Macroeconomic Adjustment in the Euro Area

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Abstract

Macroeconomic adjustment in the euro area periphery was more recessionary than pre-crisis imbalances would have warranted. To make this claim, this paper uses a Propensity Score Matching Model to produce counterfactuals for the Eurozone crisis countries (Greece, Portugal, Ireland, Cyprus, Spain) based on over 200 past macroeconomic adjustment episodes between 1960-2010 worldwide. At its trough, between 2010 and 2015 per capita GDP had contracted on average 11 percentage points more in the Eurozone periphery than in the standard counterfactual scenario. These results are not dictated by any specific country experience, are robust to a battery of alternative counterfactual definitions, and stand confirmed when using a parametric dynamic panel regression model to account more thoroughly for the business cycle. Zooming in on the potential causes, the lack of an independent monetary policy, while having contributed to a deeper recession, does not fully explain the Eurozone's specificity, which is instead to be identified in a sharper-than-expected contraction in investment and fiscal austerity due to high funding costs. Reading through the overall findings, there are reasons to believe that an incomplete Eurozone institutional setup contributed to aggravate the crisis through higher uncertainty.

Keywords: macroeconomic adjustment, financial crisis, Eurozone, growth, propensity score matching

JEL Classifications: E63, E65, F31, F32, F33, F36, F45

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MACROECONOMIC ADJUSTMENT IN THE EURO AREA

Alessio Terzi

"*The incompleteness of the EMU has made the crisis more severe*"
Mario Draghi, ECB President – 7 September 2017

I. Introduction

The Eurozone (EZ) crisis meant for several countries sharp current and fiscal account corrections accompanied by double-digit unemployment figures and a prolonged recession. Most economists would agree that when among developed economies a country (Greece) loses in peace times over 20% of its GDP in less than a decade, or when over the same timespan the unemployment rate almost triples, as was the case in Spain, there had to be a clear macroeconomic policy failure. Where the consensus tends to splinter is on the nature of such failure, with opinions usually clustered around two prominent schools of thought. On the one hand, 10 years of monetary union, combined with short-sighted political practices, led to the creation of unprecedented macroeconomic imbalances. As such, the argument goes, sharp recessions of the kind observed in some Eurozone countries were unavoidable (Lane & Milesi-Ferretti, 2012; Wickens, 2016). On the other side are those arguing that, while surely imbalances were large, the crux lies in crisis management and that such a deep recession was due to an inappropriate crisis response (Baldwin et al., 2015; Delong & Summers, 2012; Krugman, 2015; Martin & Philippon, 2017) or more in general is to be imputed to an institutional setting that aggravates macroeconomic crises.

These two worldviews carry important implications on how to reform the Eurozone. If the first view were true, the problem with the euro was that it allowed large imbalances to develop and therefore all that is needed is to prevent this from happening again, either through market mechanisms (credible no-bail-out rules) or institutional discipline (macro monitoring and sanctions). According to the second view, deeper changes to the Euro Area institutional settings would be necessary, along the lines of greater risk sharing.

Motivated by these opposing views, this paper investigates the relationship between macroeconomic imbalances, adjustment, and GDP per capita growth over a 5-year horizon. To do so, a novel quantitative framework is adopted to identify relevant comparators to the Eurozone crisis. More specifically, a non-parametric Propensity Score Matching Model (PSM) is employed to produce counterfactuals for the Eurozone crisis countries (Greece, Portugal, Ireland, Cyprus, Spain) based on over 200 past macroeconomic adjustment episodes between 1960 and 2010 worldwide.

For each EZ crisis country, a counterfactual is built as a linear combination of past macroeconomic adjustment episodes (so-called “donors”) based on three basic requirements. Aside from displaying comparable pre-crisis characteristics such as investment growth, degree of trade openness, and GDP per capita, potential donors i) had on average similar pre-crisis imbalances such as high levels of public- and private- debt, and low growth, (ii) faced a negative growth shock, and, as a consequence, iii) experienced a comparable current account correction. This method is country-specific and as such provides the necessary leeway to adjust for the fact that the mix of imbalances at the origin of each EZ countries’ crisis was somewhat different (Lane, 2012; Shambaugh, 2012). At the same time, however, it allows inspecting for common trends across EA crisis countries.

This novel approach acts as a unified statistical framework aimed at identifying comparable adjustment episodes to the EZ crisis countries in a data-driven fashion. As such, it can be seen as a middle-ground between a quantitative cross-sectional analysis and a case study. Moreover, this method constitutes a hybrid between empirical studies focussed on understanding a particular factor that contributed to the EZ crisis (eg Jordà & Taylor, 2015), and large-scale DSGE modelling aimed at mapping an overall picture of the forces at play (Martin & Philippon, 2017). As the latter have recently come under heavy scrutiny (Blanchard, 2016; Korinek, 2015), this paper can act as a useful empirical complement to these approaches.

The main findings are as follows: at its trough, between 2010 and 2015 per capita GDP had contracted on average 11p.p. more in the Eurozone periphery than in the standard counterfactual scenario, and remains below counterfactual 5 years after the crisis began. Likewise, employment contracted on average 5p.p. more than pre-2010 imbalances and shocks can explain. In most specifications, 2012 and 2013 emerge as particularly negative years, especially as by that time the counterfactual usually had started progressively recovering.

To make the claim that this is a generalised EZ problem, the paper goes at length to show that the overly recessionary character of macroeconomic adjustment in the EZ is not dictated by any specific country experience. Most notably, estimates are clearly affected, but not dictated by the Greek crisis.

These results are robust to alternative definitions of the counterfactual. In particular, alternative specifications construct counterfactuals based on a donor pool of past sudden stop episodes, as classified by Eichengreen et al (2006), or of systemic banking crises, as classified in the Laeven and Valencia (2012) database. The main findings remain unaltered, and reinforce the evidence suggesting that GDP performance in EZ crisis countries tracked that of past comparable episodes of macroeconomic crisis and adjustment up to 2010, but diverged substantially in the period 2011-2013.

To attenuate the concerns that the effect identified in the baseline is methodology specific, two alternative estimation methods are considered. A non-parametric Synthetic Control Model, adapted from Marrazzo and Terzi (2017), reaches similar conclusions. As this method corrects for time-variant uniform shocks, it reduces the standing of claims that we are now living in different times, characterised by slow productivity and secular stagnation, and that historical comparisons might therefore be biased.

To dispel doubts relating to the fact that i) the PSM might not be correctly accounting for the rich dynamics of the GDP cycle, or ii) that there might be time-invariant unobservables that are dictating the results, a modified version of the parametric fixed effect dynamic panel regression model used by Acemouglu et al (2014) is employed as a robustness check. This model reinforces the idea that the pre-2007 boom cycle and the 2008/2009 crisis are not sufficient to explain the ensuing deep recession.

Having concluded that macroeconomic adjustment in the EZ was more recessionary than pre-crisis imbalances would have warranted, the paper explores within the same framework whether this was due to the lack of national monetary policy as a stabilisation tool (Krugman, 2012; Lane, 2012). Building on the Exchange Rate Arrangement Database (Ilzetzki, Reinhart, & Rogoff, 2017; Carmen M. Reinhart & Rogoff, 2001), the paper creates separate counterfactuals for the EZ crisis countries, distinguishing between comparable episodes of macroeconomic adjustment in a fixed- and flexible exchange rate.

As expected, in all specifications considered, adjustment was comparatively less recessionary when carried out under flexible exchange rates. However, the EZ performed worse also than its fixed exchange rate counterfactual – albeit the gap being smaller than in the baseline case. The PSM model suggests that the lack of independent monetary policy contributes to explain just over 25% of the EZ recessionary bias. Complementary factors contributing to a deeper recession are to be found in a sharper and more prolonged contraction of investment than the relevant fixed exchange counterfactual, and larger fiscal austerity due to higher funding costs. Reading through the overall findings, there are reasons to believe that an incomplete Eurozone institutional setup contributed to aggravate the crisis through higher uncertainty, something I will return to in the conclusions.

Literature

This paper relates to two broad strands in the literature. The first looks at the GDP impact of current account reversals (sometimes referred to as sudden-stop literature) as in Adalet and Eichengreen (2007), and more broadly at the origins and consequences of macroeconomic crises in a historical perspective (see for example Schularick & Taylor, 2012). The second analyses specifically the EZ crisis, as for instance Pisani-Ferry (2014).

In their seminal study, Milesi-Ferretti and Razin (1998) undertake the first comprehensive cross-country study of the origins and consequences of sharp current account corrections, and conclude that their impact on GDP growth can be highly heterogeneous depending on pre-crisis macroeconomic characteristics. A finding later confirmed by Edwards (2002) and Adalet and Eichengreen (2007). Edwards (2004) further argues that the negative effect of a current account correction on growth will be sharper when a country is under a fixed-, rather than flexible-, exchange rate regime. While these studies focussed mainly on low- and middle-income countries, Freund and Warnock (2007) show how current account reversals were associated with a slowdown in growth in advanced economies between 1980 and 2003. This finding was confirmed by Lane and Milesi-Ferretti (2012) when looking specifically at the Global Financial Crisis (GFC) and its aftermath.

More broadly, several papers have been using a historical perspective to compare current macroeconomic crises to past episodes that are deemed similar in nature (Almunia, Bénétrix, Eichengreen, O'Rourke, & Rua, 2010; Cecchetti, Kohler, & Upper, 2009; C M Reinhart & Rogoff, 2014; Carmen M. Reinhart & Rogoff, 2011) or looking for broader determinants and consequences of macroeconomic crises (see for example Eichengreen et al., 2006; Gupta, Mishra, & Sahay, 2007; Carmen M Reinhart & Reinhart, 2010). Some have more specifically compared the Eurozone crisis to past crises. Cavallo et al (2014) calibrated a model based on the Latin American crises of the 1990s, to adapt it to the Eurozone experience. Latin America is taken as an analytical benchmark for the Eurozone also by Eichengreen et al (2014). These approaches complement, rather than clash with, the country-focussed studies that build on the idea that each country and crisis situation has its own peculiarities. In the end, as stressed by Gourinchas and Obstfeld (2012, p. 229): "*crises in emerging and advanced economies have their origins in very similar underlying factors*".

Several authors have focussed their attention on the Eurozone crisis specifically. Early contributions tended to be more conceptual (Lane, 2012; Shambaugh, 2012) or descriptive (Baldwin et al., 2015; Kang & Shambaugh, 2013). Moreover, some papers took a country-specific approach: on Portugal (Reis, 2015), Greece (P. Gourinchas, Philippon, & Vayanos, 2016; Carmen M. Reinhart & Trebesch, 2015), Ireland (Lane, 2011), Cyprus (Orphanides, 2014), and Spain (Jimeno & Santos, 2014). As sufficiently long data series have started to become available, recent contributions have been more empirical, largely building on DSGE modelling (P. Gourinchas et al., 2016; Martin & Philippon, 2017).

The remainder of the paper is organised as follows: Section II illustrates the methodology and data, Section III discusses the baseline results, while Section IV presents alternative specifications based on standard crisis classifications. Section V introduces two alternative estimation strategies to show that the results are not methodology-specific, while Section VI discusses some of the factors underlying the Eurozone's recessionary bias. Section VII provides some concluding remarks.

II. Methodology and data

As discussed in Section I, it is common practice in the literature to benchmark a specific crisis episode with respect to past crises of a similar nature. For example, Gourinchas et al (2016, p. 3) perform a macro-benchmarking exercise to conclude that "*Greece's drop in output was significantly more severe and protracted than during the average crisis*". The intuition behind this paper is to go beyond comparisons to the mean, but rather optimise the selection of relevant comparisons based on a set of prominent features of the Eurozone crisis. As remarked by Reinhart and Reinhart (2010), "*The events of the past three years are not without precedent. However, those precedents are spread across countries and over time*". To choose the appropriate comparators, the paper adapts a standard Propensity Score Matching Model, as introduced by Rosenbaum and Rubin (1983), to a macro-setting. It therefore falls into the recent stream of work that extends the use of non-parametric microeconometric matching techniques to answer macroeconomic questions (Abadie, Diamond, & Hainmueller, 2010; Billmeier & Nannicini, 2013; Jordà & Taylor, 2015).

in line with the recent empirical literature on the topic (see for example P. Gourinchas et al., 2016), 2010 will be considered as the beginning of the EZ crisis[1], and matching will therefore be performed before this date. Moreover, I will focus on the five countries that had to resort to an IMF/EU macroeconomic adjustment programme (Greece, Ireland, Portugal, Spain, and Cyprus), and therefore experienced first-hand the EZ crisis management, starting from a situation of large imbalances[2].

The identification strategy is then organised in two steps. As a first step, we want to identify the potential donors, or else macroeconomic adjustment episodes that could potentially serve as a comparator to the EZ crisis countries. To do this, a parsimonious rule-based method is adopted, based on the history of the EZ experience. More specifically, we will identify a potential donor episode starting at t as respecting the following conditions:

[1] This is just a working assumption, which is however corroborated in Section IV where different start dates are used, and once again 2010 is confirmed to be the beginning of a Eurozone specific negative trajectory.

[2] While it is true that Spain had only a partial IMF programme, aimed at its banking sector, the country did experience a pronounced macroeconomic adjustment in the aftermath of a credit boom-and-bust cycle. Its inclusions seems therefore relevant. However, I will show that results do not depend on the inclusion of any specific EZ crisis country.

1. An adjustment episode is preceded by a negative growth shock at t-1, to mimic the 2009 recession in the EZ;
2. following that, only countries that saw an improvement in their current account can be considered[3];
3. the run up to macroeconomic adjustment was not characterised by hyperinflation, as this does not square with the EZ experience and as such does not provide a reasonable comparison.

In practice, condition (1) requires GDP per capita (from here onwards "GDPpc") growth to be -1% or lower at t-1. Formally,

$$\frac{GDPpc_{t-1} - GDPpc_{t-2}}{GDPpc_{t-2}} < -1\% \qquad \text{[C1]}$$

Condition (2) will be implemented by imposing that the change in the current account (CA) balance during [t-2 , t+3] is positive[4],

$$CA_{t+3} - CA_{t-2} > 0 \qquad \text{[C2]}$$

Finally, condition (3) requires that only episodes where inflation ($infl$) at t-2 was less than 30% be selected[5].

$$infl_{t-2} < 30\% \qquad \text{[C3]}$$

Tweaks around the definition of both (1) and (2) are tested in alternative specifications, as discussed in Section III and displayed in Appendix 4. Furthermore, I exclude extremely small countries (whose population is under 1 million) due to the high volatility of their GDP series. I also exclude other Eurozone countries, as we are precisely aiming at identifying the difference between macroeconomic adjustment within the euro and elsewhere.

In the second step, I match potential donors, so episodes respecting the conditions above, to the five EZ crisis countries based on a set of macroeconomic covariates. These include the size of the current account correction, together with the degree of trade openness, average pre-crisis GDPpc

[3] This assumption helps to avoid the risk of interpolation bias, or else the idea that the PSM might end up selecting a country whose current account is deteriorating, together with one where it is improving, and the average might reproduce a EZ country. As such, it makes less likely the selection of extreme cases among the donors.
[4] The selection of this interval is dictated by the fact that for the EZ crisis countries, on average, it is the longest and largest period of monotonic current account correction.
[5] This can be considered a conservative estimate when compared to the literature, which usually defines hyperinflation as >40% (Giuliano, Mishra, & Spilimbergo, 2013) or >50% (Abiad & Mody, 2005).

growth, average pre-crisis investment growth, pre-crisis (log) GDPpc, together with pre-crisis levels of public debt- and credit-to-GDP (see details and data sources in Appendix 1).

As the matching takes place at the country-level, the PSM is country-specific and as such provides the necessary leeway to adjust for the fact that the mix of imbalances at the origin of each EZ countries' crisis was somewhat different (Lane, 2012; Shambaugh, 2012). This two-step identification strategy will therefore generate counterfactuals for each of the five EZ crisis countries. Going beyond the specific country experiences, most of the paper will however be devoted to inspecting for common trends across EA crisis countries. The outcome variable of interest is yearly GDP per capita growth (constant prices). Following the notation of Caliendo and Kopenig (2005), the Average Treatment on Treated effect (ATT), or, in our setting, the average GDPpc growth bias associated with experiencing a current account correction inside the Eurozone vis-à-vis those experienced in other potential donors, can be formalised as follows:

$$\tau_{ATT,t}^{PSM} = E_{t,P(\boldsymbol{X})|EZ=1}\{E[GDP_t|EZ = 1, P(\boldsymbol{X})] - E[GDP_t|EZ = 0, P(\boldsymbol{X})]\} \quad [1]$$

where $P(\boldsymbol{X})$ is the Propensity Score, $\boldsymbol{X}$ is a vector of macroeconomic characteristics, and t is the time horizon over which we are interested in estimating the EZ crisis impact. Intuitively, the PSM estimator is simply the mean difference in GDPpc outcomes, weighted by the Propensity Score. To estimate the Propensity Score, a logit regression model is used while a nearest neighbour matching (with replacement) algorithm is employed to compute the PSM coefficients. In all estimation, the common support and overlap assumption was met, with standard levels of tolerance. The idea of having N-nearest neighbours (with N>1) is that while it is true that no crisis will be identical to another along multiple covariates, this is more likely to be the case for a linear combination of past crisis episodes[6].

The selection of the macro-covariates composing $\boldsymbol{X}$ is based on the literatures to which this paper relates. The sudden stop literature suggests that the GDP impact of a current account reversal is influenced by the degree of trade openness of an economy (Edwards, 2004) and whether the deficit cumulated in the run up to the crisis was used to finance consumption or investment (Adalet & Eichengreen, 2007). The Eurozone crisis literature instead discusses how the pre-crisis macroeconomic imbalances that developed in the EZ relate in varying degree to a loss of competitiveness (hence low growth), private-, and public- debt (Lane, 2012; Martin & Philippon, 2017; Shambaugh, 2012)[7].

[6] Alternative estimations will show that our results remain robust to different choices of N.

[7] Even though not identified as individually crucial by the sudden stop literature, there could be reasons to include inflation as a covariate, as a complement to Condition (3). Perhaps unsurprisingly, this hardly affects our donor selection and main results as discussed in Footnote 9.

Crucially, the matching is not performed on ex-post variables, in particular policy variables like interest rate changes, import restrictions, or fiscal policy adjustments, as these are endogenous to the GDP process. Within our setting, they are also related to crisis management and the euro institutional set up. I do however match on the size of the current account adjustment between t-2 and t+3. The reasoning behind it is that, in a way, changes in the current account are the broadest minimum common denominator metric that can be used to identify a macroeconomic adjustment episode, without however imposing requirement on policies adopted.

III. The EZ adjustment in perspective

This Section will show how the methodology outlined in Section II works in practice, in a simplified setting. A discussion of the full set of main results then follows.

A simple PSM application

Before illustrating the main results, it is worth taking a moment to explore how the methodology works in practice. To do so, I ran a simplified version of the PSM discussed in Section II, estimating the results using only one nearest neighbour, and for only one EZ crisis country: Cyprus. Intuitively, out of 330 past (or contemporaneous) episodes that respect [C1]-[C3], the PSM identifies the macroeconomic adjustment episode that mostly resembles the pre-2010 macroeconomic situation of Cyprus, and the current account correction that ensued. Iceland (t0=2010) is identified as the most sensible counterfactual. The quality of the fit can be seen in Table 1, along the seven covariate dimensions considered (Columns 1 and 2).

Table 1. MATCHING TABLE FOR CYPRUS BASED ON ONE (ISL) AND TWO (N2) NEAREST NEIGHBOUR COUNTERFACTUAL

covariates	CYP	ISL	N2
C/A adjustment	10.21	29.57	15.03
Public debt-to-GDP	61.30	90.60	111.25
Openness	112.95	84.67	52.36
Pre-crisis investment growth	0.15	-3.08	-1.71
Pre-crisis GDP growth	0.91	1.49	1.26
Log GDPpc	10.34	10.64	10.63
Credit to GDP	236.21	165.56	193.42

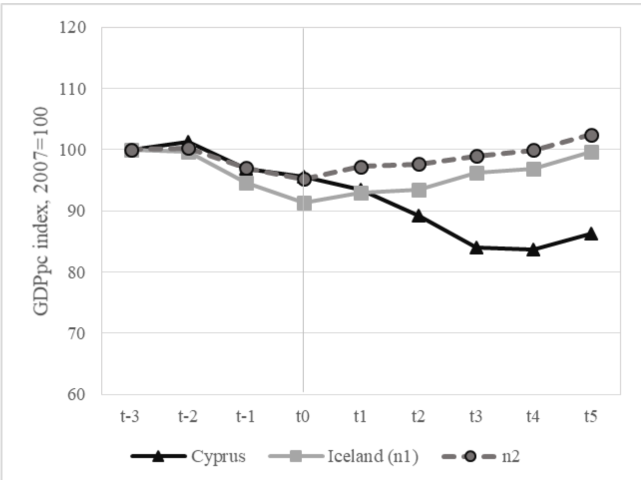
Note: Obs=330. Results based on propensity score matching estimator and logit treatment model, and 1 nearest neighbours (ISL) or 2 nearest neighbours (N2). Matching performed on average GDPpc growth during [t-5,t-1], debt to GDP at t-2,size of current account adjustment during [t-2,t+3], log GDPpc at t-2, average investment growth during [t-5,t-1], degree of openness to trade at t-2, and credit to GDP at t-2.

The quality of the covariate match is far from perfect. Iceland experienced a sharper current account correction than Cyprus, and had higher levels of debt-to GDP in 2007. It was however less open to trade, and had used its current account deficit to finance consumption rather than investment. Both countries experienced relatively low growth in the run up to the crisis, and both had a comparatively high level of credit-to-GDP, above 160, in 2007.

That there be divergences is inevitable as no single crisis episode will be identical to another across seven macroeconomic dimensions. In the baseline, I therefore use multiple donors (N>1). When setting N=2, the PSM selects the two best episodes that combined mostly resemble Cyprus' experience: Iceland 2010 and Japan during the Asian Crisis. Column 3 (Table 2) shows how increasing N to 2, rather than using one single donor, improves the covariate match along all dimensions (but public debt and trade openness), in some cases significantly, as for the current account adjustment or private debt, which is now much more comparable to that experienced by Cyprus.

Figure 1 shows how the GDPpc performance of Iceland and Cyprus differed. As the crisis hit in 2009, both countries went into recession. Iceland experienced a deeper GDPpc fall, but by 2011, it was back to growth. As Cyprus saw a protracted GDP contraction up to 2013, the gap between the two widened, stabilising from 2014 onward. *Prima facie*, it looks like being in a monetary union initially helped Cyprus buffer the shock of the crisis, but ended up amplifying and protracting the recession down the road. This finding is in line with the literature (Baldwin et al., 2015). Figure 1 also shows how the counterfactual based on N=2 tracks almost perfectly the evolution of Cyprus' GDPpc before 2010. Thereafter, the former had a V-shaped recovery, while the latter went into a prolonged recession. This pattern will be confirmed when deploying the PSM to cover all EZ crisis countries, something we now turn to.

Figure 1. PER CAPITA GDP FOR CYPRUS BASED ON ONE (ISL) AND TWO (N2) NEAREST NEIGHBOUR COUNTERFACTUAL, INDEX (2007=100)



Main results

In this Section, the main results based on the PSM estimator are illustrated. As argued by Stuart and Rubin (2008), before analysing matching results, when using a PSM the key diagnostic to check is covariate balance. Table 2 displays average covariate values for the EZ periphery and counterfactual. Columns (1)-(6) shows average values across the seven covariates for the six main specifications considered in this Section. P-values for a standard t-test comparing means is displayed in parentheses. In all instances, statistical testing fails to reject that the macroeconomic characteristics of the control differ from those of the EZ.

Table 2. SUMMARY STATISTICS FOR MATCHING PROCESS

			Counterfactual based on comparable past macroeconomic adjustment episodes					
Covariates	EZ	EZ excl GR	(1)	(2)	(3)	(4)	(5)	(6)
C/A adjustment	11.8	11.6	16.5	9.4	9.3	11.7	9.6	14.0
			[0.335]	[0.655]	[0.662]	[0.977]	[0.476]	[0.588]
Public debt-to-GDP	91.3	77.1	85.1	95.5	92.0	66.7	107.2	102.7
			[0.907]	[0.937]	[0.976]	[0.579]	[0.592]	[0.855]
Pre-crisis GDP growth	0.2	0.1	0.0	0.3	0.5	0.3	0.3	0.6
			[0.880]	[0.986]	[0.648]	[0.809]	[0.942]	[0.817]
Openness	91.9	100.1	69.5	77.4	68.2	92.1	91.1	72.5
			[0.373]	[0.587]	[0.519]	[0.889]	[0.988]	[0.442]
Pre-crisis investment growth	-1.0	-1.0	-0.8	-1.0	-0.4	-0.7	-1.0	-0.9
			[0.702]	[0.973]	[0.772]	[0.681]	[0.966]	[0.926]
Log GDPpc	10.3	10.4	9.9	10.5	10.3	10.3		10.0
			[0.430]	[0.747]	[0.960]	[0.933]		[0.572]
Credit to GDP	161.5			159.1				
				[0.951]				
Obs			272	334	293	267	161	272
p-value of χ^2			0.914	0.917	0.938	0.991	0.966	0.969

Note : Results based on propensity score matching estimator and logit treatment model. See Table 3 for details on the individual specifications. $\chi 2$ tests the joint significance of all regressors. p-values testing significant difference with the EZ in parentheses.

Aside from the t- and F- tests, a visual inspection of the average values across matching covariates suggests that for all specifications considered, the match is reasonably good. In this respect, Model (3), which is a specification excluding Greece, should be compared to the "EZ excl GR" column.

Table 3 displays the standard PSM estimated coefficients over the time interval [t-2, t+5], which for the EZ implies [2008, 2015]. I note that in all specifications, there are no significant differences in growth before 2010, complementing the information in Table 2 and suggesting a good crisis match[8]. This is particularly relevant for our purposes, as 2008 and 2009 were the GFC years. This therefore suggests that our counterfactual faced a similar shock as our EZ crisis countries before 2010. Model 1 is the baseline and contains all the macro-covariates discussed in Section II, with the

[8] This is not dependent on the inclusion of a co-variate controlling for 5-year average GDP growth. Excluding it leaves sign, size, and significance of all coefficients largely unaltered (results available upon request).

exception of credit-to-GDP[9]. As we can see, 2011-2013 is when the EZ crisis countries underperformed significantly vis-à-vis other comparable crisis episodes. By 2015, growth had picked up at a faster pace than in the counterfactual, suggesting a potential reverse to the mean effect. However, this positive effect is hardly consistent across specifications, so its relevance should not be overplayed.

Table 3. MATCHING MODEL COEFFICIENTS

	Counterfactual based on comparable past macroeconomic adjustment episodes					
EZ vs counterfactual at:	(1)	(2)	(3)	(4)	(5)	(6)
t-2	0.40	-0.61	-0.78	0.39	0.06	0.47
	(0.458)	(0.057)	(0.150)	(0.476)	(0.965)	(0.495)
t-1	0.50	0.43	0.42	0.55	0.18	0.08
	(0.328)	(0.384)	(0.219)	(0.287)	(0.765)	(0.873)
t=2010	0.39	-1.05	-1.04	0.50	0.51	-0.41
	(0.527)	(0.470)	(0.374)	(0.457)	(0.082)	(0.556)
t+1	**-2.55**	**-4.91**	**-4.92**	**-2.49**	**-3.34**	**-2.56**
	(0.000)	(0.006)	(0.002)	(0.000)	(0.000)	(0.000)
t+2	**-4.49**	**-5.27**	**-5.23**	**-4.48**	**-4.85**	**-4.45**
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
t+3	**-4.02**	**-3.13**	**-3.05**	**-4.03**	**-4.56**	**-4.89**
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.001)
t+4	-0.88	-0.47	-0.71	-0.88	-0.69	-1.11
	(0.131)	(0.136)	(0.118)	(0.133)	(0.629)	(0.149)
t+5	**1.23**	0.03	0.74	**1.25**	0.54	**1.60**
	(0.004)	(0.976)	(0.302)	(0.006)	(0.667)	(0.001)
Cumulative impact by t+4	-11.4	-13.1	-13.3	-11.4	-12.8	-12.4
Obs	272	334	292	267	161	272
N of matches	3	3	3	3	3	2
Include small countries	No	Yes	Yes	No	No	No
Exclude GR	No	No	No	Yes	No	No
Exclude LDC	No	No	No	No	Yes	No
Control for openness	Yes	Yes	Yes	Yes	Yes	Yes
Control for investment	Yes	Yes	Yes	Yes	Yes	Yes
Control for GDPpc	Yes	Yes	Yes	Yes	No	Yes
Control for credit	No	Yes	No	No	No	No

Note: Results based on propensity score matching estimator and logit treatment model, and N nearest neighbours. Matching performed on average GDPpc growth during [t-5,t-1], debt to GDP at t-2,size of current account adjustment during [t-2,t+3], log GDPpc at t-2, average investment growth during [t-5,t-1], and degree of openness to trade at t-2, unless otherwise specified. Cumulative impact by t+4 is the implied aggregate impact of coefficients between t+1 and t+4 in percentage points. p-values based on robust AI standard errors in parentheses. p<0.05 in bold.

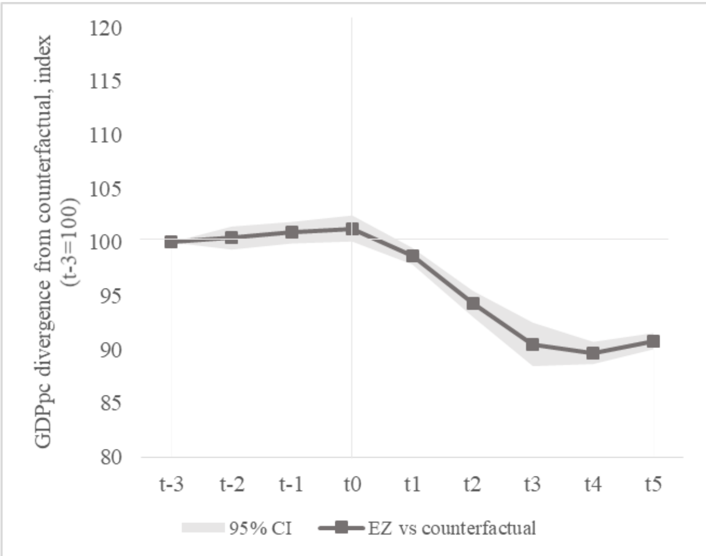
The implied cumulative Eurozone recessionary bias is roughly 11.5 p.p., and this estimate is broadly consistent across specifications. Figure 2 graphically illustrates the divergence between the EZ and its PSM counterfactual. Five years after the crisis began, EZ crisis countries were still below counterfactual.

Conversely from standard parametric estimations, the PSM guarantees maximum transparency in the construction of the counterfactual, as argued by (Nielsen, 2016), and discussed in Appendix 2. Crisis episodes identified by the PSM as jointly composing a good counterfactual for the

[9] In an alternative specification, inflation was also included as a covariate. The inflation difference between the EZ periphery and the counterfactual was 1.1% and highly insignificant (p=0.776). The estimated coefficients in Table 3 and their significance remain practically identical.

EZ crisis countries based on macro-covariates include: Denmark, Switzerland, Latvia, and the US in synchronous with the EZ crisis. These are combined with past episodes as the Finnish banking crisis of the 1990s, the twin crisis of 1993 in Nicaragua, the Swiss recession of the early 1990s due to the strong Franc, and the low oil price shock in the aftermath of the Asian crisis that forced macroeconomic adjustment in Libya and Saudi Arabia. Some of these crisis episodes, particularly the ones involving emerging markets, will surely make some eyebrows rise. In the words of Reinhart and Rogoff (2014, p. 54): *"Even after one of the most severe multi-year crises on record in the advanced economies, the received wisdom in policy circles clings to the notion that high-income countries are completely different from their emerging-market counterparts".* The reasoning behind the approach of this paper is indeed that, with due caution, useful information can be sifted out of past crisis episodes, especially those that took place in less-advanced economies. Once a battery of macroeconomic covariates have been optimised, differences between advanced and emerging markets crises over a business cycle should not be overplayed[10].

Figure 2. EUROZONE PERIPHERY PER CAPITA GDP DIVERGENCE FROM COUNTERFACTUAL, INDEX



Model 2 extends the baseline scenario by including credit-to-GDP among the covariates, in line with the conclusions of Gourinchas and Obstfeld (2012) that stress the importance of this variable in the run up to a financial crisis in general, and of Baldwin et al (2015) in the EZ crisis in particular. Model 2 is not the preferred specification because the large size of the financial sector in some of the EZ crisis countries forces us to lift the "small country" restriction, in order to generate a reasonable covariate balance. In particular, this is possible thanks to the inclusion in the donor pool of Iceland,

[10] For the reader that remains sceptical at this point, I note that successive model specifications in this Section generate counterfactuals largely based on advanced economies, as illustrated in Appendix 2. Emerging markets crisis episodes take less than 15% weight in the counterfactual to Model 2 and less than 7% in Model 3.

which as we saw in the simple application of the PSM, serves as a good comparator to the EZ in many respects. I note that sign, size, and significance of the key coefficients in the baseline stand confirm and, at most, there are reasons to believe that estimates in Model 1 are to be treated as conservative.

Some authors have argued that the crisis of the Eurozone periphery was to be considered a crisis of external debt, more than of sovereign debt in general (Gros, 2013; Sinn, 2014). Others have shown how the size of external indebtedness crucially predicts crisis likelihood and the depth of the subsequent economic downturn, both in general (Calvo, Izquierdo, & Mejia, 2008; Frankel & Saravelos, 2012; C. Reinhart & Calvo, 2000; Carmen M. Reinhart & Rogoff, 2011), and for Greece in particular (Carmen M. Reinhart & Trebesch, 2015). Building on data from Lane and Milesi-Ferretti (2007), I re-ran the standard PSM model including the level of external (public and private) debt (in percentage of GDP) at t-2 as a covariate, in place of our generic debt metrics. Results are very similar to those obtained in Model (2), with an implied cumulative Eurozone recessionary bias of 12.6p.p., consistent with all our specifications[11].

To show that the main results are not dictated by some peculiar features or classifications of GDPpc, I replicated Model (1) and (2) using Employment growth (p.p.) as an outcome variable. Appendix 3 shows how the main findings remain unaltered. No statistical difference can be detected during the GFC. However, already in 2010 the EZ crisis countries saw a larger contraction in employment than in the counterfactuals. 2011-2013 are confirmed to be the most recessionary years, while the employment situation stabilises in 2014: the last year for which data was available at global level. Between 2011 and 2014, on average employment contracted 5.4p.p. more in the Eurozone periphery than in the standard counterfactual scenario.

Our donor pool selection method is designed to identify episodes that replicate as close as possible the macroeconomic situation with which EZ crises countries entered the GFC. As remarked by Baldwin et al (2015, p. 2): "*All the nations stricken by the [EZ] Crisis were running current account deficits*". We might therefore want to impose explicitly this further condition on all potential donors. Model 3 replicates the baseline, adding the requirement that the current account balance was negative at t-2. To allow for sufficient degrees of freedom, as in Model 2, this specification lifts the "small country" requirement. Results remain broadly unchanged.

In Model 4 I replicated the baseline specification, but excluding Greece to show how results are affected, but not dictated by the Greek experience. Appendix 4 extends this Leave-one-out cross-validation, excluding one by one each individual crisis country, to convince the reader that the

[11] The significant recessionary years for the EZ periphery are confirmed to be 2011 (β=-4.60, p=0.008), 2012 (β=-5.18, p=0.000), and 2013 (β=-3.50, p=0.000).

recessionary bias is a wider EZ phenomenon and not just a country-specific effect. Towards the same objective, Appendix 5 shows the country-specific PSM simulations, to illustrate visually how the 2011-2013 Eurozone recessionary bias affected all crisis countries vis-à-vis their counterfactual.

Model 5 is particularly interesting, as it aims to capitalise further on the comparison with past (also non-advanced) crisis experiences. Instead of minimising the (log) GDPpc distance as in the baseline, this specification lifts that restriction. At the same time, Least Developed Countries (UN definitions) are excluded from the sample. Interestingly, the counterfactual now includes renowned macroeconomic adjustment episodes like the Argentinian crisis of 2001, Bulgaria's post-communist recession, or Russia's 1998 crisis. Individual estimates are slightly more negative than in the baseline, but confirming the general direction of results.

Finally, Model 6 shows how baseline estimates are robust to a reduction of the nearest neighbour to 2. Table 1 (column 6) above shows how the quality of the match does not deteriorate substantially.

Appendix 4 features some further alternative specifications, largely aimed at reducing the risk of an interpolation bias on key covariates. In particular, it shows how defining the donor pool in a different fashion, by imposing a deeper recession at t-1, or a sharper current account adjustment of at least 3 p.p. (in line with Milesi-Ferretti & Razin, 1998), does not substantially alter the baseline results.

IV. Alternative donor pools

The previous Section used a rule-based methodology to identify past macroeconomic adjustment episodes and create a potential donor pool. However, given the novelty of this method, the sceptical reader might suspect that crisis episodes, and particularly their inception year, might have been erroneously classified. As a robustness check, in this Section I will discuss alternative donor pools based on off-the-shelf crisis classifications and episodes.

Sudden stop specification

In the baseline, the 2009 financial crisis was effectively treated as a negative growth shock, when matching it to past episodes of macroeconomic adjustment. A reasonable argument could however be made that 2009 was not a simple macroeconomic shock for the EZ but rather that it marked the beginning of a sudden stop in financial flows (Accominotti & Eichengreen, 2016; Baldwin et al., 2015). As a further metric of comparable past crisis episodes, in this Section I build on the Eichengreen et al (2006) database of sudden stops to identify a sensible donor pool, before performing the standard matching exercise on macro imbalances[12] (see Appendix 6). In line with Milesi-Ferretti and Razin (1998), I impose a current account correction of at least 3p.p., to focus on the largest sudden stop episodes[13]. For this specification, we set t=2009: the time at which the literature identifies the beginning of the euro sudden stop.

Appendix 7 contains the covariate matching table for this Section. First, it should be noted that to the extent that the donor pool produces broadly comparable Propensity Scores with those of the EZ crisis countries, and therefore allows a reasonable replication of covariates, the PSM works also in small-n settings. Second, the table contains also the simple average of the sudden stop donor pool. This allows visualising the benefits of the key intuition behind this paper, i.e. moving beyond historical comparisons to the mean, in a transparent and data-driven fashion. For example, we can see that the average current account adjustment among sudden stops was around 7p.p., against a EZ crisis country average of 11.8p.p. Based on their distribution, a standard t-test rejects that the two might be equal at the 5% level. By selecting appropriate counterfactuals within the sudden stop pool, the PSM allows shrinking that distance to less than 2 percentage points. Likewise with pre-crisis public debt levels, which were on average 49.7% in the donor pool, and improve to 67.4% in the PSM counterfactual, bringing them closer to the 78.1% average of the EZ periphery.

Figure 3 (LHS) shows how striking the overlap between GDP performance of comparable sudden stops and that of EZ crisis countries is between 2007 and 2010. More in detail, Table 4 (Panel A) displays the estimated PSM coefficients. Due to the small sample size, public- (Model 1) and private- (Model 2) debt levels are estimated separately and produce however comparable results. In both instances, the 2008-2009 recession and the 2010 recovery are in line with historical episodes. Once again, 2011-2013 display strongly negative and significant coefficients and, if at all, would suggest our baseline estimates are conservative.

[12] Due to a smaller sample, this Section replicates Model 5 from Table 3, therefore excluding GDP per capita level from the covariates.
[13] The direction of results (available upon request) when this restriction is lifted does not vary substantially.

Table 4. MATCHING MODEL COEFFICIENTS BASED ON SUDDEN STOP (PANEL A) AND SYSTEMIC BANKING CRISIS (PANEL B) COUNTERFACTUALS

	Counterfactual based on comparable past macroeconomic adjustment episodes				
	Panel A: Sudden stops			Panel B: Systemic Banking crises	
EZ vs counterfactual at:	(1)	(2)		(1)	(2)
			t-2	0.29	0.24
				(0.742)	(0.811)
t-2	0.24	-0.51	t-1	-1.34	-0.93
	(0.866)	(0.763)		(0.084)	(0.375)
t-1	-1.03	-2.75	t=2008	-1.56	-1.38
	(0.497)	(0.277)		(0.363)	(0.296)
t=2009	0.83	0.99	t+1	0.95	1.02
	(0.616)	(0.415)		(0.398)	(0.170)
t+1	-1.09	-0.67	t+2	-0.88	-1.41
	(0.590)	(0.758)		(0.479)	(0.336)
t+2	**-8.21**	**-7.95**	t+3	**-5.44**	**-6.12**
	(0.000)	(0.000)		(0.001)	(0.000)
t+3	**-5.98**	**-5.57**	t+4	**-5.30**	**-5.73**
	(0.000)	(0.001)		(0.000)	(0.000)
t+4	**-4.29**	**-3.87**	t+5	**-4.35**	**-4.01**
	(0.000)	(0.000)		(0.014)	(0.021)
t+5	-1.21	0.31	t+6	-1.30	-0.28
	(0.116)	(0.904)		(0.504)	(0.866)
t+6	-0.74	0.26	t+7	1.29	**1.73**
	(0.539)	(0.901)		(0.428)	(0.000)
Cumulative impact	-18.4	-16.2		-15.5	-15.3
Obs	17	17		24	21
Include Small	No	Yes		Yes	Yes
Control for credit	No	Yes		No	Yes
Control for pre-crisis growth	Yes	No		Yes	Yes

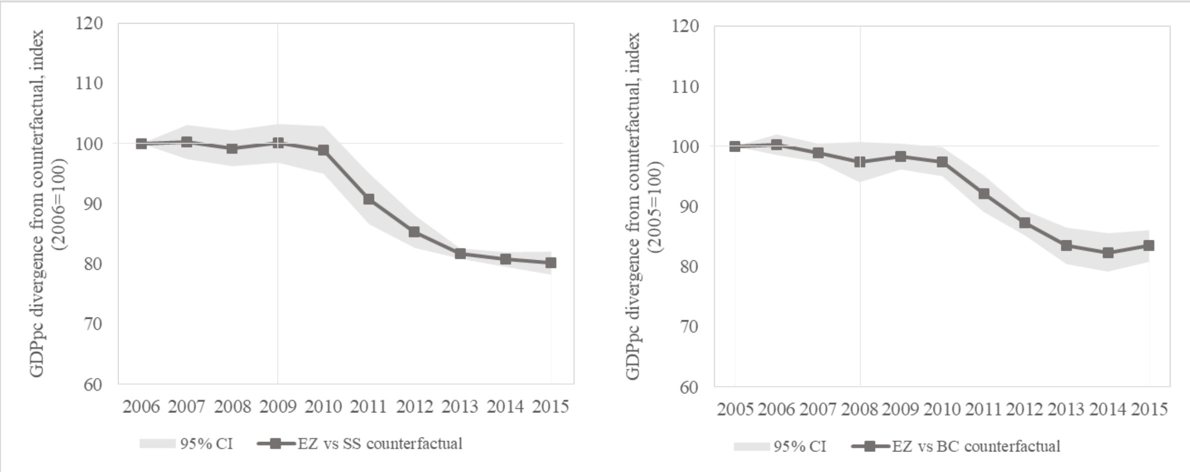
Note: Results based on propensity score matching estimator and logit treatment model, and 3 nearest neighbours. Matching performed on average GDPpc growth during [t-5,t-1], debt to GDP at t-2, average investment growth during [t-5,t-1], degree of openness to trade at t-1, and size of current account adjustment during [t-1,t+4] in Panel A and [t,t+5] in Panel B. Cumulative impact is the implied aggregate impact of coefficients between t+2 and t+5 in Panel A, and t+3 and t+6 in Panel B, in percentage points. All specifications exclude LDCs and require a current account correction of at least 3 percentage points. p-values based on robust AI standard errors in parentheses. $p<0.05$ in bold. See text for further details

Banking crisis specification

Like in the sudden stop specification, the argument could be made that the EZ faced a systemic banking crisis during the GFC and that this is not entirely captured by considering 2009 as just a negative growth shock. To this purpose, I built an alternative donor pool using the set of countries experiencing a systemic banking crisis, as identified by Laeven and Valencia (2012). Following the classification of Laeven and Valencia (2012), the beginning of the systemic banking crisis for the EZ countries is set at t=2008. Given the inclusion of Iceland's experience seems relevant in this setting, the small-country restriction was lifted (see Appendix 6). Model 1 and 2 (Table 4, Panel B) mirror those of the sudden stop specification. Figure 3 (RHS) once again visually shows how there were no significant differences in GDP performance during the banking crisis and the 2010 recovery.

Instead, coefficients for the period 2011-2013 are negative and significant. Cumulative effects, computed in a comparable way to the baseline, are very aligned with our main estimation results.

Figure 3. EUROZONE PERIPHERY PER CAPITA GDP DIVERGENCE FROM COUNTERFACTUAL BASED ON SUDDEN STOPS (LHS) AND BANKING CRISES (RHS), INDEX



Both the sudden stop- and the systemic banking crisis specification reinforce the idea that countries experiencing a comparable macroeconomic shock, being characterised by large macroeconomic imbalances (public or private debt, slow growth), and subsequently engaging in comparably steep current account corrections, experienced a better GDP performance than the EZ crisis countries. As such, arguing that large macroeconomic imbalances needed correction, or that there was a large banking crisis in 2008 accompanied by a sudden stop in 2009, is not sufficient to justify the meagre GDP performance that EZ crisis countries experienced post-2010.

V. Alternative estimation strategies

All results presented up to here relied on the PSM estimator. Given the novelty of this approach in a historical macroeconomic crisis analysis, in this Section, I show how different estimation strategies confirm the results of the PSM. In particular, I will consider an alternative non-parametric (Synthetic Control Model) method and a parametric method (dynamic fixed effect panel regression).

Synthetic Control Method

In this Section, I adapt the Synthetic Control Model (SCM) discussed in Marrazzo and Terzi (2017) to produce an alternative counterfactual for the EZ crisis countries. In a nutshell, the SCM is calibrated over the period 2000-2009 to produce a synthetic control for each EZ crisis country as a linear combination of countries displaying a similar GDPpc performance and macroeconomic characteristics. More formally, the SCM estimates the EZ growth bias α_{it} at a specific time $t > 2009$ as:

$$\hat{\alpha}_{it} = Y_{it}^{EZ} - \boldsymbol{W}_i^* \boldsymbol{Y}_{it}^{control} \quad [2]$$

based on

$$\min_{\boldsymbol{w}}\{Y_{it}^{EZ} - \boldsymbol{W}_i^* \boldsymbol{Y}_{it}^{control}\} \quad [3]$$

for $t < 2010$

and

$$\min_{\boldsymbol{w}}\{\boldsymbol{Z}_i^{EZ} - \boldsymbol{W}_i^* \boldsymbol{Z}_i^{control}\} \quad [4]$$

where Y_{it}^{EZ} and $\boldsymbol{Z}_i^{EZ}$ are GDPpc at time t and a vector of covariates of the EZ crisis country of interest i, respectively. $\boldsymbol{Y}_{it}^{control}$ and $\boldsymbol{Z}_i^{control}$ are instead a vector of GDPpc at time t and a matrix of covariates of the J countries belonging to the donor pool for the country i[14]. Borrowing from standard uses of the SCM in a macro-context, covariates include investment (% of GDP), trade openness, and industry (% of GDP). To make it relevant for our uses and comparable to the baseline, we also control for the size of the current account, public-, and private- debt levels.

A benefit of the SCM vis-à-vis the PSM, is that its long calibration period makes it less prone to unobservable confounders, as proved by Abadie et al (2010). An important downside is however that it does not allow for standard statistical inference[15].

This specification should also put to rest concerns that the recovery from the global financial crisis has been slower than normal (Lo & Rogoff 2014), even compared to other financial crises, that we are now in a secular stagnation environment (Cecchetti et al. 2009), and that as such historical comparisons might generate distorted estimates. This is because the SCM creates the donor pool in synchronous to the EZ crisis and therefore accounts for uniform time-variant shocks.

Figure 4 displays GDPpc for the real and synthetic EZ crisis countries, over the 10-year fitting period, and up to 2015. Importantly, the synthetic accurately tracks on average GDPpc of the EZ countries of interest also during the 2008-2009 crisis (for individual country calibrations, see Appendix 8). Starting in 2010, countries with similar macroeconomic characteristics and facing a comparable

[14] For further details on how the SCM was implemented in practice, see Marrazzo and Terzi (2017). For further details on the econometric theory underlying this approach, see Abadie et al (2010).

[15] While Marrazzo and Terzi (2017) propose a way to overcome this problem, that solution cannot be applied reasonably with only 5 crisis (treated) countries, as is the case in this paper.

shock during the GFC returned to growth, while the EZ crisis countries continued to experience negative GDPpc outcomes until 2013. This picture is strikingly aligned with the simple approach using the PSM and showing how Iceland (as a donor) experienced a V-shaped crisis, while Cyprus (as a EZ crisis country) had a U-shaped recession.

Figure 4. GDP PER CAPITA FOR REAL AND SYNTHETIC EUROZONE COUNTRIES, INDEX

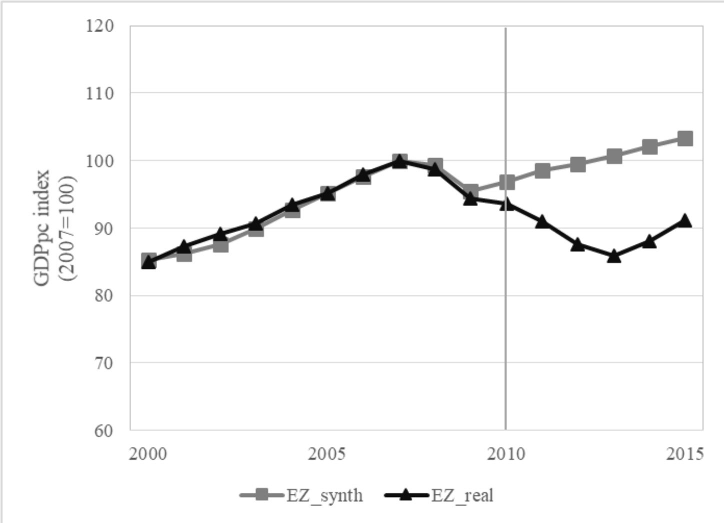


Table 5 displays the growth gap vis-à-vis counterfactual resulting from the SCM simulation individually for the five crisis countries. Over the period 2011-2012, all crisis countries underperformed their synthetic control. Ireland was the only one to be performing better already in 2013. By 2015, all were growing at a faster pace than counterfactual, with the exception of Greece. Crucially, the last two columns show aggregate estimates for all EZ crisis countries in the SCM and PSM framework. Not only are yearly estimates broadly comparable, but the imputed cumulative GDPpc loss vis-à-vis counterfactual is strikingly similar (14.7p.p. in the SCM, and 14.2p.p. in the PSM)[16].

[16] The difference vis-à-vis cumulative estimates presented before is due to the different time horizon of computation. See Notes to Table 3 and Table 5 for further details.

Table 5. GROWTH GAP BETWEEN EZ CRISIS COUNTRIES AND CONTROL

	SCM					SCM	PSM
Divergence from counterfactual at:	GRC	CYP	IRL	ESP	PRT	EZ	EZ
2010	-6.4	-3.9	2.2	-3.3	-0.1	-2.3	-1.0
2011	-10.4	-3.9	-2.1	-2.7	-4.3	-4.7	-4.9
2012	-6.9	-5.5	-1.6	-4.4	-4.8	-4.7	-5.3
2013	-3.5	-7.5	1.8	-3.5	-2.7	-3.1	-3.1
2014	-0.7	-2.6	8.2	0.0	-0.3	0.9	-0.5
2015	-1.0	1.6	7.8	1.8	0.9	2.2	0.0
trough	-25.6	-21.8	-3.7	-15.1	-14.5	-14.7	-14.2

Note: SCM estimates of country divergence from counterfactual, and comparison between SCM and PSM estimates for the EZ crisis countries. For PSM, Model 2 from Section III including all covariates was used, to ensure comparability. Trough indicates the maximum cumulative gap between real and control over the period [2010-2015].

Parametric estimation

The previous sections constructed country counterfactuals based on a variety of adapted microeconometric techniques. While the selection of the donor pool in these methods was intended to correct for the cycle, some readers might remain suspicious that the rich dynamics of GDP were not fully accounted for. I therefore resort to a dynamic panel regression model, as introduced by Acemoglu et al (2014), as a robustness check. Formally, the model with p lags can be expressed as follows:

$$y_{ct} = \sum_{k=-2}^{5} \beta_{t+k} EZ_{t+k,ct} + \sum_{j=1}^{p} \gamma_j y_{ct-j} + \alpha_c + \delta_t + \varepsilon_{ct} \qquad [5]$$

where y_{ct} is the log of real GDP per capita in country c at time t. $EZ_{t+k,ct}$ is a dummy that takes value 1 if c is a EZ crisis country at time $t = 2010$, and zero otherwise. $\sum_{j=1}^{p} \gamma_j y_{ct-j}$ represents a set of p lags of log GDP per capita, to control for the dynamics of GDP, whereas α_c and δ_t are respectively a full set of country- and time- fixed effects and ε_{ct} is an error term.

In line with standard applications of this model, equation [5] is estimated using the within estimator. All specifications include a full set of time and country fixed effects, and inference is based on clustered and robust standard errors. Table 6 reports the β_{t+k} estimated coefficients, which are our main parameter of interest. Specifications include 2 and 4 lags. Appendix 9 discusses why these seem the most appropriate time horizons, and shows how adding further lags does not improve the estimation power of the model. All reported coefficients in Table 6 are transformed, so that they can be interpreted as p.p. of GDPpc growth, therefore ensuring comparability with previous sections.

Column 1 shows the divergence of the EZ crisis countries from a "standard" economic cycle over the period 2008-2015 with 2 GDP lags. Coefficients before 2010 are not significant. Intuitively, what this implies is that once you net out the countries (time-invariant) characteristics, their boom-and-bust cycle, and global growth trends, the 2008/2009 crisis was not different in the EZ crisis countries than elsewhere. This can be seen particularly in Column 4, which displays (non-significant) coefficients for an extended pre-2010 horizon. Instead, after 2010, the EZ crisis countries underperformed disproportionately. This remains true when 4 lags are employed (Column 2), and also when Greece is excluded (Column 3), albeit with smaller coefficients, significant at a 10% level. In line with the other models, 2012 and 2013 emerge as particularly negative years. On the other hand, conversely from the baseline, this specification taking into account the rich dynamics of GDP suggests, on average, that the recession of 2011 could (just about) still be seen as cyclical, especially when Greece is excluded.

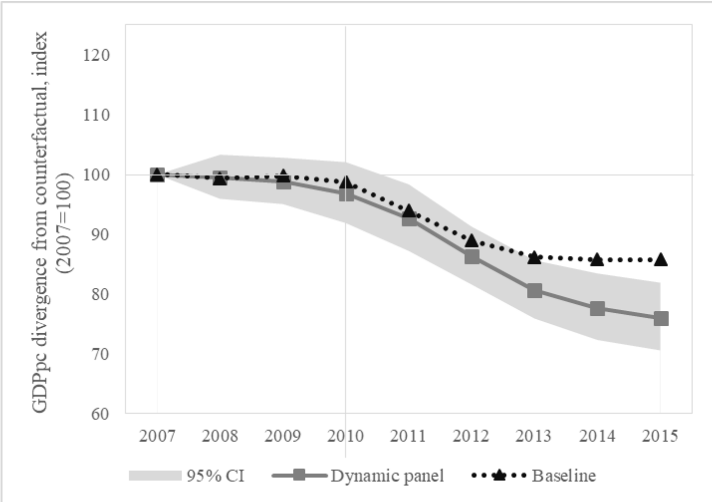
Table 6. DYNAMIC PANEL REGRESSION MODEL COEFFICIENTS

	Dynamic panel regression specification			
year	(1)	(2)	(3)	(4)
2006				3.29
				(0.204)
2007				2.04
				(0.395)
2008	-0.44	-0.64	-0.35	-0.50
	(0.815)	(0.724)	(0.862)	(0.796)
2009	-0.70	-0.92	-0.48	-0.78
	(0.723)	(0.631)	(0.826)	(0.702)
2010	-2.04	-2.19	-0.57	-2.05
	(0.440)	(0.401)	(0.826)	(0.450)
2011	-4.36	-4.60	-2.30	-4.47
	(0.145)	(0.120)	(0.356)	(0.144)
2012	**-6.81**	**-7.08**	**-5.16**	**-6.95**
	(0.014)	(0.010)	(0.042)	(0.015)
2013	**-6.56**	**-6.89**	-5.35	**-6.76**
	(0.027)	(0.021)	(0.088)	(0.028)
2014	-3.65	-4.01	-2.23	-3.88
	(0.306)	(0.261)	(0.562)	(0.288)
2015	-2.12	-2.44	-0.16	-2.31
	(0.569)	(0.512)	(0.967)	(0.544)
Cumulative impact by t+4	-21.38	-22.58	-15.04	-22.05
p-value	[0.063]	[0.049]	[0.187]	[0.062]
GDP lags	2	4	4	4
Augmented Dickey-Fuller p-value	[0.011]	[0.000]	[0.000]	[0.000]
Exclude GR	No	No	Yes	Yes
Observations	6045	5940	5888	5940
Countries in sample	176	176	175	176
R-squared	0.983	0.983	0.983	0.983

Note: This table is based on a fixed effect dynamic panel regression model with p lags. Reported coefficients are transformed to growth p.p., to ensure comparability with other specifications. P-values based on robust standard errors in parentheses. All specifications include country and time fixed effects. Cumulative impact by t+4 is the implied aggregate impact of coefficients between t+1 and t+4 in percentage points, and the p-value of this being different from 0. I report the p-value based on the inverse normal statistic of a Dickey-Fuller test of unit root. Bold indicates significance at the 5% level. See text for further details

Moreover, estimates of the cumulative impact of the crisis are broadly in line with both PSM and SCM specifications, placing the loss due to the EZ crisis vis-à-vis counterfactual between 15 and 20 p.p. of GDP by 2014[17]. Figure 5 visually displays how parametric estimates are strikingly aligned with those of the PSM[18].

Figure 5. ESTIMATED EZ GROWTH BIAS: PANEL REGRESSION ESTIMATES AND PSM (BASELINE)



Several takeaways emerge from this specification. First, we rest reassured that results are not dictated by the non-parametric methodologies used in the previous sections. This seems particularly relevant, given their novel use within a historical crisis comparison setting. Second, the sharp recession that characterised the EZ crisis countries from 2010 onwards cannot entirely be imputed neither to a disproportionately large GDPpc boom that preceded the crisis, nor to the 2008/2009 crisis itself. This corroborates the findings of the SCM specification and its 10-year model fitting time horizon. Third, we note that once the GDP cycle is more fully accounted for, together with global growth trends, the recovery observed in the tail end of our time-interval of interest in some of our previous specifications seems less extraordinary. As such, our baseline estimates should be treated, at most, as conservative.

VI. Factors behind the deeper recession

The paper has gone at length to show how the recession that characterised the EZ crisis countries from 2010 onwards was deeper than macro imbalances alone would have warranted. The logical ensuing question would be why. When trying to disentangle the relative importance of factors

[17] The cumulative impact by t+4 estimated for Model 3 is not significant at standard levels of confidence. This seems to be due to the different time profiling of the (slow recovery in the) Greek crisis. However, the cumulative impact at t+3 is still comparable (12.81 p.p.) and significant [p=0.098].

[18] PSM estimates extracted from Model (2), including all macro-covariates

that led to a specific outcome in a macroeconomic setting, structural modelling is without doubt the most appropriate approach. As such, testing the impact of individual policy decisions (e.g. imposing a haircut on private sector creditors in Cyprus) or lack of action (e.g. procrastinating debt restructuring in Greece) is unfortunately beyond the scope of this paper. However, in this Section I will stretch the logic and methodology used hitherto to explore in detail one specific overarching argument, namely that the deeper recession was to be imputed to the lack of a national monetary policy as a stabilisation tool (Krugman, 2012; Lane, 2012). To this purpose, I exploit the Exchange Rate Arrangement (ERA) Database (Ilzetzki et al., 2017; Carmen M. Reinhart & Rogoff, 2001) to build separate counterfactuals of macro adjustments, composed of fixed- and flexible- ERAs[19]. The standard matching methodology presented in Section II is then applied.

At this point, a specific caveat should be mentioned. It must be noted that this slicing exercise is particularly demanding on our data, not least because as shown by Goldfajn and Valdes (1999) large external corrections without nominal devaluations are quite rare. As a result, the donor pool under the fixed ERA is significantly downsized. While this does not severely affect the quality of the matching process (as illustrated in Appendix 10), results should nonetheless be treated with a degree of caution. With this caveat in mind, the main results are displayed in Table 7.

Model (1) and (2) reproduce previously introduced specifications but restricting the donor pool to fixed ERAs. These models control for public debt, together with the other standard covariates, while Model (3) controls for the size of private debt. Controlling for both simultaneously, while desirable, was not possible within standard tolerance limits of the PSM. Models (4)-(6) mirror the specifications of Model (1)-(3), but in a flexible ERA counterfactual.

[19] In line with the coarse classification adopted by Reinhart and Rogoff (2001), fixed ERA countries are defined as those having no separate legal tender, a pre-announced peg or currency board arrangement, a pre-announced horizontal band that is narrower than or equal to +/-2%, and a de facto peg. For our purposes, all other ERAs will be considered “flexible”, as monetary policy will not be constrained by an exchange rate objective.

Table 7. MATCHING MODEL COEFFICIENTS FOR THE EZ CRISIS COUNTRIES AGAINST A FIXED- AND FLEXIBLE EXCHANGE RATE ARRANGEMENTS COUNTERFACTUAL

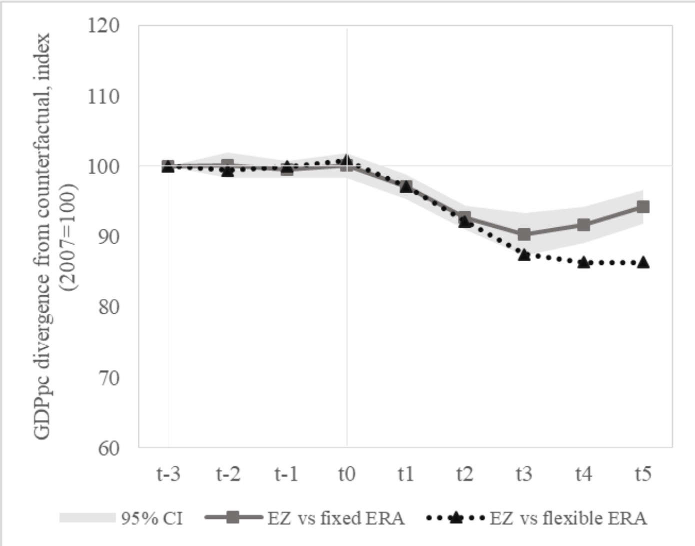
	Counterfactual based on comparable past macroeconomic adjustment episodes under:					
	Fixed Exchange Rate Arrangements			Flexible Exchange Rate Arrangements		
EZ vs counterfactual at:	(1)	(2)	(3)	(4)	(5)	(6)
t-2	0.17	0.14	-1.80	-0.59	0.09	-3.03
	(0.851)	(0.922)	(0.354)	(0.677)	(0.952)	(0.111)
t-1	-0.59	-0.78	1.17	0.53	0.36	0.12
	(0.323)	(0.139)	(0.296)	(0.411)	(0.571)	(0.817)
t=2010	0.55	-0.03	-0.23	0.90	0.54	-0.14
	(0.542)	(0.975)	(0.923)	(0.060)	(0.245)	(0.952)
t+1	**-2.99**	**-3.43**	**-6.84**	**-3.66**	**-3.29**	-5.14
	(0.001)	(0.000)	(0.038)	(0.000)	(0.000)	(0.068)
t+2	**-4.53**	**-4.72**	**-4.72**	**-5.12**	**-4.87**	**-5.07**
	(0.000)	(0.000)	(0.016)	(0.000)	(0.000)	(0.006)
t+3	-2.56	-2.85	-2.89	**-5.04**	**-4.83**	**-3.56**
	(0.123)	(0.056)	(0.072)	(0.000)	(0.001)	(0.003)
t+4	1.49	1.41	2.35	-1.36	-1.01	1.13
	(0.306)	(0.381)	(0.296)	(0.331)	(0.490)	(0.622)
t+5	**2.80**	**2.99**	1.36	0.02	0.14	0.89
	(0.036)	(0.000)	(0.582)	(0.988)	(0.919)	(0.716)
Cumulative impact by t+4	-8.4	-9.3	-11.8	-14.4	-13.3	-12.2
Obs	20	24	31	96	142	120
Larger C/A adjustment	Yes	No	Yes	Yes	No	Yes
Excl small countries	Yes	Yes	No	Yes	Yes	No
Control for public debt	Yes	Yes	No	Yes	Yes	No
Control for credit	No	No	Yes	No	No	Yes

Note: Results based on propensity score matching estimator and logit treatment model, and 3 nearest neighbours. Matching performed on average GDPpc growth during [t-5,t-1], debt to GDP at t-2,size of current account adjustment during [t-2,t+3], log GDPpc at t-2, average investment growth during [t-5,t-1], credit-to-GDP at t-2, and degree of openness to trade at t-2, unless otherwise specified. Cumulative impact by t+4 is the implied aggregate impact of coefficients between t+1 and t+4 in percentage points. p-values based on robust AI standard errors in parentheses. p<0.05 in bold.

In all specifications, the EZ crisis countries still displayed negative PSM coefficients. This suggests that the deep recession cannot be explained alone by the lack of an independent monetary policy, which instead seems to account for just over a quarter of the EZ recessionary bias (26.3%). However, all specifications suggest that it is indeed harder to adjust without a flexible exchange rate. For example, the implied cumulative crisis impact at t+4 was 14.4p.p. in Model (1), against 8.4p.p. in the analogous, but flexible ERA, Model (4). This is confirmed when looking at the Real Effective Exchange Rate (REER) correction: Appendix 11 shows how having a flexible exchange rate did help the counterfactual regain competitiveness after a shock more quickly than in the EZ setting[20]. These results are in line with the literature on macroeconomic adjustment under fixed- and flexible-exchange rate regimes (Edwards, 2004; Eichengreen & Rose, 2003; Goldfajn & Valdes, 1999; P. Gourinchas et al., 2016). Moreover, it looks like the recovery in the aftermath of a crisis and adjustment period is faster under flexible ERAs. As a result, 5 years into the crisis, the EZ was underperforming more significantly its flexible- rather than fixed- ERA counterfactual (see Figure 6).

[20] In terms of REER correction, the EZ behaved however similarly to its fixed ERA counterfactual.

Figure 6. EUROZONE PERIPHERY PER CAPITA GDP DIVERGENCE FROM COUNTERFACTUAL, INDEX



Building on this finding, I benchmark some key macroeconomic variables between the EZ crisis countries and the fixed ERA counterfactual. Specifically, we look at exports, imports, consumption, government revenues/expenses and investment, as they are all accounting components of GDP. All variables are expressed in percentage point change, and are divided by GDP (see Appendix 1 for definitions and data sources). Intuitively, this should net out the diversified recession in the EZ and counterfactual and suggest whether some variables contracted more than proportionally. As no structural model underlies this framework, I will refrain from trying to pin down these results to a specific policy. Nonetheless, some interesting findings do emerge. The period of most interest is clearly [t1,t3], which is the time interval when the EZ crisis countries suffered the greatest hit. Standard PSM coefficients are displayed in Table 8.

Table 8. COMPARISON OF SELECTED MACROECONOMIC VARIABLES BETWEEN EUROZONE CRISIS COUNTRIES AND FIXED ERA COUNTERFACTUAL

	Fixed ERA counterfactual						
	Exports	Imports	Consumption	Government Revenues	Government Expenditure	Investment	Credit
EZ vs counterfactual at:							
t-2	0.71	2.39	1.92	-1.21	1.12	0.09	-1.30
	(0.766)	(0.095)	(0.106)	(0.545)	(0.582)	(0.938)	(0.812)
t-1	-1.02	-0.95	**-1.49**	-0.78	**6.21**	-0.76	3.92
	(0.624)	(0.783)	(0.002)	(0.123)	(0.000)	(0.067)	(0.124)
t=2010	3.73	**4.74**	1.26	-0.84	1.82	-0.43	-2.89
	(0.113)	(0.001)	(0.139)	(0.219)	(0.608)	(0.541)	(0.660)
t+1	0.67	-0.57	**1.49**	-1.03	-2.18	**-1.94**	-1.56
	(0.659)	(0.553)	(0.011)	(0.147)	(0.542)	(0.015)	(0.736)
t+2	0.21	0.72	**3.80**	-1.26	**-2.28**	-1.84	-4.56
	(0.880)	(0.644)	(0.000)	(0.166)	(0.000)	(0.149)	(0.143)
t+3	2.98	0.13	0.50	**1.22**	-0.39	**-1.96**	-4.78
	(0.087)	(0.853)	(0.606)	(0.046)	(0.620)	(0.000)	(0.248)
t+4	1.69	**3.34**	1.56	0.17	-0.27	-0.77	**-12.77**
	(0.335)	(0.032)	(0.355)	(0.896)	(0.762)	(0.477)	(0.039)
t+5	0.65	-2.47	-2.46	-4.08	**-4.13**	-0.71	-9.50
	(0.808)	(0.249)	(0.294)	(0.050)	(0.001)	(0.219)	(0.148)

Note: Results based on propensity score matching estimator and logit treatment model, and 3 nearest neighbours. Matching performed on average GDPpc growth during [t-5,t-1], debt to GDP at t-2,size of current account adjustment during [t-2,t+3], log GDPpc at t-2, average investment growth during [t-5,t-1], and degree of openness to trade at t-2. p-values based on robust AI standard errors in parentheses. p<0.05 in bold.

A first interesting finding is that while export performance shows no significant difference from the counterfactual, imports have a positive and large coefficient at t. What this suggests is that being in a monetary union (and having access to ECB liquidity), allowed the EZ crisis countries to correct their current account in a less abrupt fashion (see Appendix 12). This finding has been confirmed by the EZ literature (Baldwin et al., 2015; P. Gourinchas et al., 2016; Lane & Milesi-Ferretti, 2012) and is the flipside of the debate on EZ Target2 imbalances (Sinn & Wollmershäuser, 2012), and it is particularly relevant as several authors have highlighted how abrupt current account corrections have strong contractionary effects on economic performance (Calvo et al., 2008; Cavallo & Frankel, 2008; Edwards, 2004). Aside from this consideration, it seems the trade dimension did not differ substantially from the counterfactual, at least not in the recessionary phase.

Consumption took a strong hit in 2009, but, after that, it upheld better in the EZ crisis countries than in the counterfactual. It is not implausible that Europeans had a comparatively higher possibility to dissave to smoothen consumption. At any rate, this suggests that this GDP component did not contribute disproportionately to the recession. Public finances are particularly interesting. The change in revenues before 2010 is not different from the counterfactual, once again suggesting that the GFC is appropriately controlled for. Expenditure instead increased substantially in 2009, as automatic stabilisers and bank rescue mechanisms were activated. After that, there is some evidence suggesting that public finances weighed on growth as expenditure was cut disproportionately in 2012, and taxes increased in 2013. As no statistical differences are observed when comparing the correction in the primary balance between the EZ crisis countries and the counterfactual, there are reasons to believe that the sharper fiscal austerity is to be attributed to higher funding costs (see Appendix 13). Something already remarked by Martin and Philippon (2017) when employing DSGE-generated counterfactuals.

Most notably, investment shrank more than expected and therefore mechanically dragged down GDP. Importantly, this finding resonates with DSGE models calibrated for the EZ as a whole (Vogel, Kollmann, Pataracchia, Ratto, & Roeger, 2016), and for Greece, specifically (P. Gourinchas et al., 2016). A glance at the change in credit-to-GDP suggests this investment slump was not necessarily due to a sharper-than-usual credit crunch over the period 2011-2013. Potential reasons are hard to disentangle beyond this point. Looking at the literature, some authors have argued that the drop in investment was an indirect result of austerity policies (De Grauwe & Ji, 2016). Others have connected it to deeper uncertainty (Baldwin et al., 2015) or the lack of debt write-downs (Carmen M. Reinhart, Reinhart, & Rogoff, 2015; Carmen M. Reinhart & Trebesch, 2015), which led to a freeze of (new) investment in the private sector. For our purposes, it is worth noting that both explanations are related to suboptimal crisis management decisions or, more broadly speaking, to problems with the euro area institutional setup that made these suboptimal choices a necessity.

VII. Conclusion

The Eurozone crisis that began in 2010 led to sharp contractions of GDP, soaring unemployment, involuntary migration, and widespread malaise. Understanding why this happened is a crucial step towards preventing its repetition in the future. In the words of Baldwin et al (2015): "*It is impossible to agree upon the steps to be taken without agreement on what went wrong. Absent such agreement, half-measures and messy compromises are the typical outcome. But this will not be good enough to put the EZ Crisis behind us and restore growth*". This paper contributes to this task by introducing a novel methodology to benchmark the EZ crisis with comparable adjustment episodes and testing whether the large macroeconomic imbalances that had developed in the run-up to the 2010 crisis, and their combination with a large recession as the 2008/2009 Global Financial Crisis, are sufficient alone to explain the sharp GDP contractions observed in Greece, Spain, Ireland, Cyprus, and Portugal. If this were the case, introducing strong disciplining devices (credible no bailout rules, macro monitoring and sanctioning) is all the fixing the Eurozone architecture would need.

While the large size of macroeconomic imbalances should not be disregarded, the paper shows how these are not sufficient to explain the recession experienced after 2010 in the five crisis countries. While the lack of independent monetary policy contributed to aggravate the recession, the paper shows how this alone cannot explain more than a quarter of the EZ recessionary bias. As such, one should not conclude that similarly sharp recessions are a necessity under a shared currency. As a matter of fact, the paper shows how being in a monetary union allowed the crisis countries to avoid a sudden correction of their current account. There are however reasons to believe that an incomplete Eurozone institutional setup contributed to aggravate the crisis through higher uncertainty that increased government funding costs and froze investments.

The paper therefore lends empirical backing to the proponents of more wide-reaching reforms of the Eurozone architecture. Several steps have been taken during the crisis, as creating a bailout mechanism for sovereign debt (the European Stability Mechanism), posing the foundations of a Banking Union, and beefing up macro monitoring mechanisms through the European Semester. Likewise, many proposals have emerged to increase risk sharing and attenuate recessionary pressures, ranging from the introduction of Eurobonds, to the creation of a Eurozone budget to fund a euro-wide automatic stabilising facility. Furthering our theoretical and empirical understanding of the causes of the Eurozone recession, and of the relative importance of individual reforms, will surely remain an open avenue for further research, helping the debate in Europe to progress beyond ideological preconceptions.

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Appendix 1. Data sources

VARIABLES	DESCRIPTION	TIME/INTERVAL USED WHEN MATCHING	DATA SOURCE
GDP per capita growth	Annual percentage growth rate of GDP per capita based on constant local currency	-	World Bank
Current account balance	Percentage of GDP	[t-2, t+3]	World Bank
Public debt to GDP	Percentage of GDP	t-2	Abbas, S.M. Ali, Nazim Belhocine, Asmaa el-Ganainy and Mark Horton (2010)
Pre-crisis GDP per capita growth	Annual percentage growth rate of GDP per capita based on constant local currency	[t-5, t-1]	Own calculations based on World Bank
Trade openness	Exports plus imports (% of GDP)	t-2	World Bank
Investment growth	Annual percentage growth rate of investment (% of GDP)	[t-5, t-1]	Own calculations based on World Bank
GDP per capita	GDP per capita at constant 2010 US$	t-2	World Bank
Credit to GDP	Domestic credit to private sector (% of GDP)	t-2	World Bank
Industry	Value added by Mining, Manufacturing, Utilities, and Construction (% of GDP)	-	UN Data
Exports	Exports of goods and services (% of GDP)	-	World Bank
Imports	Imports of goods and services (% of GDP)	-	World Bank
Consumption	Household final consumption expenditure (% of GDP)	-	World Bank
Investment (in PSM)	Gross fixed capital formation (% of GDP)	[t-5, t-1]	World Bank
Credit-to-GDP	Domestic credit to private sector (% of GDP)	-	World Bank
Employment	Number of persons engaged (% of population)	-	Penn World Table Feenstra, Robert C., Robert Inklaar and Marcel P. Timmer (2015)
Government Revenues	General government revenue (% of GDP)	-	IMF WEO 2017

Government Expenditure	General government total expenditure (% of GDP)	-	IMF WEO 2017
Primary Balance	General government primary net lending/borrowing (% of GDP)	-	IMF WEO 2017
Real effective exchange rate	Real effective exchange rate (CPI-based), 2007=100	-	Darvas (2012)

Appendix 2. List of PSM donors

Below is a list of the macroeconomic adjustment episode that compose the counterfactuals for Models (1)-(6) illustrated in Table 3. While every donor composition can be subject to criticism, the paper adopts a transparent and data-driven approach for their selection. When judging the relevance of individual episodes in the donor set, one should bear in mind that each donor is selected to contribute information towards the composition of a counterfactual, in combination with other episodes, and not individually. Moreover, the variety of episodes considered for the composition of the counterfactual in the six different models shows that results are not driven by single idiosyncratic behaviours in the donor pool.

(1)		(2)		(3)	
Donors	Years	Donors	Years	Donors	Years
Denmark	2010	Denmark	2009, 2010	Canada	1991
Finland	1993	Gabon	1988	Equatorial Guinea	1990
Latvia	2009	Iceland	2010, 2011	Iceland	1993, 2010
Libya	2003	Japan	1999	Israel	2003
Nicaragua	1994	Nicaragua	1994	Netherlands	1982
Saudi Arabia	2000, 2003	Switzerland	1994, 2010	Sweden	1994
Switzerland	1994, 2010	United States	2009, 2010	United States	2009, 2010
United States	2010				
(4)		**(5)**		**(6)**	
Donors	Years	Donors	Years	Donors	Years
Finland	1992, 1993	Algeria	1988	Finland	1993
Kuwait	2009	Argentina	2002	Latvia	2009
Saudi Arabia	2000, 2002, 2003	Bulgaria	1992, 2010	Nicaragua	1994
Singapore	2002	Israel	2003	Saudi Arabia	2000, 2003
Switzerland	1994, 2010	Jamaica	2009, 2010	Switzerland	1994, 2010
United States	2010	Russian Federation	1999	United States	2010
		Saudi Arabia	2002		
		Singapore	2010		
		Venezuela	1980		

Appendix 3. Employment PSM specification

The table below reports standard PSM coefficients replicating Model (1) and (2) of Table 3 in the main text. However, the independent variable in this case is employment growth (percentage points). The main results of the GDPpc specifications are confirmed. While the 2009 crisis was somewhat absorbed, from 2010 onwards employment started contracting vis-à-vis counterfactual, up until 2013. In 2014, the situation stabilised.

	Independent variable: Employment growth (p.p.)	
EZ vs counterfactual at:	(1)	(2)
t-2	-0.19	-0.07
	(0.513)	(0.847)
t-1	-1.43	-1.29
	(0.086)	(0.158)
t=2010	**-0.67**	**-0.86**
	(0.000)	(0.000)
t+1	**-0.97**	**-1.79**
	(0.000)	(0.000)
t+2	**-2.18**	**-2.51**
	(0.000)	(0.000)
t+3	**-1.86**	**-1.57**
	(0.000)	(0.000)
t+4	-0.52	-0.06
	0.11	0.63
Cumulative impact by t+4	-5.4	-5.8
Obs	256	298

Note: Model 1 and 2 replicate those of Table 3 (see relevant Note for further details). Employment time series only available up to t+4. Cumulative impact by t+4 is the implied aggregate impact of coefficients between t+1 and t+4 in percentage points, computed over this interval to ensure comparability with the GDPpc specifications.p-values based on robust AI standard errors in parentheses. $p<0.05$ in bold.

To allow comparability with the GDPpc-based results in the main text, the table also displays a similarly computed Cumulative effect by t+4. This suggests that while GDPpc was contracting up to 11p.p. more than in the counterfactual between 2011 and 2013, employment contracted 5.4p.p.

Appendix 4. Alternative PSM Specifications – Summary statistics for the matching process (Panel A) and Matching Model Coefficients (Panel B)*

PANEL A: MATCHING TABLE						
	Counterfactual based on comparable past macroeconomic adjustment episodes					
Covariates	(1)	(2)	(3)	(4)	(5)	(6)
C/A adjustment	11.8	10.5	13.3	16.0	11.2	15.4
	[0.999]	[0.744]	[0.758]	[0.442]	[0.991]	[0.529]
Public debt-to-GDP	112.5	63.7	62.2	136.2	66.0	95.9
	[0.763]	[0.209]	[0.349]	[0.666]	[0.343]	[0.966]
Pre-crisis GDP growth	0.0	0.1	1.1	-0.2	1.0	0.1
	[0.728]	[0.831]	[0.700]	[0.627]	[0.626]	[0.982]
Openness	97.7	68.7	78.8	98.7	96.1	65.6
	[0.894]	[0.357]	[0.849]	[0.968]	[0.989]	[0.499]
Pre-crisis investment growth	-0.9	-0.7	-0.2	-0.8	-0.9	-1.1
	[0.957]	[0.606]	[0.455]	[0.976]	[0.830]	[0.822]
Log GDPpc	10.1	10.5	10.2	9.7	10.4	9.9
	[0.763]	[0.690]	[0.893]	[0.455]	[0.948]	[0.495]
p-value of χ^2	0.957	.	0.350	0.968	0.96	0.943

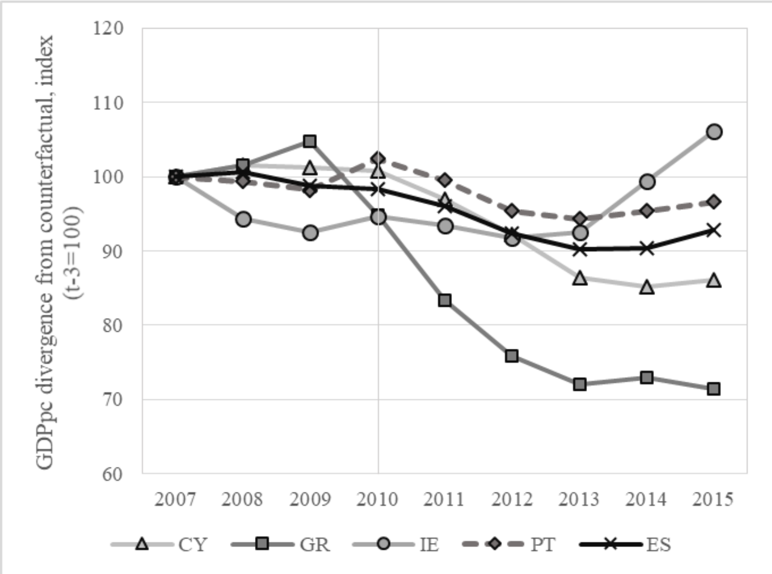
PANEL B: PSM COEFFICIENTS						
EZ vs counterfactual at:	(1)	(2)	(3)	(4)	(5)	(6)
t-2	-0.03	0.48	0.40	-1.52	0.16	-0.23
	(0.961)	(0.411)	(0.549)	(0.260)	(0.916)	(0.866)
t-1	0.46	**1.50**	0.51	0.16	0.02	0.44
	(0.351)	(0.005)	(0.202)	(0.437)	(0.951)	(0.440)
t=2010	0.61	0.35	0.48	1.06	-2.00	-1.00
	(0.284)	(0.595)	(0.510)	(0.498)	(0.195)	(0.350)
t+1	**-2.67**	**-2.71**	**-2.52**	-2.23	**-4.91**	**-4.77**
	(0.000)	(0.000)	(0.000)	(0.273)	(0.010)	(0.019)
t+2	**-4.66**	**-4.38**	**-4.48**	**-4.01**	**-5.48**	**-5.18**
	(0.000)	(0.000)	(0.000)	(0.002)	(0.000)	(0.000)
t+3	**-3.77**	**-4.03**	**-4.02**	-3.29	**-4.64**	**-2.97**
	(0.001)	(0.000)	(0.007)	(0.084)	(0.006)	(0.000)
t+4	**-1.28**	-0.91	-0.87	1.22	-1.00	-0.39
	(0.040)	(0.147)	(0.251)	(0.449)	(0.582)	(0.813)
t+5	**0.85**	**1.45**	**1.23**	2.69	0.74	0.38
	(0.046)	(0.001)	(0.000)	(0.122)	(0.668)	(0.807)
Cumulative impact by t+4	-11.8	-11.5	-11.4	-8.1	-15.1	-12.7
Obs	186	204	271	270	270	271
Larger C/A adjustment	Yes	No	No	No	No	No
Deeper crisis at t-1	No	Yes	No	No	No	No
Exclude IE	No	No	Yes	No	No	No
Exclude ES	No	No	No	Yes	No	No
Exclude PT	No	No	No	No	Yes	No
Exclude CY	No	No	No	No	No	Yes

Note: Results based on propensity score matching estimator and logit treatment model, and 3 nearest neighbours. Matching performed on average GDPpc growth during [t-5,t-1], debt to GDP at t-2,size of current account adjustment during [t-2,t+3], log GDPpc at t-2, average investment growth during [t-5,t-1], and degree of openness to trade at t-2, unless otherwise specified. Cumulative impact by t+4 is the implied aggregate impact of coefficients between t+1 and t+4 in percentage points. p-values based on robust AI standard errors in parentheses. p<0.05 in bold.

* Model (4) that excludes Spain seems to paint a more moderate negative bias for the EZ than the baseline. This result is however not consistent, and once private debt is also accounted for, the standard results and repeated negative coefficients, as in the main text, are found (results available upon request).

Appendix 5. Country-specific PSM simulation results

The Figure below shows country-specific simulation results for the five EZ crisis countries. It can be seen the GDPpc divergence widens for all countries between 2010 and 2013. This reinforces the idea that it was not only one single country experience driving the aggregate results.



Similarly, the Table below shows GDPpc growth gaps between the EZ crisis countries and their individual counterfactual between 2010 and 2015. We can see how 2011 and 2012 were negative years for all crisis countries. In 2013, only Ireland had started (marginally) growing faster than its counterfactual. By 2015, all countries were growing faster than their PSM-generated counterfactual, with the exception of Greece.

	SCM				
Divergence from counterfactual at:	GRC	CYP	IRL	ESP	PRT
2010	-9.4	-0.4	2.4	-0.4	4.3
2011	-12.1	-3.9	-1.3	-2.4	-2.9
2012	-9.1	-4.7	-1.9	-3.9	-4.2
2013	-5.0	-6.4	0.9	-2.3	-1.1
2014	1.4	-1.4	7.5	0.1	1.1
2015	-2.2	1.2	6.8	2.7	1.3
trough	-28.6	-14.8	-8.3	-9.8	-5.7

Note: Country-specific estimates for Model 2 from Section III including all macroeconomic covariates. Trough indicates the maximum cumulative gap between real and control over the period [2010-2015]. See main text for further details.

Appendix 6. Donors based on Sudden Stops and Systemic Banking Crises

Potential donors are based on the Eichengreen et al (2006) and Laeven and Valencia (2012) databases for sudden stops and systemic banking crisis, respectively. Moreover, some of the standard conditions applied in main PSM setting were applied. Actual lists of donors considered for Models (1) and (2) in Table 4 are reported, for Sudden Stops (Panel A) and Banking Crises (Panel B). The implied weight of each episode in the overall EZ counterfactual is also reported.

PANEL A: SUDDEN STOP DONORS

		(1)			(2)		
Potential Donors	Years	Donors	Years	weight	Donors	Years	weight
Argentina	2001	Brazil	2002	33%	Costa Rica	1982	33%
Brazil	1983	Costa Rica	1982	27%	Malaysia	1998	33%
Brazil	2002	Malaysia	1998	33%	Thailand	1997	27%
Chile	1983	South Africa	1985	7%	Turkey	1994	7%
Costa Rica	1982						
Korea	1997						
Malaysia	1998						
Mexico	1983						
Mexico	1995						
South Africa	1985						
Thailand	1997						
Turkey	1994						

PANEL B: BANKING CRISIS DONORS

		(1)			(2)		
Potential Donors	Years	Donors	Years	weight	Donors	Years	weight
Argentina	2001	Argentina	2001	7%	Argentina	2001	7%
Congo, Republic of	1992	Congo, Republic of	1992	13%	Congo, Republic of	1992	7%
Colombia	1998	Denmark	2008	13%	Denmark	2008	27%
Denmark	2008	Ecuador	1998	13%	Finland	1991	7%
Ecuador	1998	Finland	1991	7%	Iceland	2008	27%
Finland	1991	Hungary	2008	20%	Switzerland	2008	27%
Hungary	2008	Iceland	2008	7%			
Iceland	2008	Switzerland	2008	20%			
Latvia	2008						
Malaysia	1997						
Mexico	1981						
Mexico	1994						
Slovak Republic	1998						
Sweden	1991						
Switzerland	2008						
Thailand	1997						

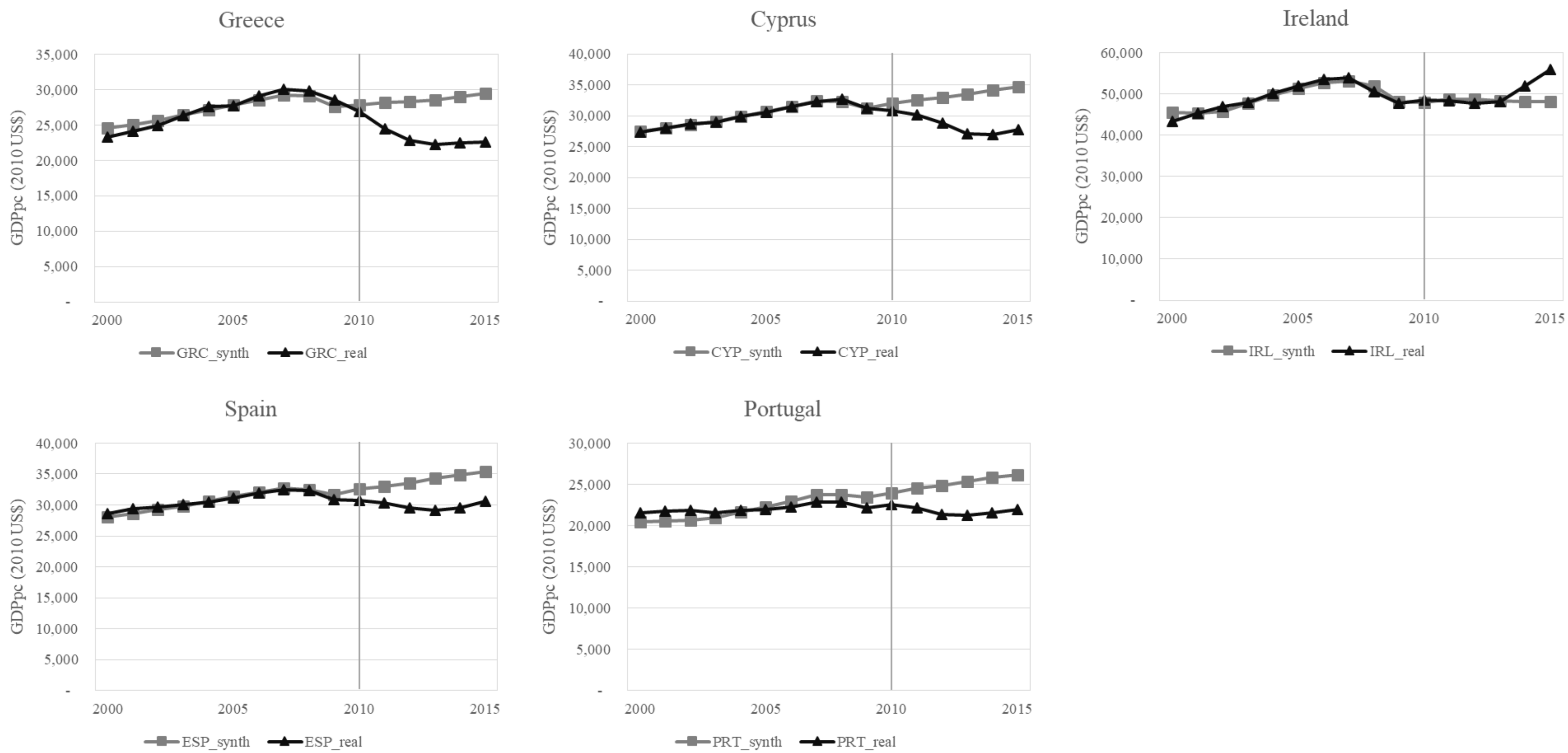
Note: Sudden stop episodes are based on Eichengreen et al (2006). Systemic Banking crisis episodes are based on Laeven and Valencia (2012). Further conditions impose a current account adjustment of at least 3p.p. and excludes Least Developed Countries. See text for further details.

Appendix 7. Matching table for sudden stop counterfactual and systemic banking crisis counterfactual

	Sudden stops					Systemic banking crises				
		(1)		(2)			(1)		(2)	
Covariates	EZ	avg	PSM	avg	PSM	EZ	avg	PSM	avg	PSM
C/A adjustment	11.8	**7.0**	10.1	**7.0**	12.6	11.8	8.2	8.8	8.1	12.6
		[0.018]	[0.480]	[0.018]	[0.536]		[0.260]	[0.366]	[0.224]	[0.877]
Public debt-to-GDP	78.1	49.7	67.4	51.5		63.6	47.4	66.5		
		[0.074]	[0.604]	[0.130]			[0.349]	[0.898]		
Pre-crisis GDP growth	1.8	3.0	2.6			2.3	3.4	1.9	3.5	2.4
		[0.300]	[0.556]				[0.438]	[0.671]	[0.399]	[0.937]
Openness	89.8	51.5	88.0		107.7	87.3	83.0	89.2	79.3	84.5
		[0.130]	[0.963]		[0.602]		[0.858]	[0.946]	[0.740]	[0.902]
Pre-crisis investment growth	-0.5	-0.7	-1.0	-0.7	-1.2	0.2	0.3	0.1	0.3	0.3
		[0.592]	[0.397]	[0.592]	[0.278]		[0.929]	[0.682]	[0.817]	[0.854]
Credit to GDP	163.1			**58.4**	104.5				**84.1**	152.2
				[0.002]	[0.197]				[0.032]	[0.878]
p-value of χ^2		**0.047**	0.622	**0.010**	0.232		0.598	0.950	0.139	0.996

Note : Results based on propensity score matching estimator and logit treatment model. See Table 4 for details on the individual specifications. Avg indicates the simple average for all covariates across the donor pool. χ2 tests the joint significance of all regressors. p-values testing significant difference with the EZ in parentheses. p<0.05 in bold.

Appendix 8. SCM country-specific simulations



Appendix 9. Effect of lags on log GDP per capita

The table below reports standard tests on different lag specifications for the dynamic panel regression model introduced in Section V. Going beyond the 4 lags does not seem to increase the estimation power of the model. While only the first lag is consistently significant, the Augmented Dickey-Fuller test fails to reject that there might be a unit root in the panel under the 1 lag specification. Therefore, on balance, the 2 and 4 lag models seem the most reasonable for our purposes, and are thus those considered in the main body of the text.

	1 lag	2 lags	4 lags	6 lags	8 lags	10 lags
	(1)	(2)	(3)	(4)	(5)	(6)
log GDP first lag	0.712	0.708	0.702	0.697	0.684	0.683
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
log GDP second lag		0.003	0.002	0.002	0.002	0.000
		(0.791)	(0.685)	(0.653)	(0.714)	(0.961)
log GDP third lag			0.002	0.003	0.002	0.000
			(0.481)	(0.425)	(0.520)	(0.896)
log GDP fourth lag			-0.001	-0.007	-0.008	0.000
			(0.906)	(0.444)	(0.426)	(0.980)
p-value first four lags	-	-	[0.000]	[0.000]	[0.000]	[0.000]
p-value additional lags	-	-	-	[0.761]	[0.914]	[0.922]
Augmented Dickey-Fuller p-value	[0.131]	[0.011]	[0.000]	[0.912]	[0.990]	[0.996]
Observations	6096	6045	5940	5827	5698	5556
Countries in sample	176	176	176	176	175	175

Notes: This table presents estimates of lagged GDP per capita on GDP per capita. In each column we add a different number of lags as specificed in the column table. Only the coefficients of the first four lags are reported. Below each model we report the p-value for a test of joint significance of the first four lags, and the p-value of the additional lags. I report the p-value based on the inverse normal statistic of a Dickey-Fuller test of unit root. P-values based on robust standard errors in parentheses.

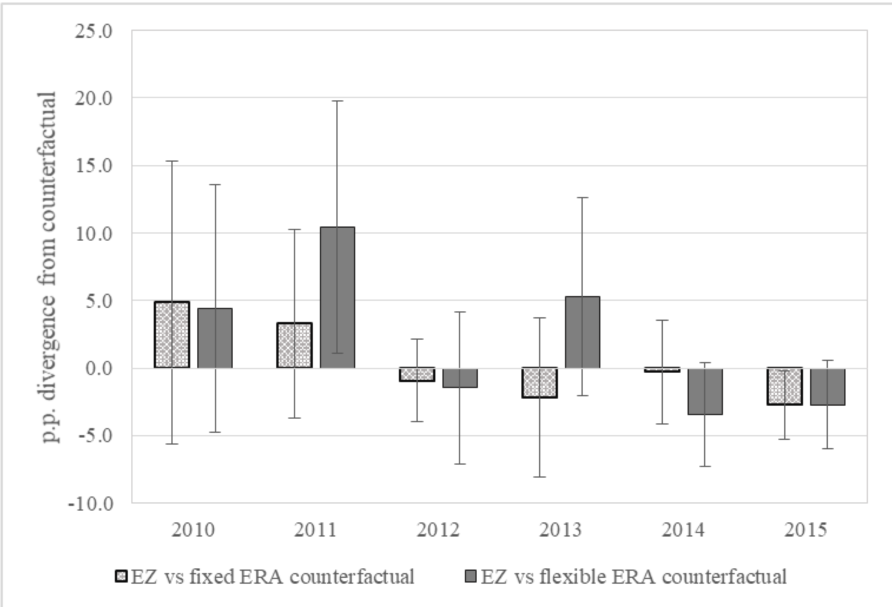
Appendix 10. Matching table for fixed and flexible ERA counterfactuals

		Counterfactual based on comparable past macroeconomic adjustment episodes under:					
		Fixed Exchange Rate Arrangements			Flexible Exchange Rate Arrangements		
Covariates	EZ	(1)	(2)	(3)	(4)	(5)	(6)
C/A adjustment	11.8	11.2	10.5	15.8	11.7	8.0	13.9
		[0.861]	[0.732]	[0.377]	[0.971]	[0.176]	[0.615]
Public debt-to-GDP	91.3	81.6	88.8		93.8	117.0	
		[0.670]	[0.918]		[0.941]	[0.388]	
Pre-crisis GDP growth	0.2	0.2	0.7	-0.5	0.9	0.8	-0.1
		[0.945]	[0.711]	[0.686]	[0.615]	[0.698]	[0.886]
Openness	91.9	78.8	78.1	98.4	76.3	124.5	109.0
		[0.565]	[0.572]	[0.768]	[0.577]	[0.616]	[0.522]
Pre-crisis investment growth	-1.0	-0.5	-0.9	-2.4	-1.1	-1.2	-1.9
		[0.576]	[0.917]	[0.172]	[0.880]	[0.761]	[0.419]
Credit-to-GDP	161.5			74.8			142.8
				[0.087]			[0.471]
	p-value of χ^2	0.972	0.986	0.328	0.965	0.448	0.790

Note: Results based on propensity score matching estimator and logit treatment model. See Table 7 for details on the individual specifications. $\chi 2$ tests the joint significance of all regressors. p-values testing significant difference with the EZ in parentheses. $p<0.05$ in bold.

Appendix 11. Real Effective Exchange Rate correction

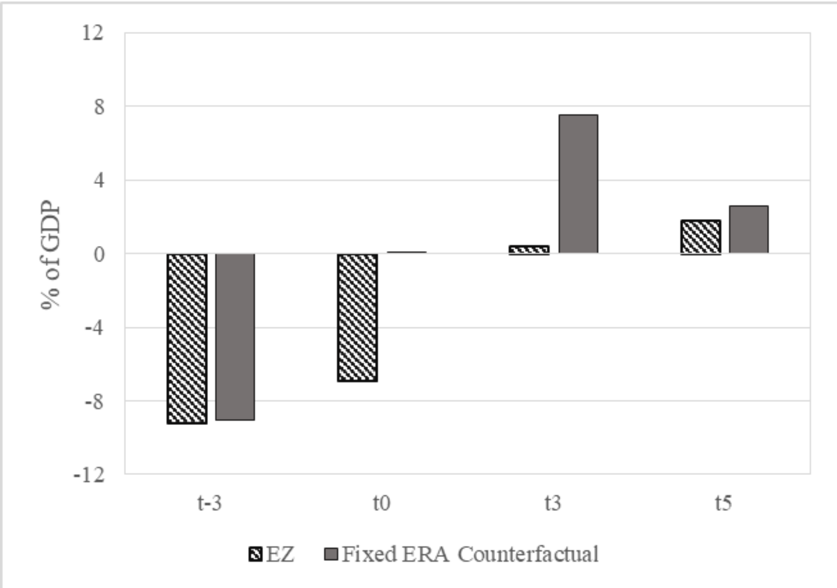
To explore further the differential dynamics of price competitiveness adjustment under fixed- and flexible- exchange rate arrangements, I accessed annual REER data, based on CPI, for 178 countries from Darvas (2012). I then looked at divergences between the EZ and its fixed/flexible ERA counterfactual over the period 2010-2015, in line with the approach of Section VI. Beta coefficients[21] are displayed in the Figure below. First, it is interesting to note that there is no significant difference between the EZ and adjustment under other fixed ERAs, at least until 2014. On the other hand, at t+1 (2011) the flexible counterfactual was regaining competitiveness at a faster pace than the EZ. Though significant only at the 10%-level, it looks like the EZ started successfully regaining price competitiveness at a faster pace than counterfactual only from 2014 onwards. We can therefore conclude that having a flexible exchange rate did help the counterfactual regain competitiveness after a shock more quickly than in the EZ setting.



[21] Specifically, Model 1 and 4 specifications from Section VI used.

Appendix 12. Speed of current account correction

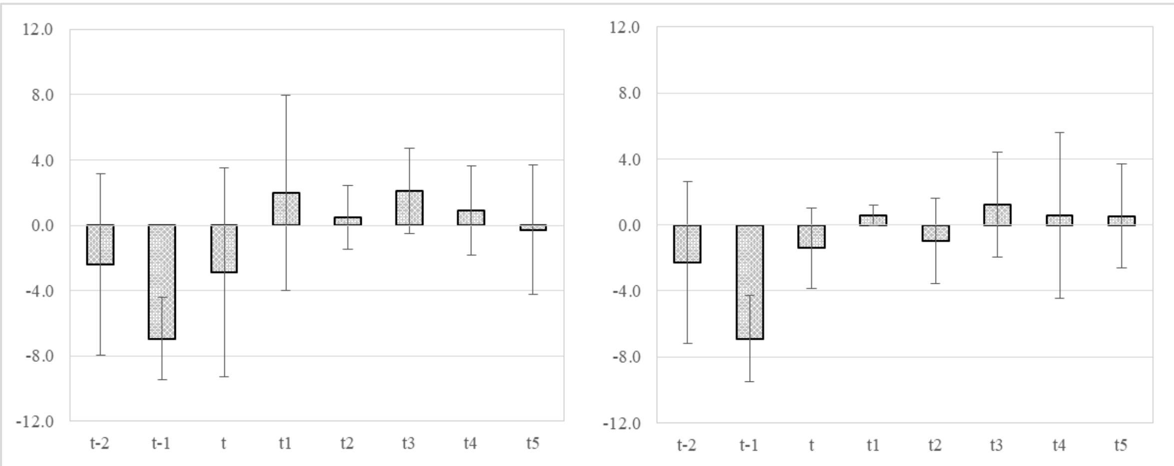
Echoing the results discussed in Section VI, I look at the current account (CA) balance in the EZ crisis countries and the Fixed ERA Counterfactual. The Figure below shows the CA balance at t-3, t, t+3, and t+5. It can be seen that before the GFC, the EZ crisis countries and their counterfactual had the same large current account deficit (roughly -9% of GDP). Similarly, at the end of period, the EZ crisis countries and their counterfactual had a comparable CA surplus. However, the current account correction in the counterfactual was much more abrupt, and by the end of t0, the counterfactual had already balanced its CA. In the EZ, a balanced CA was reached only in 2013. This reinforces the finding that being in a monetary union shielded the EZ crisis countries from having to undergo a sudden current account correction, as is often the case in Balance of Payment crises.



It must be noted that the CA improvement between t0 and t+3 was similar for the EZ and the counterfactual (roughly 7p.p.) and, once again, this reiterates the finding that the external dimension does not contribute significantly to explain the poor GDPpc performance observed in the EZ in 2011-2013.

Appendix 13. Fiscal consolidation

This Appendix discusses differences between the EZ crisis countries and their Fixed ERA counterfactual, for what concerns their fiscal policy decisions. First, I test whether EZ crisis countries were running a disproportionately loose fiscal policy vis-à-vis counterfactual in 2007, and observe no statistical significance within our standard 5% level of confidence (p=0.078). If at all, the (positive) point estimate suggests a more conservative fiscal policy on average in the five EZ crisis countries[22]. This is in line with the arguments brought forward by Baldwin et al (2015, p. 2), who stress how "*the EZ Crisis should not be thought of as a government debt crisis in its origin – even though it evolved into one*". Furthermore, I look at divergences in the change in the primary balance. The figure below (LHS) shows the PSM beta-coefficients, in line with Table 8 in Section VI. As a robustness check, the RHS panel displays computations for the same beta-coefficients, however excluding Ireland, which experienced a very high volatility in primary balance in 2010-2011 due to its unconditional bank guarantee. Negative (positive) values indicate a disproportionately expansionary (contractionary) fiscal policy decision in the EZ crisis countries.



First, we note that in 2008 there were no clear differences in fiscal policy decisions. In 2009, as discussed in the main text, automatic stabilisers and bank rescue mechanisms were activated in the EZ, leading to a strongly countercyclical fiscal policy. From then onwards, even if point estimates turn positive, we do not observe significant differences between the EZ crisis countries and the counterfactual. This is true also when Ireland is excluded, leading to a compression of error terms in 2010-2011[23]. What this suggests is that disproportionate fiscal austerity in the EZ crisis countries was likely due to higher financing costs.

[22] While true on average, this argument must not necessarily apply to all individual crisis countries.
[23] In an alternative specification, I exclude Greece. The main findings stand confirmed. (results available upon request)