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Union 2010-16**

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The determinants of austerity in the European Union 2010-16

Roberto Tamborinia^a, Matteo Tomaselli^b

Abstract

This paper aims at explaining what drove the adoption of austerity policies over the period 2010-16 in a panel of 28 European countries. Austerity is identified by year increases in the ratio between the structural primary balance and potential GDP. By means of principal component factor analysis we select the aggregate factors that might affect austerity, namely (i) fiscal consolidation (correction of high deficits and debts), (ii) market discipline (high sovereign spreads, low ratings), (iii) rule-based fiscal discipline (compliance with the Eurozone rules), and macroeconomic stabilisation (consideration for the cyclical position of the economy). Then we estimate a dynamic panel model with the system-GMM method. Results show that the most important contributions to austerity are provided by the market discipline and fiscal consolidation factors together with Excessive Deficit Procedures, with no significant role played by concomitant macroeconomic conditions. Overall, governments complied with orthodox fiscal principles and rules.

Keywords: Austerity, Fiscal reaction functions, Principal component factor analysis, Dynamic panel data analysis.

JEL Codes: E6, E62, E65

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1 Introduction

Austerity stands for the adoption of fiscal consolidation measures aimed at correcting financial imbalances and stabilise public debt. Research on the relationship between fiscal consolidations and economic activity is vast, varied, and still unsettled. On the other hand, what determines the adoption and the intensity of austerity policies is less thoroughly investigated. The most recent and widespread wave of austerity policies took place in Europe between 2010 and 2016. Were they primarily induced by European fiscal rules or were they the response of governments to excessive and increasing public debts and deficits? Were they influenced by financial market pressures, and what was the role played by the cyclical position of the economies? These are the questions addressed in this paper by means of the econometric analysis of a panel of 28 countries of the European Union (EU) both members and non-members of the Eurozone (EZ) from 2010 to 2016. These questions are particularly relevant for the EZ in relation to the debate about whether the existing system of fiscal rules is an effective driver of fiscal discipline as a complement of, or substitute for, other factors (Schuknecht et al. 2011, Wyplosz 2013, Giudice and Buti 2017).

Pooling EZ members and non-members together is important in order to identify the role of fiscal rules that, formally, only apply to EZ members. The time window has been chosen in accordance with other researches on European austerity (e.g. Alesina et al. 2015, Tamborini 2015, House et al. 2017). This is arguably a relatively narrow window, which combined with a not so large number of countries, results in a limited number of observations that challenges econometric analysis. On the other hand, an observation set circumscribed in time and space has also benefits. One lesson to be drawn from the ongoing extensive empirical research on fiscal policy is that results depend on a wide array of historical, economic, institutional and contingent factors. In this respect, the EU, and the EZ in particular, represent a unique "field experiment" of a large number of countries where some factors conditioning fiscal policy are common and exogenous, namely fiscal targets and rules, monetary policy, the exchange rate with the rest of the world. Moreover, our limited and well-defined time window may reduce the presence of significant "regime shifts" in general economic conditions, with predominant low growth, low inflation, policy interest rates at the zero-lower bound. All this facilitates better specification of the estimation model and robustness of its results with respect to flimsy attempts at world-wide, all-time, generalisation. This and other methodological issues will be discussed in section 4.

As austerity measure we have adopted the official indicator of fiscal stance of the European Commission (EC), namely the structural primary balance (STPB) as a ratio of potential GDP (PGDP), and considered four sets of factors, or channels, each consisting of one or more individual variables, that are introduced and described below: fiscal consolidation (the will to correct public finance flow-stock imbalances), market discipline (the pressure exerted by international investors), rule-based fiscal discipline (compliance with the fiscal rules of the EZ) and macroeconomic stabilisation (consideration for the cyclical position of the economy). As shown below, these general factors, and the relevant variables that may represent them, have been selected in light of the literature.

The econometric analysis of the whole pooled-panel setting, aiming at formally estimating and comparing the determinants of austerity, has been conducted in two steps. First, in order to extract some meaningful indicators from the considered variables of the dataset, thus reducing their number, the four composite factors mentioned above have been identified by employing the Principal Component Factor Analysis (PCFA). Second, we have moved to the estimation of the whole pooled- panel model regressing the austerity indicator on the four factors with the system-GMM method introduced by Arellano and Bover (1995), and Blundell and Bond (1998).

In the subsequent part of the paper, section 2 provides descriptive data on the adoption of austerity in the EU from 2010 to 2016. Section 3 surveys the literature in order to select the relevant channels and variables that may drive austerity policies. In section 4 we outline the econometric methodology and present the estimation results. They show that the most important contributions to austerity are provided by market discipline and fiscal consolidation factors. The rule-based fiscal discipline factors have the expected positive signs (i.e. they correlate with more austerity) but only the Excessive Deficit Procedures (EDP) enacted by the EC¹ are statistically significant. Also belonging to the group of most distressed countries with "Trojka" treatment is associated with significantly higher austerity levels. There is no significant evidence of macroeconomic stabilisation factors, that we interpret in the sense that the other significant factors have driven austerity unconditionally or that austerity was enacted regardless of macroeconomic conditions. Overall, the argument that governments did not comply with orthodox

¹ Defined as "an action launched by the European Commission against any European Union (EU) Member State that exceeds the budgetary deficit ceiling imposed by the EU's Stability and growth pact legislation." For further details, see the website of the European Commission (https://ec.europa.eu/info/index_en).

principles of public finance, and that the crisis was exacerbated by non-compliance, does not find support in the period under consideration. Nor is it supported the complaint that the EZ regulatory apparatus was bypassed or remained ineffective. Though in conjunction with other pressing factors, it contributed to induce fiscal discipline. Still, the considered variables and common factors are unable to comprehensively explain austerity. Finally, section 5 summarises and concludes.

2 Austerity in the European Union, 2010-16

Several different measures of austerity are available in the literature. In the first place, austerity is identified with *net changes* in the public sector's budget (generally as a ratio of GDP) that reduce a current deficit or increase a current surplus. However, what components of the budget are to be considered is open to different choices depending on the purpose of analysis. When the aim is to track the government's policy choices, this is generally obtained by subtracting the items that are not under direct control of the government (at least in the short run), namely those sensitive to the business cycle, and the interest payments on outstanding debt. The result is the "cyclically adjusted primary balance" (CAPB). A further refinement seeks to identify budgetary operations that are permanent, or "structural", and those that are temporary (some of which may also be anti-cyclical in nature), leading to the "cyclically adjusted structural primary balance" (STPB). Hence the ratio between STPB and potential GDP (PGDP) is now the official measure adopted by the EC (EU Commission 2013). Accordingly, we have measured austerity in country i , year t (A_{it}) as the positive change in the STPB/PGDP ratio over the previous year $t-1$, that is:

$$(1) \quad A_{it} = \frac{STPB_{it}}{PGDP_{it}} - \frac{STPB_{it-1}}{PGDP_{it-1}} > 0$$

Yet the STPB has been adopted, and the official data are available, from 2010, which implies that A_{it} is calculable only from 2011. Therefore, for 2009-10 we have resorted to the CAPB² (further details are presented in the Appendix).

We have created a balanced panel dataset containing yearly data over the period 2010–2016 of 28 EU countries. For preliminary data analysis four groups are considered. The primary distinction is between the members of the EZ³ and the

² As can be expected, the two indicators follow similar paths, but CAPB is quite more variable than STPB.

³ Austria, Belgium, Cyprus, Estonia, Finland, France, Germany, Greece, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Portugal, Slovakia, Slovenia, and Spain.

non-members (NoEZ)⁴. Additionally, the EZ members can be distinguished in two subgroups: the first includes the more fiscally sound countries (EZ7)⁵, while the second includes the countries that experienced either debt or bank crises and programmes of financial assistance (EZ5)⁶.

We shall now proceed to examine the characteristics, analogies and differences in austerity in the sample of countries under consideration, with particular focus on the timing and intensity of the adopted policies.

Within the fiscal consolidation literature, the first two critical characteristics are timing and intensity, that should go hand in hand. The first key ingredient in the recipe for successful austerity is an "ambitious", front-loaded restoration of sustainable public finances that stops speculative attacks, regenerates investors' confidence, and regains access to the debt market at lower interest rates. According to the evidence analysed by Buti and Pench (2012), gradual consolidations seem more likely to be successful, but gradualism may be harmful for countries starting with high debt levels and major financial distress. From this point of view, the austerity indicator given by equation (1) and depicted in Figure 1 (left) allows for the following considerations.

[Figure 1]

As to timing, almost all the countries in the dataset took the austerity stance in 2010 which peaked in 2012-13. The adoption of these fiscal adjustments was in part due to the 2010 generalized partial recovery that followed the massive fiscal stimuli of 2009; it was, however, a short-lived spring followed by further slowdown in the subsequent years. Nonetheless austerity was continued after 2012, though at a declining pace which petered out in 2014-15.

Looking at groups of countries, it is worth noting that the EZ and the NoEZ enacted roughly the same average amount of austerity in 2010-11, but they then followed a slightly different time path: the EZ shows a "front-loading" pattern peaking in 2012, whereas the NoEZ displays a smoother pattern up to 2013, which was abruptly reversed in 2014.

There are other interesting differences within the groups. In the EZ, the austerity turn was largely driven by the most financially distressed group (EZ5, and notably Greece and Portugal) averaging around 3.2% of GDP in 2011. The EZ7 group of the more fiscally sound countries followed a smoother path. Therefore,

⁴ Bulgaria, Croatia, Czech Republic, Denmark, Hungary, Poland, Romania, Sweden, and the UK.

⁵ Austria, Belgium, Finland, France, Germany, Luxembourg, and Netherlands.

⁶ Cyprus, Portugal, Greece, Ireland, and Spain.

large and "front-loaded" austerity within the EZ has been concentrated in the EZ5 countries.

To complete this first overview of the data with the intensity of austerity, it should be considered that austerity is usually viewed as a medium-term policy. Hence, we also take into consideration an additional indicator, the *cumulated austerity* from 2010 to 2016, that is:

$$(2) \quad CA_{it} = \sum_{t=2010}^{2016} A_{it}$$

This indicator represents the overall intensity of the successive austerity injections whether front- or back-loaded – see Figure 1 (right). 23 countries cumulated a net fiscal restriction ($CA_{it} > 0$), 20 of which larger than 1%. The EZ has been more restrictive than the NoEZ, 4% and 2.3% respectively.

Yet it is already known that the most severe restrictions were realized in the EZ5 reaching 9.9% on average (which includes the countries on the top of the list: Greece 18.6%, Ireland 9.3%, Portugal 8.1%, Cyprus 6.7%, and Spain 6.8%). This is equivalent to saying that the average EZ5 country cut its STPB at a year pace of about 1.4% of GDP over seven years. Among the other EZ countries, one case stands out: Slovakia was involved in a debt crisis and asked to adopt large fiscal consolidations. The EZ7, instead, cumulated substantially less austerity up to 1% (with France, however, reaching 2.6% and Netherlands 3.1%). Within the NoEZ there are no significant differences on average, but it is worth pointing out a few exceptions of countries with CA_{it} well above the average like Romania (6.4%) and Croatia (5.7%).

In the light of this first overview of the data, we may draw two conclusions. First, the "euro dummy" *per se* does appear important, but austerity has been "freely" pursued across the whole EU. Are there common cogent reasons or maybe that austerity has been perceived, or advertised, as the right policy in the aftermath of the crisis throughout the developed Western countries (see e.g. Blyth 2013)? Second, austerity has been implemented and then relaxed in different ways as to its timing and overall intensity. This holds true especially among EZ countries, despite their being subject to the same rules and to common surveillance institutions. As argued by EC officials, diversification and flexibility have in fact been actively pursued in application of the recent modifications of the relevant fiscal rules (Buti and Carnot 2013, p. 3).

Under all dimensions, austerity has been most severely enacted in the EZ5 under the worst public finance distress, which clearly stands out as the epicentre of the EU austerity. On the one hand, this evidence may appear justified by their financial threats; on the other hand, one may wonder why almost all other

countries were also pushed into austerity to a non-negligible extent. Thus, we would qualify the EZ experience as one of "uncoordinated austerity", which may have created unfavourable conditions for the countries facing stronger pressure for fiscal consolidation.⁷

In historical perspective, the figures presented here depict a unique sequence of large, simultaneous fiscal restrictions across the whole EU. However, significant differences have also emerged, and it is therefore important to try to characterize them. Therefore, a deeper analysis is required to find out what has driven the adoption of austerity measures.

3. In search of explanatory variables

In search of explanatory variables of austerity, we sorted out four groups that can be found, whether positively or normatively, in the literature: fiscal consolidation, market discipline, rule-based fiscal discipline, and macroeconomic stabilisation.

3.1 Fiscal consolidation: public deficits and debts

The first group relates to "*fiscal consolidation*" and includes public deficits and debt stocks, two variables that are commonly adopted for fiscal sustainability analyses.

The relationship between budget policy and sustainability is the main purpose of the estimation of the so-called "fiscal reaction functions" (FRFs henceforth) introduced by the seminal works of Bohn (1995, 1998)⁸. For instance, Afonso and Jelles (2011) employ FRFs in a set of OECD countries showing that primary balances have been increased to deal with the raise in public debt levels. This result is in line with Berti et al. (2016), who show that most of the European countries included in their analysis positively adjusted their fiscal balances to

⁷ On the problem of uncoordinated fiscal adjustment plans in the Eurozone, see Tamborini (2015), Berti et al. (2013), in't Veld (2013).

⁸ Bohn (1995, 1998) introduced the analysis of the response of primary balance to changes in the public debt caused by economic shocks. According to Proposition 1 in Bohn (2008), the basic FRF equation consists of the following linear relationship between the two variables:

$$s_t = \rho \cdot d_t^* + \varepsilon_t$$

where s_t is the primary balance of period t as a fraction of GDP, ρ is a constant, d_t^* is the initial debt-to-GDP ratio, and ε_t is a composite of other determinants. If ε_t is bounded as a share of GDP and the present value of GDP is finite, then $\rho > 0$ satisfies the economy's intertemporal budget constraint and the no-Ponzi game condition, thus indicating fiscal sustainability.

rising levels of public debt, though with great variability, and with Gosh et al. (2013), who show evidence of fiscal fatigue within a set of 23 advanced countries.⁹ Another application is provided by D’Erasmus et al. (2016), who adopt, among other techniques, FRFs to assess debt sustainability in USA and Europe, raising some concern about fiscal sustainability, while Legrenzi and Milas (2013) find clear evidence of fiscal fatigue for Greece, Ireland, Portugal and Spain. In addition, it seems that all countries adjusted fiscal imbalances only in the higher debt regime.

In contrast with these findings, more recent works have found that the fiscal fatigue hypothesis may not hold or may not hold for all countries (see, among others, Checherita-Westphal and Ždárek 2017, Everaert and Jansen 2017, Weichenrieder and Zimmer 2014), thus casting some doubts on the validity of the previous results.

In the first place, let us examine the evolution of the deficit-to-GDP ratios from 2010 to 2016., reported in Figure 2 (left).

[Figure 2]

As austerity was a generalized policy, so all countries have progressively brought their deficit-to-GDP ratio under control. In the EZ, the average indicator fell from 6.8% to 0.8% in 2016. While in 2010 all EZ countries (except Finland, Malta, and Luxembourg) were above the 3% ceiling, in 2016 only two (France and Spain) were above that threshold. Interestingly, even countries with no formal deficit-to-GDP target moved in tandem with the EZ: the average NoEZ deficit was cut from 5% to 1.2% in 2016, though UK and Romania still had deficits three times larger than the average.

The other key variable for fiscal consolidation is the evolution of the debt-to-GDP ratio. As shown by Figure 2 (right), on this front austerity has been less effective than in the case of deficits in all groups of countries. Starting from 2010, debt-to-GDP ratios have consistently been rising everywhere. EZ and NoEZ have followed very similar paths, but it should be noted that the EZ includes the strongest debt accumulators, that is the EZ5 countries (in particular, Greece). For this group of countries, a considerable decrease in the average debt-to-GDP ratio can be observed starting from 2014, but this tendency reversed again in 2016. Yet the fact that debt-to-GDP ratios were poorly controlled, at least in some countries, does not imply that they did not exert pressure for fiscal consolidation.¹⁰

⁹ According to Gosh (2013), fiscal fatigue is the situation in which the increase in public debt is not compensated by an equivalent growth in the primary balance.

¹⁰ The inability of austerity to curb the debt-to-GDP ratio, mainly for GDP falling faster than debt, is matter of lively debate: see e.g. De Grauwe and Ji (2012, 2013), Berti et al. (2013), House et al. (2017).

3.2 Market discipline: sovereign bonds, ratings and spreads

The second group of explanatory variables relates to "*market discipline*", which includes the interest rate spread and the rating of sovereign bonds. These are reproduced in Figure 3.

[Figure 3]

Indeed, yield spreads and credit ratings are commonly considered as devices that can incentivise the adoption of sound fiscal policies. However, departures from this idea can be found in the literature: finding that investors force governments into austerity (e.g. Born et al. 2018) does not mean that "the markets are right". The question whether sovereign spreads (and ratings) reflect fundamental factors correctly is debated, and several studies point to a negative answer. Zuccardi (2015), for instance, observes that, within the EZ, the relationship of spreads with the economic fundamentals (fiscal balance, public debt, and GDP growth rate) is weaker than in other areas, a fact that is also recognised by Ullrich (2006) who claims that "the confidence that financial markets are able to discipline the debt behaviour of governments is not very high". In the same line, Favero and Missale (2012) justify the issuing of Eurobonds on the basis of the fact that market discipline is weakened when contagion effects and market irrationality are more relevant than the fiscal fundamentals of the countries. De Grauwe and Ji (2012, 2013) provide evidence of mispricing of sovereign bonds in the EZ and of the "excessive austerity" imposed by markets. All in all, the role of government bond spreads and credit ratings as *correct* discipline devices seem weak for the EZ countries, but they may have played a role for the adoption and the intensity of the austerity policies.

Risk premia are usually measured as the spread S_{it} of a specific interest rate over the benchmark interest rate. In this context, the benchmark is the yield rate of the German ten-year government bond¹¹. As shown in Figure 3 (left), the surge of spreads was confined within the EZ; outside, only a few EU countries recorded spreads above say 300 basis points (notably Bulgaria, Hungary, and Romania), a fact that De Grauwe and Ji (2012) ascribe to the "euro dummy". However, the truly dramatic escalation of spreads occurred for the EZ5 countries under public debt attack, and in particular in Greece, the absolute outlier reaching 13.1% in 2011

¹¹ As described in the Appendix, the spread is obtained from the yield on the government bonds denominated in national currency, and it inevitably reflects the expected depreciation of the domestic currency of the NoEZ countries against the euro. Even so, it captures the sovereign risk premia (and thus the market pressure) to which the government is expected to react and is suitable for the purposes of the current analysis.

and 21% in 2012. The EZ7 group (Germany excluded) show a limited impact of spreads.

Spreads go hand in hand with another variable in the dataset: sovereign bond ratings. We have elaborated the annual weighted average of the Standard and Poor's ratings, converted into numbers between 0 and 1 so that the highest rating (AAA) corresponded to the highest value (1), and the lowest rating (D: default) corresponded to the lowest value (0).¹² Ratings, like spreads, capture the market pressure on sovereign yields: the negative correlation between the two variables (-0.76) indicates that the higher the rating, the lower the spread. Figure 3 (right) shows a pattern similar to spreads, with the worst deterioration concentrated in the EZ5 countries.

3.3 Rule-based fiscal discipline

EZ governments obey to specific policy obligations in force of the EZ regulations. In particular, whenever a member state breaches the deficit threshold of 3% of GDP, or is going to breach it, or has a public debt level above 60% of GDP that is not diminishing at a satisfactory pace¹³, the EC can first send an Early Warning and then it can open an EDP if corrective actions are not taken or are insufficient to reverse the situation. The EDP is abrogated when the excessive deficit is corrected in a "durable manner". Therefore, the third factor, "*rule-based fiscal discipline*", formally applies to the EZ membership, and it includes EDPs and the public finance forecasts of the EC.

In the first place, we included in the econometric model an "euro dummy" that captures the effect of being (*Euro* = 1) or not being (*Euro* = 0) part of the EZ. The EDP and the Stability and Growth Pact have attracted much attention in the literature — into which we do not enter — aiming at assessing their impact and evaluating the possible alternatives (see, for instance, Eichengreen 1997, Artis and Winkler 1998, Schuknecht et al. 2011, Wyplosz 2013, Giudice and Buti 2017). Some authors lament their lack of enforcement and efficacy as discipline devices. EDPs are introduced in the econometric model as a dummy variable that is equal to 1 from the year of the EDP opening to the year of its abrogation. According to the EC, between 2009 and 2014 almost every country in the dataset experienced such a procedure. The expectation is that EDPs might induce more austerity.

¹² Ratings are translated from letters to numbers between 0 and 1. See the Appendix for further details.

¹³ This means that the gap between a country's debt level and the 60% threshold needs to be reduced by 1/20th annually (on average over a period of three years).

In Spring and Autumn each year the EC releases forecasts on the evolution of public finances relevant to the EDP. Suppose the EC foresees an excess deficit, then a government may implement a correction in order to prevent the EDP.¹⁴ Therefore, we have constructed the following fiscal forecast variable:

$$(3) \quad FF_{it|t-1} = \left(\frac{STPB}{PGDP} \right)_{it|t-1} - \left(\frac{STPB}{PGDP} \right)_{it-1}$$

where $\left(\frac{STPB}{PGDP} \right)_{it|t-1}$ is obtained from the average of the two EC forecasts presented in Spring and Autumn. For some years/countries, the STPB is not available and is replaced by the CAPB.

3.4 Macroeconomic stabilisation

To complete our analysis, let us now turn to the factor that may countervail the other pressures towards austerity, "*macroeconomic stabilization*", namely the cyclical position of the economy. Preliminarily, it should be considered that our austerity measure, the STPB, is already depurated from the systematic cyclical components of the budget and from other one-off measures, some of which may be taken to stabilise the economy. Hence, one might expect no correlation between the STPB and the business cycle. Nonetheless, it may still be the case that the entity of STPB restrictions induced by the previous factors may be countervailed by negative economic conditions, resulting in some *positive* correlation.

Though central to modern macroeconomics, the measurement of business cycles remains difficult and controversial. We took into consideration the two basic measures related to GDP (Y_{it}). The first is simply the year growth rate of GDP (gY_{it}), which can be justified for being simple, "objective", widely adopted and, therefore, of direct concern of governments as they should decide their policies (Figure 4 (left)). The other measure is the official output gap (OG_{it}) used by the EC itself to extract the budgetary cyclical components (Figure 4 (right)). However, output gaps are non-observable directly, and have more a "normative" content, hence one may expect that fiscal policy decisions are less connected with them than with actual GDP fluctuations.

[Figure 4]

¹⁴ Moreover, the most recent literature argues that in measuring the effect of fiscal policy on other macroeconomic aggregates, most researchers do not take into account the effects on the same aggregates due to potential news anticipating future fiscal actions (e.g. Leeper et al. 2013, Auerbach and Gorodnichenko 2012, Fragetta and Tamborini 2017). The same principle may then be extended to governments themselves.

The first observation is that both indicators are highly correlated across countries, though with different amplitude and duration. Second, it is worth noting the "double dip" recession suffered by the EZ in 2012. Third, all groups of countries have constantly remained in negative output gap for the whole period. Once again, the EZ5 shows these phenomena on a larger scale.

A last variable to be considered is the unemployment rate (UR_{it}). Commonly employed in the FRF literature, unemployment is one of the main concerns for governments, and policies are usually adjusted according to it. Changes in unemployment can also be an indicator of the business cycle; in our dataset it is negatively correlated both with the output gap (-0.44) and the GDP growth rate (-0.62). Figure 5 depicts the first differences of the unemployment rate.

[Figure 5]

While unemployment levels created by the Great Recession were quite high for all countries, year-by-year adjustments in the period under consideration were more uneven. In the EZ5 countries unemployment kept on rising at a consistent pace until 2012, in the other countries and the EZ as a whole the increase in unemployment was more moderate. Recovery took place after 2013-14 in almost all countries.

Overall, the macroeconomic picture of the period under consideration was severely deteriorated under all dimensions, so that it may be expected some countervailing effect on austerity policies, possibly in addition to the automatic stabilizers depurated from the calculation of the STPB. As a first inspection of the data by means of the group frequency data of procyclical occurrences of A_{it} , it is possible to claim that, of the global 196 observations, 124 (63.3%) are restrictions ($A_{it} > 0$). Of these, 15.8% are concomitant with $gY_{it} < 0$, and 53.1% with $OG_{it} < 0$. Hence, globally, fiscal restrictions were realized during actual recessions in a minority of cases, whereas the signal given by output gaps was almost ignored (after the "discount" determined by consideration of the negative gap in the EDP). More problematic is the case of the EZ5, with much higher occurrence of fiscal restrictions during actual recessions (42.9%) and with negative output gaps (65.7%). These data suggest that STPB restrictions largely occurred independently of the cyclical position of the economy.

4 Econometric analysis

In this section we present the results of estimations of the pooled-panel model of all countries and variables. As a complement to previous analysis, the present

one will provide information on the explanatory power of each variable while taking all of them into account simultaneously. We start with a methodological note, and then we proceed with the results.

4.1 Methodology and data

In order to estimate the effect and explanatory power of the four sets of variables on austerity, we chose the system-GMM estimator introduced by Arellano and Bover (1995) and Blundell-Bond (1998). This estimator is designed for dynamic panels characterised by a relatively small number of time periods and a large number of individuals that may contain fixed effects and idiosyncratic errors that are heteroskedastic and correlated within individuals (but not across individuals, i.e. cross-sectional dependence is not allowed).¹⁵

Given the dependent variable, the austerity measure A_{it} , the econometric model can be written as:

$$(4) \quad \begin{aligned} A_{it} &= \alpha A_{it-1} + \beta_1' x_{it} + \beta_2' w_{it} + u_{it} \\ u_{it} &= v_i + e_{it} \end{aligned}$$

where $i = 1, \dots, N$ is the number of individuals (countries) and $t = 1, \dots, T$ is the number of time periods; α is a scalar; x_{it} is a $(K \times 1)$ vector containing K strictly exogenous explanatory variables and β_1 is the corresponding $(K \times 1)$ vector of coefficients; w_{it} is a $(J \times 1)$ vector containing J predetermined and endogenous explanatory variables and β_2 is the corresponding $(J \times 1)$ vector of coefficients; v_i are the unobserved individual effects, and e_{it} are the idiosyncratic errors. As shown in Roodman (2009), it is assumed that:

$$(5) \quad \begin{aligned} E[v_i] &= E[e_{it}] = E[v_i \cdot e_{it}] = 0 \\ E[e_{it} \cdot e_{js}] &= 0 \quad \forall i, j, t, s \quad i \neq j \end{aligned}$$

We considered the following explanatory variables introduced in the previous section:

- $EDEF_{it}$: the excess of the current (year t) total deficit-to-GDP ratio of country i over the 3% ceiling used by the EC
- D_{it} : the gross debt-to-GDP ratio
- S_{it} : the average monthly spreads of long-term government bonds relative to German bonds
- RA_{it} : the average Standard and Poor's rating of government bonds

¹⁵ Also, according to Soto (2009), this estimator is better than the difference-GMM, the fixed-effects and the OLS estimators when dealing with small panels: "small number of individuals [...] does not seem to have important effects on the properties of the system GMM estimator". Moreover, "the fixed effect and the difference-GMM are systematically outperformed by the system-GMM estimator" (Soto 2009, p. 10).

- $Euro_{it}$: a dummy variable for the EZ membership
- EDP_{it} : a dummy variable for the presence of an EDP
- $FF_{it|t-1}$: the EC's average fiscal forecast in period $t-1$ of the cyclically adjusted primary balance of period t
- OG_{it} : the current output gap
- Y_{it} : the current GDP at constant prices
- UR_{it} : the unemployment rate.

In order to reduce the number of explanatory variables, we summarised their joint behaviour by exploiting the correlations between them. The methodology is called Principal Component Factor Analysis (PCFA), and it allows for the extraction of meaningful linear combinations by decomposing the correlation matrix of a set of observed variables that may jointly explain a certain phenomenon and provide the so-called common factors and the corresponding factor loadings. The common factors are in fact latent variables which are described through their relationship with the variables of interest, while the factor loadings show the weight of each variable in explaining the factors. In details, given the observation on the j -th variable relative to the i -th unit, y_{ij} , the common factors z_{iq} relative to the same i -th unit contribute to explain it through the following relationship:

$$(6) \quad y_{ij} = z_{i1}\lambda_{1j} + z_{i2}\lambda_{2j} + \dots + z_{iq}\lambda_{qj} + \varepsilon_{ij}$$

where λ_{ij} is the factor loading and ε_{ij} is a unique factor proper of the j -th variable.

The appropriate number q of unobserved factors, necessarily smaller than the number of observed variables, depends on their observed correlations, and can be chosen either on the basis of the eigenvalues obtained from the decomposition of the correlation matrix, or on the basis of the percentage of explained variance.

In summary, the estimation was developed in two steps: the application of PCFA to extract some meaningful indicators from the considered variables of the dataset, thus reducing their number, and the estimation of a panel model with the system-GMM method.

4.2 Estimation results

The first step consisted in the implementation of the PCFA. This procedure was applied to all factors with the exclusion of "fiscal discipline", which includes only one continuous variable (the austerity EC forecast - $FF_{it|t-1}$) and two dummy variables (one for EZ membership and one for the EDPs) that cannot be appropriately included within a factor. The two dummies were inserted as independent variables in the panel estimations, whereas the forecast variable turned out to be non-significant and hence dropped from the final estimation.

On the basis of standardized variables, that allows to compare the size of the estimated coefficients, eigenvalues definitely led to identify the following factors:

- the "market discipline" factor (*MDF*) given by the sovereign spread and rating of the country; an improvement (increase) in *MDF* indicates a combination of lower spread and higher rating of the country, hence the expected estimated coefficient is negative
- the "fiscal consolidation" factor (*FCF*), given by the debt-to-GDP ratio of the country and the difference between the deficit and the 3% threshold; an improvement (increase) in *FCF* represents a combination of lower debt-to-GDP ratio and deficit of the country, hence its expected estimated coefficient is negative too
- the "macroeconomic stabilisation" factor (*MSF*), that describes the cyclical position of the economy; an improvement (increase) in *MSF* captures a combination of higher real GDP, lower output gap, lower unemployment rate, hence the expected estimated coefficient is positive.

Within our regression analysis, all the considered common factors were differenced to guarantee stationarity and lagged in order to avoid feedback effects and to take into consideration the lag that usually characterizes the implementation of fiscal policies with respect to the observation of macro data.

The second step of the analysis consisted in the estimation of the panel model described above by employing the system-GMM estimator. This technique allows for three essential facets: a dynamic approach, the inclusion of a small-sample statistics, and heteroskedastic-robust standard errors. To check the robustness of our estimations, we resorted to three pivotal tests: the Arellano-Bond serial correlation test¹⁶, the Hansen test for the validity of the over-identifying restrictions¹⁷, and the Pesaran test for weak cross-sectional dependence¹⁸.

Table 1 presents the estimations of three different specifications. Specification 1 only includes general variables common to all countries, i.e. the lagged A_{it-1} and the three differenced and lagged factors (*MDF*, *MSF*, *FCF*). Specification 2 adds

¹⁶ Though the asymptotic distribution of the test statistic requires $N \rightarrow \infty$, which is evidently not satisfied in this analysis, the application of the test might still give an indication of the presence of serial correlation.

¹⁷ We have chosen the Hansen test instead of its most common alternative, the Sargan test, because of its robustness; however, it may be weakened by a large number of instruments. Therefore, we have followed the suggestion given in Roodman (2006) according to which the number of instruments must be lower than the number of countries N . Moreover, we have paid attention to the value of the p-values since Roodman (2006) argues that high p-values (such as 0.25) should be viewed as "potential signs of trouble".

¹⁸ The system-GMM estimator requires no correlation across individuals. Therefore, the presence of strong cross-sectional dependence would invalidate our estimation results.

the *Euro* and the *EDP* dummies that capture the effect of being in the EZ and of adopting EDPs, while specification 3 replaces them with two more specific dummies that represent the EZ5 group and the EZ7 group.

[Table 1]

In the first place it may be noted that the coefficient of the lagged austerity A_{it-1} is always positive, confirming the persistence shown by the data (Figure 1), but statistically not significant. Starting with the first specification, of the three common factors only *MSF*, i.e. macroeconomic stabilisation, is not significant and with the negative (procyclical) sign, which confirms that the implementation of austerity was unconditional on the underlying business cycle, possibly with the exception of automatic stabilisers and other transitory measures deducted from the calculation of the STPB. The other two factors, *MDF* (market discipline) and *FCF* (fiscal consolidation), are both statistically significant at 5% level with the expected sign, so that an increase in the spread or a decrease in the rating of the country, as well as an increase in the debt-to-GDP ratio or in the excess deficit of the country, are associated to a higher austerity level. Moreover, *MDF* provides the greatest contribution in explaining austerity. Specification 2 shows that the *Euro* and *EDP* dummies have the expected positive sign but only the latter is statistically significant, reflecting the fact that austerity was more severe for countries under procedure. Group analysis in specification 3 confirms that belonging to the EZ5 is associated to significantly higher austerity levels, whereas belonging to the EZ7 is associated to lower austerity levels.

Finally, the third specification of Table 1 was used to estimate the level of austerity explained by the included variables for the EZ5. Figure 5 compares the observed standardised average level of A_{it} with its estimated level for the EZ5: the explained part of A_{it} fluctuates between 0% (2014) and 93% (2013). It is noteworthy that the predicted level of austerity for the period 2011-2013 is lower than the actual level. In other words, austerity is underestimated — or, from another perspective, the average level of austerity is too high to be explained by market and fiscal pressures only — and there is a part of it that remains unexplained. As to the subsequent period, from 2015 to 2016, it is the pace of fiscal expansion that remains underestimated.

[Figure 6]

5 Final remarks

This paper has presented an empirical analysis of the determinants of austerity (measured as the first difference of the STPB ratio to GDP), determinants that

have been sought for within four groups of explanatory variables commonly employed in literature: fiscal consolidation, market discipline, rule-based fiscal discipline, and macroeconomic stabilization.

We have firstly employed PCF analysis to retain the aggregate factors that might affect austerity; secondly, we have estimated a panel model by adopting the system-GMM estimator. Financial market pressure emerges as the strongest driver of EU austerity in our analysis, together with the fiscal consolidation factor and the EDP. Concomitant negative economic conditions played no significant role. Overall governments responded in accordance to orthodox public finance principles. Therefore, we can also conclude that we have found little (if any) support to the argument that EZ regulations were bypassed or remained ineffective, and that the crisis was exacerbated by non-compliance with the rules.

It is also worth noting that the considered variables and factors are often not able to fully explain austerity, either individually or jointly. Our estimated model *underestimates* the extent of austerity actually observed in the hardest years (up to 2013) for the EZ5 group as well as the degree of its reversal in the subsequent years. Further research is therefore warranted, and we join the recommendation arising from ongoing empirical studies on fiscal policy that research should be focused on time and space specific factors conditioning government decisions.

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Tables and figures

Table 1. Dynamic panel data estimation results.

Specification:	1	2	3
Dep. Var.	Austerity	Austerity	Austerity
A(-1)	0.1351 (0.1218)	0.0888 (0.1199)	0.0429 (0.1010)
D.MDF(-1)	-0.3652** (0.1569)	-0.3876** (0.1614)	-0.3794** (0.1523)
D.MSF(-1)	-0.2403 (0.2179)	-0.2800 (0.2155)	-0.2682 (0.1938)
D.FCF(-1)	-0.1983** (0.0908)	-0.2100** (0.0942)	-0.1879** (0.0863)
EDP	-	0.2544** (0.1152)	-
Euro	-	0.0520 (0.1015)	-
EZ5	-	-	0.4176** (0.1700)
EZ7	-	-	-0.1696* (0.0880)
Constant	0.3878** (0.1826)	0.1291 (0.2004)	0.3808* (0.1753)
# countries	28	28	28
Year dummies	yes	yes	yes
AR(2) t. (p-value)	0.3240	0.4290	0.4790
Hansen t. (p-value)	0.1480	0.2050	0.1700
CD t. (p-value)	0.1850	0.1590	0.1140

Notes: ***, ** and * indicate statistical significance at 1%, 5% and 10% level respectively. All robust standard errors are in parentheses. Variables are standardised.

Figure 1. Average year A_{it} (left) and cumulated A_{it} (right) by group of countries, 2010-16.

Source: elaboration on AMECO database

Figure 2. Average deficit-to-GDP (left) and debt-to-GDP (right) ratios by groups of countries, 2010-16.

Source: elaboration on Eurostat database

Figure 3. Year average of monthly spreads (left) and S&P rating (right) of government long-term bonds by groups of countries, 2010-16.

Source: elaboration on Eurostat database

Source: elaboration on S&P database

Figure 4. Average GDP growth rate (left) and output gap (right) by groups of countries, 2010-16.

Source: elaboration on AMECO database

Figure 5. Average changes in the unemployment rate by groups of countries, 2010-16.

Source: elaboration on Eurostat database

Figure 6. Average standardised austerity and its predicted value, EZ5 group, 2011-16.

Source: our elaborations on AMECO database and our elaborations

Appendix

The main data sources are the Eurostat Database and the European Commission website, from which we took the time series of the variables as reported in Table A1

Table A1. Employed variables and data sources.

Variable	Source	Type of variable
CAPB	European Commission	Annual data
CAPB forecast	European Commission	Annual data, average of Spring and Autumn forecasts
Excessive deficit procedure (EDP)	European Commission	Dummy variable
GDP at current prices	Eurostat	Annual data
Government bond yield	Eurostat	Annual data, average of monthly data
Government debt	Eurostat	Annual data
Government deficit	AMECO	Annual data (% of GDP)
Output gap	AMECO	Annual data (% of potential GDP)
S&P Rating	Trading Economics	Annual data, weighted average of daily data
STPB/PGDP	AMECO	Annual data
Unemployment rate	Eurostat	Annual data

The government bond spread was computed as the difference between the yield on the government bond of each country and the corresponding German bond yield, both for Eurozone and non-Eurozone countries.

The other source was the website Trading Economics from which we took the S&P rating of the government bonds and any change occurred between 2010 and 2016. We first converted the S&P rating into numbers according to Table A2 below, and then we computed the yearly weighted averages.

Table A2. S&P ratings and associated numbers.

S&P Rating	Associated number		
Investment grade	AAA	Prime	10
	AA+	Very high grade	9.5
	AA	Very high grade	9
	AA-	Very high grade	8.5
	A+	Upper-medium grade	8
	A	Upper-medium grade	7.5
	A-	Upper-medium grade	7
	BBB+	Lower-medium grade	6.5
	BBB	Lower-medium grade	6
	BBB-	Lower-medium grade	5.5
Non-investment grade or speculative grade	BB+	Speculative	5
	BB	Speculative	4.5
	BB-	Speculative	4
	B+	Highly speculative	3.5

B	Highly speculative	3
B-	Highly speculative	2.5
CCC+	Extremely speculative	2
CCC	Extremely speculative	1.5
CCC-	Extremely speculative	1
CC	Substantial risk	0.5
C	Default, little prospect of recovery	0
D	Default	0