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The ECB and the Cost of Independence. Unearthing a New Doom-Loop in the European Monetary Union

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Abstract

Central Bank Independence has often been praised as a "free lunch" as it lowers inflation with no costs to output. This paper, instead, claims that in a peculiar monetary union such as the European Monetary Union (EMU) defending the independence during a financial crisis can be macroeconomically costly: unconventional monetary policies may expose the European Central Bank (ECB) to the threat of fiscal dominance which, in turn, might endogenously shift the ECB's fiscal stance toward fiscal conservatism. Fiscally hawkish signals can then depress GDP and inflation, thereby forcing the ECB to prolong the unconventional stimuli to achieve its target. This paper finds evidence of this new "doom-loop" at the core of the EMU.

Keywords: ECB, monetary-fiscal interaction, CBI, unconventional monetary policy, EMU, fiscal communication

JEL: E52, E58, E61, E63

1. Introduction

Stagflation in the 1970s paved the way for a new consensus around the optimal arrangement that regulates the interface between the Central Bank and the Treasury: central bank independence (CBI). Since governments have an interest in accelerating inflation ahead of elections (Kydland and Prescott, 1977), central banks need to be insulated from politicians' short-term aims. It follows that central banks must only deal with inflation and be independent of politics to pursue effectively the mandate of price stability. This shift also led to breach the supremacy of the fiscal dominance regime towering throughout the 1970s. In such a regime, the Treasury can free ride on monetary measures and inflate away real outstanding government debt, thereby forcing the monetary authority to accommodate government deficits. As a reaction to this, CBI claims monetary policy to be the only tool necessary to stabilise the business cycle (Friedman, 1968); accordingly, fiscal policy is considered not only ineffective to stimulate GDP growth in the long-term, but also detrimental since it crowds out private investments. Therefore, the optimal set-up requires the monetary authority to actively respond to inflation while the fiscal authority to passively adjust its primary balance to stabilize public debt (Cochrane, 2005; Del Negro and Sims, 2015; Reis, 2015; Sargent and Wallace, 1981; Sims, 2013), that is, the monetary dominance regime. This is the only form of

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coordination between monetary and fiscal authority that the new consensus validates; other than this, the two authorities must be divorced.

These theories found a very fertile land in Europe in the 1990s where politicians and policy-makers were profoundly concerned about the interplay between fiscal and monetary policy (Duisenberg, 2001; Issing, 2004; Schnabel, 2020). As a result, the Treaty on the Functioning of the European Union (TFEU) thoroughly enshrines the ideas of CBI and prescribes, therefore, the utmost divorce between fiscal and monetary policy[1]. This point is made clear by Willem F. Duisenberg, the first President of the ECB:

> The ECB has a natural interest in being informed about fiscal and structural policy measures taken in the euro area [...]. All this exchange of information should not, however, be seen as a form of ex ante co-ordination of monetary policy with other policies. Indeed such a co-ordination is explicitly ruled out by the Treaty, which foresees a clear division of responsibilities and policy objectives. [...] In fact, ex ante co-ordination of fiscal and monetary policy would risk distracting national governments from carrying out their own responsibilities[2].

This utmost divorce is even more cemented by the peculiar institutional architecture of the European and Economic Monetary Union (EMU) where the European Central Bank (ECB) is not backed by a federal fiscal union and fiscal policy is still in the hand of the member states[3]. This arrangement complicates the interface between monetary and fiscal authority for at least two reasons: first, the targets of the ECB and the objectives of national governments are separated and a significant degree of policy uncertainty is always present. Second, the ECB is the only institution that can absorb a severe macroeconomic shock in the euro area while having a strict institutional constraint[4].

The sovereign debt crisis challenged this multi-country set-up since it forced the ECB to overstretch its remits. The ECB, in fact, had to implement unconventional monetary policies (UMP) to save the European project while complying with the TFEU. The tension between the two targets arises because, on the one hand, massively buying government bonds in the secondary market have sizeable direct and indirect effects on public finances and, on the other hand, the TFEU, by strictly interpreting the idea of *operational independence*[5], prohibits

[1] It includes, in particular, the prohibition of monetary financing by the central bank (Article 123), the prohibition of providing budgetary support to domestic governments via the back-door of monetary policy (Council Regulation (EC) No. 3603/93), the prohibition of privileged access by public institutions or governments to financial institutions (Article 124), the "no-bailout" clause (Article 125), the fiscal provisions for avoiding excessive government deficits (Article 126) and the Stability and Growth Pact (SGP, which is actually separate from the Treaty itself). It is of crucial importance to understand how the prohibition of monetary financing (a common practice in any OECD country) is just a particular case. More radically, the TFEU prohibits any form of budgetary support.

[2] Willem F. Duisenberg, *Current fiscal and monetary policy issues in the euro area*, Taxpayers Association of Europe's, Taxpayers' Award 2001, Brussels, 12 December 2001. The same point is made by Isabel Schnable (2020a), current Member of the Executive Board of the ECB: "[...] it would be misleading to speak of a new partnership between fiscal and monetary policy. After all, partnership implies a degree of coordination that would be inconsistent with an independent central bank".

[3] It is with regard to this architecture that Padoa-Schioppa (2000), one of the founder of the EMU, considered the Eurosystem to suffer from "institutional loneliness". For a more recent analysis of the role of the institutional arrangement of the ECB and of the euro area in the response to the crisis (see Cour-thimann and Winkle 2013).

[4] Besides, given the heterogeneity of interests and preferences among the member states, the consequences of the ECB's intervention are far from being uncontested.

[5] I follow the definition given by Balls et al. (2016) that define operational independence as the ability of the central bank to select and use monetary tools with autonomy. Different authors draw slightly different delineations (see Grilli et al. 1991; Debelle and Fisher 1994).

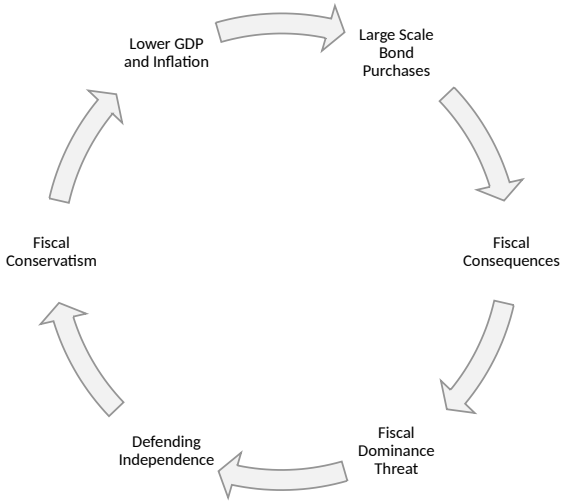
any monetary support to fiscal authorities. It follows that UMP triggers fiscal dominance concerns, that is, the fear that the ECB accommodates government deficits via monetary measures. This logic is best exemplified by quoting the previous President of the ECB, Mario Draghi:

> We view conditionality as an essential part of the activation of the Outright Monetary Transactions (OMTs). [...] Conditionality will actually have several roles. First of all, it will reduce the moral hazard by governments. The second role it will have is that it protects the independence of the ECB. Without conditionality you would certainly have what people call fiscal dominance. With conditionality the independence of the ECB is protected[6].

This paper attempts to model this relationship that, despite being at the core of the sovereign debt crisis, has received little attention. In contrast to the established pre-crisis literature that often praises CBI as an unalloyed good, this paper argues that in the EMU CBI can be macroeconomically costly during a crisis. The hypothesis is that operational independence as defined in the TFEU is able to trigger an unintended "doom-loop" between unconventional monetary measures and the "fiscal preferences" of the central bank. The economic reasoning is the following: if UMP have significant fiscal consequences, and the ECB cannot cross the line between monetary and fiscal policy for fear of fiscal dominance, the monetary authority may prefer and require unconventional measures to come along with fiscal consolidation to preserve the independence. In other words, UMP may endogenously lead the ECB − to minimise the fiscal implications of those measures and, therefore, shield independence − to have a preference toward fiscal conservatism. This, in turn, might lower GDP and inflation drawing the monetary authority to reiterate unconventional measures. Hence, the paper hypothesises that, during a financial crisis, in a monetary union such as EMU operational independence, rather than a "free lunch" (Summers and Alesina, 1993), becomes a drag on inflation and GDP − Figure 1 exemplifies the logic.

[6]Mario Draghi, *Introductory statement to the press conference (with Q&A)*, Frankfurt, October 4 2012.

Figure 1: Graphical Representation of the "Doom-Loop"



On empirical grounds, I first quantify the communicated degree of fiscal policy accommodation (DFPA) by originally applying Wordscore (Laver et al., 2003) to a subset of the ECB's Press Conferences. Second, I build a monthly FAVAR identified with a proxy for Large-Scale Bond Purchases (LSBP) shocks. Last, I run historical decompositions as a counterfactual exercise to estimate the impact of DFPA shocks on inflation and GDP.

The main results are as follows. First, when an expansionary LSBP shock hits the policy indicator, the DFPA decreases significantly, that is, the ECB becomes more fiscally conservative. Second, I find empirical evidence that sending fiscally hawkish signals to preserve independence is macroeconomically costly. In fact, GDP and inflation are higher in the scenario in which the DFPA shock is turned off; in particular, during the sovereign-debt crisis. These results together prove the existence of a new "doom-loop" between large-scale government bond purchases and the ECB's degree of fiscal policy accommodation in the euro area.

This paper claims original contributions under many regards: on the empirical ground, it is, to my knowledge, the first attempt to quantify the DFPA of a central bank as well as identifying a DFPA shock using sign restrictions. As far as I am concerned, it is also the first endeavour to uncover the interdependence between UMP, "fiscal stance" and the institutional architecture of the ECB. This leads to turn CBI's logic on its head. While it is true that the independence can be called into question if countries free ride on UMP, it is not less true that excessive fiscal prudence may also be a form of fiscal dominance *per se*; in fact, fiscal conservatism may backfire the effort of the ECB to fulfil its mandate[7]. The fear of fiscal dominance is still a form of fiscal dominance that violates the pillar of operational independence. In plain words, if the ECB needs to worry about the fiscal consequences of monetary measures to comply with the Treaty, it no longer has the freedom to use whatever

[7] Buti (2020) makes the same point on his account of the economic and financial crisis in Europe. That said, I reached this conclusion before reading his paper.

instrument to achieve the inflation target of close but below 2%. In doing so, the monetary authority is led by fiscal, rather than monetary, concerns and (operational) independence is infringed. The ECB monetary framework, designed with the good intention of protecting EMU from fiscal dominance, is therefore able to trigger what it wanted to avoid the most: fiscal dominance.

The paper proceeds as follows: Section 2 reviews the literature. Section 3 illustrates the econometric methodology. Section 4 presents the empirical results. Finally, I will draw conclusions. Many technical details as well as additional results are deferred to the Appendix.

2. Literature

This paper intersects three streams of literature: EMU, CBI and the monetary-fiscal interaction.

The EMU's shortcomings and their relation to the sovereign-debt crisis are well known. De Grauwe (2011) and De Grauwe and Ji (2013) maintain that the fragility of the EMU stems from the fact that member states issue debt in a currency over which they have no control. Member countries are therefore prone to movements of distrust that triggers self-fulfilling crises. A consequence of this is the so-called "doom-loop" between sovereigns and banks (Brunnermeier et al., 2016; Farhi and Tirole, 2018): when investors sell a large amount of government bonds held in banks' balance sheets, the value of bank equity is eroded since interest rates spike. This "vicious circle" magnified the sovereign-debt crisis. Scholars have also stressed the absence of a fiscal backstop in the EMU that provides additional stimulus in the event of severe economic downturns (Farhi and Werning, 2017; Furceri and Zdzienicka, 2015)[8]. This incompleteness led the ECB to be the only player during the sovereign-debt crisis, putting pressure on its independence (Issing, 2018). Scholars, however, have failed to spot how the institutional architecture of the ECB along with the necessity to enforce UMP generated the "feedback loop" that this paper uncovers.

The Great Recession has questioned CBI: Balls et al. (2016) and Haan and Eijffinger (2017) argue that, compared to the 1990s when CBI arose, nowadays in many leading economies inflation is too low, not too high. This puts in doubt the suitability of CBI in facing deflationary trends. Besides, even if many CBs have been endowed with far more powers since the crisis, they have not become more accountable and transparent. Accordingly, a democratic deficit emerges (Buiter, 2014; Issing, 2011; Tucker, 2018). These new powers have also threatened CBI: the unprecedented size of the CB balance sheets has far reaching implications for the financial dimension of independence (Del Negro and Sims, 2015; Reis, 2015; Sims, 2013), the balance of power between fiscal and monetary dominance (Blinder, 2012) and the redistributive consequences of unconventional measures (Fernández-Albertos, 2015; Masciandaro and Volpicella, 2016). Although the post-crisis literature no longer praises CBI as an unalloyed good, it still fails to acknowledge the case of the EMU where CBI, rather than a "free lunch", can become a cost to inflation and output.

[8] The value added of a central fiscal capacity is often questioned (see Heijdra et al. 2018; Feld 2018).

A great deal of research has paid attention to the interface between monetary and fiscal policy during a recession. For instance, Bradford Delong and Summers (2012), focusing on the Fed, contend that extraordinarily low levels of real interest rates question the efficacy of monetary policy as a source of stimulus, but reduce the cost of a fiscal expansion. Therefore, during severe downturns expansionary fiscal policy can be self-financing at the zero lower bound (ZLB). Similar conclusions have been achieved by Corsetti et al. (2016) and Jarociński and Maćkowiak (2017) with regard to the ECB. These studies showed how a much more effective macroeconomic stabilisation would have been possible under an alternative arrangement between monetary and fiscal policy.

Hachula et al. (2020) and Bodea and Higashijma (2015) come closer to this paper. The former examine the fiscal effects of conventional and unconventional shocks in the euro area. They prove, among other results, that government spending increases as a consequence of an UMP surprise. However, they do not relate this finding to the ECB's fiscal stance and EMU institutional architecture. The latter, instead, relate the institutional arrangement of central banks with governments' spending power by showing that CBI in democracies has a deterrent effect on fiscal overspending. Nevertheless, it doesn't link the findings to UMP.

Despite invaluable contributions, scholars tended to tackle these issues separately. This paper, instead, aims to uncover the deep interrelation among UMP, the ECB's fiscal stance and its institutional architecture within EMU. In doing so, it provides a more comprehensive insight to the extant literature.

3. Econometric Methodology

This section explains the econometric models used in the paper. In particular, 3.1 and 3.2 document in detail how I quantify the DFPA of the ECB and the derivation of the monetary policy shocks, 3.3 outlines the monthly FAVAR identified with external instruments and 3.4 presents the counterfactual exercises.

3.1. Quantifying the Communicated Degree of Fiscal Policy Accommodation (DFPA)

The role of fiscal policy in central bank decision-making and communication is twofold. On the one hand, central banks regard fiscal policy as a factor that affects macroeconomic and price developments. In this respect, fiscal policy retains a *descriptive* function. On the other hand, governments and central banks interact in their decisions. As governments have a preference toward how monetary policy ought to be carried out, likewise central banks have a preference on the desired course of fiscal policy from a monetary policy perspective. These preferences, *normative* in their nature, are reflected in central banks' official communication. I call these "preferences" the (communicated) degree of fiscal policy accommodation (DFPA).

Despite quantitative text analysis (QTA) techniques gaining momentum in macroeconomics (Allard et al., 2013; Bholat et al., 2015; Hansen et al., 2019; Jansen and Haan, 2010; Shapiro and Wilson, 2019), this is, to my knowledge, the first time that QTA is applied to quantify the fiscal stance of a central bank. Empirically, I exploit the official communication of the ECB to quantify the DFPA[9]. The dataset includes 216 Press Conferences from January 2002 to December 2019[10]. The dataset was, first, manually subsetted to extract only sentences that *normatively* refer to fiscal policy and, then, validated by applying classification and regression trees (CART) (Jones and Linder, 2015)[11].

After pre-processing the dataset[12], I apply Wordscore (Laver et al., 2003) (hereafter, LBG), a supervised machine learning model, to extract policy dimensions over normative fiscal policy. The model estimates the scores of L out-of-sample documents, the *virgin texts*, given R *reference texts* with known positions or scores on a policy dimension. Start with a set of R reference texts, represented by an $R \times J$ document-feature matrix F_{rj}, where r indexes the rth document and j indicates the jth word. Wordscores for the *reference texts* are generated as:

$$\underset{(1\times J)}{S} = \underset{(1\times R)}{a} \cdot \underset{(R\times J)}{P}$$

where S is the $1 \times J$ vector containing the single score for every word in the reference texts, a_{rd} is the assumed *apriori* position of reference text r on dimension d and $P_{rj} = \frac{F_{rj}}{\sum_{r=1}^{R} F_{rj}}$ indicates a $R \times J$ matrix of conditional probabilities where F_{rj} is the relative frequency, as a proportion of the total number of words in the text, of each different word used in reference text r. Each element in P_{rj} tells us the probability that we are reading reference text r, given that we are reading word j.

Given S, the aim is now to obtain a single score for any new text (virgin text). This is obtained as follows:

$$\underset{(1\times V)}{V} = \underset{(1\times J)}{S} \cdot \underset{(J\times V)}{W}$$

where V is the $1 \times V$ vector of document score (the mean dimension score of all of the scored words that it contains, weighted by the frequency of the scored words), S is the $1 \times J$ vector

[9] There are five types of documents available: Governing Council decisions, Press conferences (PC), Monetary policy accounts, Speeches and Interviews. This paper focuses on the Press Conferences led by the President and the Vice-President of the ECB. Governing Council (GC) Decisions were excluded since numbers are more frequent than text. Yet, this choice does not affect the reliability of the study since PCs simply expand in words (and in much more detail) what is contained in the GC decisions. Monetary Policy Accounts are also excluded from the sample because they are available only from 2015. Finally, Speeches and Interviews were excluded due to the high variance of topics examined.

[10] PCs include Q&A. This is because, as Ehrmann (2009) note, the Q&A session fulfils a clarification role as (a) the size of market movements are significantly larger during Q&A sessions than during comparable times; (b) the direction of movements is significantly different as the higher likelihood of directional changes indicates; and (c) market movements during the Q&A are long-lasting.

[11] Additional details will be given in Appendix.A.1.

[12] I removed stopwords, currency symbols, punctuation, numbers, separators and features that, across all documents, do not occur at least ten times. I also created bigrams and trigams and lemmatized the corpus to better score economic words.

of wordscores derived above and $W_{jv} = \frac{P_{vj}}{\sum_{v=1}^{V} P_{vj}}$ is a $J \times V$ matrix of relative frequency of each word in the virgin text word as a proportion of the total number of words in the virgin text.

In the empirical specification, *virgin* texts are the ECB's Press Confereces subsetted as above and the *apriori* policy dimension is as simple as -1 for the *fiscally hawkish* reference text and 1 for the *fiscally dovish* one[13]. Details on how I built reference texts are in Appendix. Table 1 shows the most representative and extreme words with their relative score:

Table 1: Estimated Wordscores in the Training Model

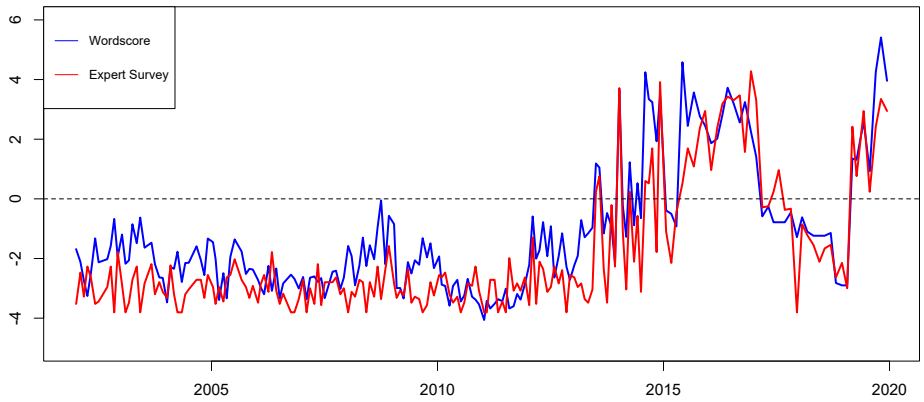
	Hawkish		Dovish
budget balance	−0.31	demand	0.75
rebuild fiscal buffer	−0.66	fiscal space	0.98
fiscal consolidation	−0.54	government expenditure	0.46
get their house in order	−0.35	job creation	0.42
avoid any procyclical bias	−0.35	flexibility	0.62
expenditure restraint	−0.86	automatic stabiliser	0.66
budget retrenchment	−0.81	public investment	0.99
no case for fiscal activism	−0.59	public sector	0.68
Ricardian effect	−0.35	fiscal union	0.40
deficit reduction	−0.86	growth friendly	0.70
debt sustainability	−0.81	ease social hardship	0.68
fiscal stability	−0.77	infrastructure	0.40

Note: The table shows the estimated wordscores of the reference texts. A negative score means that the word is a fiscally hawkish word, while a positive score indicates a fiscally dovish one.

The choice of reference texts involves crucial substantive and qualitative decisions by the researcher. To minimize the degree of subjectivity in choosing the reference texts, I built an external validation exercise. It consists of an expert survey that asks respondents to score 15 ECB's Press Confereces randomly assigned (details in Appendix). The scoring is as simple as: -1, 0, 1, where -1 stands for fiscally hawkish, 1 for fiscally dovish and 0 for fiscally neutral. I gathered 200 responses and each Press Conference received, on average, 14 responses. Figure 2 plots the results of the supervised model and the expert survey:

[13] Fiscally hawkish is defined a document whose content encourages governments to keep government budgets under control (sizeable reduction of government deficit and stabilization of government debt) by advocating for cuts in government spending or higher taxes or a combination of both. Fiscally dovish is defined a document whose content encourages governments to increase government deficit (and hence possibly debt) to finance sizeable government spending to sustain aggregate demand.

Figure 2: Estimated Degree of Fiscal Policy Accommodation



Note: The figure shows the estimated DFPA for Wordscore (blue line) and the mean of the responses in the expert survey (red line). Above 0 indicates a *dovish* score, while below 0 a *hawkish* one. The results of the expert survey were rescaled to make comparability easier.

The two series are significantly correlated (87.1%). More importantly, the signs of the series differ only in 4 cases (2% of the total observations) that, upon closer inspection, appear to be among the most contentious Press Conferences[14].

3.2. Identifying Monetary Policy Shocks in the Euro Area

To identify monetary policy shocks, I exploit the *Euro Area Monetary Policy Event-Study Database* (EA-MPD) by Altavilla et al. (2019) (henceforth, ABGM). Nevertheless, unlike ABGM that derive monetary policy factors by only using OIS rates, I exploit the entire dataset of price changes that includes OIS rates, sovereign bond yields, stock prices and exchange rates for a total of 35 series from November 2005 to December 2019. The reason for doing so is twofold: first, narrowing the identification to OIS rates would cut off a crucial source of variation since unconventional measures in the euro area work more through sovereign yields than the term structure of risk-free rates (Cour-thimann and Winkler, 2013; Wright, 2019). Besides, following ABGM's strategy would have discarded the essential period of the sovereign debt crisis. Second, between January 2015 and January 2016 the press release mentioned whether "further measures" (without stating what measures were decided) will be announced during the press conference. In March 2016, the content of the decisions on non-standard policy measures was included in the press release. This means that excluding the information in the press release as in ABGM may result in losing important information for the derivation of the QE factor.

I therefore extract four factors from the entire EA-MPD dataset by using a factor model whose baseline specification is[15]:

[14] Further details in Appendix.A.3.

[15] The selection of the number of factors follow the reduced rank test of Cragg and Donald (1997). I test the number of statistically significant factors over the full sample, the pre-crisis sample and the pre-QE sample. Additionally, the factors take

$$X = \Lambda F + \epsilon \ ,$$

where X is a $1 \times N$ vector of observed variables, F is a $1 \times K$ vector of latent factors, $\Lambda = (\lambda_{ij})$ is a $K \times N$ matrix of factor loadings and ϵ is a $1 \times N$ vector of residuals.

The latent factors F do not have a structural interpretation as monetary policy surprises and then require a rotation strategy to make them interpretable. However, the second factor appears to resemble pretty closely a "Save the Euro" (henceforth, STE) factor[16]. Table 2 shows the variance shares explained by the second factor (almost 14%) along with the loadings of the selected variables:

Table 2: "Save The Euro" Factor

	Factor 2
Variance Share (%)	13.7
Loadings:	
Germany 2Y yield	0.048
Germany 5Y yield	0.079
Germany 10Y yield	0.115
France 2Y yield	0.061
France 5Y yield	0.019
France 10Y yield	0.003
Italy 2Y yield	−0.286
Italy 5Y yield	−0.340
Italy 10Y yield	−0.336
Spain 2Y yield	−0.236
Spain 5Y yield	−0.305
Spain 10Y yield	−0.330
STOXX50E Index	0.348
SX7E (Bank) Index	0.384
Euro-Dollar	0.032
EUR-Pound	0.018
EUR-Yen	0.107

Note: The table reports the variance shares and loadings for the first four principal components of all the asset price changes from November 2005 to December 2019 in the ABGRM dataset.

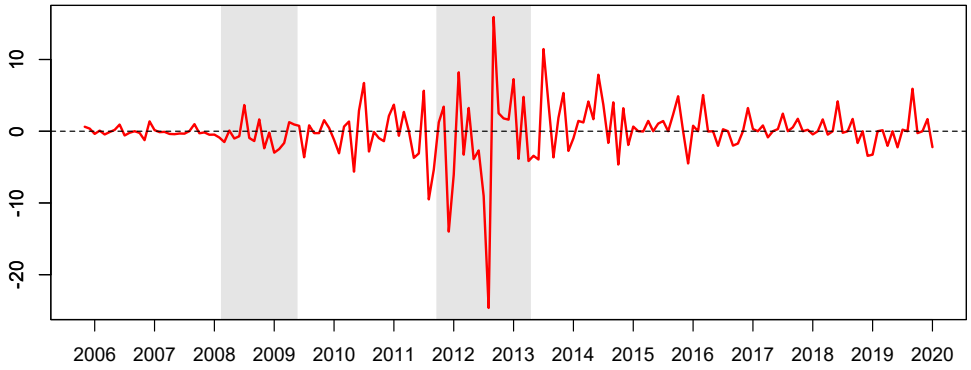
This factor raises German and French yields, lowers Italian and Spanish yields, appreciates the euro and increases stock prices. These responses can be explained at least by two factors. First, several of the unconventional measures taken during the sovereign debt crisis led to a positive reaction of German and French yields and to a negative reaction of Italian and Spanish ones. Government bonds of France and Germany were perceived as a safe haven by the market and, as unconventional measures decreased uncertainty and risk, the demand for safe-haven assets declined while the demand for riskier assets increased. Second, unconventional measures reduced the risk of a break-up of the euro area lowering redenomination risks priced in these bonds. This, other than reinforcing the inverse response

value zero on non-announcement days.

[16] I borrowed this definition as well as the idea from Wright (2019).

of Northern and Southern yields, appreciated the euro and inflated stock prices. Figure 3 plots the times series of STE factor:

Figure 3: "Save the Euro" Factor



Note: This figure plots the time series of the second principal component of all the asset prices changes from November 2005 to December 2019 in the monetary event windows (from before the press release to after the press conference) in the ABGRM dataset.

The STE factor barely exists prior to 2008 but then becomes relevant in magnitude from 2010 and even more so during the sovereign debt crisis. This factor would not have appeared, had I used OIS rates alone. Accordingly, the STE factor can be seen containing all the unexpected shocks related to sizeable government bond purchases announced or not by the ECB.

As for the three remaining factors, I follow Swanson (2017)'s methodology that AGBM applies to euro area monetary policy data[17]. The orthogonal factors are identified by imposing the following restrictions on the rotation matrix:

1. the first factor does not load on the one-month OIS;
2. the second factor does not load on the one-month OIS;
3. the third factor has the smallest variance in the pre-crisis period (2 January 2002 - 7 August 2008).

The third condition identifies the QE factor that, once linearly combined with the STE one, originates the LSBP factor, the shock around which this study builds all the hypotheses[18]. In particular, the STE factor goes from January 2009 to December 2013, while the QE factor goes from January 2014 to January 2020.

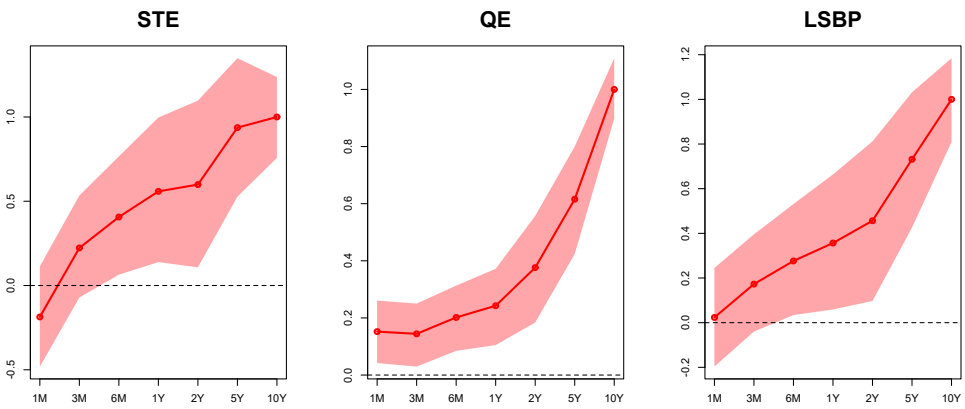
Finally, Figure 4 shows the factor loadings of the rotated factors over the seven maturities

[17] A similar rotation strategy that does not consider QE has been used since Gurkaynak (2005) and was first applied to the euro area data by Brand et al. (2010) using intraday data.

[18] The STE factor is normalized to have a unit effect on 10Y German yields. Additionally, the shocks can reveal information not just about policy but also about the central bank's assessment of the economic outlook. Accordingly, to control for the presence of information frictions in the economy, I project these monetary surprises on their own lags (Miranda-Agrippino and Ricco, 2017).

in the analysis[19]:

Figure 4: Factor Loadings



Note: The figure shows the factor loadings. For each maturity the loadings are obtained by regressing the surprises onto the factors, controlling for the standardized surprise associated with the release of the US initial jobless claims. Every factor displayed is normalized to have unit effect on the 10-year yields. The shaded areas indicate the 90% confidence intervals.

The estimated shape in Figure 4 proves the plausibility of the rotation strategy. In fact, similarly to the STE and QE factor, the impact of the LSBP factor is stronger the longer the maturity. This is exactly what identifies large-scale government bond purchases.

3.3. Factor Augmented Vector Autoregressive (FAVAR) Model

This paper claims that large-scale purchases of government bonds may lead the ECB to become more fiscally conservative in the attempt to defend its operational independence. To address this hypothesis, I set up a monthly factor augmented VAR (Bernanke et al., 2005) identified with an external instrument. The transition equation for the model can be expressed as follows:

$$\begin{bmatrix} F_t \\ Y_t \end{bmatrix} = \Phi(L) \begin{bmatrix} F_{t-1} \\ Y_{t-1} \end{bmatrix} + \epsilon_t \quad ,$$

where F_t is a $K \times 1$ vector of unobserved factors to be identified, Y_t is a $M \times 1$ vector of observable variables, $\Phi(L)$ is a lag-polynomial of finite order p and $\epsilon_t = (\epsilon_t^F, \epsilon_t^Y)'$ is a $(K+M) \times 1$ vector of independent and identically distributed (iid) white noise.

This model cannot be directly estimated since F_t is unobservable. Therefore, I collected a panel of time series that contains information about real activity, inflation and financial indicators in the euro area (see Appendix). The $N \times 1$ vector X_t denotes this panel and

[19] The release of the *US initial jobless claims* (IJC) coincides in many occasions with the beginning of the ECB's Press Conferences as Brand et al. (2010) noted. For this reason, I control for it by employing a continuous measure of IJC surprises that is standard in the literature. The variable is obtained by subtracting the market expectation to the actual value of the release; this difference is then standardized by its standard deviation.

is related to the unobservable factors F_t and the observed variables Y_t by the following observation equation:

$$X_t = \Lambda^f F_t + \Lambda^y Y_t + e_t \quad ,$$

where Λ^f is the $N \times R$ matrix of factor loadings, Λ^y is a $N \times M$ matrix of coefficients and $e_t \sim N(0, V)$ is the $N \times 1$ vector of error terms and V is a diagonal matrix. I then estimate the observation equation via principal component method and extract four latent factors (see Appendix), while the observed variables correspond to the policy indicator and the DFPA derived above.

Next, by applying the Wold representation theorem, the FAVAR model can be rewritten as:

$$y_t = \Phi(L)\upsilon_t \quad ,$$

where $\upsilon_t = H\epsilon_t$ is a $N \times 1$ vector of innovations, $\Phi(L) = \phi_0 + \phi_1 L_1 + ... + \phi_p L^p$ is the infinite order vector moving average (VMA) polynomial, Φ_j, $j = 1, ..., \infty$, are $K \times K$ matrices of VMA coefficients and L is the lag operator such that $Ly_t = y_{t-1}$ and H is a matrix of coefficients. VAR models result in an identification problem as the matrix H is not unique. In other words, monetary policy contemporaneously reacts to other variables in the model. The identification problem results in finding the part of the variation in monetary policy that is orthogonal to the other variables in the model. In the VAR literature, the standard identification strategy is to impose timing restrictions by the Cholecky factorization of the orthogonal matrix U. This approach is particularly problematic for two reasons: firstly, it suffers from simultaneity problems; secondly and most importantly for this paper, the Cholesky decomposition strategy fails to identify asset purchases shocks (Elbourne and Ji, 2019). For these reasons, I follow the so-called external instrument approach (Mertens and Ravn, 2013; Montiel Olea et al., 2015; Stock and Watson, 2012) where information outside the VAR is used to isolate the variation in the reduced-form residuals in the VAR due to monetary policy shocks. The main intuition behind this strategy is that when regressing the instrument z_t on the VAR innovations υ_t, the fitted value of the regression $\Pi\upsilon_t$ identifies the structural shock up to sign and scale (see Appendix).

Although neither the exogeneity nor the relevance condition is directly testable in the current setting, I examined the relevance on a representative VAR system with industrial production, HICP, CISS, real exchange rate, DFPA and the 2Y OIS as a policy indicator. The model is identified using the instrument derived above. I report further details and all results in Appendix, but it should be noted that in this baseline specification the instrument is strong, with a first-stage F-test statistic of 12.5. This confirms the relevance of the external instrument.

3.4. Historical Decompositions as Counterfactuals

What would have happened to GDP and inflation, had the ECB held constant the DFPA? To answer this question, I use historical decompositions (HD) as counterfactuals similarly to Kilian and Lee (2014). HD can be computed from covariance stationary VAR models in three steps: first, computing the structural MA coefficient matrices $\Theta_0, \ldots, \Theta_{T-1}$; second, identifying the structural shocks $w_t = A_0 u_t, t = 1, \ldots, T$ and, finally, matching up each shock j with the appropriate impulse weight to form $T \times 1$ vectors of fitted values for variable k, denoted $\hat{y}_t^{(j)} = \sum_{s=0}^{t-1} \Theta_s w_{t-s}$. Therefore, constructing the counterfactual is as simple as:

$$y_{kt} - \hat{y}_{kt}^{(j)},$$

where y_{kt} denotes the k^{th} actual time series variable and $\hat{y}_{kt}^{(j)}$ is the cumulative contribution of shock j to the evolution of variable k up to date t. The counterfactual series indicates how the variable of interest would have evolved had one replaced all realizations of shock j by zero while preserving the remaining structural shocks in the model.

HD is particularly suited for the purpose of this paper since it enables me to explain what happened to GDP and inflation during specific historical episodes such the sovereign-debt crisis. Besides, an additional advantage of HD is that it avoids the Lucas (1976) critique: in fact, it assumes that every event already happened and agents behaved accordingly; the question is rather to what extent the fact that agents behaved as they did contributed to the historical evolution of the variables of interest. In the current specification, the goal is to quantify how much the DFPA shock affected the historically observed developments of GDP and inflation.

Deriving such a counterfactual, as explained in the second step above, entails the identification of a DFPA shock. To do so, I use a VAR in GDP, inflation, interest rate (EONIA), DFPA, Composite Index of Systemic Stress (CISS), total government revenue and total government expenditure. The VAR system consists of these seven variables at a monthly frequency from 2002-1 to 2019-12, has six lags (AIC criterion), a constant with no time trend, and uses the first difference of CISS, the log-difference of GDP and inflation and the logarithm of remaining variables except interest rate and DFPA, where I use the level[20]. Since a DFPA shock is a surprise change in the communicated fiscal stance of the ECB, a negative DFPA shock corresponds to an unexpected communication on contractionary fiscal policy that the ECB encourages European countries to implement.

I identify such a shock by imposing a set of sign restrictions on the DFPA variable itself as well as imposing orthogonality to a fiscal policy and a monetary policy shock to filter out the effects of these shocks on the other variables. No sign restrictions are imposed on the responses of GDP and inflation so that the method remains agnostic with respect to

[20] Government revenue and expenditure were linearly interpolated to get a monthly frequency. For inflation, I used HICP (total), while GDP is proxied by industrial production (manufacturing). Results are consistent using different indicators for inflation and GDP. I also experimented with the factors for economic activity and price pressure identified in Appendix. C.2. Results were qualitatively and quantitatively similar to the baseline case.

the responses of the variables of interest. More in detail, a fiscal policy shock is defined as an increase in government revenues that negatively affects output and inflation for twelve months following the shock[21]. A monetary policy shock instead moves interest rates up and inflation and GDP down for twelve months after the shock. I also require the monetary policy shock to be orthogonal to the fiscal policy shock.

Finally, a DFPA shock is identified only through negatively restricting the impulse response of the DFPA variable for the first twelve months and through the requirement that it is orthogonal to both fiscal policy and monetary policy shocks. The only assumption I make in the model is that governments respond with a 2-month lag to the DFPA shock by cutting expenditure and rising revenues (Table 3). Although in the literature scholars distinguish between different types of fiscal consolidation (Alesina and Ardagna, 2013), in this paper I assume that governments implement a mixture of expenditure-based and tax-based adjustments since, as Table 4 shows, this fiscal strategy was the most frequent one across European countries during the sovereign-debt crisis[22]:

Table 3: Identifying Sign Restrictions

	Gov. Rev	Gov. Exp	Interest Rate	DFPA	GDP	Inflation	CISS
Fiscal Policy Shock	+				−	−	
Monetary Policy Shock			+		−	−	
DFPA Shock	+	−		−			

Note: This table shows the sign restrictions on the impulse responses for each identified shock. A "+" means that the impulse response of the variable in question is restricted to be positive for twelve months following the shock, including the month of impact. Likewise, a "−" indicates a negative response. A blank entry indicates that no restrictions have been imposed.

Table 4: Adjustment Type by Country

Country	**Year**		**Adjustment**	
	Begin	*End*	*EB*	*TB*
Ireland	2010	2014	X	
Spain	2009	2014	X	X
Portugal	2010	2014	X	X
Italy	2011	2012	X	X
Greece	2010	2014	X	X

Note: The table shows the type of adjustment that European countries underpinned during the Great Recession as well as the sovereign-debt crisis. The table is based on Alesina et al. EB stands for expenditure-based consolidation, while TB for tax-based adjustment. (2019)'s dataset.

Although the identification strategy draws on Mountford and Uhlig (2009) in so far

[21] The results are robust to different identifications of the fiscal shock (i.e., cut in government expenditure).

[22] In Appendix.D.2, I provide additional simulations. Moreover, the time lag for the governments to respond to a DFPA shock is set to two for statistical reasons. In fact, with six variables I can impose at most five zero restrictions. To be symmetrical then I set it to two. Results are robust to more than two lags when adding further variables.

as it controls for additional shocks, the actual implementation follows Arias et al. (2018) (hereafter ARRW)[23]. This is because the literature raised several issues with Mountford and Uhlig (2009)'s penalty function approach (PFA) (see Arias et al., 2018). Here, I just want to remind the most significant one: since the PFA rewards orthogonal matrices that imply responses strongly satisfying the sign restrictions (Uhlig, 2005), this rewarding strategy can result in imposing additional restrictions. Under this regard the PFA approach is not truly agnostic but it rather introduces additional sign restrictions on variables that are seemingly unrestricted. In contrast, ARRW's algorithm amends this issue by properly drawing from the posterior distribution of structural parameters conditional on the sign and zero restrictions. It follows that ARRW's methodology is truly agnostic with regard to the unrestricted variables.

4. Results

In this section, I will show and comment the results of the econometric models outlined in Section 3. In particular, 4.1 analyzes the results of the Proxy FAVAR and 4.2 reports the outcome of the counterfactual exercise.

4.1. Proxy FAVAR

The sample consists of monthly observations for the period 2002:1-2019:12[24]. The unconventional monetary policy shock is identified by using the LSBP factor derived in 3.2. However, the instrument is available for a shorter period from 2010:01 to 2019:12. Accordingly, I use the full sample to estimate the lag coefficients and obtain the reduced form residuals. Then, I use the LSBP factor and residuals for the corresponding period to identify unconventional monetary policy surprises as in Gertler and Karadi (2015). Based on the Akaike Information Criterion (AIC), the lag length in the FAVAR is set to four. All impulse responses are for a 0.25% decrease in the policy indicator and I show results for a forecast horizon of 30 months. I report 90% and 68% confidence intervals computed using a recursive wild bootstrap using 10,000 replications.

Figure 5 shows how a selection of macroeconomic time series across the euro area respond to a 0.25% decrease in the policy indicator due to an exogenous LSBP shock. The model performs in accordance with economic theory. In fact, focusing on the first row, industrial production and manufacturing turnover index rise, as does a soft indicator like industrial confidence. Notably, the model does not suffer from the "price puzzle" since all the variables

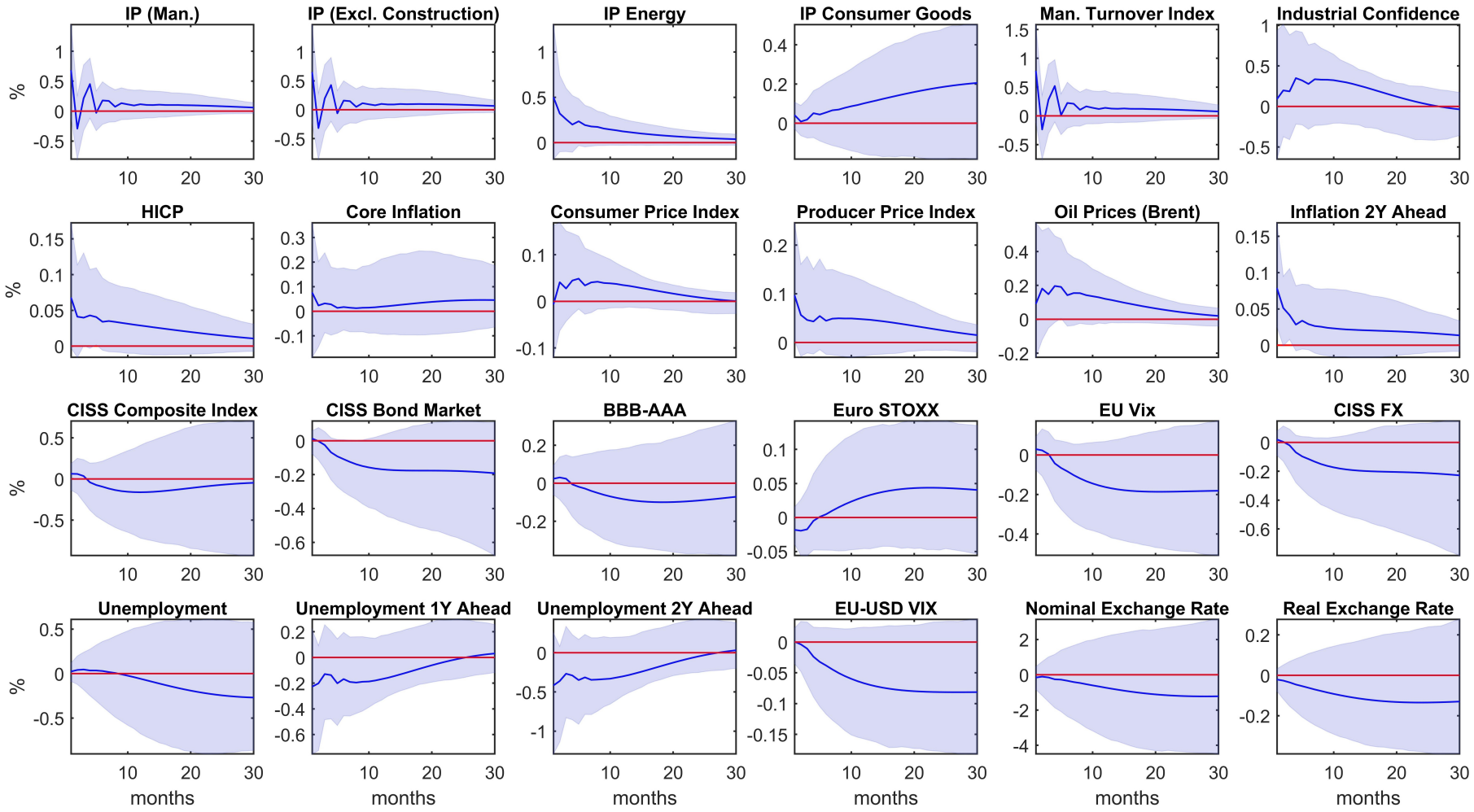
[23] Despite following ARRW, I adapt the algorithm to my empirical specification by imposing a Minnesota prior for the parameters of the VAR model. In specifying the Minnesota prior, I set the two hyperparameters λ and θ to 0.5. While the former controls the prior variance of all VAR coefficients, the latter controls the tightness of the variances of the coefficients of lagged variables other than the dependent variable in a given equation. No attempt is made to determine the hyperparameters following a formal rule (see Giannone et al. (2015)) but rather follow a widely used set-up in the literature. In any case, results are robust to different hyperparameters.

[24] The sample excludes the Covid-19 period for two reasons: on the one hand, the paper was finished before the start of the pandemic; on the other hand, governments are not directly responsible of the recession generated by the pandemic in so far as it is an exogenous event. Therefore, the the moral hazard issue that drives the doom-loop hypothesised in this paper is very different compared to a crisis spurred by endogenous reasons where governments' policy may be considered part of the problem.

measuring price pressure correctly increase after the expansionary shock. This result proves that the model can accurately describe the macroeconomic dynamics of the euro area. The remainder of the series also behave as suggested by theory. In particular, CISS bond market significantly drops after the monetary easing, while European stock prices surge. Nominal and real exchange rate depreciate and unemployment contracts after the shock.

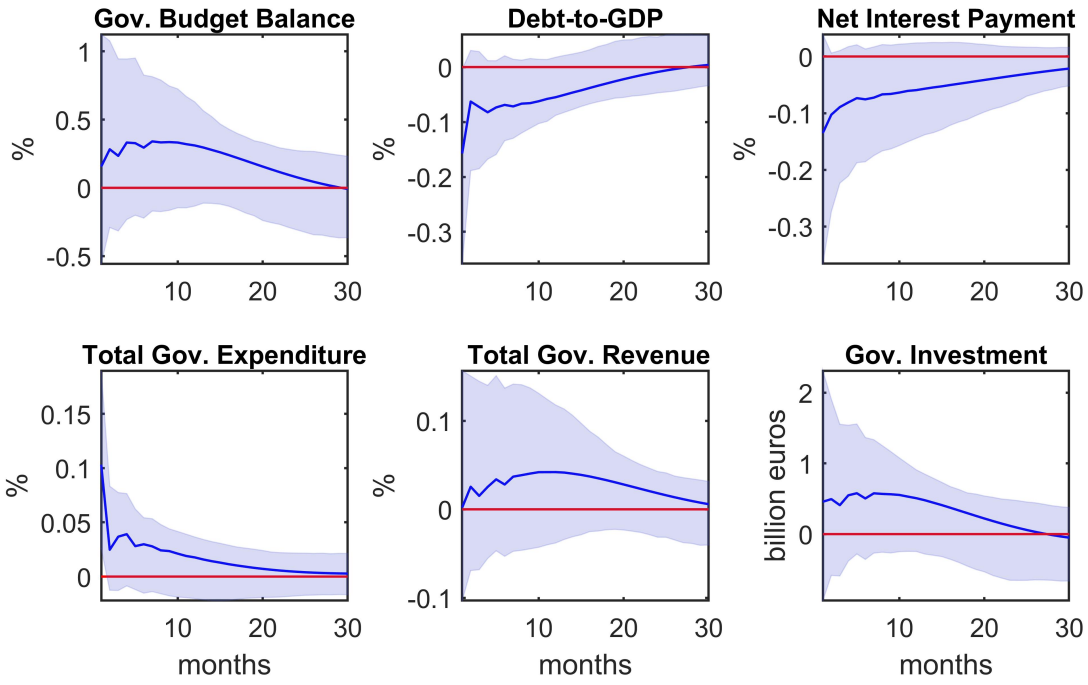
Next, Figure 6 reveals the behaviour of the fiscal variables given an expansionary bond-purchases shock.

Figure 5: Proxy FAVAR



Note: The figure shows the impulse responses to a 0.25% decrease in the policy indicator due to a LSBP shock. 95% bands are displayed.

Figure 6: Fiscal Variables

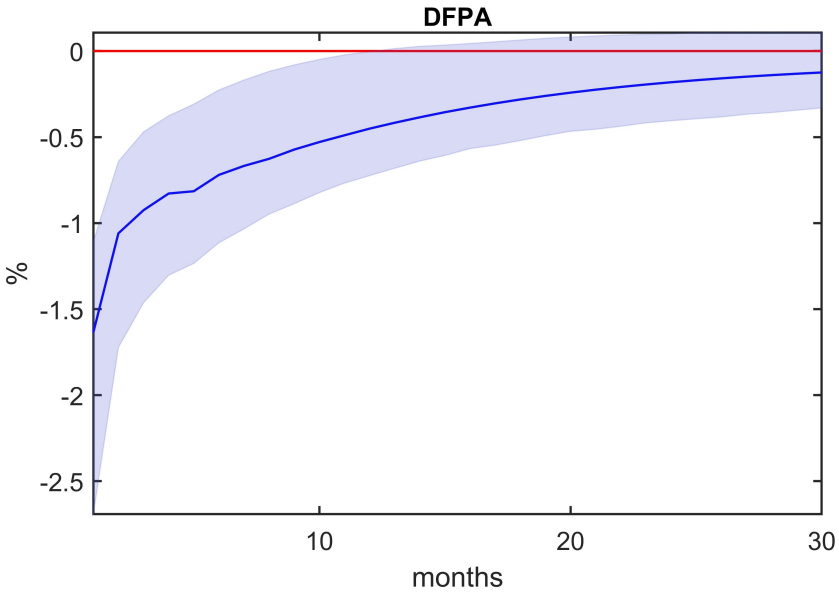


Note: Fiscal responses at the euro area level. The figure shows the response to a 0.25% decrease in the policy indicator due to a LSBP shock. 90% bands are displayed.

The figure shows that government bond purchases have sizeable windfall gains for EA countries, that is, government budget improves, debt-to-GDP and net interest payments significantly decline and government revenue increases. Besides, governments internalize the positive fiscal effects of monetary measures and increase government spending and investment, thereby proving, as in Hachula et al. (2020), that the response of government spending behaves countercyclically. This finding is important since the fiscal consequences of government bond purchases is what threatens the independence of the ECB via fiscal dominance concerns.

The variable of interest to this paper is, however, the DFPA that captures the communicated "fiscal stance" of the ECB. Figure 7 displays the response of this variable to an expansionary LSBP shock. The result supports the hypothesis according to which the ECB requires fiscal consolidation to come with large-scale purchases of government bonds. In fact, the model shows that the DFPA plunges 1.6% on impact and remains significantly negative for twelve months after the shock. The ECB, therefore, calls on governments to procyclically constrain fiscal policies after an unconventional monetary easing. Notably, as showed in Appendix, the significantly hawkish response is specific to a government-purchase shock. Neither a conventional monetary policy shock nor a forward guidance surprise is, in fact, able to trigger such a reaction.

Figure 7: Impulse Response to an Expansionary LSBP Shock



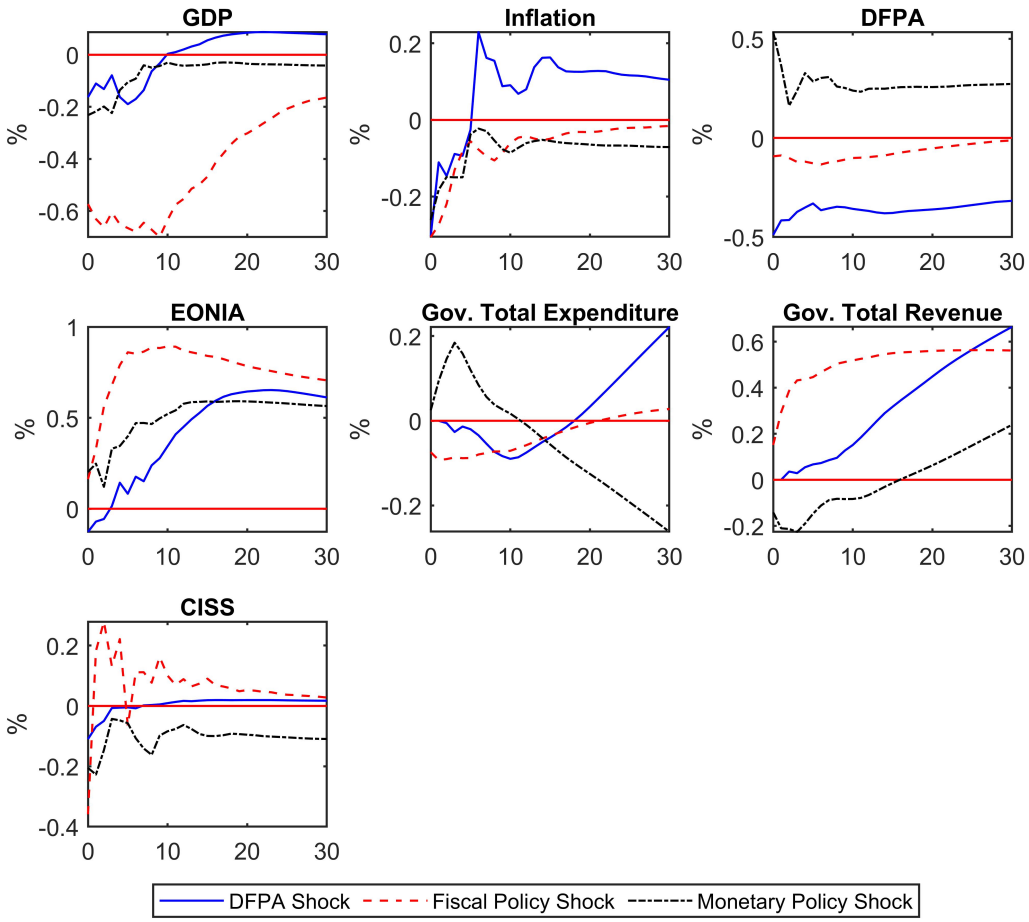
Note: The figure shows the response to a 0.25% decrease in the policy indicator due to a LSBP shock. 68% and 95% bands are displayed.

On balance, the model consistently demonstrates that there is an inverse relationship between the communicated fiscal stance of the ECB and a bond-buying surprise. It also shows the significant fiscal consequences of an unconventional monetary easing which I claim to be the main reason pushing the ECB to become more fiscally prudent. In Appendix, I provide further evidence in support of this pass-through by deriving an index of "threat to ECB independence". The finding is that large-scale purchases of government bonds increase the risk of fiscal dominance. As a result, the ECB calls on governments to enforce fiscal retrenchment and, in so doing, minimize the windfall gains of monetary measures.

4.2. Historical Decompositions

A DFPA shock is identified as a shock that is orthogonal to the fiscal and monetary policy shock and where government spending and government revenue are restricted to respectively decrease and rise for twelve months only two months after the shock. The impulse responses for this shock (solid blue lines) as well as the fiscal (dashed red lines) and monetary (dash-dotted black lines) ones are displayed in Figure 8. To save space, I do not display the structural shocks identified (see Appendix).

Figure 8: Impulse Responses to a DFPA Shock

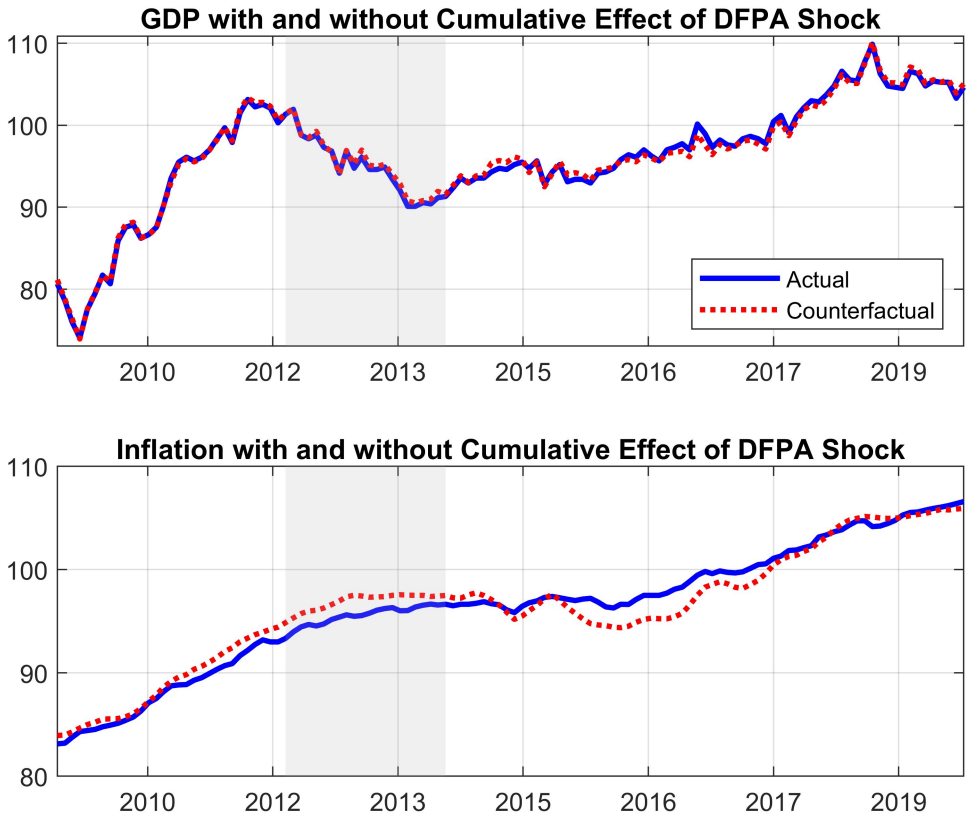


Note: The solid blue lines indicate the impulse responses to a DFPA shock, the dashed red lines are the responses to a fiscal policy shock and the black dash-dotted lines represent the impulse responses to a monetary policy shock. Every impulse response indicates the posterior median.

Focusing on the variables left unrestricted, Figure 8 shows that a DFPA shock lowers GDP and inflation for 10 and 6 months, respectively, before turning positive[25]. These results are in line with the claims of the paper: when the ECB requires European countries to restrain fiscal policy, they do so with a lag and this drives output and price pressure down. Based on this structural VAR model, Figure 9 provides the historical counterfactuals of GDP and inflation.

[25] The response of interest rate is also interesting: higher rates further complicates fiscal easing and therefore strengthens the fiscal reprimands of the ECB.

Figure 9: Historical Counterfactuals

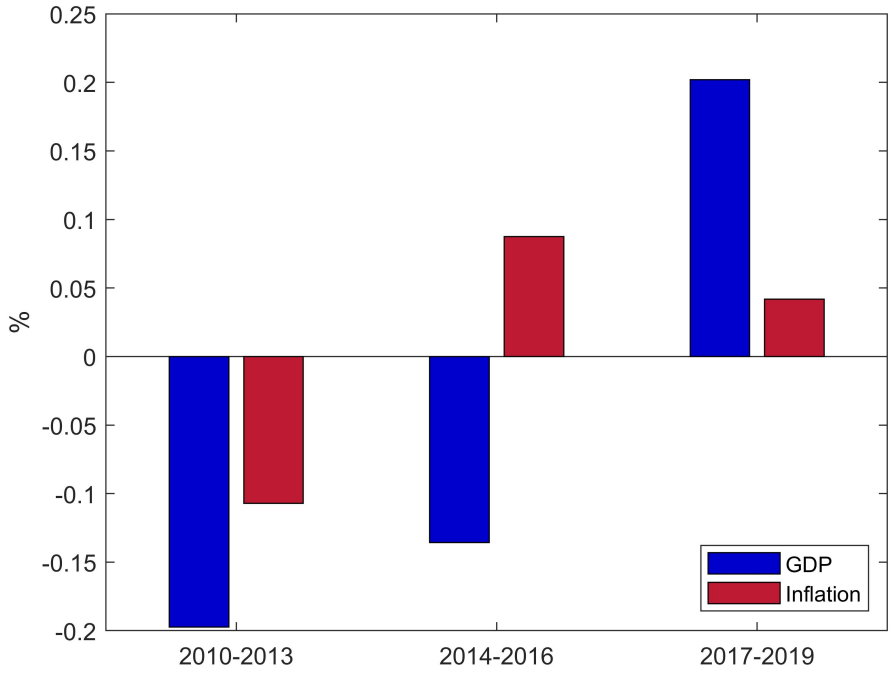


Note: The figure shows GDP (proxied by industrial production) and inflation from January 2010 to December 2019 with and without the cumulative effect of the DFPA shock.

The counterfactuals show how GDP and inflation would have evolved had one been able to replace all realizations of the DFPA shock by zero while preserving the LSBP shock in the model. If the counterfactual exceeds the actual series, this means that the DFPA shock lowered the actual series and vice versa. The first panel therefore shows that while, in the absence of a DFPA shock, GDP would have followed approximately the same path as the actual series from 2010 to the end of 2011, it would have been slightly higher from 2012 to 2015, and then been again marginally below the actual series thereafter. The second panel instead shows that inflation, in the absence of a DFPA surprise, would have been higher between 2010 and 2015 hitting a peak at the height of the sovereign-debt crisis. In other words, fiscally hawkish signals from the ECB helped somewhat depress GDP and inflation outweighing the effects of monetary stimuli.

The same results can be presented differently to highlight the cumulative net effect of the DFPA shock over sub-periods of time. Figure 10 illustrates these findings. When the bar is below zero indicates that DFPA surprises had a contractionary effect on the series and vice versa.

Figure 10: Historical Counterfactuals Cumulated by Period



Note: The figure shows the cumulative counterfactual for GDP and inflation in 2010-2013, 2014-2016 and 2017-2019. The y-axis indicates the share of the

Between 2010 and 2013, the period that covers the sovereign-debt crisis, GDP and inflation could have been higher by around 0.2% and 0.1% respectively. From 2014 to 2016, while the effect on GDP remained negative although somewhat reducing in magnitude (around -0.1%), the impact on inflation turned positive (0.1%). Finally, over the time period 2017-2019, the counterfactual for GDP and inflation was positive for either variables, respectively almost 0.2% and 0.05%. Hence, the contractionary effects due to fiscally conservative messages were stronger in magnitude during the period in which the economy of the euro area needed to be stimulated the most.

The paper showed that large purchases of government bonds triggers fiscal dominance concerns. This drives the ECB to call on governments to constrain fiscal policy today to protect monetary dominance tomorrow. This strategy however has macroeconomic costs: in fact, inflation and GDP would have been higher during the sovereign-debt crisis and beyond had the ECB maintained a more prudent strategy on fiscal policy.

5. Conclusion

The very-well known "doom-loop" in the existing literature refers to the relationship between banks and sovereigns in the euro area that arises when a large amount of government bonds in banks' balance sheets erodes the value of bank equity as interest rates spike. This

paper, however, unearths a new "doom-loop" between the institutional architecture of the ECB, its UMP decisions and "fiscal stance". While CBI has often been praised as a "free lunch" because it lowers inflation with no costs to output, this paper shows that defending the independence during a financial crisis in the EMU is macroeconomically costly: since UMP exposes the ECB to the threat of fiscal dominance, the monetary authority of the euro area reacts by shifting its fiscal stance towards fiscal conservatism. In other words, to protect monetary dominance, the ECB demands governments to constrain fiscal policies thereby preventing them from free-riding on monetary measures. This, in turn, outweighs the positive effects of unconventional measures and results in a level of GDP and inflation that is lower than what would have been had the fiscal stance been constant.

These novel results entail a number of theoretical and policy lessons. First of all, finding that CBI was macroeconomically costly for the ECB does not imply that a politicised central bank provides a better service. It rather means that the EMU should be developed to further free the ECB from the institutional overburdening of the fiscal consequences of its unconventional measures[26]. Second, despite being monetary institutions, central banks communicate also on fiscal policy and, as this paper shows, the impact of the fiscal communication can be as important as the one on monetary issues. Third, CBI, for good reasons, led us to believe that unless countries conduct disciplined fiscal policy, the independence of monetary policy can be questioned. This paper, however, shows that excessive fiscal conservatism can also turn into a form of fiscal dominance: when unconventional measures are put in place, fiscal discipline may backfire the effort of the central bank to fulfil its mandate. Hence, the utmost divorce between monetary and fiscal authority might hamper the recovery by leading to an unbalanced policy mix.

[26] The best example of this is the ruling of the German Federal Constitutional Court (GFCC) on 5 May 2020. In opposition to the sentence of the ECJ on 11 December 2018 that regarded the PSPP in compliance with the EU law, the GFCC questioned the legality of the ECB's bond purchases and ordered the German government and parliament to ensure the ECB carried out a "proportionality assessment" of its purchases of government debt to ensure their "economic and fiscal policy effects" did not outweigh its policy objectives, and threatened to block new bond-buying unless the ECB did so within three months.

ONLINE APPENDIX

This Appendix is organised as follows: section A gives further details on the methodology used to quantify the degree of fiscal policy accommodation of the ECB; section B explains formally the derivation of the shocks; section C provides further analyses and proofs concerning the proxy FAVAR used in the paper; finally, section D identifies the fiscal policy shock with different fiscal policy responses.

A. Quantifying the Degree of Fiscal Policy Accommodation (DFPA)

A.1 explains the classification model used to check the dataset I applied Wordscore to; A.2 deepens the choice of reference texts; A.3 sheds light on the external validation exercise and A.4 runs some robustness checks.

A.1. Classification Model

The selection of the dataset containing sentences/paragraphs on normative fiscal policy was computed manually. The following quote is an example of a normative paragraph:

> In order to support confidence, sustainable growth and employment, the Governing Council calls upon governments to restore sound fiscal positions. Commitments under the Stability and Growth Pact need to be fully honoured and weaknesses in competitiveness forcefully addressed. National policy-makers need to fully meet their responsibilities to ensure fiscal sustainability.

To avoid any bias in the selection procedure, I apply classification and regression trees (CART). I proceed as follows: first, I select a random sample of 100 paragraphs from the manually selected dataset and 900 paragraphs from the corpus of all ECB Press Conferences (from which "fiscal" paragraphs have been carefully excluded). I then bind the samples in a unique one containing 1000 paragraphs and label each paragraph as "fiscal" or "non-fiscal" according to its content. Second, I convert text into a $M \times N$ document-feature matrix (dfm) where M is the number of paragraphs and N is the the number of words. Thus, each cell ij in the dfm indicates the number of times that term j occurs in paragraph i. Afterwards, I multiply term counts by the inverse document frequency in order to downweight words that are likely to have low discriminating power. The inverse document frequency measures the frequency of occurrence of a term across all documents:

$$idf_j = log \frac{M}{m:j \in m}$$

where m is the number of paragraphs containing term j. The resulting tf-idf matrix is used as an input to the CART algorithm. CART is a method that relies on repeated partitioning of the data to estimate the conditional distribution of a response given a set of explanatory

variables (Jones and Linder, 2015). Let the outcome of interest be a vector of observations $y = (y_1, \cdots, y_n)'$ and X a matrix of explanatory variables. Here y is a binary variable that takes value 1 if the paragraph is relevant to the topic of interest, and 0 otherwise. X is given by the tf-idf matrix. The goal of the algorithm is to partition y conditional on the values of X such that the resulting subgroups of y are as homogeneous as possible. In this application, the CART algorithm identifies words that have high discriminating value to predict whether a paragraph is related to the topic of interest and splits the data in two classes, based on whether each word is predicted to belong to the set of paragraphs of interest.

The CART classifier appears to perform very well since $accuracy = 0.99$ and $precision = 1$, meaning that nearly all of the relevant paragraphs in the test set are identified properly. Nonetheless, it is noteworthy that the high value of the results for the evaluation criteria are also due to the imbalanced nature of the two classes. Indeed, fiscal paragraphs are a small minority of all paragraphs in the training and test sets. Hence, the classifier could reach high levels of accuracy even by simply classifying all paragraphs as non-fiscal. An accurate inspection of the results ensures that it is not the case: 33 out of 35 fiscal paragraphs in the test set are correctly classified by CART.

I finally compared the text corpus derived manually with the one obtained via automated classification. There is a strong degree of overlapping since the former is *always* contained in the latter. However, the automated text also includes sentences that are fiscal but not normative in nature. Both datasets are available upon request.

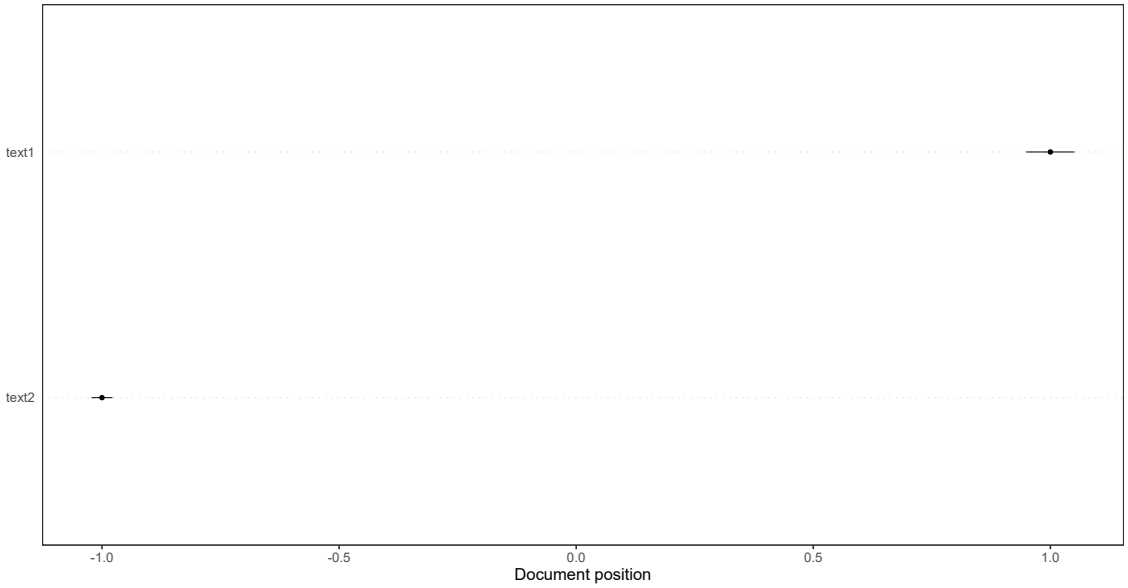
A.2. Reference Texts

In choosing the reference texts I follow the guidelines outlined in LBG. First, reference texts should use the same lexicon, in the same context, as the virgin texts being analyzed. Second, policy positions of the reference texts should "span" the policy dimensions under study. Last, reference texts should contain as many different words as possible. While the first and third recommendations are easily met as any document used as reference texts comes from the official communication of the ECB, the second one proved to be more challenging as it requited qualitative judgement. I proceeded in the following way: first, I collected ECB Press Conferences, Speeches, Monetary Hearings and Interviews from 2002 to 2019 and extracted only the paragraphs that referred to fiscal policy using Latent Dirichlet Allocation (Lafferty and Blei, 2006), obtaining a corpus of around 5000 documents that I, in turn, subsetted into sentences. Second, I inspected the entire dataset qualitatively classifying each sentence according to the three categories defined in 3.1: fiscally hawkish, fiscally neutral and fiscally dovish. Finally, I only kept those sentences that clearly belonged to either "fiscally hawkish" or "fiscally dovish" category and, among these, I chose the ones I considered to be more neatly representative of the two policy dimensions. This strategy led me to have a total of 6133 words for the dovish reference text and 36026 for the hawkish one − such an unbalanced dataset is consistent with the results of the expert survey where the number of fiscally hawkish documents is much bigger than the number of dovish ones, respectively,

157 (83%) and 33 (17%)[27]. To make the reference texts homogeneous to the virgin text, I followed the same pre-processing steps: I removed stopwords, currency symbols, punctuation, numbers, separators and features that, across all documents, do not occur at least ten times; I also created bigrams and trigrams and lemmatized the corpus to better score economic words (i.e. "fiscal consolidation" instead of "fiscal" and "consolidation"). When the corpus of reference texts was transformed into a dfm, it resulted in 2,207 features (33.7% sparse); instead the dfm of the virgin text contained 2,266 features (96.0% sparse). The words that were present in the virgin text and absent in the reference text were carefully checked and deemed insignificant.

To deal with the unbalanced nature of the corpus of reference texts, I set the smoothing parameter equal to 0. In fact, by smoothing by 1 as in Lafferty and Blei (2006), I will attach a high weight to the terms associated with the smaller training class (the fiscally dovish class). This will result in an inappropriate scoring since although dovish terms may occur more often in the hawkish texts, they have higher *relative* frequency in the shorter, dovish text. To show the plausibility of my choice, one can consider Figure 11 that shows the predicted document position of reference texts rather than virgin texts:

Figure 11: Predicted document position using reference texts



Note: The figure shows the predicted document position of reference texts. The horizontal line is the standard error.

The figure shows that the the composition of the reference text, despite being unbalanced, is appropriate since the predicted position coincides with the *apriori* definition. However, this does not lead to the conclusion that I identified the "true" reference texts. As I said before, choosing reference texts involves a great deal of qualitative and subjective decisions and the reference texts I used are in no way the only possible ones. Researchers can experiment many other combinations as long as the result is validated by any reliable source.

[27] I ran Wordscore way before the results of the expert survey. Therefore, the initial inspection was qualitative.

A.3. External Validation

As any machine learning algorithm, the selection and composition of an appropriate training set is of crucial importance. The problem that occurs in this case is that the choice of reference texts requires qualitative and subjective decisions that are not validated by any source. In fact, being the first time that such a methodology is applied to central banks' documents, there are no official references that guide the selection. For this reason, I set up an expert survey to validate the choices I made.

The external validation exercise consists of an expert survey that I carried out in *Qualtrics* between May 8 and July 5 2020. Every expert is randomly assigned 15 documents (average length 300 words) containing normative fiscal policy paragraphs in the Press Conferences. Since necessary information was provided on the context of the survey and the content of the study, randomization was to prevent the respondents from directly recognising the time period. Moreover, Presidents' and officials' names were removed for similar reasons and dates kept only when deemed necessary to the correct execution of the task. The sample of experts was composed of macro and political economists whose expertise lies between monetary and fiscal policy in the euro area. The survey was sent to each expert by email. I collected 200 responses whose breakdown by sector is summarized in Table 5[28].

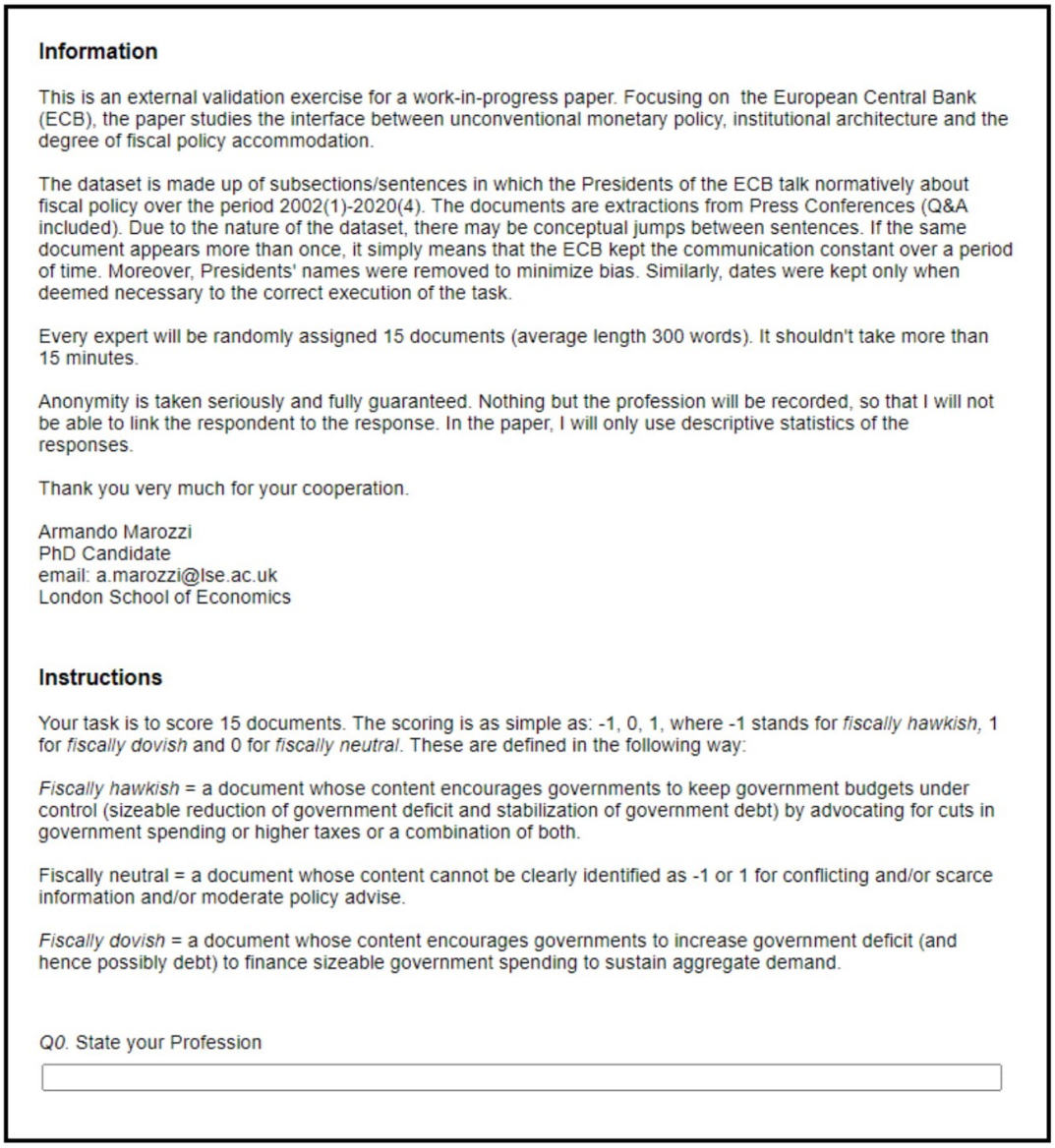
Table 5: Respondents by Sector

Sector	*Share*
Prefer not to say	7.5%
Central Bank	4%
Academia	57.2%
Financial Sector	17.3%
Generic Economist	14%

The task of the experts was to score each document. The scoring was as simple as: -1, 0 and 1, where -1 stands for *fiscally hawkish*; 1 for *fiscally dovish* and 0 for *fiscally neutral*. The categories are defined as in 3.1: fiscally hawkish is a document whose content encourages governments to keep government budgets under control (sizeable reduction of government deficit and stabilization of government debt) by advocating for cuts in government spending or higher taxes or a combination of both; fiscally dovish is a document whose content encourages governments to increase government deficit (and hence possibly debt) to finance sizeable government spending to sustain aggregate demand; fiscally neutral is a document whose content cannot be clearly identified as -1 or 1 for conflicting and/or scarce information and/or moderate policy advise. Figure 12 and Figure 13 show, respectively, the introductory part of the survey and an example of a Press Conference to be scored:

[28] Anonymity was fully guaranteed. I also said in advance that nothing but the profession was going to be recorded.

Figure 12: Introduction to Expert Survey



Information

This is an external validation exercise for a work-in-progress paper. Focusing on the European Central Bank (ECB), the paper studies the interface between unconventional monetary policy, institutional architecture and the degree of fiscal policy accommodation.

The dataset is made up of subsections/sentences in which the Presidents of the ECB talk normatively about fiscal policy over the period 2002(1)-2020(4). The documents are extractions from Press Conferences (Q&A included). Due to the nature of the dataset, there may be conceptual jumps between sentences. If the same document appears more than once, it simply means that the ECB kept the communication constant over a period of time. Moreover, Presidents' names were removed to minimize bias. Similarly, dates were kept only when deemed necessary to the correct execution of the task.

Every expert will be randomly assigned 15 documents (average length 300 words). It shouldn't take more than 15 minutes.

Anonymity is taken seriously and fully guaranteed. Nothing but the profession will be recorded, so that I will not be able to link the respondent to the response. In the paper, I will only use descriptive statistics of the responses.

Thank you very much for your cooperation.

Armando Marozzi
PhD Candidate
email: a.marozzi@lse.ac.uk
London School of Economics

Instructions

Your task is to score 15 documents. The scoring is as simple as: -1, 0, 1, where -1 stands for *fiscally hawkish,* 1 for *fiscally dovish* and 0 for *fiscally neutral*. These are defined in the following way:

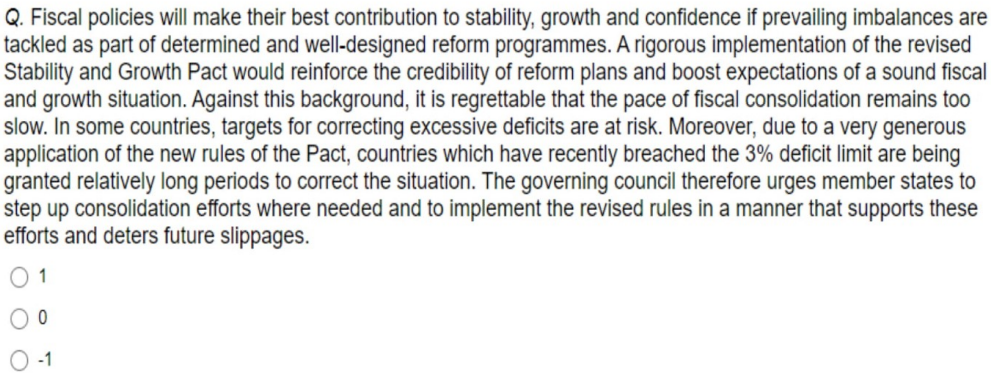
Fiscally hawkish = a document whose content encourages governments to keep government budgets under control (sizeable reduction of government deficit and stabilization of government debt) by advocating for cuts in government spending or higher taxes or a combination of both.

Fiscally neutral = a document whose content cannot be clearly identified as -1 or 1 for conflicting and/or scarce information and/or moderate policy advise.

Fiscally dovish = a document whose content encourages governments to increase government deficit (and hence possibly debt) to finance sizeable government spending to sustain aggregate demand.

Q0. State your Profession

Figure 13: Sample Question



The results of the expert survey were shown in Figure 2. The two series are clearly correlated (87.1%) and also the signs of each observation correspond throughout the period. In only 4 occasions the two series show different signs. It is worth exploring the disagreement between the supervised model and the expert survey. The first controversial Press Conference is on 5 June 2014:

> In this context, the Governing Council takes note of the European Commission's recommendations on fiscal and structural policies, published on 2 June 2014, to continue the path of reducing budgetary and macroeconomic imbalances. The recommendation to the Council to abrogate the excessive deficit procedures for four euro area countries indicates continued progress in restoring sound public finances. However, euro area countries should not unravel progress made with fiscal consolidation. A full and consistent implementation of the euro area's macroeconomic surveillance framework, together with the necessary policy actions by euro area countries, will help to raise potential growth, increase the euro area's resilience to shocks and facilitate job creation. I would say the word, the message that the ECB has sent has always been you have to consolidate your budget, but governments have to do so in a growth-friendly way. And the growth-friendly way means lower current government expenditure, lower taxes, to the extent that it's possible within the Stability and Growth Pact higher capital goods expenditure, higher public investment and all this should be accompanied by structural reforms. If any of these pieces falls down then you don't have a growth-friendly consolidation. If governments pursue fiscal consolidation only through the increase in taxes, we have what we have today, namely that this is the area of the world where you have the highest taxes. And that doesn't seem to be conducive to growth. If governments think that they can consolidate the budget and that's enough and they don't pursue structural reforms, you can see that that's not sustainable. We shouldn't forget that one of the reasons for this crisis was the condition in which many budgets of European countries were at the beginning of the crisis and the level of debt and deficits in many countries. This was not the only cause of the crisis, but certainly

it was one of the important ones. So we don't want to go back to that situation. And that's why I always insist to growth-friendly fiscal consolidation.

The document is certainly controversial to score. This difficulty is reflected in the expert survey attributing -0.57, while the supervised algorithm 0.52. In this case, both magnitudes are below one and their average would result into a plausible fiscally neutral document according to the definition I gave above.

The second conflicting result is with respect to the Press Conference on 6 November 2014 and is the one that registers the biggest deviation between the two observations:

> As regards fiscal policies, countries with remaining fiscal imbalances should not unravel the progress already made and should proceed in line with the rules of the Stability and Growth Pact. Throughout the procedural steps under the agreed framework, the Pact should remain the anchor for confidence in sustainable public finances. The existing flexibility within the rules should allow governments to address the budgetary costs of major structural reforms, to support demand and to achieve a more growth-friendly composition of fiscal policies. A full and consistent implementation of the euro area's existing fiscal and macroeconomic surveillance framework is key to bringing down high public debt ratios, to raising potential growth and to increasing the resilience of the euro area economy to shocks.

The expert survey scores this document -1.78; instead, wordscore results in 1.93. It very much depends on the weight that one gives to each sentence and the overall interpretation of the document. Once again, though, the difference emerges in an intrinsically controversial document. Besides, even in this scenario, averaging the two observations would result in a balanced document.

The other two controversial results have the same content and correspond to the Press Conferences that took place, respectively, on 8 June 2017 and 20 July 2017:

> Regarding fiscal policies, all countries would benefit from intensifying efforts towards achieving a more growth-friendly composition of public finances. A full, transparent and consistent implementation of the stability and growth pact and of the macroeconomic imbalances procedure over time and across countries remains essential to bolster the resilience of the euro area economy.

Being the documents the same, Wordscore gives correctly the same result: -0.78. Instead, interestingly, experts score the June Press Conference 0.24 and the July one 0.96. This largely reflects the randomization of the survey and the, by default, the mean of the scoring of different experts. That said, the document is prone to controversial results since the opening (and shorter) sentence can be considered fiscally dovish, while the second (and longer) one is more tilted toward a hawkish score - always according to the definition of the task. In this case as well, the average is very close to 0.

Overall, the documents that register different signs are the most controversial ones and some mild form of measurement error needs to be accounted for. Fortunately, these deviations are always small in magnitude and often negligible. Nonetheless, rather than

trying to solve the tensions between these observations, I will run the models with both series to test whether any significant deviation occurs.

A.4. Robustness checks

I carried out two main robustness checks as to the DFPA variable. The first check regards the frequency of the series. At its inception in 1999, the ECB Governing Council took policy decisions twice a month, whereas a press conference took place only once a month, on the first meeting of the month. After November 2001 only one meeting per month was a policy meeting, taking place on the first Thursday of the month, regularly accompanied by the press conferences, with some exceptions (see Ehrmann and Fratzscher, 2009). As of January 2015, the frequency of monetary policy meetings has moved to a six-week cycle. This is to say that the frequency of the series is not monthly; from 2002(1) to 2019(12), 26 observations are missing to obtain a monthly frequency. In the main specification, I assumed that, when a Press Conference is missing, the ECB keeps the "fiscal stance" constant, that is, it does not have the opportunity to update its considerations on fiscal policy in the euro area. In practical terms, this assumption means to fill the missing observations at time t with the lag value at time $t-1$. Alternatively, I linearly interpolated the missing observations. In either cases, the differences between the two methodologies is marginal (99% correlation in either cases). Besides, the FAVAR is not only robust to this alternative specification but also to an analysis carried out with a real-time dataset.

The second check consists in running the algorithm with different pre-processing decisions, essentially without lemmatization and ngrams (bigrams and trigrams). The result is essentially the same as the pre-processed series, 95.1% correlation. More importantly, the FAVAR is robust to different text pre-processing decisions.

B. Extracting Monetary Policy Shocks

Although in the paper I prioritized the LSBP shock, the identification strategy of the factors retrieve two other shocks, Jump and Forward Guidance (FG), which I will use to get additional results. In what follows, I first formally explain the rotation strategy (B.1) and the compare the surprises to notable events in the euro area as a robustness check (B.2).

B.1. Rotation Strategy

I follow Swanson (2017) to identify Jump, FG and QE shocks. Given the $T \times n$ matrix X of n asset price responses to the T ECB announcements in my sample, I first demean and scale each column of X to have zero mean and unit variance. I then extract the first three principal components of the standardized matrix to estimate the three latent factors that explain a maximal fraction of the variance of the (standardized) data. Let F denote the

$T \times 3$ matrix of these first three principal components, and Λ the $3 \times n$ matrix of loadings of the data X on F. It is straightforward to show that a 3×3 orthogonal matrix U is uniquely identified by three parameters. Thus, three identifying restrictions are required to uniquely identify the rotation U that maps the principal components F into three factors $\tilde{F} = FU$ that have a structural interpretation as 1) the surprise change in the short term rate (Jump), 2) the surprise change in FG, and 3) the surprise change in asset purchases (QE).

The first two identifying assumptions are that QE and FG have no effect on the short term rate. These two zero restrictions can be written as:

$$U'\Lambda_2 = \begin{bmatrix} . \\ 0 \\ 0 \end{bmatrix}$$

where Λ_2 denotes the second column of Λ, the loadings of the short term rate (1M OIS) on the three factors F. Letting U_i denote the ith column of U, these restrictions correspond to $\Lambda_2' U2 = 0$ and $\Lambda_2' U_3 = 0$. Effectively, these two restrictions imply that only the first factor has any systematic effect on the short-term rate.

The third identifying restriction is that the variance of the QE factor is as small as possible over the sample from November 2005 to January 2008. The QE factor is given by FU_3, so this restriction amounts to minimizing $U_3'(F^{pre})'U_3(F^{pre})$. This is a constraint on U_3 that does not directly affect U_1 or U_2, except via the orthogonality conditions between the columns of U.

Computationally, I implement these restrictions as follows. Restrictions one and three are implemented in one step as a quadratic minimization problem subject to a linear constraint: I temporarily ignore the unit length requirement on U3 and normalize the third element of U_3 to unity; I then minimize:

$$\begin{bmatrix} u_{13} & u_{23} & 1 \end{bmatrix} (F^{pre})'F^{pre} \begin{bmatrix} u_{13} \\ u_{23} \\ 1 \end{bmatrix}$$

subject to $\Lambda_2' \begin{bmatrix} u_{13} & u_{23} & 1 \end{bmatrix}' = 0$ where Λ_2 denotes the first column of Λ. After computing the minimizing vector $\begin{bmatrix} u_{13} & u_{23} & 1 \end{bmatrix}$, I rescale it to have unit length and call the resulting vector U_3.

To implement the second restriction, I then solve equation:

$$\begin{bmatrix} \Lambda_2' \\ U_3' \end{bmatrix} \begin{bmatrix} u_{12} \\ u_{22} \\ 1 \end{bmatrix} = \begin{bmatrix} 0 \\ 0 \end{bmatrix}$$

for u_{12} and u_{22} which ensures that $\begin{bmatrix} u_{12} & u_{22} & 1 \end{bmatrix}$ satisfies the identifying restriction and is orthogonal to U_3. I then rescale the vector $\begin{bmatrix} u_{12} & u_{22} & 1 \end{bmatrix}$ to have unit length and call the result U_2.

I compute U_1 by an analogous procedure, normalizing the third element of U_1 to unity,

then solving the equation:

$$\begin{bmatrix} U_2' \\ U_3' \end{bmatrix} \begin{bmatrix} u_{11} \\ u_{12} \\ 1 \end{bmatrix} = \begin{bmatrix} 0 \\ 0 \end{bmatrix}$$

and renormalizing $\begin{bmatrix} u_{11} & u_{12} & 1 \end{bmatrix}$ to have unit length. This ensures U_1 is orthogonal to U_2 and U_3.

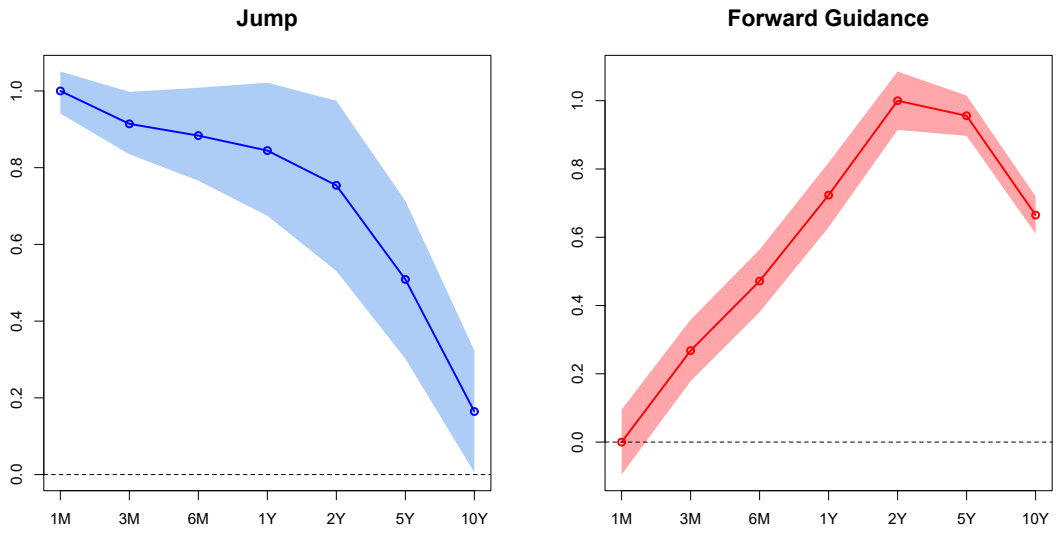
This uniquely identifies U and $\tilde{F}$ up to a sign and scale. The Jump factor is normalized to have unit effect on the 1-month OIS. The Forward Guidance and QE factors are normalized to have unit effect on the 2-year and on the 10-year yields, respectively. This normalization has no effect on the variance shares and statistical significance of the results.

B.2. Correspondence of Factors to Notable ECB Announcements

In this subsection, I describe and discuss the Jump, Forward Guidance and LSBP factors[29]. I compare these identified surprises with ECB's relevant policy actions and check that I have an accurate mapping. I will mainly follow ABGM in describing events. I focus in particular on larger surprises and compare these with market commentaries to see whether the two coincide. The estimated factor loadings for Jump and FG are displayed in Figure 14 while the time series of the surprises are shown in Figure 15:

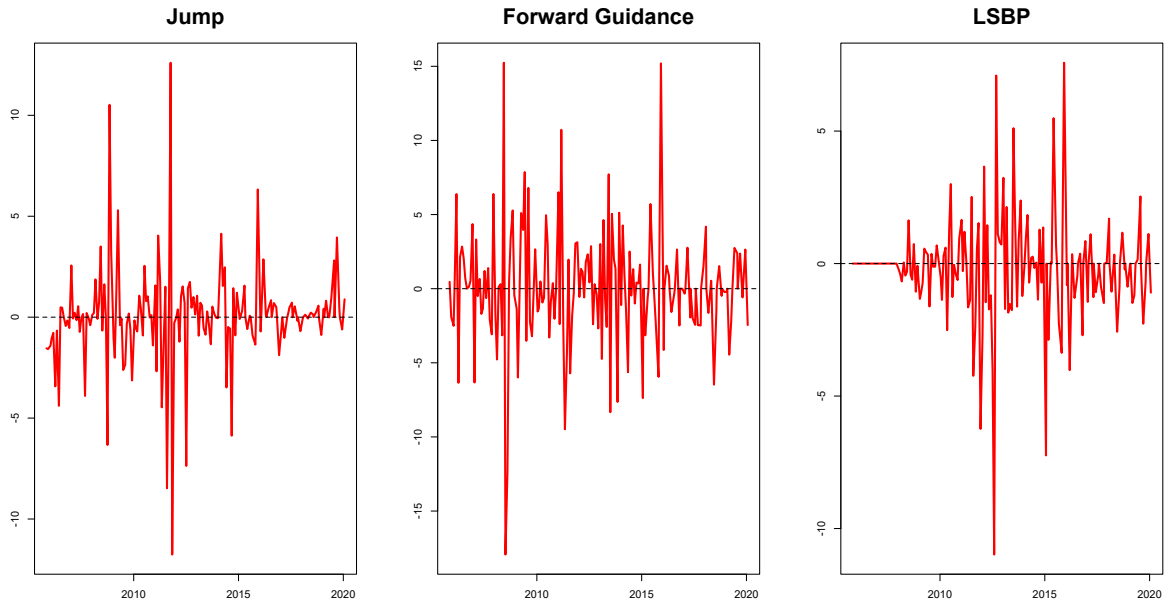
[29] The ECB policy communication extends over two separate windows where the policy action is first announced in a press release with no motivation, and then a statement is read by the President, followed by a Q&A session. As to factors, ABGM distinguishes between Timing and Target: "Timing" captures the shifts in market expectations over the next few meetings that leaves longer-term interest rates essentially unchanged, while "Target" captures interest rate shocks. Similarly, Jarocinski and Karadi (2018) have suggested a separation of monetary policy instrument shocks from monetary policy communication shocks, sometimes also termed target and path shocks. The Jump factor instead encompasses these two forms of surprises.

Figure 14: Factor Loadings



Note: The figure shows the factor loadings. For each maturity the loadings are obtained by regressing the surprises onto the factors, controlling for the standardized surprise associated with the release of the US initial jobless claims. The Jump and FG factors are normalized to have unit effect on the 1-month and 2-year OIS, respectively. The shaded areas indicate the 90% confidence intervals.

Figure 15: Estimated Factors



Note: The figure shows the estimated factors over time reported in basis points. As the factors are identified up to scale, I scale them such that Jump has unit effect on one-month OIS, FG has unit effect on the two-year and LSBP has unit effect on the ten-year yields.

As can be seen in the first panel, the largest realization for the Jump factor occurred on 3 November 2011 when the ECB cut its policy rates by 25 basis points, which came unexpectedly in part because it was the first meeting of Mario Draghi as ECB President. After the deposit facility rate (DFR) was brought down to zero on 5 July 2012, which shows

up as a large and negative realization for the Jump surprise, realizations for the Jump factor have become smaller, with the exception of two episodes: a sizeable negative realization on 4 September 2014 when the ECB cut the DPR to more negative values, which was unexpected as also suggested by surveys among analysts ahead of the policy meeting[30]; and a positive realization on 3 December 2015 when the ECB cut the deposit facility rate by a further 10 basis points[31]. There are other three episodes that are worth highlighting: 4 August 2011, 3 March 2011, 5 June 2008. In these cases, even if the policy rates were left unchanged, there were important announcements during the Press Conference. In the second and third episodes, the Introductory Statement during the Press Conference contained expressions ("strong vigilance" in one case and "state of heightened alertness" and readiness to act "in a firm and timely manner" in the other case) meant to signal high likelihood of policy actions in the subsequent policy meetings. I find large and positive realizations and indeed in both episodes the policy rates were hiked in the following policy meeting. On 4 August 2011, the ECB President announced in the Press Conference several non-standard measures to support liquidity provision operations at least until the end of the year. As a result, I find a very large negative realization and a relatively large and negative realization in the FG factor.

The largest realisation of the Forward Guidance factor occurred on July 3 2008, and was a negative surprise. This is interesting because on that date policy rates were increased by 25 basis points, and this move was fully expected as survey evidence gathered ahead of the policy meeting shows. However, the press conference was taken as signalling that no more hikes were planned, leading markets to price out further rate increases. Another noteworthy episode is on July 4 2013 when the ECB, for the first time and unexpectedly according to market commentaries, announced FG on policy rates. In fact, the used methodology correctly identifies a large and negative realization of the FG factor.

The two largest realisations of the LSBP factor are on August 2 2012 and on January 22 2015; they are negative and correspond, respectively, to the OMT announcement and the ECB's Asset Purchase Programme (APP)[32]. Other sizeable realizations of the QE factor coincide with ECB's communication on its asset purchase programme, such as on December 3 2015 when the ECB announced in the Press Conference the extension of the asset purchases. On that date I find a positive realization of the LSBP factor, suggesting that markets were expecting a more forceful action, as also evidenced by surveys and market commentaries[33].

[30] Bloomberg News on 4 September 2014 at 1:01 am reported that "Of 57 economists surveyed by Bloomberg News, 51 said [today] the ECB will keep its key interest rate unchanged".

[31] On 3 December 2015 at 13:50 Bloomberg News reported on the 10 basis point cut and on the prediction made by Nick Kounis, head of macro research at ABN Amro NV in Amsterdam, before the publication of the decision: "10 basis points [cut] could be overall a disappointment". Associated Press at 13:59 reported: "The size of the cut, however, appeared to be a disappointment for investors".

[32] ECB President Draghi's "whatever it takes" speech (26 July 2012) is not in the ABGRM database because it wasn't announced in a Governing Council meeting. However, on August 2 2012, Draghi clarified the point made a few days before: "The Governing Council, within its mandate to maintain price stability over the medium term and in observance of its independence in determining monetary policy, may undertake outright open market operations of a size adequate to reach its objective. In this context, the concerns of private investors about seniority will be addressed. Furthermore, the Governing Council may consider undertaking further non-standard monetary policy measures according to what is required to repair monetary policy transmission".

[33] On December 3 2015 Reuters News at 14:43 reported in real time President Draghi's announcement of QE extension: "We decided to extend the asset-purchase programme. The monthly purchases of 60 billion euros under the APP are now intended to run until the end of March 2017 or beyond if necessary [...]". Reuters news added that: "Analysts polled by Reuters last week had expected the ECB to increase the monthly purchases to 75 billion euros as well as extending the purchases". Reuters News

The large positive realization on June 3 2015 is also relevant: against the background of increasing long-term rates in the weeks preceding the policy meeting, President Draghi said during the Press conference that "we should get used to periods of higher volatility" and that "the Governing Council was unanimous in its assessment that we should look through these developments and maintain a steady monetary policy stance". These remarks led to market participants' assigning lower probability to future non-standard policy easing. Finally, it is interesting to highlight two most recent events such as the announcement of a second round of the APP (12 September 2019) and the first Lagarde's Press Conference (12 December 2019). In either cases, the LSBP factor reports positive realizations. In the first case, markets expected the monthly pace of the APP to be higher than 20 billion euros a month; in the second case, Christine Lagarde was perceived by the market as a potential *hawk* given her call to be more consensual than her predecessor.

C. Proxy FAVAR

C.1 gives details on the dataset used to run the FAVAR model; C.2 explains the strategy adopted to identify the factors; C.3 formally proves the identification of the FAVAR with external instruments; C.4 shows the FAVAR by adding the Index of "Threat to ECB independence" to the model; C.5 runs the same analysis considering conventional and Forward Guidance shocks and C.6 runs robustness checks.

C.1. Dataset

The table below contains a complete list of the series in the dataset as well as detailed descriptions and information regarding transformations, geographical coverage and sources. Abbreviations and codes are laid out in the following:

Transformation code (T)

1. no transformation
2. logs
3. difference in levels
4. difference in logs

Geography

EA - Euro area

at 15:48 reported: "Disappointment that he (President Mario Draghi) didn't do even more [...] Euro zone bond yields rose and stock markets fell". The Wall Street Journal on the following day (4 December 2016) reported: "Markets were expecting so much more. Royal Bank of Scotland economists, for instance, had forecast a 0.2-point rate reduction, a 25 billion euros-a-month increase in the pace of bond purchases and a six-month extension. The market reaction was violent: European stocks fell by more than 3%, the euro jumped more than three cents against the dollar and eurozone bond yields shot higher".

EA12 - Euro area (12 countries)

EA19 - Euro area (19 countries)

EACC - Euro area (changing composition)

$EA11_i$ - 11 individual series for sample countries

Factor analysis (F)

Y - included in data set for principal component analysis

Seasonal adjustment[34]

WDSA - working day and seasonally adjusted

SA - seasonally adjusted (SA)

NA - neither working day nor seasonally adjusted

[34] When the seasonal adjustment was not available, I seasonally adjusted the series in R with X-ARIMA-12.

Description	T	SA	Source	Geography	Start	End	F
Real Activity							
Retail sales volume index	4	WDSA	ECB SDW	EA19	2002(1)	2019(12)	Y
Manufacturing turnover index	4	WDSA	ECB SDW	EA19	2002(1)	2019(12)	Y
Construction production index	4	WDSA	ECB SDW	EA19	2002(1)	2019(12)	Y
Retail sales of non-food production (excl. fuel)	4	WDSA	ECB SDW	EA19	2002(1)	2019(12)	Y
Industrial Production (excluding construction)	4	WDSA	ECB SDW	EA19	2002(1)	2019(12)	Y
Industrial Production: manufacturing	4	WDSA	ECB SDW	EA19	2002(1)	2019(12)	Y
Industrial Production: energy	4	WDSA	ECB SDW	EA19	2002(1)	2019(12)	Y
Industrial Production: consumer goods	4	WDSA	ECB SDW	EA19	2002(1)	2019(12)	Y
Industrial Production: consumer durables	4	WDSA	ECB SDW	EA19	2002(1)	2019(12)	Y
Industrial Production: capital goods	4	WDSA	ECB SDW	EA19	2002(1)	2019(12)	Y
Industrial Production: consumer non-durables	4	WDSA	ECB SDW	EA19	2002(1)	2019(12)	Y
Industrial Production: intermediate goods	4	WDSA	ECB SDW	EA19	2002(1)	2019(12)	Y
New orders: manufacturing	4	WDSA	ECB SDW	EA19	2002(1)	2019(12)	Y
New orders: capital goods	4	WDSA	ECB SDW	EA19	2002(1)	2019(12)	Y
New orders: consumer durables	4	WDSA	ECB SDW	EA19	2002(1)	2019(12)	Y
New orders: consumer non-durables	4	WDSA	ECB SDW	EA19	2002(1)	2019(12)	Y
New orders: intermediate goods	4	WDSA	ECB SDW	EA19	2002(1)	2019(12)	Y
Prices							
Harmonised Index of Consumer Prices (HICP)	4	SA	ECB SDW	EACC	2002(1)	2019(12)	Y
HICP: energy	4	SA	ECB SDW	EACC	2002(1)	2019(12)	Y
HICP: food	4	SA	ECB SDW	EACC	2002(1)	2019(12)	Y
HICP: goods	4	SA	ECB SDW	EACC	2002(1)	2019(12)	Y
HICP: excl. energy	4	SA	ECB SDW	EACC	2002(1)	2019(12)	Y
Producer Price Index (PPI)	4	SA	ECB SDW	EACC	2002(1)	2019(12)	Y
Oil Prices (Brent)	4	SA	ECB SDW	EACC	2002(1)	2019(12)	Y
Surveys							
Economic Sentiment Indicator (ESI): industrial confidence	3	SA	EUROSTAT	EA19	2002(1)	2019(12)	Y
ESI: consumer confidence	3	SA	EUROSTAT	EA19	2002(1)	2019(12)	Y
ESI: economic sentiment	3	SA	EUROSTAT	EA19	2002(1)	2019(12)	Y

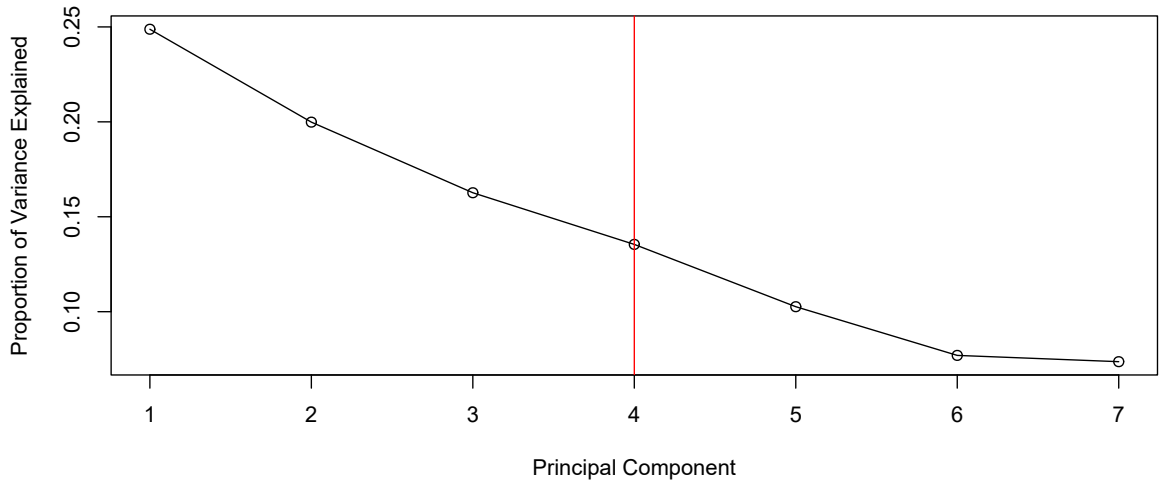
Description	T	SA	Source	Geography	Start	End	F
ESI: business climate	3	SA	EUROSTAT	EA19	2002(1)	2019(12)	Y
ESI: services confidence	3	SA	EUROSTAT	EA19	2002(1)	2019(12)	Y
ESI: retail confidence	3	SA	EUROSTAT	EA19	2002(1)	2019(12)	Y
Employment							
Unemployment rate: persons under 25	4	WDSA	EUROSTAT	EACC	2002(1)	2019(12)	Y
Unemployment rate (total)	4	WDSA	EUROSTAT	EACC	2002(1)	2019(12)	Y
Unemployment rate: women	4	WDSA	EUROSTAT	EACC	2002(1)	2019(12)	Y
Unemployment rate: persons over 25	4	WDSA	EUROSTAT	EACC	2002(1)	2019(12)	Y
Financial							
VSTOXX volatility index	3	SA	Bloomberg	EA	2002(1)	2019(12)	Y
EU VIX	3	SA	Bloomberg	EA	2002(1)	2019(12)	Y
EUR-USD VIX	3	SA	Bloomberg	EA	2002(1)	2012(12)	Y
CISS: Composite Indicator of Sovereign Stress: GDP weigths	3	SA	ECB SWD	EA	2002(1)	2019(12)	Y
CISS Bond Market: gov and NFC volatility	3	SA	ECB SWD	EA	2002(1)	2019(12)	Y
CISS Money Market: 3M rate volatility	3	SA	ECB SWD	EA	2002(1)	2019(12)	Y
CISS FX Market: euro volatility	3	SA	ECB SWD	EA	2002(1)	2019(12)	Y
CISS FIN Interm: bank volatility	3	SA	ECB SWD	EA	2002(1)	2019(12)	Y
CISS NF equity volatility	3	SA	ECB SWD	EA	2002(1)	2019(12)	Y
Systemic stress indicator	3	SA	ECB SWD	EA	2002(1)	2019(12)	Y
BBB-AAA corporate spread (2Y)	3	SA	Bloomberg	EA	2002(1)	2019(12)	Y
Nominal exchange rate (42 trading partners)	4	SA	ECB SWD	EA	2002(1)	2019(12)	Y
Real eff. exchange rate (42 traing partners, CPI based)	4	SA	Bloomberg	EA	2002(1)	2019(12)	Y
Quarterly (linearly interpolated)							
Fixed Capital Formation	4	SA	ECB SWD	EA19	2002(1)	2019(12)	Y
Real GDP	4	SA	ECB SWD	EA19	2002(1)	2019(12)	Y
Final Consumption Exp. Households	4	SA	ECB SWD	EA19	2002(1)	2019(12)	Y
Capacity Utilization	4	SA	ECB SWD	EA19	2002(1)	2019(12)	Y
ECB SPF: inflation next year	1	SA	ECB SDW	EA19	2002(1)	2019(12)	Y
ECB SPF: inflation two years ahead	1	SA	ECB SDW	EA19	2002(1)	2019(12)	Y
ECB SPF: GDP growth next year	1	SA	ECB SDW	EA19	2002(1)	2019(12)	Y

Description	T	SA	Source	Geography	Start	End	F
ECB SPF: GDP growth two years ahead	1	SA	ECB SDW	EA19	2002(1)	2019(12)	Y
ECB SPF: unemployment rate next year	1	SA	ECB SDW	EA19	2002(1)	2019(12)	Y
ECB SPF: unemployment rate two years ahead	1	SA	ECB SDW	EA19	2002(1)	2019(12)	Y
Government budget balance	3	SA	EUROSTAT	EA19	2002(1)	2019(12)	Y
Government debt/GDP	3	SA	EUROSTAT	EA19	2002(1)	2019(12)	Y
Gov. Net Interest Payments	3	SA	EUROSTAT	EA19	2002(1)	2019(12)	Y
Gov. Total Expenditure	3	SA	EUROSTAT	EA19	2002(1)	2019(12)	Y
Gov. Total Revenue	4	SA	EUROSTAT	EA19	2002(1)	2019(12)	Y
Gov. Investment	4	SA	EUROSTAT	EA19	2002(1)	2019(12)	Y

C.2. Interpreting Factors

Factor analysis involves the selection of the appropriate number of factors. To do so, I rely on a number of specific tests and information criteria. In particular, I estimate the factors r using the test proposed by Onatski (2009), which suggests $r = 6$, the eigenvalue difference method proposed by Onatski (2010) suggesting $r = 3$, the criterion by Bai and Ng (2002) suggesting $r = 3$, and the bi-cross-validation method proposed by Owen and Wang (2016) suggesting $r = 5$. I choose $r = 4$ for the baseline specification which is approximately the average of these results. Figure 16 shows the variance of the data explained by each additional factor. Four factors account for almost 80% of the total data variance. This result further justifies the selection choice.

Figure 16: Variance explained by each additional factor



Next, Although principal component analysis does not identify factors economically, Table 7 provides an indication for every factor. I report the highest R^2 obtained by regressing each transformed data series on one of the 4 factors at a time and correlations between the factors and the original series. Following these results, I suggest the following interpretation: Factor 1 is likely to represent a measure of real economic activity. It shows in fact very high correlation coefficients as well as R^2 with a variety of real activity indices. Factor 2 is plausibly a measures of price pressure. It shows a high correlation with a variety of price indices, while being negatively correlated with unemployment. It also explains more than half of the overall variance in HICP. Factor 3 is very closely related to a measure of financial stress. It shows a positive correlation with the main volatility indices and explains way more than half of the variance in the VSTOXX, bank spread and CISS. Lastly, the interpretation of Factor 4 seems to be much more contentious than the previous ones since it is positively related to unemployment and industrial production, while it is negatively correlated to building confidence, private consumption and final household expenditure. Accordingly, I do not believe that a straightforward interpretation is possible.

Table 7: *Factor Interpretation*

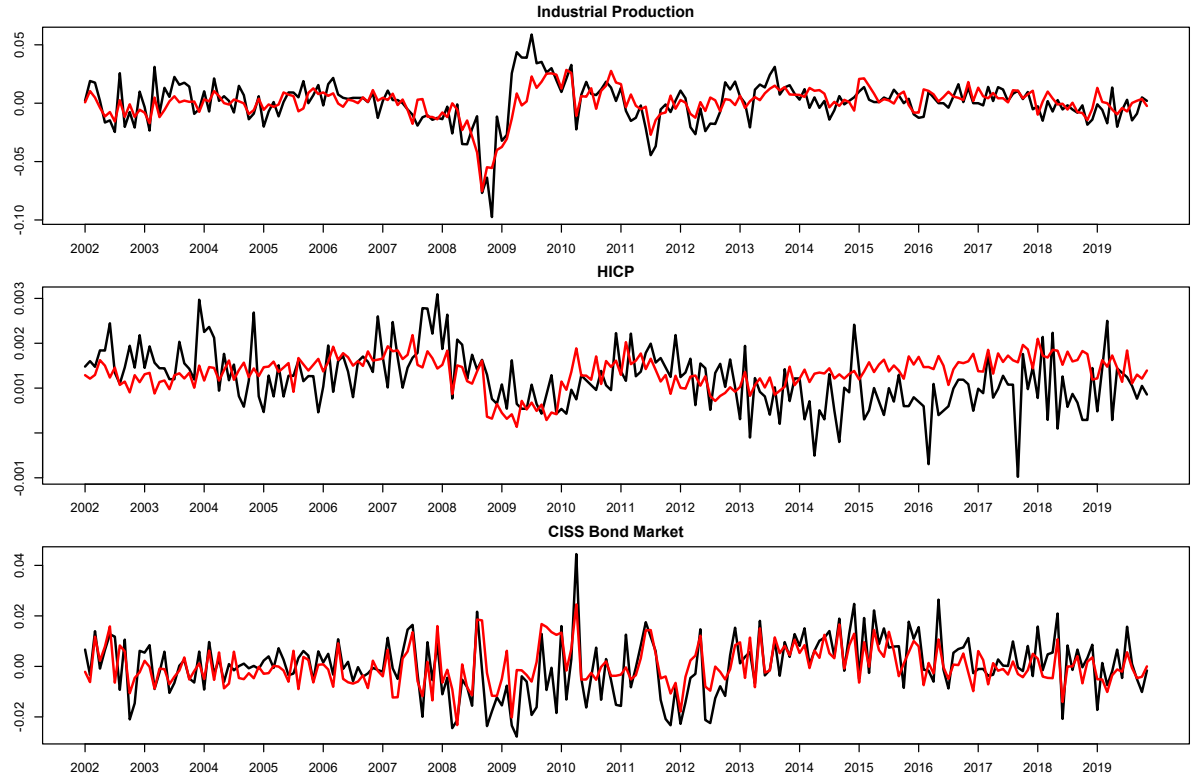
	Series	R^2	Corr
Factor 1	Services Confidence	0.64	0.80
	Capacity Utilization	0.45	0.67
	Retail Confidence	0.45	0.67
	Building Confidence	0.39	0.62
	Manufacturing Turnover Index	0.28	0.53
	IP (Excluding Construction)	0.56	0.54
	IP (Manufacturing)	0.65	0.55
	New Orders: Intermediate Goods	0.24	0.50
	GDP 1Y Ahead	0.45	0.63
	Inflation 1Y Ahead	0.40	0.55
Factor 2	SPF INF 1Y	0.52	0.64
	SPF INF 2Y	0.57	0.43
	HICP	0.45	0.55
	SPF Unemployment 1Y	0.30	-0.54
	SPF Unemployment 2Y	0.53	-0.53
	Core Inflation	0.67	0.33
	CPI	0.54	0.42
	CISS Systemic Stress	0.21	-0.46
Factor 3	VSTOXX	0.34	0.58
	CISS Composite	0.24	0.49
	CISS Bond Market	0.48	0.69
	CISS Money Market	0.22	0.47
	EURO STOXX	0.27	-0.51
	CISS NF Equity	0.41	0.64
Factor 4	Building Confidence	0.40	-0.63
	IP (Manufacturing)	0.22	0.47
	Private Consumption	0.35	-0.59
	Final Expenditure (Households)	0.36	-0.60
	Unemployment	0.52	0.72

Note: List of series that are best explained by a single extracted factor according to R^2 of a linear regression of the (transformed) series on the respective factor and have the highest correlation with the original variables.

Further evidence on the plausibility of the interpretation can be gathered by comparing actual (transformed) industrial production, HICP and CISS data (black line) with corresponding fitted series (red line) on the basis of the extracted factors (Figure 19)[35].

[35] Factor 4 is not displayed due to the difficulty of interpretation.

Figure 17: Explanatory Power of Factors



Note: The figure compares actual (transformed) industrial production, HICP and CISS data with corresponding fitted series on the basis of 3 extracted factors. In Dynamic Factor Model (DFM) terminology, the fitted series (red line) represent the *systematic component* of the data series, while the actual series (black line) also contains an *idiosyncratic component*.

On the whole, it can be emphasised that factors 1, 2 and 3 seem to represent the economic concepts of real economic activity, price pressure and financial stress.

C.3. Identification with External Instrument

In the paper I claimed, without providing a proof, that the fitted value ($\Pi \upsilon_t$) of a regression of the instrument (z_t) on the innovations (υ_t) identifies the structural shock ϵ_{1t} up to a sign and scale. This paragraph provides a formal proof.

Following the VAR literature and the notation in Stock and Watson (2012), I model a linear relationship between the VAR innovations υ_t and the structural shocks ϵ_t:

$$\upsilon_t = H\epsilon_t = [H_1 ... H_k] \begin{bmatrix} \epsilon_{1t} \\ \vdots \\ \epsilon_{kt} \end{bmatrix}, \tag{1}$$

where H is a matrix of coefficients and H_1 is the first column of H. It follows that $\sum_{\upsilon\upsilon} = H \sum_{\epsilon\epsilon} H'$ where $\sum_{\upsilon\upsilon} = E(\upsilon\upsilon')$ and $\sum_{\epsilon\epsilon} = (\epsilon\epsilon')$. If the system is invertible - a standard

assumption in the VAR literature - structural shocks can be expressed as linear combinations of innovations: $\epsilon_t = H^{-1}\upsilon_t$.

An instrument is now employed that is correlated with the structural shock to be uncovered, while being uncorrelated with all other shocks in the system. This corresponds to the standard assumptions of *relevance* and *exogeneity* in the instrumental variables literature. Formally,

1. Relevance: $E(\epsilon_{1t}Z_t) = \alpha \neq 0$
2. Exogeneity: $E(\epsilon_{jt}Z_t) = 0$, $j = 2, \ldots, k$
3. Uncorrelated shocks: $\sum_{\epsilon\epsilon} = D = diag(\sigma^2_{\epsilon k}, \ldots, \sigma^2_{\epsilon k})$,

where D is a $K \times K$ matrix. The last condition is the standard structural VAR assumption that structural shocks are uncorrelated. This assumption does not fix the variance of shocks. From equation 1:

$$E(\upsilon_t z_t) = E(H\epsilon_t z_t) = [H_1 \cdots H_k] \begin{bmatrix} E(\epsilon_{1t}Z_t) \\ \vdots \\ E(\epsilon_{kt}Z_t) \end{bmatrix} = H_1\alpha \ \ ,$$

where the last identity follows from the relevance and exogeneity conditions. It follows that H_1 is identified up to scale and sign by the covariance between the VAR innovations and the instrument. To identify the shocks themselves, the third condition on uncorrelated shocks is needed. It implies that the variance-covariance matrix of υ_t can be rewritten as:

$$\sum_{\upsilon\upsilon} = H \sum_{\epsilon\epsilon} H' = HDH' \tag{2}$$

Additionally, by defining Π the matrix of coefficients from the OLS population regression of Z_t on υ_t, the fitted value of this regression is:

$$\Pi\upsilon_t = E(z_t\upsilon_t') \sum_{\upsilon\upsilon}^{-1} \upsilon_t \ , \tag{3}$$

which, using equation 2 and 3, can be written as:

$$E(z_t\upsilon_t') \textstyle\sum_{\upsilon\upsilon}^{-1} \upsilon_t = \alpha H_1'(HDH')^{-1}\upsilon_t$$

by simplifying and using equation $\epsilon_t = H^{-1}\upsilon_t$:

$$\alpha(H_1'(H')^{-1})D^{-1}\epsilon_t = \alpha H_1'(HDH')^{-1}\epsilon_t$$

Finally, noting that $H^{-1}H_1 = e_1$ where $e_1 = (1, 0, \cdots, 0)'$ implies:

$$\alpha H_1'(HDH')^{-1}\epsilon_t = \alpha D^{-1}\epsilon_t = (\tfrac{\alpha}{\sigma^2_{\epsilon 1}})\epsilon_{1t} = \alpha\epsilon_{1t} = \Pi\upsilon_t$$

This proves the original statement that the fitted value ($\Pi\upsilon_t$) of a regression of the instrument (z_t) on the innovations (υ_t) identifies the structural shock ϵ_{1t} up to a sign and scale.

Following what I just layed down, I now turn to evaluate the choice of the policy indicator and the instruments for policy shocks in the monthly FAVAR. I run the following regression:

$$(\epsilon_t^i)^k = \alpha + \gamma \tilde{F}_t^j + u_t \ ,$$

where ϵ_t^i is the first stage residual for the policy indicator in the representative VAR with six variables, k indicates respectively Eonia, 1Y OIS, 2Y German and 10Y OIS, $\tilde{F}_t$ is the rotated factor as in 3.2 and j is Jump, FG and LSBP. In short, I consider four policy indicators for every instrument. Table 8 summarizes the results.

Table 8: *Effects of Instruments on the First Stage Residuals of the Representative VAR*

	Eonia	Eonia	Eonia	1 year	1 year	1 year
	(1)	(2)	(3)	(1)	(2)	(3)
Jump	0.013***			0.009***		
	(0.003)			(0.0033)		
FG		0.015***			0.006*	
		(0.004)			(0.004)	
LSBP			0.007*			0.009***
			(0.004)			(0.003)
Observations	209	209	136	209	209	136
F Statistic	5.5	**15.13**	3.40	7.26	3.01	5.85
	2 year	2 year	2 year	10 year	10 year	10 year
	(1)	(2)	(3)	(1)	(2)	(3)
Jump	0.014***			0.007		
	(.004)			(0.005)		
FG		0.014***			0.006**	
		(0.003)			(0.003)	
LSBP			0.009**			0.008*
			(0.004)			(0.004)
Observations	209	209	136	209	209	136
F Statistic	1.97	5.55	**12.5**	1.79	4.32	3.48

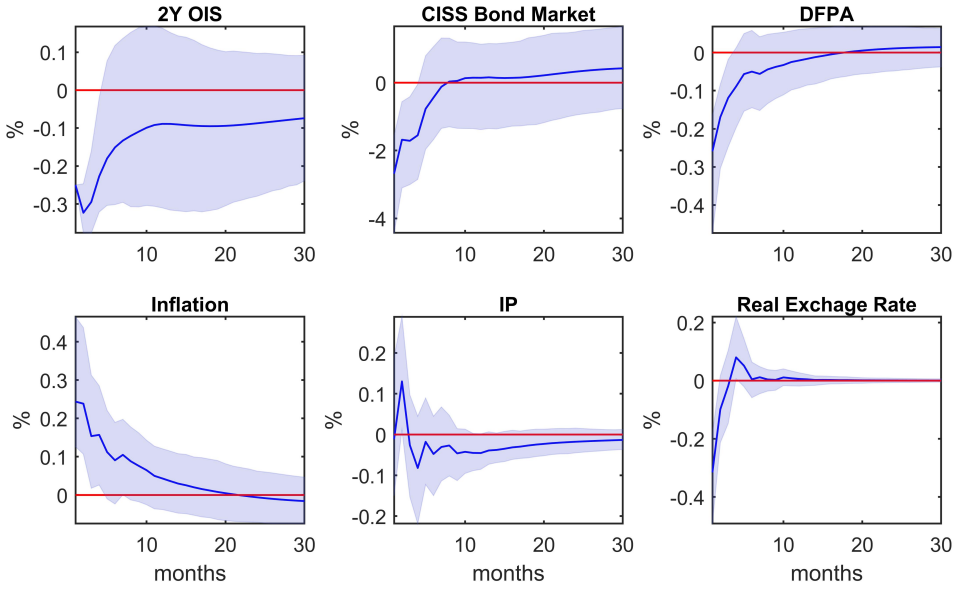
Note: The table shows the effects of instruments on the first stage residuals of the four variable (monthly) VAR described earlier. The columns considered are the first stage regression residual of a particular policy indicator regressed on various instrument sets. The robust F-test assess the relevance of the instrument with respect to the policy indicator. Robust standard errors in parentheses; ***, ** and * denote statistical significance at the 1%, 5% and 10% levels, respectively.

To be confident that a weak instrument problem is not present, Stock et al. (2002) recommend a threshold value of ten for the F-statistic from the first-stage regression. The table shows that the combinations of policy indicator and instrument that provide the best instrument strength are reasonably: EONIA-Jump, FG-EONIA and LSBP-2Y OIS.

Last, in Figure 18 I show the results of the representative VAR in industrial production,

HICP, CISS Bond Market, real exchange rate, DFPA and 2Y OIS I used to test the relevance of the instrument.

Figure 18: Representative VAR Identified with LSBP



Note: The figure plots the impulse responses to a 0.25% decrease in the policy indicator due to a LSBP shock. 90% error bands are displayed.

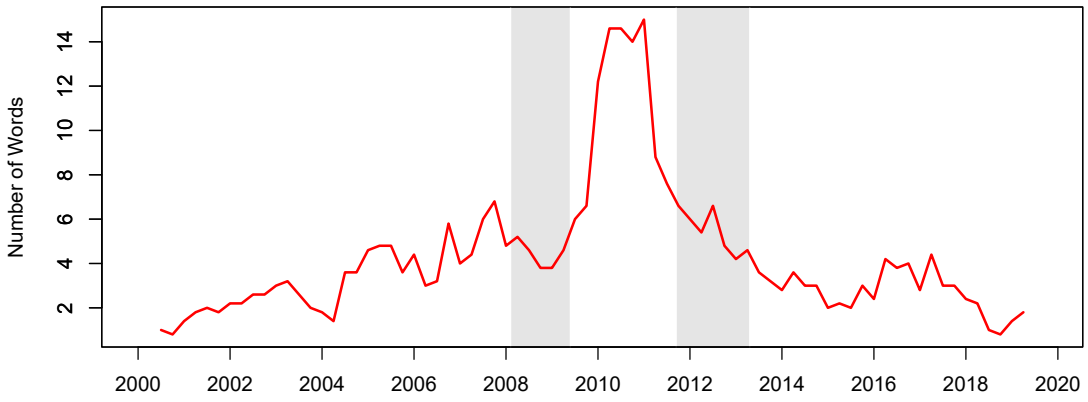
Even in this representative VAR the results are consistent with the FAVAR and with the main hypotheses of the paper.

C.4. FAVAR with an Index of "Threat to CBI"

The "doom-loop" proposed in this paper implies that the ECB, as a result of large purchases of government bonds, sees its independence in danger. This reasoning can be further tested by deriving an index of "threat to CBI". To do so, I construct a simple dictionary that searches for all the *ngrams* (bigrams and trigrams) that refer directly or indirectly to central bank independence in the ECB Press Conferences[36]. Figure 17 plots the result:

[36] The dictionary is composed by the following ngrams: "monetary financing", "Article 123", "within our mandate", "monetary dominance", "are forbidden to finance government", "to give credit to government", "TFEU", "Treaty on the Functioning of the European Union", "monetary dominance", "fiscal dominance", "finance government deficit", "independence", "ECJ", "European Court of Justice", "independent", "Article 124", "Article 125", "Article 126", "debt monetization", "institutional constraint".

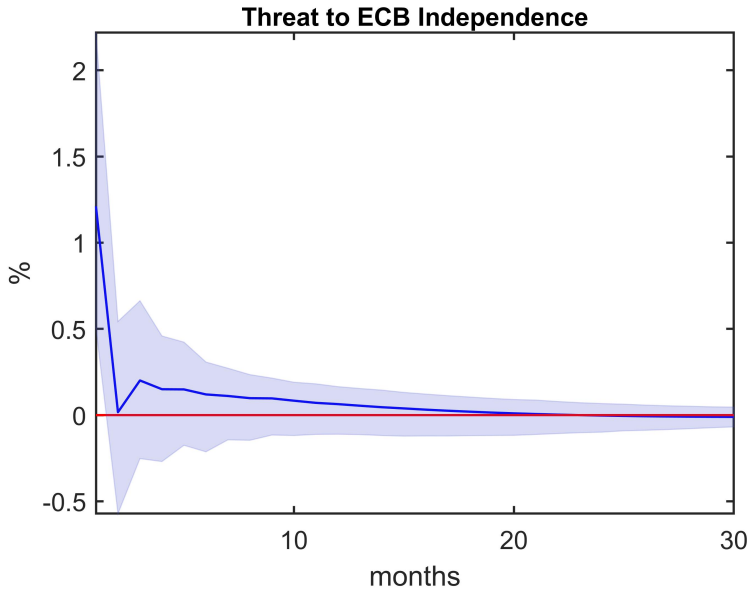
Figure 19: Index of "Threat to CBI"



Note: The figure plots the absolute number of *ngrams* (bigrams and trigrams) referred to ECB independence. The time series can be interpreted as a proxy for "how threatened is the independence of the ECB".

This time series is interpreted as an index of threat to central bank independence: the higher the absolute number of words in the Press Conferences, the more the ECB feels its independence in peril. The cumulative sum of this series is then used in a FAVAR model with 7 variables. Figure 20 shows the impulse responses to a LSBP shock:

Figure 20: FAVAR with "Threat to CBI" – LSBP shock



Note: The figure shows the impulse response to an expansionary LSBP shock. 90% error bands are displayed.

Overall, these results corroborate the findings above: given an LSBP shock, the index of "threat to CBI" increases and the DFPA decreases. In other words, large scale purchases of government bonds, first, increase the pressure on the independence of the ECB and, second,

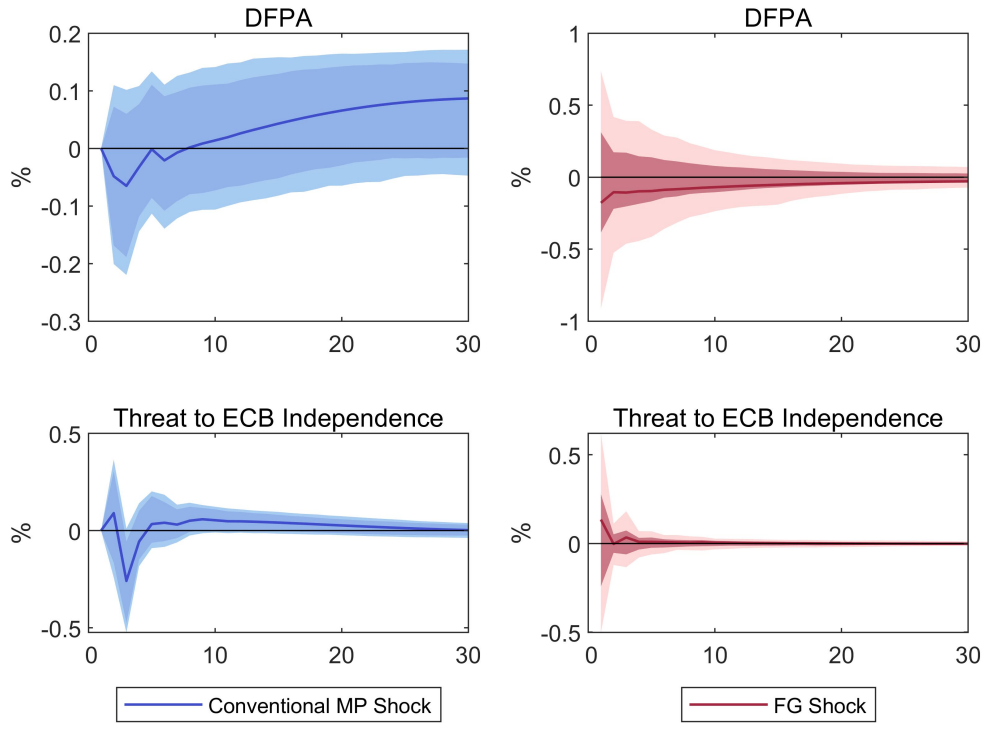
lead the ECB to become more fiscally hawkish to protect the endangered independence. Moreover, this "doom-loop" is specific to LSBP shocks. In fact, in presence of conventional MP shock the index of "threat to CBI" significantly decreases while in presence of FG shock it remains constant around 0.

C.5. Additional Results

Is the "doom-loop" specific to government bond purchases? In this subsection I try to answer this question by identifying the monthly FAVAR, first, with a conventional monetary policy shock, and then with a Forward Guidance (FG) one.

Figure 21 shows the effects of a 0.25% decrease in the policy indicator (EONIA) due to a conventional monetary policy shock (left panel) identified with standard Cholesky decomposition and FG shock (right panel) identified with the FG factor derived above[37]. The sample consists of monthly observations for the period 2003:1-2019:12. Lag-length is set to 3 according to AIC criterion and 90% and 68% confidence intervals computed using a recursive wild bootstrap using 10,000 replications (Gonçalves and Kilian, 2004) are displayed.

Figure 21: Impulse Responses to a Conventional Monetary Policy Shock



Note: The figure shows the impulse response to a 25 basis points expansionary conventional monetary policy shock (left panel) and FG shock (right panel). 90% and 68% error bands are displayed.

[37] The Cholesky identification was chosen since the Jump factor proved to be rather weak with an F-test for the first stage regression around 5.5 in the representative VAR.

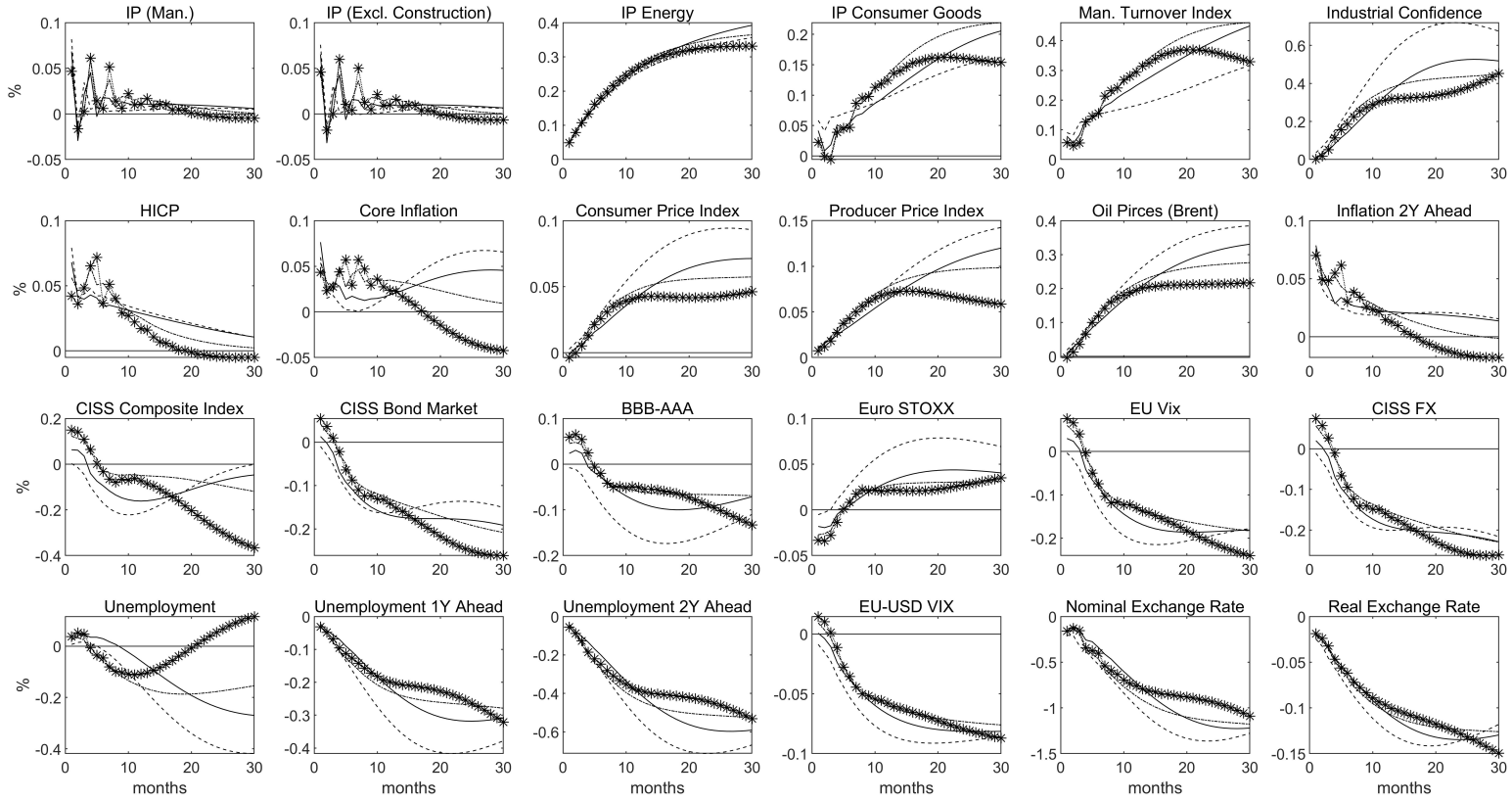
Given a conventional rate cut, the fiscal stance of the ECB, first, slightly decreases for 11 months and then rises for the entire forecast horizon. On the other hand, the "threat to ECB independence" index lowers for two months before reverting back to 0. In either case, the impulse responses are never statistically significant. As to FG surprises, DFPA turns marginally negative, while the CBI indicator somewhat picks on impact. As before, though, zero is never outside the error bands.

In summary, the results prove that the degree of fiscal policy accommodation of the ECB behaves differently compared to a LSBP shock. While bond purchases drive the ECB to be more fiscally hawkish, conventional monetary policy and FG shocks have no substantial effect on the "fiscal stance" of the European monetary authority. Neither these shocks are able to trigger any concerns related to the independence of the ECB. This finding can be explained as follows: even if every monetary policy has fiscal consequences, the magnitude of these consequences significantly differs between conventional and unconventional monetary policy (especially in the case of government bond purchases). It follows that the ECB's DFPA does not react to the negligible effects of the former, but it does respond to the sizeable effects of the latter. Put it differently, the fiscal stance of the ECB reacts proportionally to the size of the fiscal effects of monetary measures.

C.6. Sensitivity Analysis

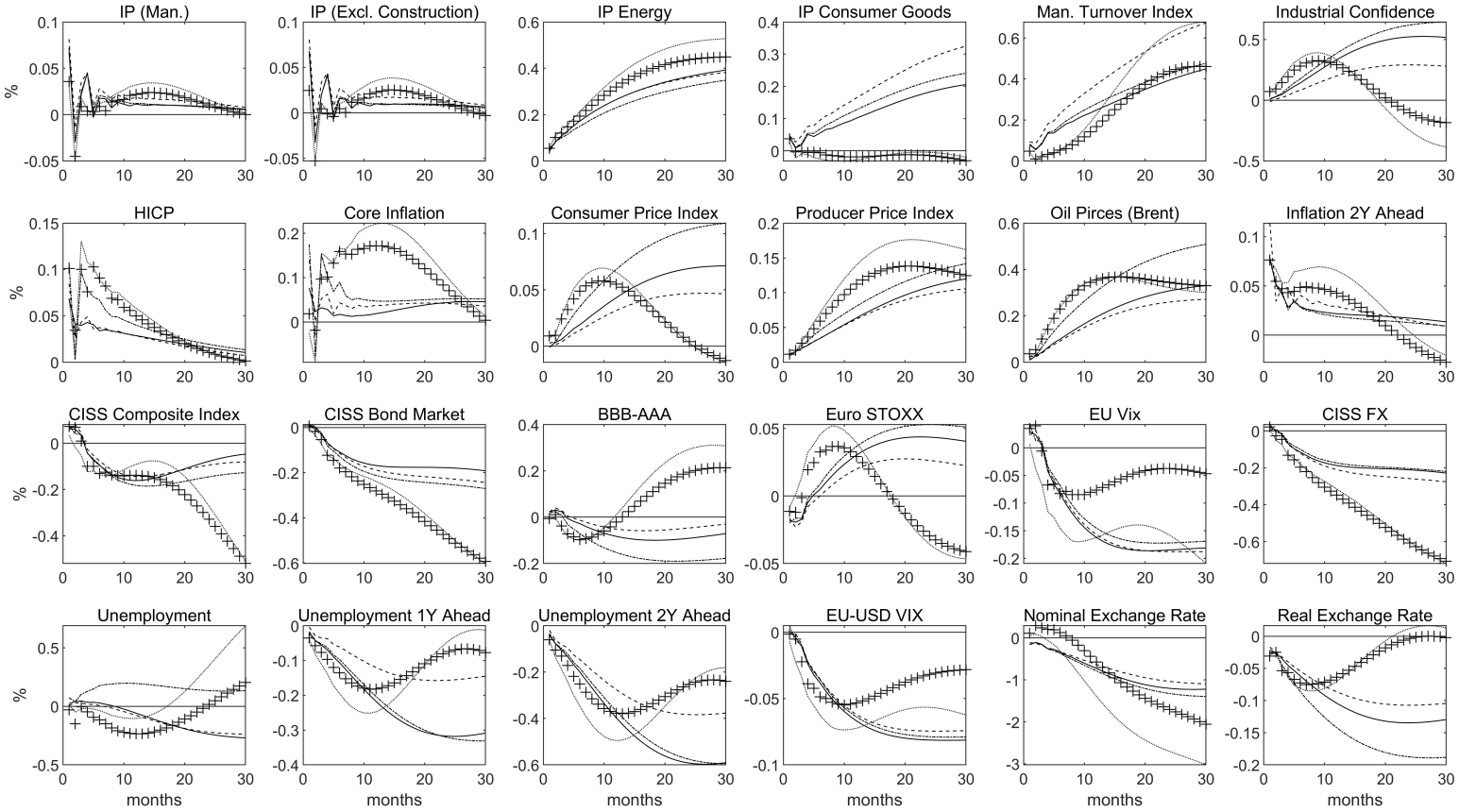
First, I set up the model with different lags (Figure 22). Second, I ran the model with different number of factors (Figure 23). Third, I ran it using the series derived in the expert survey (Figure 24). As the figures below show, in the vast majority of cases the results are robust to lag-length and the selection of the number of factors.

Figure 22: Proxy FAVAR



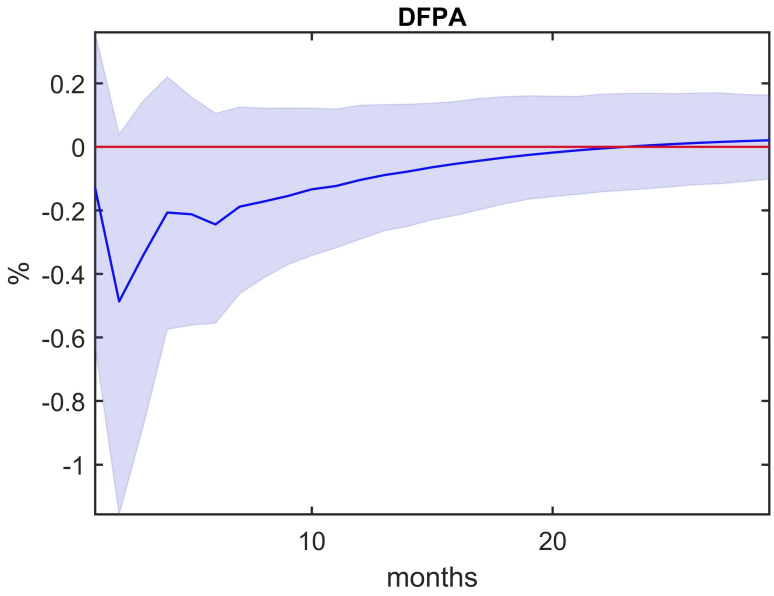
Note: The figure shows the impulse responses of a selection of macroeconomic variables to a 0.25% decrease in the policy indicator due to a LSBP shock. The solid line indicates 3 lags as in the baseline model, the dashed line is for 2 lags, the dash-dot line indicates 4 lags, the dotted line 5 and the asterisk line 6.

Figure 23: Proxy FAVAR



Note: The figure shows the impulse responses of a selection of macroeconomic variables to a 0.25% decrease in the policy indicator due to a LSBP shock. The solid line indicates 4 factors as in the baseline model, the dashed line is for 3 factors, the dash-dot line indicates 5 factors, the dotted line 6 and the plus line 7.

Figure 24: DFPA Response to an Expansionary LSBP Shock – Expert Survey



Note: The figure displays the DFPA impulse response to a 0.25% LSBP shock. 68 and 90% error bands are shown. The DFPA variable is the time-series of the expert survey in this case.

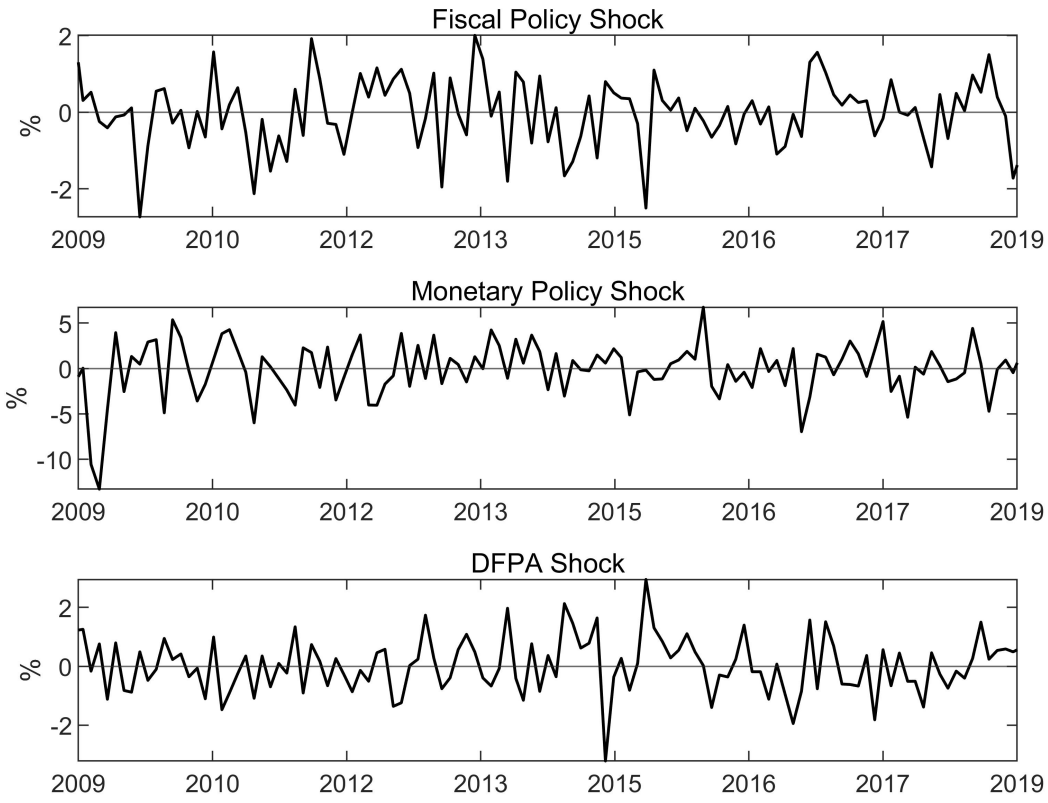
D. The DFPA Shock

D.1 displays the identified shocks that I omitted in the paper to save space. D.2 shows the results of different governments' reaction to a DFPA shock.

D.1. Additional Results

Figure 25 displays the three identified shocks.

Figure 25: Structural Shocks Identified with Sign Restrictions



Note: The three shocks identified with sign restrictions: fiscal policy, monetary policy and DFPA shocks.

Focusing on DFPA surprises and the most notable ECB decisions, Figure 25 shows how in correspondence of the announcement of the OMTs (August 2 2012), there is a negative (hawkish) shock. Similarly, there is a negative realisation on January 22 2015, when the APP was announced. These results reinforce the inverse relationship between UMP and DFPA that I found in 4.1.

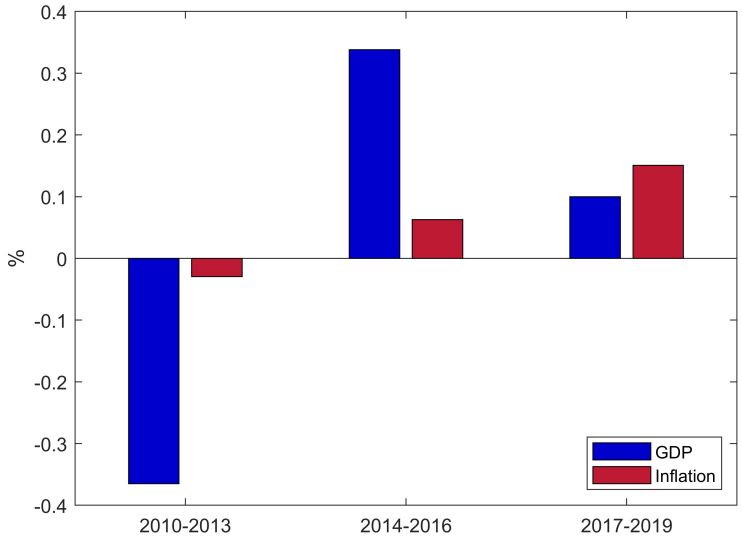
D.2. Fiscal Policy Scenarios

The literature on fiscal policy shocks stresses how the composition of a fiscal adjustment can have different effects on economic activity (Alesina and Ardagna, 2013). In the paper I chose the adjustment that more closely resembled the historical experience of the sovereign-debt crisis, i.e. a combination of tax-based and expenditure-based adjustment (see Alesina et al., 2019). In this paragraph, I extend the analysis in 4.2 by assuming that governments react to a DFPA shock in four alternative ways implementing: a tax-based adjustment (Figure 26), an expenditure-based adjustment (Figure 27), a balanced budget adjustment (Figure 28) where the increase in government spending is matched by the increase in tax revenue and a balanced budget adjustment where the decrease in tax revenue in matched by a decrease in

government expenditure (Figure 29).

Figure 26 shows the counterfactual with DFPA shocks identified with governments implementing a tax-based adjustment:

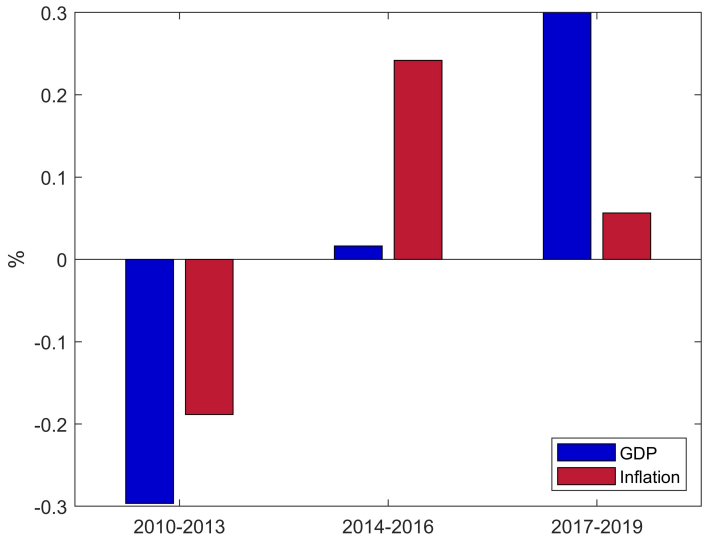
Figure 26: Historical Counterfactuals Cumulated by Period – Tax-based Adjustment



Note: The figure shows the cumulative counterfactuals for GDP and inflation for 2010-2013, 2014-2016 and 2017-2019. Results are based on the assumption that governments follow tax-based adjustments as a result of DFPA shocks.

Figure 27 shows the counterfactual with governments following an expenditure-based adjustment after fiscally hawkish communication:

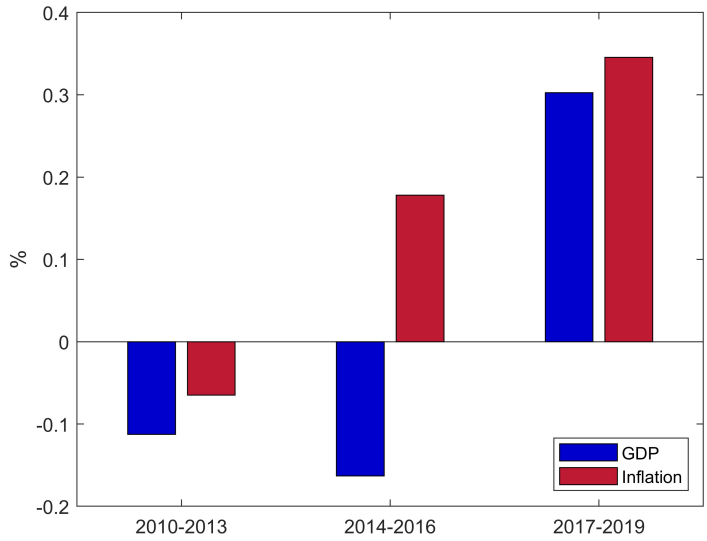
Figure 27: Historical Counterfactuals Cumulated by Period – Expenditure-based Adjustment



Note: The figure shows the cumulative counterfactuals for GDP and inflation for 2010-2013, 2014-2016 and 2017-2019. Results are based on the assumption that governments follow expenditure-based adjustments as a result of DFPA shocks.

Figure 28 shows the counterfactual when governments follow the fiscal reprimands of the ECB with a balanced budget adjustment where the increase in government spending is matched by the increase in tax revenue:

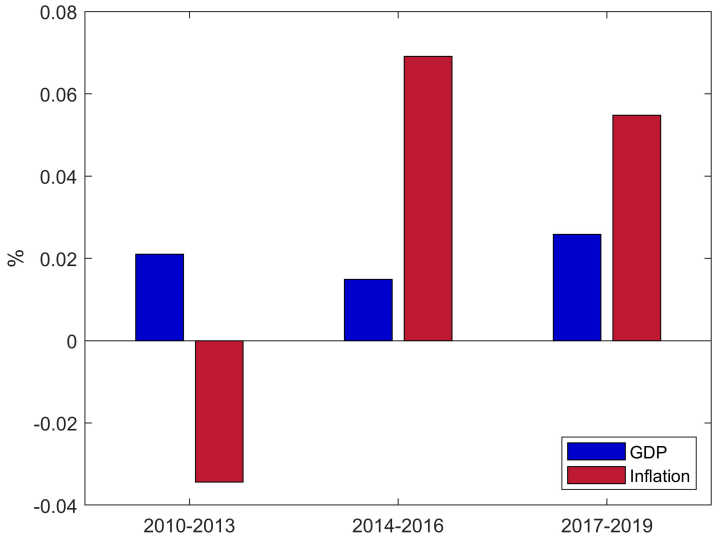
Figure 28: Historical Counterfactuals Cumulated by Period − Balanced Budget Adjustment (Tax Side)



Note: The figure shows the cumulative counterfactuals for GDP and inflation for 2010-2013, 2014-2016 and 2017-2019. Results are based on the assumption that governments follow a balanced budget cut via the tax side as a result of DFPA shocks.

Figure 29 shows instead the counterfactual when a balanced budget adjustment is composed by a decrease in tax revenue matched by a decrease in government expenditure::

Figure 29: Historical Counterfactuals Cumulated by Period − Balanced Budget Adjustment (Expenditure Side)



Note: The figure shows the cumulative counterfactuals for GDP and inflation for 2010-2013, 2014-2016 and 2017-2019. Results are based on the assumption that governments follow a balanced budget cut via the expenditure side as a result of DFPA shocks.

In the case of either a tax-based or expenditure-based adjustment, GDP and inflation qualitatively follow a similar path, despite diverging quantitatively. In fact, while GDP would have been higher by around the same quantity (0.3%) in 2010-2013, in the same period inflation would have been higher with an expenditure-based adjustment rather than a tax-based adjustment. In 2014-2016, the situation reversed with GDP that, in absence of DFPA surprises, would have been less lower in the expenditure-based scenario, while for inflation the opposite holds. Finally, in 2017-2019, while the effect on inflation was broadly similar across fiscal responses, GDP would have been lower in the tax-based case compared to the expenditure-based scenario.

Next, when EU governments respond to a DFPA shock by implementing a balanced-budget consolidation, it does matter if the adjustment comes from lowering taxes or increasing spending, especially in 2010-2013 and 2014-2016. In fact, during the period that covers the sovereign-debt crisis GDP and inflation would have been higher by around 0.1% in the absence of DFPA surprises and following a balanced-budget adjustment coming from the tax side. Instead, there is basically no effect on the variables of interest if the balanced-budget adjustment had been engineered from the expenditure side. In 2014-2016, with a balanced-budget from the tax front GDP would have been still higher by more than 0.1%, while inflation would have been lower in absence of DFPA surprises by 0.2%. On the other hand, with a balanced-budget from the expenditure side, the effects on GDP and inflation would remain marginal (way below 0.1%). Overall, it is rather difficult to conclude which adjustment plan would have been more effective since the evidence proposed is not conclusive in this respect.

Finally, I ran the following robustness checks: first, I changed the length of duration of the shocks (6, 8 and 18 months); second, I experimented the model with different lag-length and, third, I imposed more zero restrictions by adding more macro variables. In every scenario, the results confirm the findings in the baseline model.

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