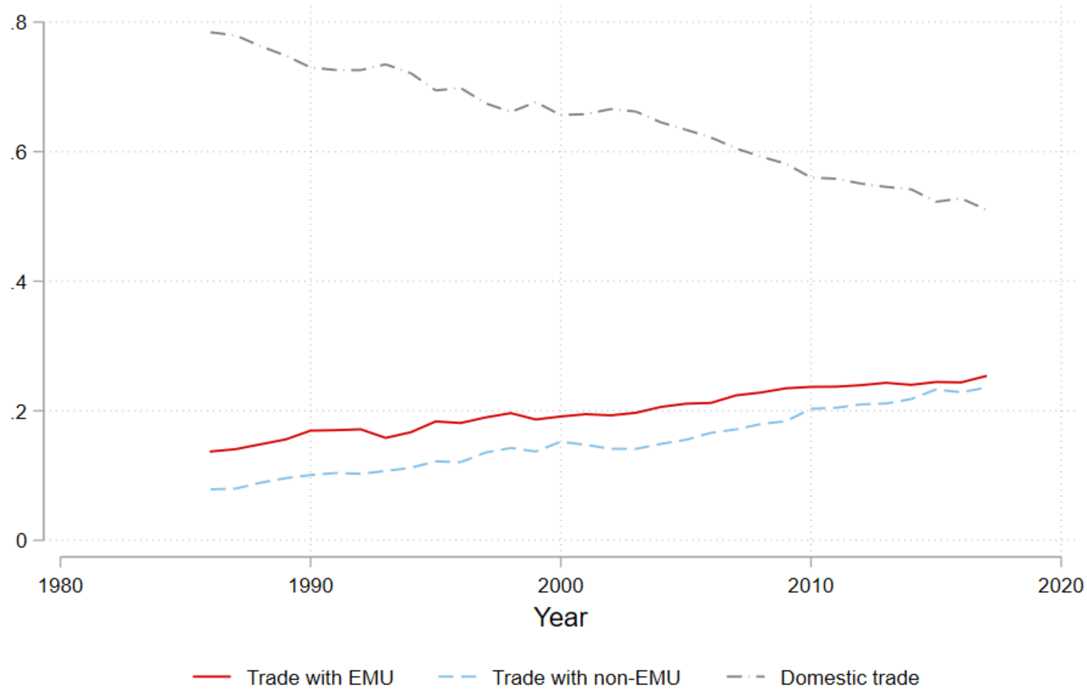

Figure 2: Counterfactual CF1: No EURO

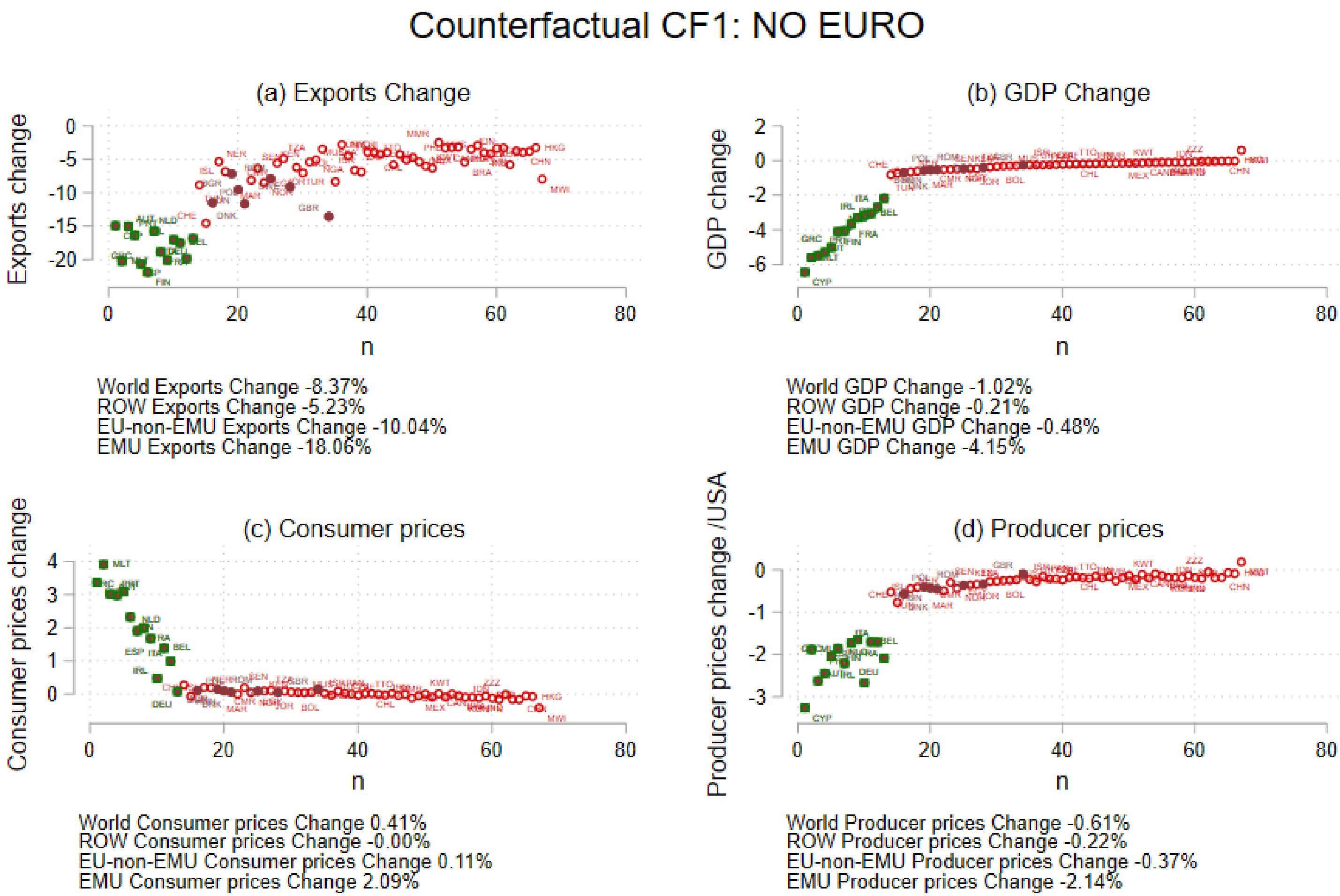

Figure 3: Counterfactual CF2 EURO only core

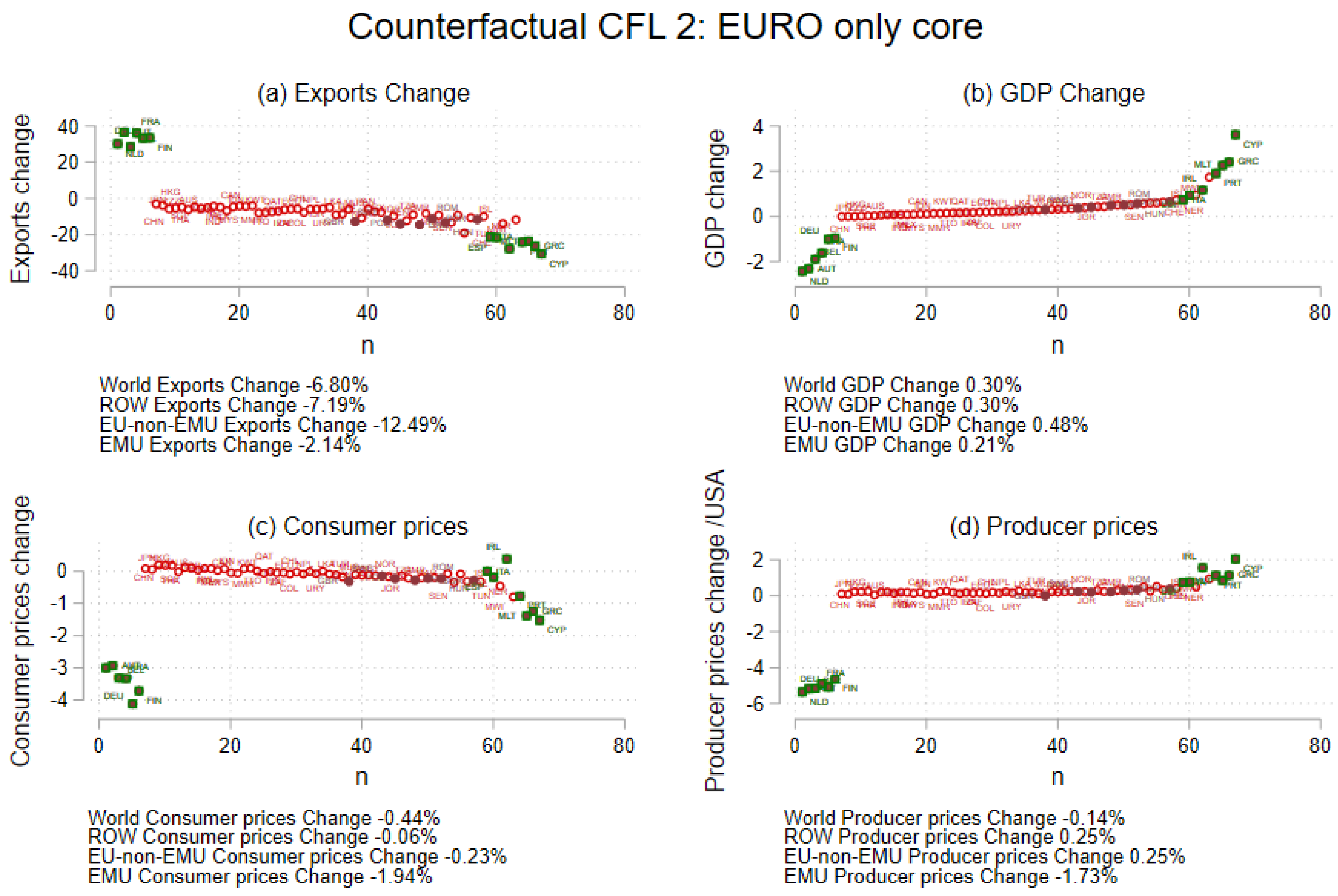

Figure 4: Counterfactual CF3:No EURO ONE