In search of the Euro area fiscal stance

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In search of the Euro Area Fiscal Stance[*]

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Abstract

This paper investigates the role of fiscal policies over the aggregate EMU business cycle. Previous studies, based on the assumption of non-separability between public and private consumption, obtain a large public consumption multiplier, a small fraction of non-Ricardian households and, consequently, a relatively small multiplier for public transfers. We provide motivations for assuming separability and, on these grounds, we estimate a relatively large share of non-Ricardian households. As a result, we obtain that both multipliers are large. We also find that, in spite of their potentially strong effects, fiscal policies were substantially muted during the EMU years. This result is confirmed even for the post 2007 period. In fact fiscal policies did not complement the monetary policy stimulus in response to the financial crisis. Further, we cannot detect any substantial aggregate effect of austerity measures. Finally, the post-2007 surge in expenditure-to-GDP ratios was apparently determined by non-policy shocks that reduced output growth.

Keywords: DSGE, Limited Asset Market Participation, Bayesian Estimation, Euro Area, Business Cycle, Monetary Policy, Fiscal Policy

JEL codes: C11, C13, C32, E21, E32, E37

1 Introduction

Following the apparent inability of monetary policies to avoid the recession that hit all advanced economies during the 2007 financial crisis, fiscal policies have been used to provide additional stimulus. The fiscal expansion was particularly large in the US and in the UK. By contrast,

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governments in the Euro area have been criticized for timid action in the 2007-2009 period (IMF, 2009) and for the "austerity" measures that were imposed onto peripheral countries after the beginning of the Greek crisis in 2010 (Cottarelli, 2012; Krugman, 2012; De Grauwe and Ji, 2013; Wolf, 2013; Stiglitz et al., 2014).

One specific feature of the Euro area is that national fiscal policies were constrained by the Stability and Growth Pact (SGP). According to Lane (2012) the Pact did not enforce sufficient discipline during the 1999-2007 period, characterized by a relatively favorable growth performance and by low cost for government finance. Then, after the onset of the Greek crisis in 2010, the SGP in its revised form imposed an unduly rapid fiscal correction in peripheral countries, accompanied by conservative fiscal stances in the rest of the area. This, in turn, caused an over-restrictive fiscal stance for the Euro area as a whole, that jeopardized the debt-reduction objective and left a legacy of higher than normal debt levels even in core countries. As a matter of fact, in 2014 the combination of persistently slow growth, high unemployment and declining inflation expectations induced the ECB to announce a large-scale asset purchase program, including purchases of sovereign bonds.

This paper investigates the role of fiscal and monetary policies over the aggregate EMU business cycle, with a specific focus on fiscal policies. The issue is important for at least two reasons. First, by looking at aggregate fiscal policies it is possible to understand the global implications of the Stability and Growth Pact, that was designed to impose a certain mix of discipline and discretion on individual countries. We shall therefore investigate the role played by fiscal feedbacks to business conditions and by discretionary actions, identified by shocks to fiscal variables. Second, over the next few years EMU policymakers will be confronted with the twofold task of reducing accumulated debt and, at the same time, of providing adequate stimulus to an economy that will be characterized by high unemployment and slow growth for several years to come. A correct assessment of fiscal multipliers and of the transmission channels associated to each fiscal instrument is therefore crucial to design fiscal policies that preserve macroeconomic stability for the Euro area as a whole. Achieving this goal should also facilitate the task of achieving fiscal adjustment in

peripheral countries.

A vast literature, based on DSGE models, has analyzed the role of shocks and monetary policy in determining the EMU business cycle, starting from the seminal work of Smets and Wouters (2003, 2007; SW henceforth). Empirical evidence on fiscal policies is instead sparse. The relatively few models that incorporate analysis of fiscal policies extend the SW framework by introducing Limited Asset Market Participation, that is, a distinction between a fraction of households who are asset holders and smooth their consumption over the business cycle, and the remaining share of non-Ricardian households who do not participate in financial markets and entirely consume their current disposable income in each period. This allows to incorporate the possibility that public consumption shocks stimulate private consumption, as in Galí et al. (2007), and that transfers shocks provide a demand stimulus, as documented in Oh and Reis (2011). Coenen and Straub (2005, CS henceforth) investigate the effects of government spending shocks on aggregate consumption over the 1980-1999 period. Forni, Monteforte and Sessa (2009, FMS henceforth) focus on a slightly longer period, essentially restricted to the pre-crisis years. Both studies find that the share of non-Ricardian households is too small to establish a positive reaction of private consumption to public consumption shocks and therefore also assign a limited role to public transfers policies. Coenen, Straub and Trabandt (2012, 2013; CST henceforth) estimate their model over the 1985 first quarter to 2010 second quarter sample and focus on the role played by fiscal policies during the 2008-2009 recession period. They estimate a far smaller share of non-Ricardian households. They also show that this result is crucially determined by complementarity between private and public consumption in households preferences. As a consequence, Ricardian households raise their consumption in response to a public consumption increase. In this framework public transfers inevitably play an even more limited role than in CS and in FMS. Relative to these studies, we differentiate our contribution in certain crucial aspects of the theoretical model and in the focus of the empirical analysis.

First, instead of imposing that only Ricardian households preferences shape wage setting decisions, in our model wage-setting labor unions maximize an objective function that takes into

account the marginal rate of substitution of all labor market participants, weighted by the shares of the two household types, as in Motta and Tirelli (2012, 2014). As shown in Motta and Tirelli (2013), this specification of the wage-setting mechanism has important implications for wage sensitivity to business cycle conditions. Therefore excluding this effect here might well bias the results.

Second, and more important, we do not "force" nonseparability between private consumption and total public consumption, as CST do. By and large the analysis of aggregates may be misleading, because different components of public expenditures might exert opposite effects on private individual consumption decisions (Karras, 1994). For instance, Fiorito and Kollintzas (2004) show that in a panel of twelve European countries "public" goods (defense, security, judicial system expenditures) are substitutes for private spending, whereas complementarity arises for "merit" goods (expenditures for services also available in the market, such as health and education). Thus, to identify the effects of public consumption shocks one should consider separately the "merit" and the "public" goods.[1] Further if one postulates that private and public consumption enter a CES utility bundle, then the weight associated to public consumption should be estimated along with the elasticity of substitution between the two goods. Unfortunately it is hard to identify these two parameters even in medium scale DSGE models (McGrattan, Rogerson and Wright, 1997; Cantore et al. 2014). In fact CST set the public consumption weight at the average sample value of the public-consumption-to-GDP ratio, and obtain a relatively strong degree of complementarity. As shown in Ercolani and Valle e Azevedo (2014), fixing the weights in the utility bundle may severely bias the sign of the public consumption externality. In fact they find that the complementarity result is fully reversed in a small RBC model of the US. Unfortunately we cannot replicate their approach in the paper because, just like CST, we could not identify the large DSGE model by estimating both the public consumption share and the elasticity of substitution between private and public goods.

Finally, the third distinctive feature of our model is that we are able to discuss the contribution of fiscal shocks during the post-2010 sovereign bond crisis. In fact post 2010 evidence is crucial

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[1]Unfortunately disaggregate data are not available at the Euro-area level.

to understand the current EMU predicament and the implications of the controversial decision to implement austerity measures.

Our results in a nutshell. Relative to CS, FMS and CST we obtain a much larger posterior estimate for the share of non-Ricardian households, 53%. As a consequence, our estimates for public consumption and public transfer multipliers are also substantially larger. We could not identify a systematic reaction of tax rates and public expenditure variables to the Eurozone cyclical conditions. In other words, there seem to be no fiscal Taylor rules for the Eurozone as a whole. In this regard, our results are in line with FMS whereas CST obtain a significant feedback only for the labor tax variable. Historical output growth decomposition shows that fiscal shocks were substantially irrelevant before and after the financial crisis. Thus, our results convey the picture of a Euro area where the burden of implementing stabilization policies entirely falls on the European central Bank, whereas fiscal policies remain neutral in spite of their potentially important effects identified by the estimated multipliers. Finally, we are able to identify the shocks that caused the post-2007 increase in the public-consumption-to-GDP ratio. The increase in this ratio, typically regarded as an indicator of governments profligacy, was almost entirely determined by persistently adverse non-policy shocks.

In the remainder of the paper Section 2 describes the model and Section 3 presents the results; Section 4 concludes discussing policy implications.

2   The model

The structure of our model is pretty much similar to SW (2005, 2007). As pointed out in the introduction, the main difference is that we allow for the possibility of LAMP and distinguish between Ricardian and Non-Ricardian households. Ricardian agents behave identically to SW. As described in Figure (1), only Ricardian households supply capital services to monopolistic producers of intermediate goods. All households delegate wage setting decisions to monopolistic labor unions. At the given wage rate, labor is then supplied on demand to producers of intermediate

goods. The final good is produced under perfect competition by assembling the intermediate inputs. The nominal interest rate and the fiscal policy decisions are respectively allocated to the Central Bank and to the Government. The model features standard nominal and real frictions, i.e. price and nominal wage stickiness, investment adjustment costs, variable capacity utilization, external consumption habits. The technical Appendix provides a full description of the model. In what follows we focus on certain aspects of the model that are crucial to understand our results, i.e. characterization of preferences and shocks.

Figure 1: Model structure
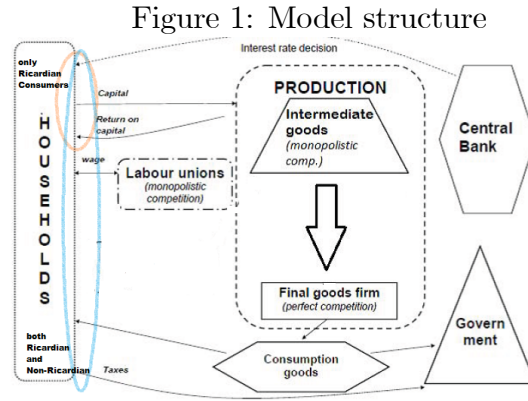
There is a continuum of households indexed by $i \in [0,1]$. Their preferences are

$$E_0 \sum_{t=0}^{\infty} \beta^t \left\{ \frac{1}{1-\sigma} \left(\frac{c_t^i}{(c_{t-1})^b} \right)^{1-\sigma} \exp \left(\frac{(\sigma-1)}{1+\phi_l} (h_t)^{1+\phi_l} \right) \right\} \tag{1}$$

where $c_t^i = \frac{C_t^i}{z_t}$ and $c_t = \frac{C_t}{z_t}$ are individual and total real consumption levels normalized by a labour-augmenting non-stationary technology shifter z_t. The presence of z_t in 1 guarantees that the model has a balanced growth path when productivity is non stationary.[2] In contrast with CST (2012, 2013) we abstract from non-separability between private and public goods and stick to the utility function used in SW (2005, 2007), characterized by non separability between consumption and labor effort.[3] In fact our effort is to keep at a minimum the deviations from the SW model

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[2]See Section 2.4 for more details.

[3]CST impose separability between consumption and labor effort.

which is a benchmark for the analysis of business cycle features. Our substantial deviation from SW is to incorporate the LAMP hypothesis. We assume that a fraction $1 - \theta$ of households (Ricardian households, superscript $i = o$) can access financial markets, own firms, trade government bonds, accumulate physical capital and rent capital services to firms, where $0 < \theta < 1$ is a parameter. The remaining θ households (Non-Ricardian or LAMP households, superscript $i = rt$) do not have access to financial markets and entirely consume their disposable income.

Parameter $0 < b < 1$ measures the degree of external habit in consumption. Differently from Smets and Wouters (2007) who use habits in differences, our specification here is based on habits in ratios. The specification chosen for characterizing consumption habits is inconsequential under the representative agent hypothesis (Dennis, 2009). This may not be the case here because individual wealth holdings and consumption levels differ across the two groups, both in steady state and in response to shocks. Carroll (2000) supports the alternative habits-in-ratio specification to avoid the risk of obtaining negative marginal utility of consumption. In the context of LAMP in DSGE models, Motta and Tirelli (2013) show that under the habits-in-difference specification indeterminacy may arise even for relatively small values of θ. By contrast, Menna and Tirelli (2014) show that indeterminacy is a lesser problem under the habit-in-ratio specification adopted in (1). In the context of an empirical LAMP model, the habit-in-difference specification might bias the posterior estimates because the Dynare[4] estimation routine forces estimates of the posterior distributions to be located in the determinacy region, i.e. it discards all posterior draws associated to indeterminacy.[5]

Parameter $\sigma > 1$ is crucial to capture the standard effect of consumption habits, that is, to raise the marginal utility of consumption. In our empirical model $\sigma > 1$ also implies complementarity between worked hours and consumption. Right from the outset, we emphasize that in our estimates no boundary will be imposed on the value of σ.

Each household supplies the bundle of labor services $h_t^i = \left\{ \int_0^1 [h_t^i(j)]^{\frac{1}{1+\lambda_t^w}} \, dj \right\}^{1+\lambda_t^w}$. For each

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[4]Dynare software developed by Adjemian et al. (2011), http://www.dynare.org.

[5]In section 3 below we compare our benchmark results under those obtained under the habits-in-difference specification.

labor type j, the wage setting decision is allocated to a specific labor union. At the given nominal wage W_t^j, households supply the amount of labor that firms demand $h_t^j = \left(\frac{W_t^j}{W_t}\right)^{-\frac{1+\lambda_t^w}{\lambda_t^w}} h_t^d$, where $h_t^i = \int_0^1 h_t^j dj$ is the total labor demand. Demand for labor type j is split uniformly across the households, so that households supply an identical amount of labor services. Labor income is $W_t^i h_t^i = h_t^d \int_0^1 W_t^j \left(\frac{W_t^j}{W_t}\right)^{-\frac{1+\lambda_t^w}{\lambda_t^w}} dj$. Here, the parameter $\lambda_t^w < 1$ is inversely related to the intratemporal elasticity of substitution between the differentiated labour services supplied by the households, $\frac{1+\lambda_t^w}{\lambda_t^w}$. The parameter λ_t^w is assumed to follow an AR(1) process with i.i.d. Normal error term that is typically defined as a wage markup shock (SW, 2007).[6]

The flow budget constraint of Ricardian households is

$$
\begin{aligned}
(1 + \tau_t^c) P_t c_t^o + P_t i_t^o + \frac{B_{t+1}^o}{\varepsilon_t^b} = R_{t-1} B_t^o + \left(1 - \tau_t^l - \tau_t^{wh}\right) W_t h_t^o + P_t d_t^o + \\
+ \left(1 - \tau_t^k\right) \left[R_t^k u_t^o - a\left(u_t^o\right) P_t\right] K_t^o + \tau_t^k \delta P_t K_t^o + P_t tr_t^o - P_t t_t^o
\end{aligned}
\tag{2}
$$

were P_t is the consumption price index, i_t^o defines investment in physical capital, B_t^o are nominally riskless government bonds, d_t^o are firms profits, R_t is the nominal interest rate, W_t is the nominal wage rate index, K_t^o is the physical capital stock, u_t^o defines capacity utilization, R_t^k is the nominal rental rate of capital and $a\left(u_t^o\right)$ defines capacity utilization costs. Note that (2) accounts for tax rates levied on wage and capital incomes and on households consumption, τ_t^l, τ_t^k and τ_t^c respectively, for social contributions levied on labor incomes, τ_t^{wh}, for public transfers, tr_t^o, and for lump-sum taxes t_t^o. Term ε_t^b is a risk premium shock that affects the intertemporal margin, creating a wedge between the interest rate controlled by the central bank and the return on assets held by the households. It is assumed to follow a first-order autoregressive process with an i.i.d. Normal error term:

Capital stock dynamics are $K_{t+1}^o = (1 - \delta) K_t^o + \varepsilon_t^i \left[1 - S\left(\frac{I_t^o}{I_{t-1}^o}\right)\right] I_t^o$, where δ is the depreciation rate and ε_t^i denotes an investment-specific technology shock that affects the real price of investment. It is assumed to evolve as an AR(1) process with i.i.d. Normal innovation term. The term $S\left(\frac{I_t^o}{I_{t-1}^o}\right)$ represents investment adjustment costs.

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[6]We also allow for price markup shocks as in SW (2007).

Non-Ricardian households consume their disposable labor income in each period:

$$(1 + \tau^c) P_t C_t^{rt} = \left(1 - \tau_t^l - \tau_t^{wh}\right) W_t^{rt} h_t^{rt} + T R_t^{rt} \tag{3}$$

where TR_t^{rt} defines public transfers to non-Ricardian households.

Intermediate firms z are monopolistically competitive and use as inputs capital and labor services, $u_t^z K_t^z$ and h_t^z respectively. Firms are subject to a payroll tax, τ_t^{wf} when using the labor input. The production technology is:

$$Y_t^z = \varepsilon_t^a [u_t^z K_t^z]^\alpha [z_t h_t^z]^{1-\alpha} - z_t \Phi$$

where Φ are fixed production costs. ε_t^a defines a transitory total factor productivity shock, evolving as an AR(1) process with an i.i.d. Normal innovation term. The term z_t denotes a labor-augmenting technology process with permanent effects. We posit that $g_{z,t} = \left(\frac{z_t}{z_{t-1}}\right)$ also evolves as an AR(1) process around a deterministic trend.

2.1 Monetary and fiscal policy rules

Following CCW, the Central Bank sets the nominal interest rate according to a log-linear Taylor rule:

$$\hat{R}_t = \left\{ \begin{array}{c} \phi_R \hat{R}_{t-1} + (1 - \phi_R)\widehat{\bar{\pi}}_t + \phi_\pi \left(\hat{\pi}_{t-1} - \widehat{\bar{\pi}}_t\right) + \\ +\phi_y \hat{y}_t + \phi_{\Delta\pi} \left(\hat{\pi}_t - \hat{\pi}_{t-1}\right) + \phi_{\Delta y} \left(\hat{y}_t - \hat{y}_{t-1}\right) + \hat{\varepsilon}_t^r \end{array} \right\} \tag{4}$$

where the hatted variables define log-deviations from steady state. In particular, $\hat{y}_t = \widehat{Y_t/z_t}$ is the log-deviation of observed output from the trend output level implied by the permanent technology component. Variable $\hat{y}_t$ is also interpreted as the output gap measure. ε_t^r is a monetary shock that follows a first-order autoregressive process with an i.i.d. Normal error term. Similarly to CST (2011, 2012), we assume a set of log-linear fiscal feedback rules such that

$$\hat{x}_t = \rho \hat{x}_{t-1} + \phi_{x,b} \hat{b}_{t-1} + \phi_{x,y} \hat{y}_t + \eta_t^x \tag{5}$$

where $\hat{x} = \hat{g}, \widehat{tr}, \hat{\tau}_t^l, \hat{\tau}_t^k, \hat{\tau}_t^c, \hat{\tau}_t^{wh}, \hat{\tau}_t^{wf}$; g is public consumption; η_t^x defines the fiscal policy shock. Our priors imply that $\phi_{x,b}$ and $\phi_{x,y}$ are strictly negative when $x = g, tr$ and strictly positive otherwise.

3   Results

Our estimates of the full model are quite disappointing. The global sensitivity tests implemented in Dynare (Ratto, 2008) show serious identification problems for some parameters, especially for those of the fiscal sector. The problem persists even if we change shape (for example, an Inverse Gamma instead of a Normal) and parameters of the priors distributions. Further, the DSGE-VAR à la Del Negro and Schorfheide (2004) suggests the models is not well specified because the hyperparameter which represents the weight of the DSGE model restrictions is close to zero, implying that the DSGE model fails to explain the data.[7] For all the posteriors of the fiscal feedbacks $\phi_{x,b}$ and $\phi_{x,y}$ the Highest Posterior Density interval (HPD Int.) includes the zero value, and it is therefore impossible to obtain evidence of systematic fiscal policies at business cycle frequencies (see Online Technical Appendix, Table 2). The situation did not change when we estimated only subsets of the rules and alternative specifications for the statistical distributions of parameters that characterize feedbacks on debt and output.

The next step has been to estimate a restricted DSGE model where the fiscal feedbacks $\phi_{x,b}$ and $\phi_{x,y}$ have been removed altogether but the economy is assumed to react to fiscal shocks.[8] This restricted model is better specified than the model with fiscal reaction functions. Considering the DSGE-VAR à la Del Negro and Schorfheide (2004), we note a dramatic improvement in model ability to match the data. In fact the estimated hyperparameter is now around 0.95.[9]

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[7]The DSGE-VAR à la Del Negro and Schorfheide (2004) suggests the possible misspecification in structural models such as the DSGE. The estimated hybrid model, the DSGE-VAR, is a combination between restrictions from the economic model, and the statistical representation of the model, a VAR. The restrictions are "weighted" using a hyperparameter which evidences how much the DSGE model is misspecified.

[8]In this case model stability obtains because the implicit lump-sum taxation ensures government solvency.

[9]When the hyperparameter is close to zero, it means we can use a reduced VAR, and the restrictions of the DSGE model does not count in the data. The selected DSGE model is misspecified to explain the data. When the hyperparameter is greater than zero, the grade of misspecification is decreasing. There is not a statistical rule to comment how much the model is more or less misspecified, it depends on several features such as the lag length and the shape of the marginal data density. For more technical details, see Del Negro et al. (2007) to an explanation of the DSGE-VAR in function of the model's marginal likelihood and lag length. In our empirical analysis, we

(see Online Technical Appendix, Table 3). For all parameters the marginal posterior distributions are unimodal, MCMC's convergence criteria are satisfied. Metropolis-Hastings convergence graphs suggest a fast and efficient convergence for all parameters.[10]

The posterior for consumption utility (σ = 2.091, 90% HPD interval:1.709-2.474) is large relative to our prior and the lower boundary of the HPD interval is reassuringly larger than 1. This result implies that our estimated utility function is "well behaved", i.e. habits increase the marginal utility of consumption. Our estimated posterior for σ also implies complementarity between consumption and worked hours.

The posterior for the fraction of Non-Ricardian households is about 53% (HPD interval: 43%-62%). This fraction is much larger than the 18%, found in CST (2011, 2012) for the sample 1985:Q1 - 2010:Q2. By and large, the remaining posteriors are in line with previous studies,

As a robustness check, we estimated the model under the alternative habits in differences specification. In this case we obtained an even larger value for the share of non-Ricardian households ($\theta = 0.81$, HPD interval: 75%-88%), a smaller habit parameter ($b = 0.63$, HPD interval: 0.55-0.71) and a very small value for the consumption utility parameter ($\sigma = 0.32$, HPD interval: 0.20-0.44). This latter result would imply an implausibly large value for the intertemporal elasticity of substitution, at odds with a large body of empirical evidence (see Guvenen, 2006, and references cited therein). Furthermore, we noticed that the large elasticity of intertemporal substitution is crucial to avoid model indeterminacy, which occurs for $\sigma > 0.5$. This provides indirect support to our conjecture that under the habit-in-difference assumption results might be biased because estimates of the posterior distribution are forced into the determinacy region.

In concluding this discussion, note that we avoid a Bayes Factor comparison between our model and a closed-economy version of CST (2012). In principle, one might estimate an encompassing model where the consumption bundle incorporates public goods and then compare it with a re-

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estimate the DSGE-VAR with a different lag length, changing the prior for the hyperparameter, controlling the marginal likelihood in each exercise. The result is robust and the estimated hyperparameter is always close to 1.

[10]Visual diagnostics of the estimation results are available in the online Technical Appendix. The posterior distributions are computed considering 1,500,000 draws for 4 Markov chains, with 300,000 draws being discarded as burn-in draws. The average acceptance rate is roughly 28 percent.

stricted version where utility is separable in public and private consumption. In practice the encompassing model cannot be identified unless one calibrates the public goods share in the consumption bundle. As a consequence we would be comparing two models characterized by the decision of forcing the share of public goods in the consumption bundle to take either value zero (separability case) or the average sample value (CST case). The marginal likelihoods could be calculated, but the results would be driven by the two mutually exclusive calibrations.

3.1 Fiscal multipliers

In this section we describe our fiscal multipliers in comparison with those obtained in CST and in FMS. Both in the short and in the long run[11] our estimated model predicts large public consumption multipliers (Table 1), which are almost identical to CST. Their results are driven by the complementarity between private and government consumption. In our context the large effect of public consumption on output is mainly determined by the large share of non-Ricardian households who raise consumption in response to an increase in their labor incomes, in line with the theoretical mechanism identified in Galí et al. (2007). IRFs presented in Figure 2[12] show that the initial output variation has a negligible effect on inflation. The ensuing small real interest rate increase and the positive effect of hours worked on the marginal utility of consumption limit the fall in consumption of Ricardian households. FMS obtain smaller multipliers and their model predicts a fall in aggregate consumption in response to the public consumption shock. This is mainly explained by the larger share of non-Ricardian household we estimate in our model and by the stronger inflation-output correlation estimated in their model, which elicits a monetary policy response that is more contractionary than in our model.

The public transfers multiplier is substantial in our model, whereas it is negligible in CST. This is easily explained by the larger share of non-Ricardian households we obtain in our estimates. Figure 3 shows that the positive response in the consumption of these households is reinforced by

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[11]Short run and long run multipliers are defined as in Faia et al. (2013), the short run multiplier being the impact multiplier and the long run multiplier being the cumulative effect over the 40 periods considered.

[12]In Figures 2 to 4, we plot the Bayesian IRFs obtained at the posterior mean (solid lines) and the 90% confidence bands (dotted lines). The standard deviations for each shock is the estimated standard deviation.

Table 1: Fiscal multipliers. Tax rates multipliers are computed as a percentage increase in output or consumption following a 1 basis point increase in the tax rate.

|	gov spending	transfers	consumption tax	labor tax	households ssc	firms ssc
	output					
short run	1.48	0.59	-0.48	-0.37	-0.34	0.09
long run	1.20	0.42	-0.41	-0.47	-0.37	-0.01
	aggregate consumption					
short run	0.45	0.85	-0.70	-0.53	-0.50	-0.04
long run	0.26	0.83	-0.74	-0.71	-0.60	-0.15
	Ricardians consumption					
short run	-0.04	-0.20	-0.28	-0.02	0.03	-0.02
long run	-0.76	-0.60	-0.18	-0.20	-0.07	-0.06
	LAMP consumption					
short run	0.97	1.98	-1.15	-1.09	-1.07	-0.07
long run	1.34	2.35	-1.34	-1.26	-1.17	-0.25

the surge in real wages and worked hours. This latter increase elicits an initially positive variation in consumption of Ricardian households, due to non-separability between consumption and labor effort and to the limited real interest rate increase.

The multiplier associated to consumption taxes is almost identical to CST, whereas we obtain a much larger multiplier for labor taxes and households social security contributions. The labor tax and social contributions multipliers obtained in FMS are closer to ours than to CST. Once more, the results are explained by the different role paid by LAMP. In fact, labor taxes and social security contributions mainly affect the supply side when the majority of consumers is represented by Ricardian households, whereas the contemporaneous variation in current disposable incomes becomes important when the size on non-Ricardians is relatively large. Further, non-separability implies that the fall in hours worked has a depressing effect on Ricardian households' demand for consumption goods. By contrast, LAMP does not substantially change the output response to a consumption tax increase. When Ricardians dominate, the negative output multiplier is determined by households incentive to postpone consumption, whereas the fall in current disposable income is the key driver when LAMP is important.

Figure 4 presents the IRFs in response to the labor tax rate shock. The tax rate increase has a contractionary effect on the economy, inflation decreases, thus also the nominal interest rate decreases, causing a real interest rate fall. This, in turn, triggers a positive response of

investments. Our results unambiguously show that the brunt of adjustment to the shock is borne by non-Ricardian households, who suffer from the sharp reduction in disposable income, whereas non-Ricardian households are able to smooth their consumption.

Figure 2: IRFs to a one standard deviation government spending shock.
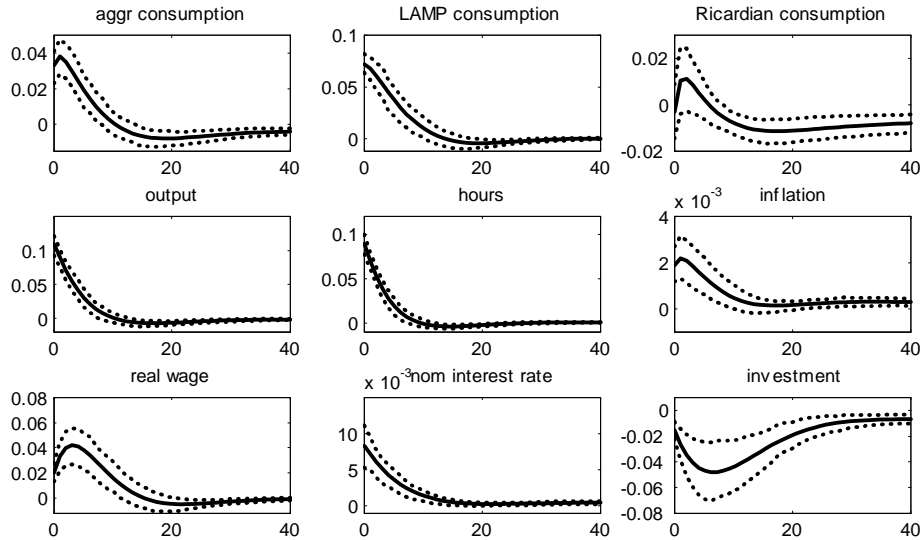
3.2 Variance and historical growth decompositions

Table 2 reports the variance decomposition for some key variables. The risk-premium (η^b) and interest rate (η^r) shocks cause about 55% of output growth volatility (Δy) (60% for consumption growth, Δc). Shocks to the growth rate of productivity (η^{g_z}) account for about 20% of output and consumption growth volatility. Technology shocks (η^a) play a much larger role in determining volatilities of inflation (π) and *investments* growth (Δi). Wage markup shocks (η^w) contribute to 18% of real wage growth (Δw) volatility, but have a limited role otherwise. Price markup shocks (η^p) play a minor role even on inflation. The most striking result is the irrelevance of fiscal shocks (η^g, η^{tr}, $\eta^{\tau c}$, $\eta^{\tau l}$, $\eta^{\tau wh}$, $\eta^{\tau wf}$).[13] By contrast, note that monetary policy shocks provide the largest

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[13]FMS obtain an identical result over a different sample period (1980:1 to 2005:4) and under a different (restricted) composition of the Eurozone.

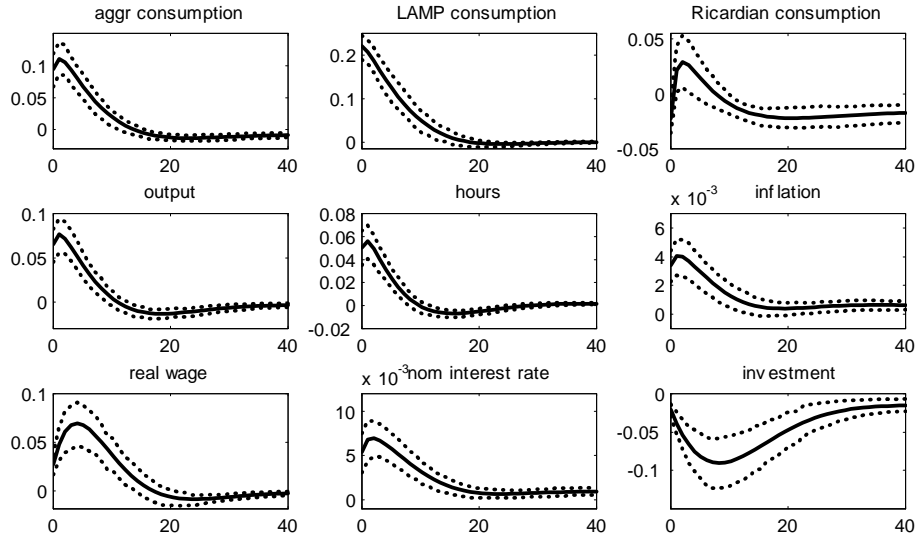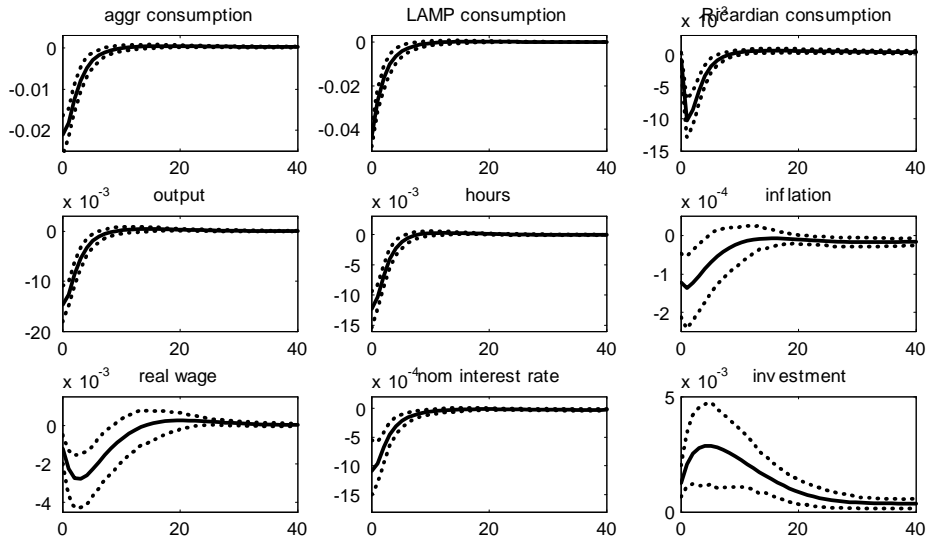Figure 3: IRFs to a one standard deviation transfers shock.

Figure 4: IRFs to a one standard deviation labor tax rate shock.

contribution to the volatility of consumption, output, and real wage growth. In addition, monetary policy shocks rank as the second largest contributor to inflation volatility.

Table 2: Variance decomposition

|	Δc	Δy	π	Δw	Δi	r
η^a	6.88	9.05	40.89	12.64	38.10	11.51
η^b	31.01	26.54	14.56	18.66	40.28	17.43
η^i	3.55	10.55	0.76	2.85	3.04	43.86
η^r	31.51	29.63	27.00	26.83	5.23	20.70
η^p	1.83	1.71	5.10	2.61	0.43	0.79
η^w	2.37	1.43	6.14	17.96	5.59	4.15
η^{g_z}	22.42	20.73	5.55	18.41	7.30	1.54
η^g	0.03	0.24	0.00	0.01	0.01	0.01
η^{tr}	0.02	0.00	0.00	0.00	0.00	0.00
$\eta^{\tau c}$	0.05	0.02	0.00	0.00	0.00	0.00
$\eta^{\tau l}$	0.01	0.00	0.00	0.00	0.00	0.00
$\eta^{\tau wh}$	0.00	0.00	0.00	0.00	0.00	0.00
$\eta^{\tau wf}$	0.00	0.00	0.00	0.00	0.00	0.00

η stand for innovations of the following shocks: temporary technology (a), risk premium (b), investment specific (i), interest rates (r), price markup (p), wage markup (w), productivity growth (g_z), government expenditure(g), gov transfers (tr), consumption taxes (τ_c), labor taxes (τ_l), households (τ_{wh}) and firms (τ_{wf}) social security contrributions. Concerning macroeconomic variables, a Δ stands for the growth rate, y is output, c is consumption, π is inflation, w is the real wage, i is investment and r is the real interest rate.

The analysis of GDP growth historical decomposition allows to identify the specific contributions of policy and non-policy shocks (Figure 5). The 2008:1-2009:4 crisis was triggered by adverse productivity and investment-specific shocks,[14] whereas the post-2010 slowdown is associated to a sequence of adverse risk premium shocks in coincidence with the onset of the Greek crisis. Perhaps surprisingly, in this period we detect favorable productivity shocks, signalling that the crisis had induced substantial restructuring by firms. Turning to policy shocks, note that monetary policy generated a sequence of negative stimuli that began in 2007, but then turned expansionary and contributed to the temporary recovery. A a matter of fact, the ECB interest rate on the main refinancing operations remained fixed at 4% until July 2008, when it was raised by 25 basis points. Interest rates in the Euro area started decreasing gradually only from October 2008. During the second contraction, we observe a persistent reversal of discretionary monetary policies, that turned

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[14]The investment-specific shock might capture the effect of financial disintermediation on the the ability to turn savings into capital (Justiniano et al., 2011).

contractionary once more.

Figure 5: Historical decomposition of GDP growth.
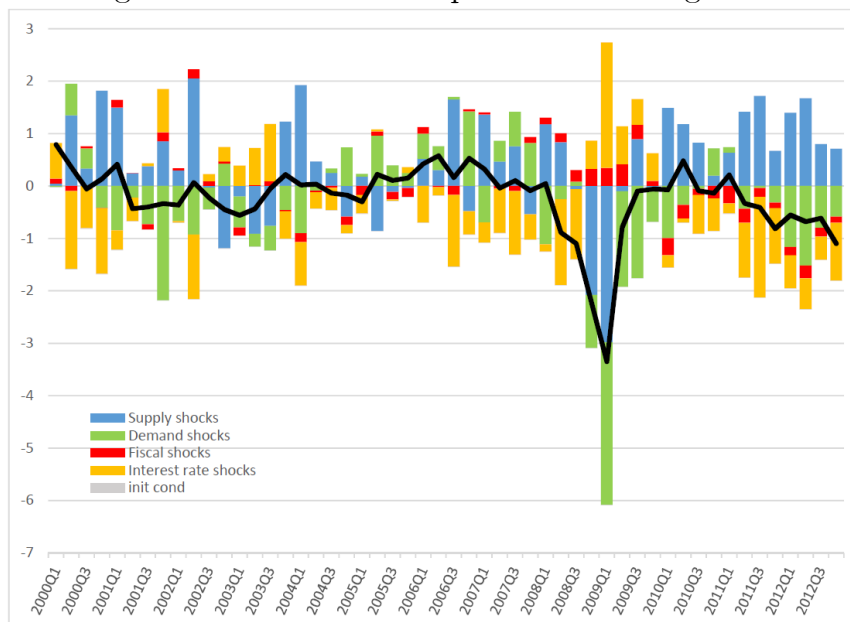
3.2.1 Fiscal policies during the financial and sovereign bond crises

The analysis of GDP growth historical decomposition confirms that it is difficult to identify episodes when fiscal shocks played an important role. Figure 6 shows that the admittedly marginal contribution of fiscal policies to output growth during the two crises was almost entirely determined by expenditure adjustments. Public consumption and transfers shocks were expansionary during the 2008 downturn. Then, after the onset of the Greek crisis we observe persistently contractionary shocks. Nevertheless, given the limited size of these shocks, the Eurozone fiscal stance was almost neutral during the whole crisis period, suggesting that the deterioration of the fiscal ratios was caused by the dismal output growth performance. This is confirmed by the historical decomposition of the Public-Consumption-to-GDP ratio (Figure 7).

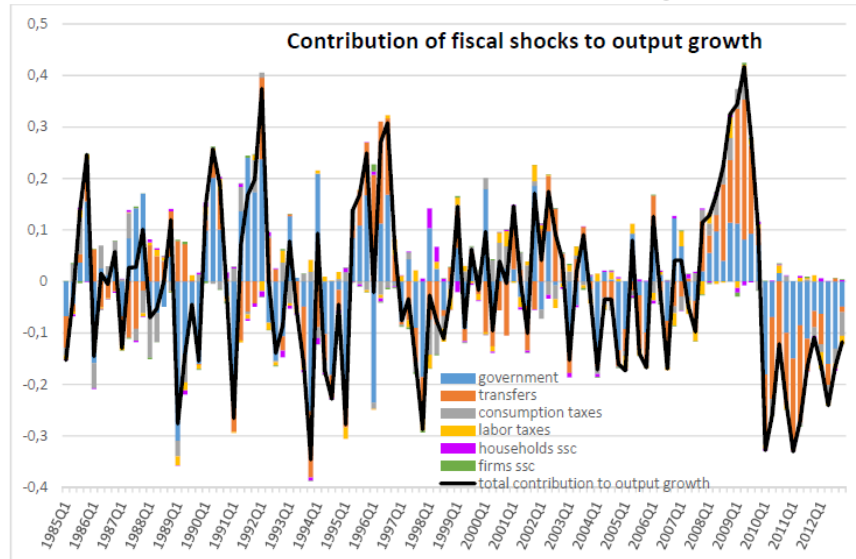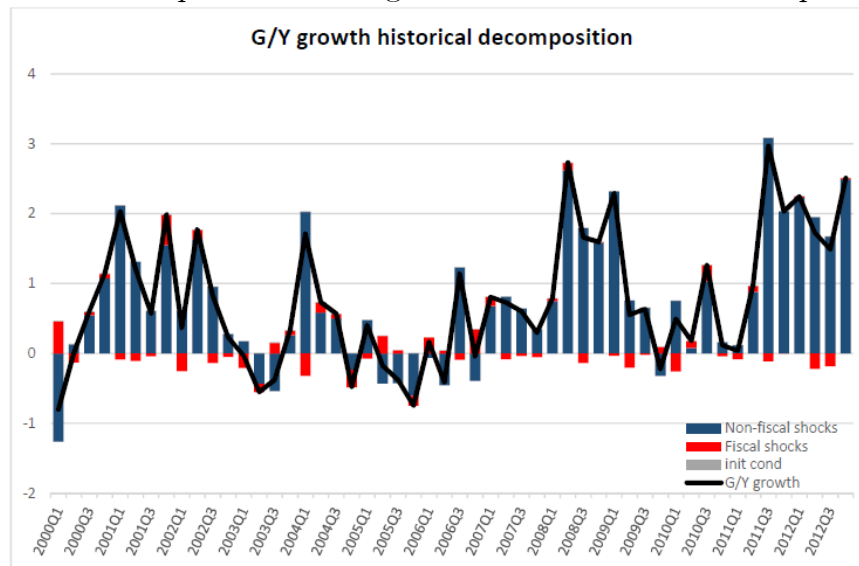Figure 6: Contribution of fiscal shock to output growth.

Figure 7: Historical decomposition of the growth rate of Public-Consumption-to-GDP ratio.

4 Conclusions

Our results convey a key message: aggregate fiscal policies played a very limited role in determining the Euro area business cycle. The minimal contribution of fiscal shocks, i.e. the absence of discretionary fiscal policies, is consistent with the spirit of the SGP. To some extent, the apparent inability to detect fiscal feedbacks on output is also consistent with the view that the SGP should allow the working of automatic stabilizers in presence of asymmetric shocks (Buti and Franco, 2005), while stabilization of the Euro area business cycle should be sole responsibility of the ECB. We also find that post-2010 austerity had a negligible aggregate impact: Eurozone stagnation and fading inflation expectations that induced the ECB to implement quantitative easing were caused by non-policy shocks.

Another important result is that the post-2007 rise in fiscal ratios was the consequence of such non-policy shocks that reduced output growth, whereas discretionary policies played no role in it. Given the large fiscal multipliers, this should sound a word of caution about the implementation of an aggregate fiscal consolidation before the Euro area has fully recovered. Finally, our estimates suggest that public expenditure contractions would strongly increase inequality between asset-holders and non-Ricardian households. Thus, the fiscal policy mix should be carefully designed to deal with this problem. In this regard, our results provide strong empirical support to the theoretical work of Ferrara and Tirelli (2014) who show that combining public expenditure contractions with labor tax reductions and accommodative monetary policies limits the output contagion caused by a debt consolidation, also allowing to support incomes of those households who cannot exploit financial markets to smooth their consumption.

References

[1] Adjemian S, Bastani H, Juillard M, Karamé F, Mihoubi F, Perendia G, Pfeifer J, Ratto M and Villemot S, 2011. Dynare: Reference Manual, Version 4, Dynare Working Papers, 1, CEPREMAP

[2] Adjemian S, Darracq-Pariès M, Moyen S, 2008. Towards a Monetary Policy Evaluation Framework. ECB Working paper 942.

[3] Albonico A, Paccagnini A, Tirelli P, 2014. Estimating a DSGE model with Limited Asset Market Participation for the Euro Area, Working Papers 286, University of Milano-Bicocca, Department of Economics.

[4] Albonico A, Rossi L, 2014. Policy Games, Distributional Conflicts, and the Optimal Inflation, Macroeconomic Dynamics, Volume 19, Issue 06, September 2015, pp 1261-1293.

[5] Bilbiie FO, 2008. Limited asset market participation, monetary policy and (inverted) aggregate demand logic. Journal of Economic Theory 140, 162–196.

[6] Buti M, Franco D, 2005. Fiscal policy in Economic and Monetary Union: theory, evidence, and institutions. Edward Elgar Publishing.

[7] Cantore C, Levine P, Melina G, Yang B, 2014. Deep versus Superficial Habit: It's All in the Persistence. School of Economics Discussion Papers, 714.

[8] Carroll CD, 2000. Solving consumption models with multiplicative habits, Economics Letters, Elsevier, vol. 68(1), pages 67-77, July.

[9] Colciago A, 2011. Rule-of-thumb consumers meet sticky wages. Journal of Money, Credit and Banking 43, 325–353.

[10] Coenen G, Straub R, 2005. Does Government Spending Crowd in Private Consumption? Theory and Empirical Evidence for the Euro Area, International Finance, Wiley Blackwell, vol. 8(3), pages 435-470, December.

[11] Coenen G, Straub R, Trabandt M, 2012. Fiscal Policy and the Great Recession in the Euro Area, American Economic Review, Papers & Proceedings, American Economic Association, vol. 102(3), pages 71-76, May.

[12] Coenen G., Straub R., Trabandt M., 2013. Gauging the effects of fiscal stimulus packages in the euro area, Journal of Economic Dynamics and Control, Elsevier, vol. 37(2), pages 367-386.

[13] Cottarelli C, 2012. Fiscal adjustment: Too much of a good thing?. VoxEU.org, 8.

[14] De Grauwe P, Ji Y, 2013. The legacy of austerity in the Eurozone. CEPS Commentary, 4.

[15] Del Negro M, Schorfheide F, 2004. Priors from General equilibrium Models for VARs, International Economic Review, 45, 643-673.

[16] Del Negro M, Schorfheide F, Smets F, Wouters R (2007) On the Fit of New-Keynesisan Models: Rejoinder, Journal of Business, Economics and Statistics, 25(2), 159-162.

[17] Dennis R, 2009. Consumption Habits in a New Keynesian Business Cycle Model, Journal of Money, Credit and Banking, Blackwell Publishing, vol. 41(5), pages 1015-1030, 08.

[18] Ercolani V, Valle e Azevedo J, 2014. The effects of public spending externalities, Journal of Economic Dynamics and Control, Elsevier, vol. 46(C), pages 173-199.

[19] Faia E, Lechthaler W, Merkl C, 2013. Fiscal stimulus and labor market policies in Europe, Journal of Economic Dynamics and Control, Elsevier, vol. 37(3), pages 483-499.

[20] Ferrara M, and Tirelli P, 2014. Fiscal Consolidations: Can We Reap the Gain and Escape the Pain?, University of Milan Bicocca Department of Economics, Management and Statistics Working Paper No. 283. Available at SSRN: http://ssrn.com/abstract=2509715 or http://dx.doi.org/10.2139/ssrn.2509715

[21] Fiorito R, Kollintzas T, 2004. Public goods, merit goods, and the relation between private and government consumption, European Economic Review, Elsevier, vol. 48(6), pages 1367-1398, December.

[22] Forni L, Monteforte L, Sessa L, 2009. The general equilibrium effects of fiscal policy: Estimates for the Euro area, Journal of Public Economics, vol. 93(3-4), pages 559-585.

[23] Furlanetto F, Seneca M, 2012. Rule-of-Thumb Consumers, Productivity, and Hours, Scandinavian Journal of Economics, Wiley Blackwell, vol. 114(2), pages 658-679, 06.

[24] Furlanetto F, Natvik GJ, Seneca M, 2013. Investment shocks and macroeconomic comovement, Journal of Macroeconomics, Elsevier, vol. 37(C), pages 208-216.

[25] Galí J, López-Salido D, Vallés J, 2004. Rule-of-thumb consumers and the design of interest rate rules, Journal of Money, Credit and Banking 36, 739–764.

[26] Galí J, López-Salido D, Vallés J, 2007. Understanding the effects of government spending on consumption, Journal of the European Economic Association 5 (1), 227–270.

[27] Guvenen F, 2006. Reconciling conflicting evidence on the elasticity of intertemporal substitution: A macroeconomic perspective, Journal of Monetary Economics, 53(7), 1451-1472

[28] IMF, 2009. IMF Group of Twenty meeting of the ministers and central bank governors March 13–14, 2009 London, U.K. Global Economic Policies and Prospects.

[29] Karras G, 1994. Government Spending and Private Consumption: Some International Evidence, Journal of Money, Credit and Banking, Blackwell Publishing, vol. 26(1), pages 9-22, February.

[30] Krugman P, 2012. Europe's austerity madness, New York Times, 28, A35.

[31] Justiniano A, Primiceri G, Tambalotti A, 2011. Investment Shocks and the Relative Price of Investment Review of Economic Dynamics, Elsevier for the Society for Economic Dynamics, vol. 14(1), pages 101-121, January.

[32] Lane PR, 2012. The European sovereign debt crisis, The Journal of Economic Perspectives, 26(3), 49-67.

[33] McGrattan, E. R., Rogerson, R., & Wright, R. 1997. An equilibrium model of the business cycle with household production and fiscal policy. International Economic Review, 267-290.

[34] Menna L, Tirelli P, 2014. The Equity Premium in a DSGE Model with Limited Asset Market Participation, mimeo.

[35] Motta G, Tirelli P, 2012. Optimal Simple Monetary and Fiscal Rules under Limited Asset Market Participation, Journal of Money, Credit and Banking, Blackwell Publishing, vol. 44(7), pages 1351-1374, October.

[36] Motta G, Tirelli P, 2013. Limited Asset Market Participation, Income Inequality and Macro-

economic Volatility, Working Papers 261, University of Milano-Bicocca, Department of Economics, Dec 2013.

[37] Motta G, Tirelli P, 2014. Money Targeting, Heterogeneous Agents, and Dynamic Instability, Macroeconomic Dynamics, available on CJO2014. doi:10.1017/S1365100513000394.

[38] Oh H, Reis R, 2011. Targeted Transfers and the Fiscal Response to the Great Recession, NBER Working Papers 16775.

[39] Ratto M, 2008. Analysing DSGE Models with Global Sensitivity Analysis, Computational Economics, Society for Computational Economics, vol. 31(2), pages 115-139, March.

[40] Smets F, Wouters R, 2003. An Estimated Dynamic Stochastic General Equilibrium Model of the Euro Area, Journal of the European Economic Association, MIT Press, vol. 1(5), pp. 1123-1175.

[41] Smets F, Wouters R, 2007. Shocks and Frictions in US Business Cycles: A Bayesian DSGE Approach, American Economic Review, American Economic Association, vol. 97(3), pp. 586-606.

[42] Stiglitz JE, Fitoussi JP, Bofinger P, Esping-Andersen G, Galbraith JK, Grabel I, 2014. A Call for Policy Change in Europe, Challenge, 57(4), 5-17.

[43] Wolf M, 2013. How austerity has failed. New York Review of Books, 11.

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