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Limited Asset Market Participation and Macro-dynamics in Medium-scale DSGE models. A perspective for the Eurozone*

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Abstract

In the paper we investigate the implications of Limited Asset Market Participation for a theoretical medium scale DSGE model that is otherwise akin to empirical DSGE models estimated for the Eurozone (Smets and Wouters, 2003, 2005). Our interest lies in the analysis of the link between LAMP, macroeconomic policies and consumption inequality. The first step in our analysis is the identification of Ramsey-optimal fiscal and monetary policies, accounting for both the endogenous long-run inflation rate and the responses to shocks. The second step is the analysis of simple monetary and fiscal rules. In this regard we analyze the combination of a standard Taylor rule with fiscal redistributive policies that limit after-tax income and consumption inequality. Then we analyse the effects of debt consolidations on the consumption levels of asset holders and of households excluded from asset market participation, focusing on alternative tax schemes designed to reduce consumption inequality. The paper bears theoretical insights for macroeconomic policies in the Eurozone, including the optimal inflation rate and the complementarity between the ECB policy and the Eurozone global fiscal stance.

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1 Introduction

The 2008-2009 financial crisis and the ensuing sovereign bond crisis that hit the Eurozone has triggered the search for new developments in macroeconomic models that allow to develop a new policy framework (Blanchard et al. 2010). The issue is particularly relevant for the Eurozone, where both monetary and fiscal policymakers have long resisted calls to follow the bold policy actions undertaken in the US, in the UK and even in Japan.

This paper is based on the premise that designing the future of macroeconomic policies in Europe requires a substantial rethinking of the underlying macroeconomic model and a new vision about what markets and policymakers can accomplish. The old consensus view assigned monetary policy the goal of controlling inflation by keeping aggregate demand close to potential output. The underlying theoretical framework was based on the assumption that the "representative" consumer had full access to complete financial markets. For this reason, traditional fiscal stabilization policies aiming at demand management played virtually no role. To the contrary, "fine tuning" of tax rates over the business cycle was deemed counterproductive and the main task of tax and public expenditure policies was to stabilize debt-to-GDP ratios (Schmitt-Grohé and Uribe, 2006). In contrast with this prescription, between 2007 and 2009 in many developed economies fiscal stimuli were implemented through temporary tax cuts and fiscal transfers, and seem to have played an important role in cushioning private demand at a time of increasing unemployment (Oh and Reis, 2012).

Furthermore, the years following the global 2007 financial crisis have witnessed growing concern for incomes inequality and for the distributional effects of macroeconomic policies. Historically, redistributive actions have been the domain of fiscal policies, but in recent years even monetary policies have come under scrutiny for their effects on inequality. For instance Coibion et al. (2012) document that in the US monetary policy contractions have substantial and persistent redistributive effects, increasing income and consumption inequality.

To understand the ECB's official characterization of business cycle determinants, it is illuminating to look at the New Area Wide Macroeconomic Model (NAWM, Christoffel et al. 2008), which is designed for use in the Macroeconomic Projection Exercises regularly undertaken by ECB staff and for policy analysis. The NAWM is centered around intertemporal decisions of households and firms which are maximising expected life-time utility and the expected stream of profits, respectively. It incorporates the standard frictions that characterize medium scale DSGE models estimated for the US and for the Eurozone (Christiano et al. 2005, Smets and Wouters, 2003, 2005). Its recent version incorporates a banking sector and a financial accelerator mechanism (Smets et al., 2010). In these models Ricardian equivalence obtains and all households have full access to financial markets. As a result, in these models the temporary fiscal transfers and tax rebates that played a crucial role during the crisis are simply irrelevant. Furthermore, this theoretical and empirical apparatus completely neglects the interactions between monetary and fiscal policies in determining the global macroeconomic policy stance at the EMU level.

Following a seminal contribution by Mankiw (2000), a strand of New Keynesian literature emphasizes the role of rule-of-thumb (henceforth RT) consumers who do not participate to financial markets and therefore cannot save or borrow. In their Sigma model Erceg Guerrieri, and Gust (2006) calibrate the share of RT consumers at 50% in order to replicate the dynamic performance of the Federal Reserve Board Global Model. Galì et al. (2007) as well as Furlanetto and Seneca (2009) show that RT consumers can rationalize the empirically observed response of aggregate consumption to public spending shocks. In Furlanetto and Seneca (2013) the RT hypothesis helps to account for recent empirical evidence on productivity shocks. Andres et al. (2008) show that nominal rigidities and RT consumers can rationalize the empirically observed negative correlation between government size and consumption volatility in OECD countries. In Boscà et al. (2011), the combination of RT consumers and consumption habits significantly improves the ability of an otherwise standard search model to reproduce some of the stylized facts characterizing the US labor market.

Empirical research cannot reject the RT consumer hypothesis. Estimates of structural equations for consumption growth report a share of RT consumers ranging from 26% to 40% (see among others, Coenen and Straub, 2005; Forni, Monteforte, and Sessa, 2009). The findings in Parker et al. (2011) are also consistent with RT assumptions. Critics of the approach might argue that the empirical relevance of RT consumers is bound to gradually decline along with the development of financial markets (Bilbiie, Meier, and Müller, 2008). In fact, increasing regulation in the aftermath of the 2008 crisis is likely to raise the share of liquidity-constrained households in the near future.

The LAMP hypothesis has substantial implications for the conduct of monetary policies within the Euro Area. According to the old view, the ECB alone should stabilize the union-wide economy and automatic stabilizers should take care of within-EMU differences (Buti et al., 2001, 2005). In fact, if the LAMP hypothesis is taken seriously, the global fiscal stance of the Eurozone should be an essential complement to the ECB monetary policy.

Another important issue concerns the identification of the ECB inflation target. The DSGE literature on Ramsey-optimal monetary and fiscal policies is based on the representative agent (RA) assumption and is silent about the redistributive effects of inflation. Its standard prescription is that the optimal steady state inflation rate is near to zero or slightly negative and inflation should be almost completely stabilized along the business cycle (Schmitt-Grohé and Uribe, 2011). The result follows from the trade-off between monetary transaction costs, that call for a zero nominal interest rate and a negative growth rate of prices (the Friedman rule), and price adjustment costs, that push the optimal inflation rate to zero. Moreover, a popular argument in favour of price stability is the asymmetric incidence of the inflation tax when wealth is unevenly distributed and portfolio composition of poorer households is skewed towards a larger share of money holdings, so that the inflation tax burden would disproportionately fall on the poor (Erosa and Ventura, 2002; Boel amd Camera, 2009; Schmitt-Grohé and Uribe, 2011). In fact, this is the key justification for endorsing price stability as the primary ECB objective that contributes to reducing inequality and poverty. For instance, in a speech at the International Day for the Eradication of Poverty, Intergroup "Extreme Poverty and Human Rights, Fourth World Committee" event, held on October, 17th 2012 at the European Parliament in Brussels Benoît Cœuré, Member of the Executive Board of the ECB, stated that "*...poorer households tend to hold a larger fraction of their financial wealth in cash, implying that both expected and unexpected increases in inflation make them even poorer. In addition, monetary policy shocks and surprise inflation can have an impact on inequality through other sources of income. Income from labour and the unemployment of less-skilled workers tend to be adversely affected to a disproportionate degree during recessions. All in all, recent studies suggest that a higher inflation rate is accompanied by greater income inequality*".

Finally, LAMP may have important implications for the identification of debt consolidation strategies in the Eurozone. Following the large increases in public-debt-to-GDP ratios observed in the aftermath of the 2007-financial crisis, fiscal consolidation, i.e. a reduction in the debt-to-GDP ratio, has come to the forefront of political debate and macroeconomic analyses (Blanchard et al., OECD 2012). The issue is particularly relevant for the Eurozone, where institutional arrangements such as the Maastricht Treaty and the Stability and Growth Pact (SGP) should oblige member States to pursue a 60% debt-to-GDP ratio. In fact the 'corrective arm' of the SGP should be activated whenever public debt exceeds 60% of GDP and the excess debt is not reduced by 5% per year on average over three years (European Commission).

In the paper we investigate the implications of LAMP for a theoretical medium scale DSGE model that is otherwise akin to empirical DSGE models estimated for the Eurozone (Smets and Wouters, 2003, 2005). Our key interest lies in the analysis of the link between LAMP, macroeconomic policies and consumption inequality. The first step in our analysis is the identification of Ramsey-optimal fiscal and monetary policies, accounting for both the endogenous long-run inflation rate and the responses to shocks. The second step is the analysis of simple monetary and fiscal rules and of their effects on consumption inequality. In this regard we analyze the combination of a standard Taylor rules with fiscal redistributive policies that limit after-tax income and consumption inequality. Then we analyse the effects of debt consolidations on the consumption levels of asset market participants and of households excluded from asset market participation, focusing on alternative tax schemes designed to reduce inequality.

The remainder of the paper is organized as follows. Section 2 outlines the model, section 3 deals with Ramsey-optimal policies, sections 4 and 5 present results concerning simple policy rules. Section 6 concludes.

2 The Model

2.1 Households

There is a continuum of households indexed by i, $i \in [0,1]$. All households share the same utility function $U\left(c_t^i, l_t^i, G_t\right)$, where $c_t^i = \left[\int_0^1 c_t(z)^{\frac{\eta-1}{\eta}} dz\right]^{\frac{\eta}{\eta-1}}$ is the consumption bundle, $l_t^i = \left[\int_0^1 l_t(j)^{\frac{\eta_w-1}{\eta_w}} dj\right]^{\frac{\eta_w}{\eta_w-1}}$ denotes individual labor supply of a differentiated labor bundle, and G_t represents government consumption.

Demand for each good z takes the form of:

$$c_t(z) = \left[\frac{P_t(z)}{P_t}\right]^{-\eta} c_t$$

where $P_t(z)$ defines the price of good z and

$$P_t = \left[\int_0^1 P_t(z)^{(1-\eta)} dz\right]^{\frac{1}{1-\eta}}$$

is the price consumption index.

A demand for money is motivated by assuming that money facilitates transactions. Consumption purchases are subject to transaction costs:[1]

$$s\left(\frac{P_{t,i}c_{t,i}}{M_{t,i}}\right), \quad s'\left(\frac{P_{t,i}c_{t,i}}{M_{t,i}}\right) > 0 \text{ for } \frac{P_{t,i}c_{t,i}}{M_{t,i}} > v_i^* \tag{1}$$

where $\frac{P_{t,i}c_{t,i}}{M_{t,i}}$ is the ratio of nominal household's expenditures to money balances. The features of $s\left(\frac{P_{t,i}c_{t,i}}{M_{t,i}}\right)$ are such that a satiation level of money balances ($v^* > 0$) exists where the transaction cost vanishes and, simultaneously, a finite demand for money is associated to a zero nominal interest rate. Following Schmitt-Grohé and Uribe (2004a) the transaction cost is parameterized as follows

$$s\left(\frac{P_{t,i}c_{t,i}}{M_{t,i}}\right) = A\frac{P_t c_{t,i}}{M_{t,i}} + \frac{B}{\frac{P_t c_{t,i}}{M_{t,i}}} - 2\sqrt[2]{AB} \tag{2}$$

Households are split into two groups, non-Ricardians (rt, c) and Ricardians (o), respectively defined over the intervals $[0,\theta]$ and $[\theta,1]$. Note that Ricardian households (o) have full access to financial markets, whereas the access of non-Ricardians is restricted. In the following we shall consider two alternatives concerning financial market access for these agents. In one case the non-Ricardians (c) are constrained to use their money holdings as the only store of value that can be exploited to smooth consumption. In the other case the non-Ricardians are Rule-of-thumb households (rt) who cannot smooth consumption and entirely consume their current disposable labor income as in Galì et al., 2004.

[1] See Sims (1994), Schmitt-Grohé and Uribe (2004a), Guerron-Quintana (2009).

2.2 Labour market structure

Following the literature on LAMP in DSGE models, for sake of tractability we assume that the labor supplies of the two households groups are perfect substitutes in production (Galì et al., 2004, 2007; Bilbiie, 2008; Colciago, 2011; Furlanetto and Seneca, 2012 ;Motta and Tirelli, 2012 and 2013). This assumption is probably not realistic, but it is consistent with the stylized fact that wage dispersion does not seem to exhibit much variation at business cycle frequencies (Krueger et al. 2010; Heathcote et al. 2010; Maestri and Roventini, 2012).[2]

Labor type-specific unions indexed by $j \in [0,1]$ are entrusted with wage-setting decisions in a monopolistically competitive environment. Given the wage $W_t(j)$, households are assumed to supply labor on demand

$$l_t(j) = \left[\frac{W_t(j)}{W_t}\right]^{-\eta_w} l_t^d \tag{3}$$

where h_t^d is the aggregate labour demand and $W_t = \left[\int_0^1 W_t(j)^{(1-\eta_w)} dj\right]^{\frac{1}{(1-\eta_w)}}$ is the aggregate wage index. As in Galì (2007), it is assumed that the fraction of Ricardian and non-Ricardian households is uniformly distributed across unions and the aggregate demand for each labor type is uniformly distributed across households. Therefore Ricardians and non-Ricardians supply the same amount of labor.

2.3 Ricardian Households

Ricardian agents own physical capital, K_t^o, and rent it to firms at the rental rate r_t^k. Capital utilization, u_t, is variable at the cost $a(u_t)$. Ricardian households also receive firms dividends, d_t^o. They also hold a nominally riskless, one period government issued bond, B_t, that pays the interest rate R_t. Ricardian households must pay taxes on real labor income, w_t, and capital, respectively denoted as τ_t^h and τ_t^k, and lump-sum taxes, t_t^{ls}.

Therefore, their period budget constraint reads as:

$$c_t^o\left[1 + s\left(\frac{P_t c_t^o}{M_t^o}\right)\right] + i_t^o + \frac{M_t^o}{P_t} + \frac{B_t^o}{P_t} = \frac{M_{t-1}^o}{P_t} + \frac{R_{t-1}B_{t-1}^o}{P_t} + t_t^{ls} + \tag{4}$$

$$+\left(1-\tau_t^k\right)\left[r_t^k u_t - a(u_t)\right]K_t^o + \tau_t^k q_t \delta K_t^o + \left(1-\tau_t^h\right) l_t^d \int_0^1 w_t(j)\left(\frac{w_t(j)}{w_t}\right)^{-\eta_w} dj + d_t^o$$

[2] Further, dynamics that typically arise in LAMP models are determined by the profit margins variations associated to changes in real wages earned by RT consumers. By contrast, cyclical variations in real wages earned by Ricardian households are entirely offset by the corresponding changes in profit margins. In this regard, our results should survive richer labor market characterizations, such as in Lansing and Markiewicz (2013) who allow for capital-skill complementarity, where the Ricardian agents are viewed as skilled whereas RT households are not. One related issue is that the two households groups might supply different amounts of labor at the given wage rate. We discuss it below.

where i_t^o denotes the real purchases of investment goods, q_t is the consumption price of capital and δ is the capital depreciation rate.[3]

The capital stock evolves as:

$$K_{t+1}^o = (1-\delta)K_t^o + i_t^o \left[1 - S\left(\frac{i_t^o}{i_{t-1}^o}\right)\right] \tag{5}$$

where $S(\cdot)$ introduces adjustment costs on investment and satisfies the following standard properties: $S(1) = S'(1) = 0$, $S''(1) > 0$. Following CEE (2005), the investment adjustment cost function and the capital utilization function are given by:

$$S\left(\frac{i_t^o}{i_{t-1}^o}\right) = \frac{k}{2}\left(\frac{i_t^o}{i_{t-1}^o} - 1\right)^2$$

$$a(u_t) = \gamma_1 (u_t - 1) + \frac{\gamma_2}{2}(u_t - 1)^2$$

The Ricardian household maximises their utility function subject to (4), (5). The first order conditions of their optimization problem are:

$$\frac{U_c(c_t^o, l_t^o, G_t)}{\left[1 + s\left(\frac{c_t^o}{m_t^o}\right) + \frac{c_t^o}{m_t^o} s'\left(\frac{c_t^o}{m_t^o}\right)\right]} = \lambda_t^o \tag{6}$$

$$\lambda_t^o = \beta R_t \frac{\lambda_{t+1}^o}{\pi_{t+1}} \tag{7}$$

$$\lambda_t^o q_t = \beta E_t \lambda_{t+1}^o \left[\left(1 - \tau_{t+1}^k\right) r_{t+1}^k u_{t+1} - a(u_{t+1}) + (1-\delta) + \delta \tau_{t+1}^k\right] \tag{8}$$

$$\begin{aligned} \lambda_t^o &= q_t \lambda_t^o \left[1 - S\left(\frac{i_t^o}{i_{t-1}^o}\right) - \left[S'\left(\frac{i_t^o}{i_{t-1}^o}\right)\right] i_t^o\right] + \\ &\quad -\beta q_{t+1} \lambda_{t+1}^o S'\left(\frac{i_{t+1}^o}{i_t^o}\right) i_{t+1}^o \end{aligned} \tag{9}$$

$$1 - E_t\left[\frac{\beta}{\pi_{t+1}} \frac{\lambda_{t+1}^o}{\lambda_t^o}\right] = s'\left(\frac{c_t^o}{m_t^o}\right)\left(\frac{c_t^o}{m_t^o}\right)^2 \tag{10}$$

$$a'(u_t) = r_t^k \tag{11}$$

where $m_t^o = \frac{M_t^o}{P_t}$. As in Schmitt-Grohé and Uribe (2004a), condition (6) states that the transaction cost introduces a wedge between the marginal utility of consumption, $U_c(c_t^o, l_t^o, G_t)$, and the marginal utility of wealth, λ_t^o, that vanishes only if $\frac{c_t^o}{m_t^o} = v^*$. Equation (7) is a standard Euler condition where $\pi_t \equiv \frac{P_t}{P_{t-1}}$ defines the gross inflation rate, while equations (8) and (9) are standard Euler conditions for capital and investment. Equation (10) implicitly defines the money

[3] A capital tax allowance is in place for depreciation.

demand function. Taking into account (7), condition (10) takes the familiar form

$$1-\frac{1}{R_t}=s'\left(\frac{c_t^o}{m_t^o}\right)\left(\frac{c_t^o}{m_t^o}\right)^2$$

where the nominal interest rate captures the opportunity cost of holding money. Finally, condition (11) defines the optimal level of capital utilization.

2.4 Non-Ricardian households

Non-Ricardian households maximize their utility subject to the flow budget constraint

$$c_t^{c,rt}\left[1+s\left(\frac{P_t c_t^{c,rt}}{M_t^{c,rt}}\right)\right]+\frac{M_t^{c,rt}}{P_t}=\left(1-\tau_t^h\right)l_t^d\int_0^1 w_t\left(j\right)\left(\frac{w_t\left(j\right)}{w_t}\right)^{-\eta_w}dj+\frac{M_{t-1}^{c,rt}}{P_t}+t_t^{rt} \tag{12}$$

where t_t^{rt} defines transfers to non-Ricardian households. The first-order condition with respect to consumption is

$$\lambda_t^{c,rt}=\frac{u_c\left(c_t^{c,rt},l_t^{c,rt},G_t\right)}{1+s\left(\frac{c_t^{c,rt}}{m_t^c}\right)+\frac{c_t^{c,rt}}{m_t^c}s'\left(\frac{c_t^{c,rt}}{m_t^c}\right)} \tag{13}$$

When non-Ricardian households use money as a reserve of value the money demand

$$1-E_t\left(\frac{\beta}{\pi_{t+1}}\frac{\lambda_{t+1}^c}{\lambda_t^c}\right)=s'\left(\frac{c_t^c}{m_t^{c,rt}}\right)\left(\frac{c_t^{c,rt}}{m_t^{c,rt}}\right)^2 \tag{14}$$

is a negative function of expected inflation and a positive function of the expected increase in the marginal utility of wealth (14). Note that the functional forms in (14) and (10) are identical because both households types define their current money-to-consumption ratio taking into account the discounted pay-off from carrying money into the next period. However the implied money-to consumption ratios for the two types are identical only in steady state, when $\frac{\lambda_{t+1}^u}{\lambda_t^u}=\frac{\lambda_{t+1}^c}{\lambda_t^c}=1$ and $R=\frac{\pi}{\beta}$. Outside the steady state, Ricardian households can always manage to equalize discounted returns on money and discounted returns on bonds, whereas this possibility is precluded to constrained households. Microeconomic evidence suggests that money holdings are unlikely to be a significant substitute for interest bearing assets, but we shall maintain this assumption in section 3 below to show that LAMP still matters for determination of optimal policy responses to shocks even if we "stack the cards" against our approach.

When non-Ricardians are rule-of-thumb consumers, they hold the amount of money that minimizes transaction costs for a given amount of consumption.

$$s'\left(\frac{c_t^{c,rt}}{m_t^{c,rt}}\right)\left(\frac{c_t^{c,rt}}{m_t^{c,rt}}\right)^2=0$$

In this case $m_t^{rt} = c_t^{rt} \sqrt[2]{\frac{A}{B}}$, implying that their consumption dynamics follow a backward-looking pattern:

$$c_t^{c,rt}\left(1+\sqrt[2]{\frac{A}{B}}\right) = \left(1-\tau_t^h\right) l_t^d \int_0^1 w_t(j)\left(\frac{w_t(j)}{w_t}\right) dj + \frac{c_{t-1}^{rt}}{\pi_t}\sqrt[2]{\frac{A}{B}} + t_t^{rt}$$

2.5 Wage Setting

Each labor union maximises a weighted average of the lifetime utility of its members

$$E_0 \sum_{t=0}^{\infty} \beta^t \left[(1-\theta)\, u\left(c_t^o, l_t, G_t\right) + \theta u\left(c_t^{c,rt}, l_t, G_t\right)\right]$$

subject to their budget constraints, (4) and (12), to the labor demand condition (3), and to a Rotemberg (1983) quadratic adjustment cost:[4]

$$\frac{\xi_w}{2}\left(\frac{W_t(j)}{\pi_{t-1}^{\chi_w} W_{t-1}(j)} - 1\right)^2 h_t$$

where χ_w defines the degree of (costless) indexation of the nominal wage to past inflation.

The standard wage setting equation takes the following form:

$$\begin{aligned} mrs_t \quad = \quad & \frac{\eta_w - 1}{\eta_w} w_t + \frac{\xi_w}{\eta_w}\left(\frac{w_t}{w_{t-1}}\frac{\pi_t}{\pi_{t-1}^{\chi_w}} - 1\right)\frac{w_t}{w_{t-1}}\frac{\pi_t}{\pi_{t-1}^{\chi_w}} + \\ & -\beta \frac{\lambda_{t+1}}{\lambda_t}\frac{\xi_w}{\eta_w}\left(\frac{w_{t+1}}{w_t}\frac{\pi_{t+1}}{\pi_t^{\chi_w}} - 1\right)\frac{l_{t+1}}{l_t}\frac{w_{t+1}}{w_t}\frac{\pi_{t+1}}{\pi_t^{\chi_w}} \end{aligned} \quad (15)$$

where $mrs_t = \frac{u_l(c_t^o, l_t, G_t)}{\lambda_t}$ and

$$\lambda_t = \left[(1-\theta)\,\lambda_t^o + \theta \lambda_t^{c,rt}\right]$$

is the average marginal utility between Ricardian λ_t^o and non-Ricardian $\lambda_t^{c,rt}$ agents' marginal utility.

2.6 Firms

The representative intermediate firm produces the good z in a monopolistically competitive market under a standard Cobb-Douglas technology of the following type:

$$y_t(z) = a_t\left[l_t(z)\right]^{\alpha}\left[u_t k_{t-1}(z)\right]^{1-\alpha} \quad (16)$$

[4]Following the simplifying assumptions in De Paoli et al (2010), adjustment costs for nominal wages and goods prices are intangible, i.e. they are not subtracted to households incomes but they do enter the price- and wage-setting decisions.

where a_t is total factor productivity, and faces a downward sloping demand function,

$$y_t(z) = y_t^d \left[\frac{P_t(z)}{P_t}\right]^{\frac{1}{\rho-1}} \tag{17}$$

The representative firm marginal costs are:

$$mc_t = \left(\frac{r_t^k}{1-\alpha}\right)^{1-\alpha} \left(\frac{w_t R_t}{\alpha}\right)^{\alpha} \tag{18}$$

We assume a sticky price specification based on a Rotemberg (1982), quadratic cost of nominal price adjustment:

$$\frac{\xi_p}{2} y_t(z) \left[\frac{P_t(z)}{\pi_{t-1}^{\chi_p} P_{t-1}(z)} - 1\right]^2 \tag{19}$$

where χ_p defines the degree of (costless) indexation of the price to past inflation.

In a symmetrical equilibrium the price adjustment rule satisfies the following condition:

$$mc_t = \left(\frac{\eta-1}{\eta}\right) + \frac{\xi_p}{\eta}\left(\frac{\pi_t}{\pi_{t-1}^{\chi_p}} - 1\right)\frac{\pi_t}{\pi_{t-1}^{\chi_p}} - \beta E_t \frac{\xi_p}{\eta}\lambda_{t+1}^o \left(\frac{\pi_{t+1}}{\pi_t^{\chi_p}} - 1\right)\frac{\pi_{t+1}}{\pi_t^{\chi_p}}\frac{y_{t+1}}{y_t} \tag{20}$$

2.7 Final Good Firms

Final good firms buy differentiated goods from intermediate firms and produce an aggregated good which can be used both for private and public consumption and for investment. They operate under perfect competition and solve the following problem:

$$\max\ P_t y_t^d - \int_0^1 P_t(z)\, y_t(z)\, dz$$

s.t.

$$y_t^d = \left[\int_0^1 y_t(z)^{\frac{\eta-1}{\eta}}\, dz\right]^{\frac{\eta}{\eta-1}}$$

The optimality conditions lead to equation (17) and to the price index $P_t = \left[\int_0^1 p_t(z)^{(1-\eta)}\, dz\right]^{\frac{1}{1-\eta}}$.

2.8 Aggregation

Equations (21)-(28) define respectively aggregate consumption, aggregate hours, aggregate real money balances, bonds, profits, aggregate capital and total output:

$$c_t = (1-\theta)\, c_t^o + \theta c_t^{c,rt} \tag{21}$$

$$l_t = (1-\theta)\, l_t^o + \theta l_t^{c,rt} \tag{22}$$

$$m_t = (1-\theta)\, m_t^o + \theta m_t^{c,rt} + \tag{23}$$

$$B_t^o = \frac{B_t}{1-\theta} \tag{24}$$

$$\Pi_t^o = \frac{\Pi_t}{1-\theta} \tag{25}$$

$$k_t^o = \frac{k_t}{1-\theta} \tag{26}$$

$$i_t^o = \frac{i_t}{1-\theta} \tag{27}$$

$$\begin{aligned} y_t \quad = \quad & (1-\theta)\, c_t^o \left[1 + s\left(\frac{c_t^o}{m_t^o}\right)\right] + \theta c_t^{c,rt} \left[1 + s\left(\frac{c_t^{c,rt}}{m_t^c}\right)\right] \\ & + i_t + G_t + a\,(u_t) \end{aligned} \tag{28}$$

2.9 Government budget

The government flow budget constraint is describe by:

$$\begin{aligned} G_t + \theta t_t^{rt} + \frac{R_{t-1}B_{t-1}}{P_t} \quad = \quad & \tau_t^k \left[r_t^k u_t - a\,(u_t) - q_t \delta\right] K_t + \tau_t^h w_t l_t \\ & + (1-\theta)\, t_t^{ls} + \frac{B_t}{P_t} + \frac{M_t - M_{t-1}}{P_t} \end{aligned} \tag{29}$$

It requires that the public spending, G_t, transfers to non-Ricardian households, θt_t^{rt} and repayment of the last-period real debt with interests to be equal to revenues from taxes on capital and labour, lump sum taxes and seigniorage, $\frac{M_t - M_{t-1}}{P_t}$. Note that $r_t^k u_t - a\,(u_t) - q_t \delta$ is the pre-tax return on capital.

3 Ramsey policies

In this section we follow Schmitt-Grohé and Uribe (2004a) who identify the set of Ramsey optimal tax and monetary policies when the government supplies an exogenous amount of public good G_t and the economy is subject to a productivity shock. To facilitate the comparison with their benchmark results, we assume the identical household utility function:

$$U\left(c_t^i, l_t^i\right) = \ln c_t^i + \rho^l \ln\left(1 - l_t^i\right) \tag{30}$$

The key difference with respect to Schmitt-Grohé and Uribe (2004a) is that here we assume the LAMP hypothesis, where non-Ricardian households can only use money as a store of wealth.

For the sake of simplicity and to sharpen our analysis concerning the implications of LAMP, we introduce a number of restrictions on the model presented above. First, we assume that the Ramsey planner levies a uniform income tax rate, so that $\tau_t^h = \tau_t^k = \tau_t$. Second, we assume away capacity-utilization and investment-adjustment costs, and inflation-indexation terms: $a(u_t) = S\left(\frac{i_t}{i_{t-1}}\right) = \chi_w = \chi_p = 0$.

Competitive Equilibrium

Definition 1 *A competitive equilibrium is a set of plans*

$$\left\{c_t^o, c_t^c, c_t, l_t^o, l_t^c, l_t, \lambda_t^o, \lambda_t^c, mc_t, \pi_t, w_t, m_t^o, m_t^c, m_t, y_t, b_t, R_t, k_t, r_t^k, \tau_t\right\}_{t=0}^{\infty},$$

that, given initial values $\left\{m_{-1}^u, m_{-1}^c, m_{-1}, b_{-1}, k_{-1}\right\}$ *and the stochastic processes* $\{g\}_{t=0}^{\infty}$ *and* $\{a\}_{t=0}^{\infty}$*, satisfies equations (6)-(28).*[5]

Ramsey Optimal Policy

Definition 2 *A Ramsey optimal policy is a competitive equilibrium that attains the maximum of the following additive social welfare function*

$$SW = E_0 \sum_{t=0}^{\infty} \beta^t \left[\left(1 - X^R\right) u\left(c_t^u, l_t\right) + X^R u\left(c_t^c, l_t\right)\right] \tag{31}$$

where $X^R = 0, 1, \theta$ *allows to define alternative weights that the Ramsey planner attaches to constrained (unconstrained) households welfare.*

The Ramsey program is non-stationary, in the sense that in the initial period the Ramsey planner has an incentive to generate surprise movements in inflation or taxes. We neglect these non-stationary transitory components and concentrate on the time-invariant long run outcome, called Ramsey steady state. This procedure is common in the literature (see for instance Schmitt-Grohé and Uribe, 2004a).[6]

Table 1 reports our calibration. The time unit is a year as in Schmitt-Grohé and Uribe, 2004a, and we set the subjective discount rate β to 0.96 to be consistent with a steady-state real rate of return of 4 percent per year. As Erosa and Ventura (2002), we set α to 64% and δ to 10%. To check the effect of capital accumulation on the optimal inflation rate we also consider the case where labor is the only factor of production ($\alpha = 1$). Following Schmitt-Grohé and Uribe, 2004a, we set η and η_w such that in the goods and labor markets monopolistic

[5] The standard no-Ponzi game condition and the non-negativity constraint $R_t \geq 1$ must also be satisfied.

[6] Since the analytical derivation of the first order conditions of the Ramsey plan is cumbersome, we compute them using symbolic Matlab routines. The steady state of the Ramsey program is obtained using the OLS approach suggested in Schmitt-Groè and Uribe (2011) Dynamics of the Ramsey plan around the steady state are computed using Dynare.

competition implies a gross markup of 1.2, and the annualized Rotemberg price and wage adjustment cost are set to 4.375. Moreover, the preference parameter ρ^l is such that under a zero inflation steady state the average household would allocate 20% of the time to work.[7] Monetary transaction cost parameters A and B are set at 0.011 and 0.075 respectively, and public consumption is 19% of GDP.

Parameters		Description
β	0.96	Discount Factor
α	0.64/1	Labor Share
δ	0.1	Depreciation Rate
ρ^l	2.9	Leisure Weight
A	0.011	Trans. Cost Parameter
B	0.075	Trans. Cost Parameter
η	6	Inverse Price Mark-up
η_w	6	Inverse Wage Mark-up
ξ_p	4.375	Rotemberg Par. on Prices
ξ_w	4.375	Rotemberg Par. on Wages
$\frac{G}{Y}$	0.19	Public Consumption over GDP
$\frac{B}{PY}$	0.6/0.8	Public Debt over GDP

Table 1: Calibration

As usual in Ramsey problems where the government issues non-state contingent nominally riskless debt, the Ramsey steady state is indeterminate. This is easily seen by taking the derivative of the Lagrangian of the Ramsey problem with respect to public debt, b_t, that is

$$\phi_{b,t} = \beta E_t \frac{\phi_{b,t+1} R_t}{\pi_{t+1}} \tag{32}$$

where $\phi_{b,t}$ is the Lagrange multiplier on the government budget constraint. Evaluated at the steady state, both (7) and (32) become

$$\frac{1}{R} = \frac{\beta}{\pi}$$

As a consequence, it is not possible to pin down a specified steady state public debt level and we must calibrate it. Following Cogan et al (2013) we set steady state public debt at 60% of GDP. To highlight the effect of steady state public debt on the optimal rate of inflation, we also consider the case where the debt-to-GDP ratio is 80%. We also experiment with different calibrations of the share of constrained agents θ, but in the benchmark case we set it at 0.8 to match the wealth Gini index for the United States which is around 0.78 (see Quadrini and Rìos-Rull, 1997).[8]

[7] This is computed when the public consumption-to-GDP ratio and public debt are nil. With positive public consumption-to-GDP ratios, public debt and inflation rates, the time spent working is slightly lower. Parameter ρ^l takes on value 2.9, as in Schmitt-Grohè and Uribe (2004a).

[8] The Gini coefficient is computed for a zero inflation steady state model economy and

3.1 Ramsey Steady State

Table 2 summarizes our results. Taking the *labor only model* as our benchmark,[9] the first column allows us to identify the inflationary effects of capital accumulation and rising debt-to-GDP ratio under the representative agent hypothesis ($\theta = 0$). In the model with capital accumulation we obtain an increase in the optimal inflation. Note that in a similar model Schmitt-Grohé and Uribe (2006) obtain that the optimal inflation is 0.5%, slightly below our result.

Their upshot could be explained by taking into account two offsetting forces: on one hand their choice of including transfers in the public expenditure variable unambiguously raises the planner's incentive to inflate, as shown in Di Bartolomeo et al. (2015); on the other hand, the cash in advance constraint on firms working capital and the (partial) taxation of profits at the uniform income tax rate work tend to deflate. Further, their assumption that public debt is only 44% of GDP reduces the optimal inflation rate because debt service payments are equivalent to public transfers and the propensity to inflate rises with the size of transfers. In fact we obtain that optimal inflation is unambiguously higher when public debt raises to 80% of GDP.

LAMP hypothesis has a non monotonic effect on the optimal inflation rate, which falls for $\theta \leq 0.3$ and rises thereafter.[10] To rationalize this finding we ran a separate experiment identifying the optimal inflation rate when the Ramsey planner cares only about the welfare of Ricardian agents. A planner who cares only about these agents' welfare would always set a smaller inflation rate relative to the representative household case. To understand this result bear in mind that a high inflation *cum* low taxation scenario raises transaction costs (thus penalizing the richer households) and raises labor incomes, thus benefitting the poorer households. Note that non-Ricardian households, who do not own profits, are particularly penalized by the negative effect of monopolistic competition on labor demand, whereas Ricardian households do not see benefits from increasing their labor effort. Hence, under the Ramsey planner's preferences (31) the non-monotonic relationship between inflation and θ obtains because even if a higher inflation rate always benefits Non-Ricardian agents, at relatively low X^R values $\left(X^R = \theta\right)$ such welfare gain is smaller than corresponding welfare loss suffered by Ricardian agents.

By assuming a competitive labor market, we also introduced the possibility that individual labor supplies may be different. Note that in this case the flexible nominal wage reduces inflation costs, but the absence of monopolistic distortions also limits the incentive to use inflation as a substitute for income taxes. Under the RA assumptions the net effect on equilibrium inflation is a reduction in the optimal inflation rate by about half percentage point. Under LAMP hypothesis, for any given inflation and tax rate non-Ricardian house-

when the public consumption-to-GDP ratio and public debt are nil. It changes only slightly in the presence of positive levels of public consumption and public debt.(Results available upon request).

[9] This model is the same as in Schmitt-Grohé and Uribe (2004a).

[10] In $\theta = 0.3$ the optimal inflation rate is around 0.43%.

holds raise both worked hours and consumption, whereas Ricardian households do just the opposite. By contrast, in a unionized labor market the labor effort is identical and therefore too large (small) for Ricardian (non-Ricardian) households. Hence, in a unionized labor market an inflation-financed tax reduction forces Ricardian households to further increase a labor effort which is already suboptimally high at the given wage rate. Conversely, in a competitive labor market each group can optimally adjust its labor supply to the new policy mix. As a result, even at low values of θ the optimal inflation rate increases relatively to the representative household case.[11]

	$\theta = 0$	$\theta = 0.2$	$\theta = 0.4$	$\theta = 0.6$	$\theta = 0.8$
no capital	−0.32%	−0.33%	−0.33%	−0.31%	−0.19%
full model	0.73%	0.47%	0.45%	0.8%	2.48%
$\frac{b}{y} = 0.8$	0.94%	0.58%	0.55%	0.95%	3.17%
max welfare Ricardian HH	0.73%	−0.23%	−0.65%	−0.89%	−1.07%
comp. labor market	0.33%	0.47%	0.73%	1.51%	–

Table 2: Optimal Inflation Rates

3.2 Ramsey dynamics

In this section we compute the optimal dynamics for the full model, in presence of i.i.d. government consumption and productivity shocks. Under the RA assumption, the permanent adjustment of debt to shocks allows to achieve consumption smoothing through the optimal allocation of distortionary taxes necessary to finance debt service payments (see Schmitt-Grohé and Uribe, 2004a). Our purpose here is to understand whether concern for redistribution changes this result.

Figures 1 and 2 report the impulse response functions of the main variables to a 1% shock under the assumptions that the number of non-Ricardians increases up to $\theta = 0.8$ and public debt is 60% of GDP in steady state.

3.2.1 Government consumption shock

The optimal response of variables to a government spending shock under the representative agent (RA) assumption is well known in the literature (see Schmitt-Grohé and Uribe, 2004a) and the addition of capital accumulation does not seem to imply important differences. The trade-off between stabilizing inflation to avoid price adjustment costs and keeping the nominal interest rate constant to avoid swings in transaction costs is resolved in favor of the former: the Ramsey planner almost completely stabilizes inflation. Public debt is used as a cushion

[11] We do not report results for $\theta = 0.8$ under the competitive labor market model. This is due to the fact that when the share of constrained agents is above 63%, the non negativity constraint on worked hours of unconstrained agents is binding. Studying such a corner solution is beyond the scope of the paper.

to stabilize tax rates and is increased permanently. Output and worked hours increase.

Debt accumulation still exhibits a unit root under LAMP, but its long-run adjustment in response to the shock is much smaller than under the RA model. This happens because debt accumulation has a powerful redistributive effect in favor of Ricardian households. The planner therefore chooses to front load tax adjustment with such a strength that consumption of unconstrained households falls even if their gross labor income increases. The different time profile of tax rates implies that output and worked hours are less sensitive to the shock. Finally, the inflation path is also strongly affected by LAMP. Notice that the optimal response to a government consumption shock does not imply a positive response neither of unconstrained agents' consumption, nor of constrained agents consumption.

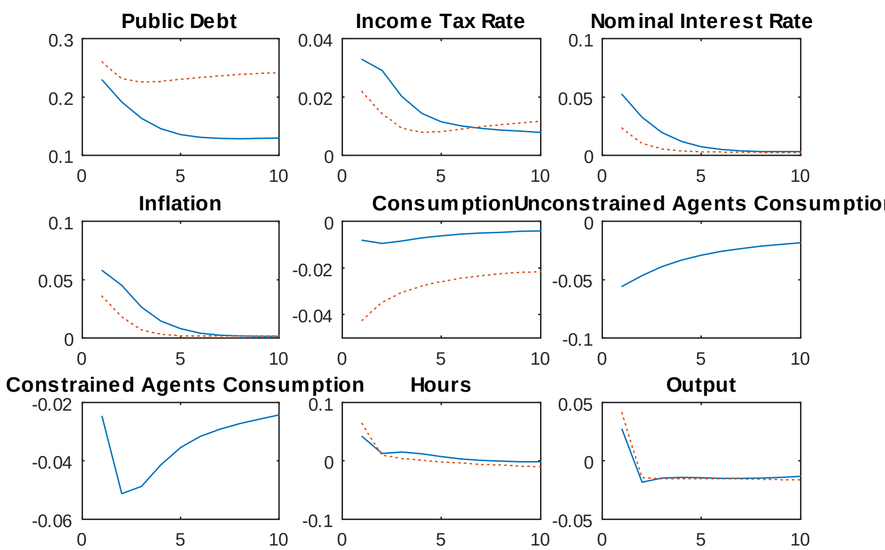

Figure 1: Response to a government consumption shock. Blue line: heterogenous agents model. Dotted line: representative agent model. - All responses are in percentage deviations from the steady state, apart from the tax rate, the nominal rate and inflation. The latter three variables are 100 times the deviation in levels from the steady state.

Empirical evidence on the effect of government consumption shocks shows that private consumption responds positively, see e.g. Galì et al. (2007). Our objective is not to fit the empirical evidence, but to outline the optimal response to a government spending shock. In fact, we find that it is optimal to let private consumption fall following exogenous shifts in government consumption.[12]

3.2.2 Productivity shock

It is well known that under sticky prices, productivity shocks cause a fall of worked hours and a negative output gap. Under the RA hypothesis we observe a reduction of the nominal interest rate and of the tax rate, which are meant to remove these effects. In fact output, worked hours and consumption increase, and the surge in total incomes allows to reduce public debt. The lower debt allows to reduce future taxes and to smooth the consumption increase.

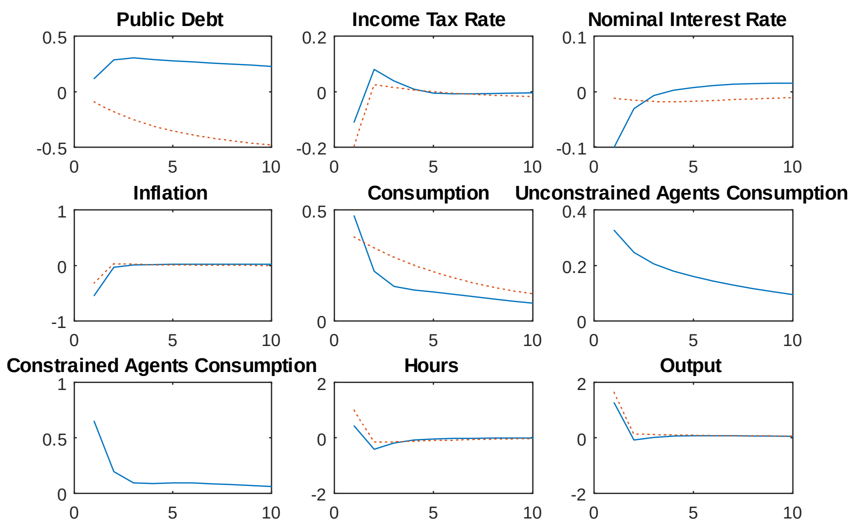

Figure 2: Response to a productivity shock. Blue line: heterogenous agents model. Dotted line: representative agent model. - All responses are in percentage deviations from the steady state, apart from the tax rate, the nominal rate and inflation. The latter three variables are 100 times the deviation in levels from the steady state.

[12]This result is compatible with the findings of Horvath (2009), who shows that it is optimal to let private consumption fall in response to public spending shocks in a model where the government minimizes a quadratic welfare function.

$\theta = 0$ ($\theta = 0.8$)	Mean (%)	St. Dev. (%)	Corr. with Output (%)
Tax rate	32.33 (31.46)	1.59 (1.14)	−0.6 (−0.33)
Inflation	0.56 (4.57)	1.62 (3.34)	−0.46 (−0.5)
Nominal rate	4.73 (8.89)	0.55 (2.04)	−0.43 (−0.42)
Output	0.31 (0.32)	1.94 (1.42%)	1
Hours	0.2 (0.21)	0.53 (0.27)	0.62 (−0.46)
Consumption	0.2 (0.2)	1.14 (0.99)	0.9 (0.92)
Unconstrained consumption	(0.55)	(2.69)	(0.91)
Constrained consumption	(0.11)	(0.56)	(0.92)

Table 3: Moments of Stochastic Simulation with a second order approximation. Shocks to government spending and productivity have a standard deviation of 0.0302 and 0.0229 and autocorrelation of 0.9 and 0.82 respectively, as in Schimtt-Grohé and Uribe (2004a)

4 Simple Inflation targeting rule under LAMP

In this section we investigate the implications of an inflation targeting rule under LAMP in terms of determinacy and redistributive effects of monetary policy shocks. The LAMP hypothesis has characterized a rapidly expanding literature which investigates the dynamic stability of DSGE models where rule-of-thumb (RT) consumers cannot smooth consumption over the business cycle. Galì et al. (2004) and Bilbiie (2008, Bilbiie henceforth) show that satisfying the Taylor principle may not ensure model determinacy in a very simple model where price stickiness and LAMP are the only frictions. This result occurs because imperfect price adjustment to wage increases causes profit losses which are entirely borne by Ricardian agents. As a consequence, a real interest rate increase may be associated to a surge in aggregate demand and production even if it induces a fall in the consumption of Ricardian agents. In contrast with Bilbiie, Ascari et al. (2011) show that a modest amount of nominal wage rigidity is sufficient to limit profit volatility and to restore the standard Taylor Principle even for a very large share of RT consumers. Other contributions show that internal consumption habits (Motta and Tirelli, 2012) and steady state income and consumption inequality between the two consumer groups (Natvik, 2012) restore the Bilbiie result for empirically plausible calibrations of a business cycle model characterized by price and nominal wage rigidities.

Our model differs from previous contributions to the LAMP literature in three key aspects. First, we assume external consumption habits, in the catching-up-with-the-Joneses tradition popularized by Abel (1990) and widely used thereafter (see Smets and Wouters, 2003, 2005, 2007; Christoffel, Coenen and Warne, 2008). This allows to model the reaction of wage setting decisions to RT households' concern for relative consumption levels, a key driver for our results. Note that recent works do account for external habits and LAMP, but the wage sensitivity to RT concern for relative consumption is removed through some ad hoc assumptions as in Coenen and Straub, 2005; Forni, Monteforte Sessa, 2009;

Coenen, Straub and Trabandt, 2012; Furlanetto and Seneca, 2012. Second, we extend the basic labor-only production function to include capital accumulation. This, in turn, allows to investigate the effects of wealth holdings inequality on dynamic stability and on the dynamic adjustment to monetary policy shocks. Third, we analyze the impact of redistributive fiscal policies that target consumption inequality between the two households groups.

To this end we introduce some amendments to the model used so far. First of all, we now refer to the following utility function for $i = \{o, rt\}$

$$U_t^i = E_0 \sum_{t=0}^{\infty} \beta^t \left\{ \ln \left(c_t^i - bc_{t-1} \right) - \frac{\rho^l}{1+\phi_l} l_t^i \quad ^{(1+\phi_l)} \right\} \tag{33}$$

which incorporates external consumption habits and a characterization of disutility from labor effort that is in line with the literature on model determinacy under LAMP.[13] Second, in line with the literature on determinacy under LAMP we assume away monetary transaction costs $\left(s\left(\frac{P_{t,i}c_{t,i}}{M_{t,i}} \right) = 0 \right)$ and impose that non-Ricardian households are RT) consumers. Third, we incorporate investment adjustment costs and variable capacity utilization:

$$S\left(\frac{i_t}{i_{t-1}}\right) = \frac{k}{2}\left(\frac{i_t}{i_{t-1}} - 1\right)^2$$

$$a\left(u_t\right) = \gamma_1\left(u_t - 1\right) + \frac{\gamma_2}{2}\left(u_t - 1\right)^2$$

The parameter governing the degree of habit persistence, b, and the labor utility parameter, ϕ^l are respectively set at 0.65 and 3, well in the ranges of the estimates obtained by Smets and Wouters (2005).

In line with the benchmark literature, we consider quarterly frequencies and set $\beta = (1.04)^{-0.25}$ which implies a steady-state annualized real interest rate of about 3%. Rotemberg parameters for the adjustment cost of prices and nominal wages, ξ_p and ξ_w, are calibrated to generate slopes of the log-linear price and wage Phillips curves equal to the ones estimated in Christiano et al. (2005) under the Calvo model, where the average duration of contracts is 2.5 and 2.8 quarters respectively. Following Christiano et al. (2005), the parameters governing investment adjustment costs and the capital utilization function are $k = 2.48$, $\gamma_1 = \frac{1}{\beta}$, $\gamma_2 = \frac{0.01}{\gamma_1}$.

Finally, we replace the Ramsey-optimal policies with a simple monetary rule, where it is assumed that the Central Bank controls the nominal interest rate and follows a standard Taylor rule.

$$\left(\frac{R_t}{R^{**}}\right) = \left(\frac{\pi_t}{\pi^{**}}\right)^{\phi_\pi} \tag{34}$$

[13] In fact, as shown in Bilbiie, results on determinacy are sensitive to the Frisch elasticity of labor supply, $\frac{1}{\phi_l}$.

where $R^{**} = \frac{1}{\beta}$, $\phi_\pi = 1.5$ as in Motta and Tirelli (2012), $\pi^{**} = 1$.[14] As for fiscal policies, we neglect the issue of public sector financing ($G = B = \tau_t^h = \tau_t^k = 0$). Our only concern here will be for the implications of redistributive policies that impose lump-sum taxes on Ricardian households to finance transfers to RT. consumers. Such rules will be defined below.

4.1 Stability analysis

In this section we provide a numerical investigation of the effects of LAMP for model determinacy, with a specific focus on the role of inequality and on the potential implication of fiscal redistributive policies, as mentioned above.

Previous contributions (Colciago, 2011; Ascari et al., 2011) suggest that under wage stickiness the potential indeterminacy caused by RT households is de facto unlikely. If we impose a labor only production function the model is stable and uniquely determined for $\theta < 0.79$, thus confirming previous results. Note that under the the labor only production function, in steady state we get $\frac{c^o}{c^{rt}} = \frac{\mu-\theta}{1-\theta}$, where $\mu = \frac{\eta}{\eta-1}$ defines the flexible price markup. In this case consumption inequality is entirely determined by firms profits: $\frac{c^{rt}}{c} = \frac{1}{\mu} \simeq 0.83$.[15] Introducing physical capital unambiguously increases consumption inequality in steady state:

$$\begin{aligned} \frac{c^o}{c^{rt}} &= 1 + \frac{1}{1-\theta}\left\{\frac{\mu-1}{\mu}\left[\frac{1-\beta(1-\delta)}{\beta\alpha}\right]^{\frac{\alpha}{1-\alpha}} + \frac{(1-\beta)\alpha}{\beta[1-\beta(1-\delta)]}\right\}\left(\frac{1}{\mu}\right)^{\frac{-1}{1-\alpha}}\frac{1}{1-\alpha}; \\ \frac{c^{rt}}{c} &= \frac{1}{1+\left\{\frac{\mu-1}{\mu}\left[\frac{1-\beta(1-\delta)}{\beta\alpha}\right]^{\frac{\alpha}{1-\alpha}} + \frac{(1-\beta)\alpha}{\beta[1-\beta(1-\delta)]}\right\}\left(\frac{1}{\mu}\right)^{\frac{-1}{1-\alpha}}\frac{1}{1-\alpha}} \end{aligned} \tag{35}$$

This, in turn yields $\frac{c^{rt}}{c} = 0.6936$. We obtain that the model is stable and uniquely determined for $\theta^{**} \simeq 0.29$. Thus consumption inequality in steady state has a very strong effect on the determinacy threshold.

4.1.1 Sensitivity analysis

Our analysis suggests that in a medium scale model determinacy should depend on a limited number of parameters. Among these, the capital income share α and the price markup μ influence steady state consumption inequality,[16] whereas the habit coefficient, b, the inverse of the Frisch elasticity, ϕ_l, the parameters governing price and nominal wage stickiness, ξ_p and ξ_w, affect income redistribution outside steady state.

If we impose $\mu = 1$, the θ threshold for determinacy grows from 0.29 to 0.79. Raising α up to 0.4 the threshold falls to 0.11. For values of b in the range $[0.60, 0.67]$, the threshold varies between 0.55 and 0.12.[17] The threshold value

[14] The assumption of a zero net inflation target is justified by the need to preserve comparability with the literature on this subject.

[15] Note that term $\frac{c^{rt}}{c}$ is independent from the fraction of RT consumers.

[16] See equation (35).

[17] $b = 0.68$ is the maximum value we can set in presence of habit persistence in order to avoid a negative steady state marginal utility of consumption for RT consumers.

for θ lies in the interval $[0.15, 0.38]$ for values of ϕ_l in the range $[0.2, 5]$. Wage stickiness is another key parameter: the threshold value for θ grows to 0.42 if we raise the wage adjustment cost to the value that replicates a four-quarters-wage contract duration under Calvo. The opposite result is achieved considering the same cost for price adjustment: in this case determinacy is obtained for $\theta < 0.23$.

4.1.2 Fiscal redistribution

Here we consider redistributive transfers to rule-of-thumb consumers financed by lump-sum taxes levied on Ricardian households. Transfers incorporate both a constant payment proportional to the steady state consumption gap between the two households types, γ^T, and a linear function of the cyclical consumption gap, τ.[18]

$$t_t^{rt} = \gamma^T \left(c^o - c^{rt}\right) + \tau \left(\hat{c}_t^o - \hat{c}_t^{rt}\right) \tag{36}$$

In Table 4 we show that for $\theta = 0.3$ the ratio $\frac{c^o}{c^{rt}}$ falls from 1.65 to 1.19 as γ^T is raised from 0 to 0.5. Correspondingly, we observe important effects on the determinacy threshold θ, which grows from 0.29 to 0.71. By contrast, we could not detect any significant effect for $0 < \tau < 0.5$.

	γ_T= 0	γ_T= 0.05	γ_T= 0.1	γ_T= 0.15	γ_T= 0.2	γ_T= 0.25	γ_T= 0.5
$\theta = 0.3$	0.29	0.46	0.54	0.59	0.62	0.65	0.72
$\frac{c^o}{c^{rt}}$	1.63	1.51	1.43	1.37	1.32	1.29	1.19

Table 4

4.2 The redistributive effects of a monetary shock

In this section we investigate the effects of an interest rate shock, ε^r, on aggregate volatility and on income and consumption inequality. The shock follows a first-order autoregressive process with an *i.i.d.* Normal error term.

In Table 5 we report standard deviations for the key macroeconomic variables under full asset market participation and under LAMP ($\theta = 0.25$) for a different strength of the fiscal redistributive policy. Parameter γ^T takes values 0 and 0.15 which implies a 20% reduction in the post tax Gini index in steady state.[19] We also consider the possibility that the fiscal transfer also reacts to cyclical consumption inequality and set $\tau = 0.5$, in line with a number of studies on the role of automatic stabilizers (Van den Noord, 2000; Westaway, 2003; Colciago et al. 2008; Motta and Tirelli, 2012).

[18] Hatted variables define log-deviations from steady tate values.

[19] This is consistent with empirical evidence for the US (Heathcote et al., 2010).

	$\theta = 0$	$\theta = 0.25$	$\theta = 0.25$	$\theta = 0.25$
	no fiscal	no fiscal	$\gamma^T = 0.15$	$\gamma^T = 0.15, \tau = 0.5$
$\sigma_{\hat{y}}$	0.0398	0.1064	0.0375	0.0385
$\sigma_{\hat{c}}$	0.0139	0.0706	0.0259	0.0190
$\sigma_{\widehat{\pi}}$	0.0303	0.1493	0.0564	0.0449
$\sigma_{\hat{h}}$	0.0460	0.1531	0.0391	0.0423
$\sigma_{\hat{w}}$	0.0331	0.2172	0.0688	0.0530
$\sigma_{\widehat{i}}$	0.1102	0.3659	0.0590	0.0719
$\sigma_{\widehat{c}^o}$	0.0139	0.0825	0.0121	0.0106
$\sigma_{\widehat{c}^{rt}}$	–	0.0909	0.0899	0.0560
$\sigma_{\widehat{mc}}$	0.0376	0.1582	0.0684	0.0550

Table 5: Monetary shock ($\sigma_r = 0.24, \rho_r = 0.15$)

It is easy to see that without fiscal policies LAMP assumption causes a substantial increase in volatility, whereas redistributive fiscal policies have a powerful dampening effect on volatility. In addition, the bulk of the stabilization is obtained implementing steady state redistributive policies, whereas the cyclical rule plays a lesser role.

To support our intuition, we plot IRFs to an interest rate shock in Figures 3 and 4. Under full asset market participation inflation output, consumption, worked hours and the real wage fall. Introducing LAMP without fiscal policies causes an inversion in the relationship between the real interest rate and output, that now increases in response to the contraction. The fall in real wage redistributes income in favor of Ricardian agents whose consumption grows, driving the surge in total consumption. The increase in hours raises the productivity of capital, inducing Ricardian households to raise investment as well. It is interesting to note that under full asset market participation Ricardian households would do just the opposite, decumulating capital to smooth consumption.

Fiscal policies bring IRFs for aggregate variables under LAMP much closer to what we observe under full asset market participation. Nevertheless, the monetary policy shock still has redistributive effects between the two household groups. In fact, in spite of the fiscal policy actions the interest rate shock raises gaps in relative income and consumption levels ($\hat{y}_t^o - \hat{y}_t^{rt}$, $\hat{c}_t^o - \hat{c}_t^{rt}$).

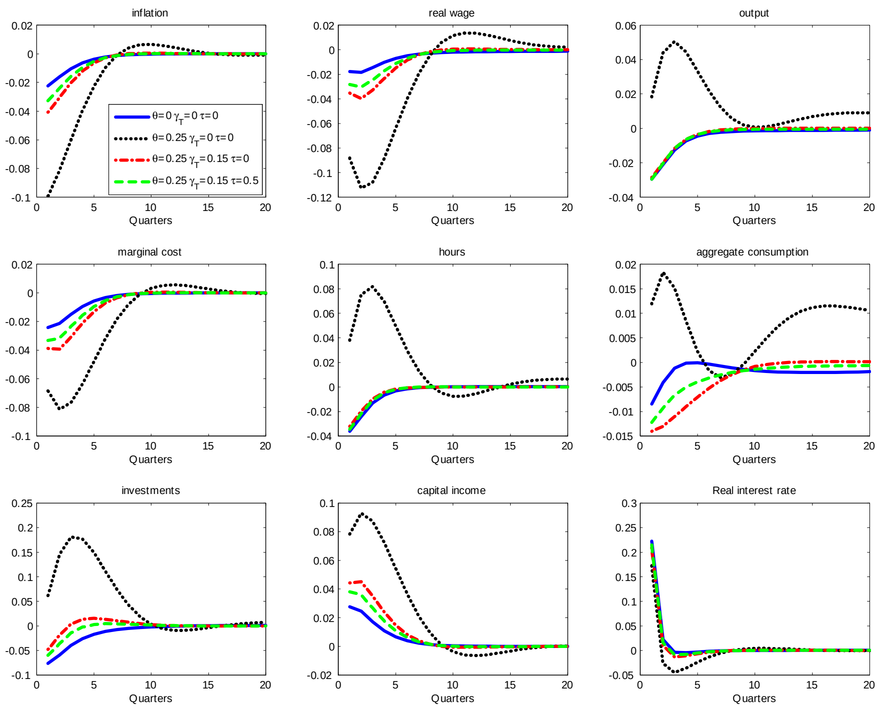

Figure 3. Impulse response functions to a restrictionary monetary policy shock

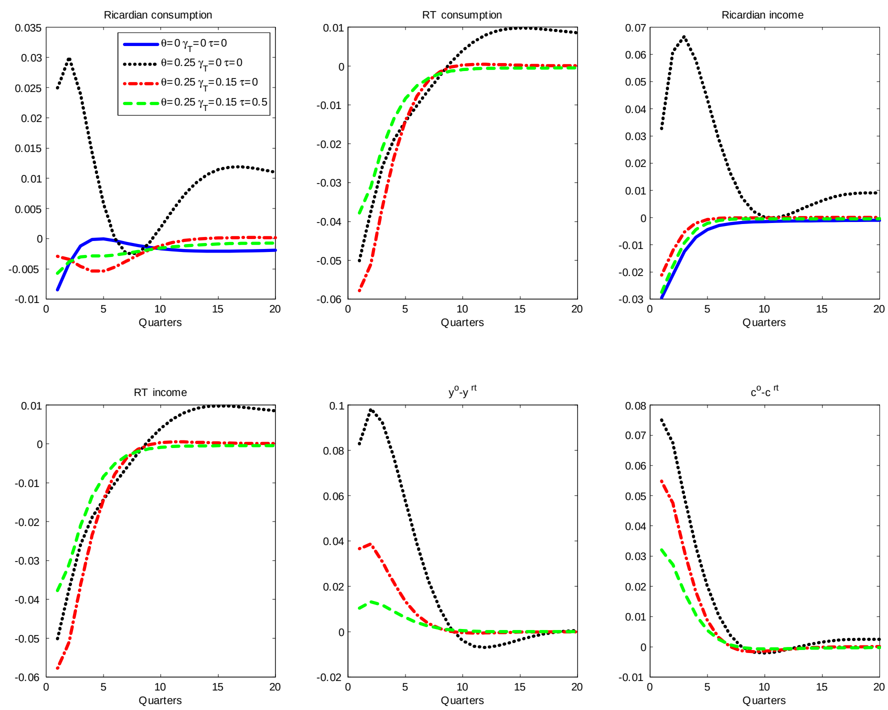

Figure 4. Impulse response functions to a restrictionary monetary policy shock

5 Simple rules for public debt reduction. Can We Reap the Gain and Escape the Pain?

Following the large increases in public-debt-to-GDP ratios observed in the aftermath of the 2007-financial crisis, the issue of fiscal consolidation, i.e. a reduction in the debt-to-GDP ratio, has come to the forefront of political debate and macroeconomic analyses (OECD 2012).

Empirical contributions emphasize the importance of achieving fiscal consolidation through public expenditures reductions. In empirical research, early enthusiasm towards expansionary contractions seems to have vanished (Perotti, 2011). However Nickel, Rother and Zimmermann (2010) find that major debt reductions in the EU-15 during the period 1985-2009 were mainly caused by strategies based on reduction of government consumption, whereas revenue-based consolidation efforts were less successful. The same conclusion is reached in Alesina, Favero and Giavazzi (2012), who argue that spending-based adjustments are associated with mild and short-lived output losses, while tax-based adjustments are associated with deep and prolonged recessions.

Within the theoretical framework of DSGE models characterized by complete financial markets and optimizing households, expenditure based on fiscal consolidations are a win-win strategy that reduces steady state distortionary taxation and raises private consumption even in the short run. This latter effect obtains because, despite the output drop, a *positive wealth effect* is in place, driven by the expectation of permanently lower taxes. From this viewpoint, the NK-DSGE model gives similar predictions to those of RBC models (see, for example, Linnemann and Schabert, 2003). Therefore, expenditure-based consolidations produce a *gain without pain*, as the policy entails a short-run consumption boom, as in Nickel, Rother and Zimmermann (2010) Linnemann and Schabert (2003).

By contrast, the predicted effect of fiscal consolidations may look rather grim if one takes into account the hypothesis of LAMP. For these households the fiscal consolidation envisages a *gain with pain* if the short-run decline of output is associated to a reduction in their disposable income. This point is emphasized in earlier contributions that incorporate the LAMP hypothesis (Coenen, Mohr and Straub, 2008, CMS henceforth; Almeida et al., 2013). This result has been implicitly assumed in policy-oriented research that emphasizes the importance of pursuing consolidation plans which are also "equity friendly" (OECD, 2013).

To simulate expenditure-based fiscal consolidation we use the DSGE model described in section 4 augmented with a better specification of the fiscal sector. We investigate the contribution of fiscal and monetary policies that may stabilize consumption of RT consumers, potentially restoring the *gain without pain* result. When all households are Ricardian, consumption choices react to the present value of future tax payments, irrespective of the selected time path for the tax reduction. Under LAMP a fraction of households would certainly react to tax reductions implemented in the early phase of the consolidation process, when employment falls due to nominal rigidities. In addition, an important role might be played by temporary public transfers, that would be irrelevant under the representative household assumption. Another important issue is whether such policies might indeed have a limited effect on the pace of debt consolidation due to their stimulus to output growth and therefore to fiscal revenues. Finally, monetary policy might have a powerful stabilizing effect on the consumption of constrained households only if it exploited the complementarity between the consumption of Ricardian households, stimulated by the interest rate fall, and the labor income accruing to RT households.

One important distinction between our work and previous contributions is that while inherited debt implies a deadweight loss in terms of distortionary taxation, we assume that reducing public consumption is costly for the policymaker. This issue is typically neglected in the theoretical literature on fiscal consolidations, despite the apparent difficulties that governments meet when attempting to cut their expenditures. We simply assume that public consumption enters the households' utility function, thus our policy experiment accounts for the costs associated to the abrupt and/or persistent reductions in public consumption-to-GDP ratios. We design a consolidation experiment where the long-run debt reduction is obtained through a temporary fall in public consumption and is associated to a permanent fall in tax rates. During the transition period we allow taxes (and public transfers) to react to the temporary drop in output.

One strand of literature apparently related to our study is concerned with tax reforms and with the identification of the (Ramsey optimal) financing mix between labor and capital taxation (see Chamley, 1986; Judd, 1997; Guo and Lansing 1999; Greulich and Marcet, 2008; Garcia-Milà Marcet and Ventura, 2010). In fact our focus is quite different because we are mainly interested in the identification of a short-run policy mix that can enhance the sustainability of long term debt reductions. At first sight, our contribution is akin to Cogan et al. (2012) who consider the effects of fiscal consolidations in a model that accounts for LAMP and emphasizes the importance of phasing in tax reductions. Indeed there are some important differences between their work and ours. First, their definition of LAMP is such that a fraction of households do not participate in stocks and bonds markets but are allowed to hold money. Therefore, to the extent that their initial holdings of money balances are sufficiently large, these households may partly smooth consumption in response to a fiscal consolidation that reduces output and labor incomes. In their model intertemporal consumption optimization therefore plays an important role even for constrained households. Second, they consider a consolidation experiment which is based on the contraction of public transfers and the contemporaneous reduction of distortionary taxes. Since transfers are by assumption equally shared by all households and Ricardian consumers account for two thirds of the population, the fall in transfers has a limited effect on aggregate demand, whereas the lower tax rates unambiguously increases efficiency. The overall effect on demand is so strong that output increases even in the short run. In our analysis we abstract from apparently "easy" solutions where reducing public expenditures is costless by assumption. Further, in our experiment redistributive transfers may be a useful stabilization tool. Third, we consider the potential complementarity between fiscal and monetary policies during the transition.

In a nutshell, our results are summarized as follows. First, we show that it is possible to both reduce public debt and boost consumption of RT households. This is obtained by allowing taxes to immediately undershoot their post-consolidation steady-state values. These "overexpansionary" fiscal policies allow to raise the disposable income of RT consumers, and yet we do not observe a significant slow down in the pace of debt reduction due to the favourable impact of consumption growth on output and government revenues. A similar result is obtained if temporary public transfers to RT households are exploited to stimulate demand. This is in sharp contrast with recent consolidation plans in advanced countries, that apparently rely on both expenditure reductions and tax hikes, as shown in Figure 5. Our findings suggest that such a policy mix is bound to depress consumption and economic activity. In fact, this study calls for new tax/transfer policies that limit the consumption gap between Ricardian and RT households and improve the performance of the macroeconomy in the short-medium run.

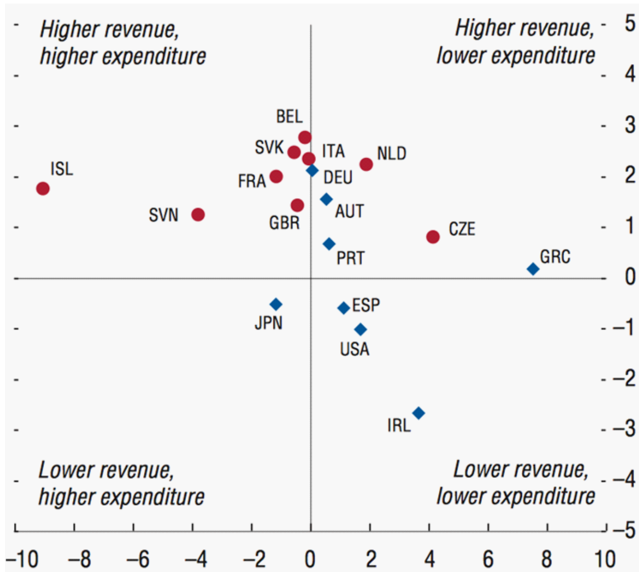

Figure 5. Change in planned measures 2009-2013. (Source: IMF, 2013). Orizontal axis: expenditure cuts relative to plans (% of potential GDP). Vertical axis: revenue increases relative to plans (% of potential GDP)

Second, we find that an interest rate rule which reacts not only to inflation but also to the output gap is an effective complement to fiscal policy as a stabilization tool. In fact, the output gap target induces the Central Bank to implement a stronger interest rate cut which triggers a surge in the consumption of Ricardian households. This, in turn, has beneficial effects on labor incomes and on RT households' consumption. We obtain the apparently paradoxical result that such a policy allows to obtain better control of inflation, limiting deflationary pressures.

5.1 The Fiscal Consolidation Exercise

We model fiscal consolidation as a permanent reduction of the debt-to-output ratio via a temporary decline of the expenditure ratio. The fiscal consolidation exercise entails a transition from one initial steady state where the debt-to-GDP ratio b_y^{**} is set at 70% to a new steady state where $b_y^{**} = 60\%$, in line with Coenen, Mohr and Straub (2008). In this experiment we assume that savings on interest payments are used to reduce taxes while public spending ratio comes back to the initial steady state level. Therefore in the steady state associated to $b_y^{**} = 60\%$ tax distortions are unambiguously reduced and $y^{**} > y^*$.

To avoid trivial results and in contrast with authors such as Forni et al. (2010), we take into account the fact that public consumption is not a mere dissipation of resources but generates utility to households, as in Stahler and

Thomas (2012). Therefore utility function (33) now becomes

$$U_t^i = E_0 \sum_{t=0}^{\infty} \beta^t \left\{ \ln\left(c_t^i - bc_{t-1}\right) - \frac{\rho^l}{1+\phi_l} {l_t^i}^{(1+\phi_l)} + \xi \ln\left(G_t\right) \right\} \tag{37}$$

Our policy experiments are better characterized as multi-period plans and the full consolidation is achieved after several years. In this regard, the expectation of future variations in the policy instruments drives the bulk of our results. This approach is consistent with the analysis in Alesina et al. (2012) who document that fiscal consolidations in OECD countries took the form of multi-year plans.

The key tool used to achieve the debt reduction is an unanticipated temporary reduction in public consumption. We assume that the fiscal authority follows the rule:

$$\left(\frac{g_{y,t}}{g_y}\right) = \left(\frac{b_{y,t}}{b_y^{**}}\right)^{-\phi_g} \tag{38}$$

where $g_y = (G^*/y^*) = (G^{**}/y^{**})$ is the constant public consumption-to-GDP target ratio, $g_{y,t} \equiv (G_t/y^{**})$ and $b_{y,t} \equiv (B_t/y^{**})$ respectively define time t levels of public consumption and debt in terms of post-consolidation steady-state output.

Unlike the model described in section 3 we allow for different capital- and labor-income tax rates in the initial steady state but, since we are not interested in policy-induced long-run changes in capital-labor ratios, we posit that $\left(\tau^{k**}/\tau^{l**}\right) = \left(\tau^{k*}/\tau^{l*}\right)$. To model the behavior of taxes during the transition phase, we assume that relative tax rates are constant throughout the transition, i.e. $\left(\tau_t^k/\tau_t^h\right) = \left(\tau^{k**}/\tau^{h**}\right)$. Thus, from now on we only refer to labor tax rate.

We consider two alternative tax rules. In the first case, we assume that taxes follow a highly inertial path towards the new steady state:

$$\tau_t^l = (1-\phi^\tau)\,\tau_{t-1}^l + \phi^\tau \tau^{l**} \tag{39}$$

In the early stages of the consolidation experiment this allows to identify the permanent income effect of a future tax reduction, that only affects consumption choices of Ricardian households.

With the second rule we model taxes as automatic stabilizers in the spirit of Colciago *et al.* (2008).[20]

$$\left(\frac{\tau_t^l}{\tau^{l**}}\right) = \left(\frac{y_t}{y^{**}}\right)^{\delta_0} \tag{40}$$

This allows to assess the contribution of short-run tax adjustments to output stabilization, where taxes immediately impact on RT consumers' disposable income. Due to LAMP assumptions, temporary redistributive policies may have powerful stabilization effects on RT consumption and no effect on Ricardian

[20] See also Van den Noord (2000), Westaway (2003) and Andres and Domenech (2006).

households. To investigate this issue we also assume that transfers to RT consumers evolve according to the following rule:

$$\left(\frac{tr_{y,t}}{tr_y}\right) = \left(\frac{y_t}{y^{**}}\right)^{-\delta_1} \tag{41}$$

where $tr_y = (TR^*/y^*) = (TR^{**}/y^{**})$ is the constant public transfer-to-GDP target ratio and $tr_{y,t} \equiv (TR_t/y^{**})$ defines time t levels of public transfers in terms of post-consolidation steady-state output. Fiscal transfers operating according to (41) temporarily increase thanks to lower interest rate payments.

Moreover, we assume that steady state transfers are paid only to constrained households. This guarantees that levels of consumption are not too dissimilar across the two household groups (see Coenen *et al.*, 2008).

5.2 Monetary Policy

The monetary authority sets its policy instrument R_t according to a standard Taylor rule:

$$\left(\frac{R_t}{R}\right) = \left[\left(\frac{\pi_t}{\pi}\right)^{\phi_\pi} \left(\frac{y_t}{y^{**}}\right)^{\phi_y}\right]^{1-\phi_R} \left(\frac{R_{t-1}}{R}\right)^{\phi_R} \tag{42}$$

where π_t, π, R and y_t/y^{**} respectively denote the inflation rate, the inflation target, the interest rate target and the output gap defined with reference to the post-consolidation steady state. Parameter ϕ_R captures interest rate inertia in the monetary policy rule.

5.3 Calibration

The baseline calibration of structural parameters is as in section 4. As for fiscal sector, the parameter governing the debt stabilization ϕ_g in the government spending rule is set equal to 1, in line with the debt reduction experiment carried out by Coenen, Mohr and Straub (2008).

As in Colciago *et al.* (2008), fiscal responses to output - δ_0 in (40) and δ_1 in (41) - are calibrated at 0.5. This value is also consistent with the empirical evidence in Van den Noord (2000) and adopted in studies on fiscal stabilization (e.g. Westaway, 2003). Moreover, to guarantee the inertial behavior of taxes according to (39) we set $\phi^\tau = 0.01$. Furthermore, we draw from the estimates reported in Mendoza, Razin and Tesar (1994) to assign the value to the average effective capital-labor tax rate ratio,[21] i.e. $\left(\frac{\tau^{k**}}{\tau^{h**}}\right) = 0.92$.[22] Finally, the public spending and transfer steady state ratios are both fixed at 0.18, consistently with the national accounts data for euro area countries.[23]

[21] The calibrated labor tax rate is such that the fiscal authority's budget is balanced at the debt-to-GDP target.

[22] Results hold for different values of capital-labor tax rate ratios found in the literature, (Coenen *et al.*, 2008; Schmitt-Grohé and Uribe, 2005)

[23] Our results would not change if we used instead the corresponding ratios that charaterise the US economy.

As for monetary policy, the parameter governing inflation stabilization, ϕ_π, is calibrated at 1.1, and the parameter governing output stabilization, ϕ_y, is set at 0.5. Finally, monetary policy inertia is characterized by $\phi_R = 0.9$.

The parameter denoting the weight of public spending in the utility function, ξ, is set at a level such that in the initial steady state the calibrated public-consumption-to-GDP ratio is indeed optimal according to the social planner choice and temporary expenditure reductions lower welfare.

The fraction of rule-of-thumb consumers in the euro area had been estimated in a range between 0.25 and 0.40.[24] We follow more recent contributions that account for the effects of the financial crisis, and estimate the fraction of liquidity constrained consumers at 0.50, as in Albonico, Paccagnini and Tirelli, 2015. As a matter of fact, raising the share of RT consumer "stacks the cards" against the possibility that the tax reductions necessary to stabilize consumption do not substantially slow down the pace of debt reduction.

5.4 Results

5.4.1 The Long-Run Effects of Fiscal Consolidation

In Table 6 we report the steady state adjustment of some key variables in consequence of the fiscal consolidation.

$\Delta\tau^{h**} = -0.70$	$\Delta\left(\frac{k^{**}}{h^{**}}\right) = 0.42$
$\Delta\tau^{k**} = -0.70$	$\Delta h^{**} = 0.14$
$\Delta y^{**} = \Delta G^{**} = 0.27$	$\Delta w^{**} = 0.13$
$\Delta c_{pc}^{o**} = -0.18$	$\Delta c_{pc}^{rt**} = 0.65$

Table 6 - Steady state percentage variations after consolidation

where c_{pc}^{o**} and c_{pc}^{rt**} respectively define the per-capita consumption levels of the two household types.

The fiscal consolidation improves the budgetary position of the government. These resources are used to lower labor and capital income taxes. This, in turn, causes an output expansion, due to an increase in both capital and labor supply. RT consumption unambiguously increases. Just like RT consumers, Ricardian households benefit from the labor tax reduction. In addition they entirely appropriate the capital income tax reduction. However, they loose public debt service payments. As a result, the steady state variation in their consumption is negative.

5.4.2 Transition Dynamics

The next step in our analysis is a discussion of the short-run effects under different fiscal and monetary rules. We consider alternative scenarios.

[24] See, for instance, Coenen and Straub (2005), Forni *et al.* (2009).

1. No short-run fiscal stabilization and pure inflation targeting. In this case we are able to identify the role of "pure" announcements of future tax reductions. The tax rule follows (39), transfers are held constant and we set $\phi_y = 0$ in (42).

2. Short run fiscal stabilization is based on (40), constant transfers and pure inflation targeting.

3. Taxes follow (39), monetary policy is a pure inflation targeter and transfers to RT consumers are activated as stabilizers according to (41).

4. The Taylor rule reacts to the output gap, i.e. $\phi_y = 0.5$. We consider the contribution of output gap targeting under the alternative tax rules described in (40) and in (41) , scenarios $4a$ and $4b$, respectively.

In the following we report transition paths for the relevant variables under scenarios 1-4. Each panel shows the transition dynamics starting from the initial steady state in which the value of the debt-to-GDP ratio is equal to 70%.[25]

Scenario 1. No fiscal stabilizers and pure inflation targeting (Figure 6) Achieving the desired fall in the debt-to-GDP ratio takes 37 quarters. Consider first what happens when all agents are Ricardian (blue line). After the government consumption reduction of about 2.5% points, the recessionary effect is unavoidable. This is in turn associated to a lower real wage. As a consequence, marginal costs fall, bringing down inflation and interest rates. Note that without RT agents the output reduction is associated with a boom in consumption, which initially overshoots its new long-run level. In line with previous contributions in this field (see, for instance, Linnemann and Schabert, 2003), expenditure-based fiscal consolidations produce a *gain without pain* result because private consumption rises and the labor supply falls.

By contrast, with RT consumers (red line) the initial output fall is larger due to the fall in RT consumption. Note that in this case the fiscal consolidation causes a temporary but strong increase in consumption inequality. In fact while Ricardian households raise their consumption, RT households do just the opposite in consequence of the fall in their current income. In turn, this brings down aggregate consumption producing a *gain with pain*.

[25] All dynamic effects are reported as percentage deviations from the initial steady state, with the exception of fiscal ratios which are reported in absolute values.

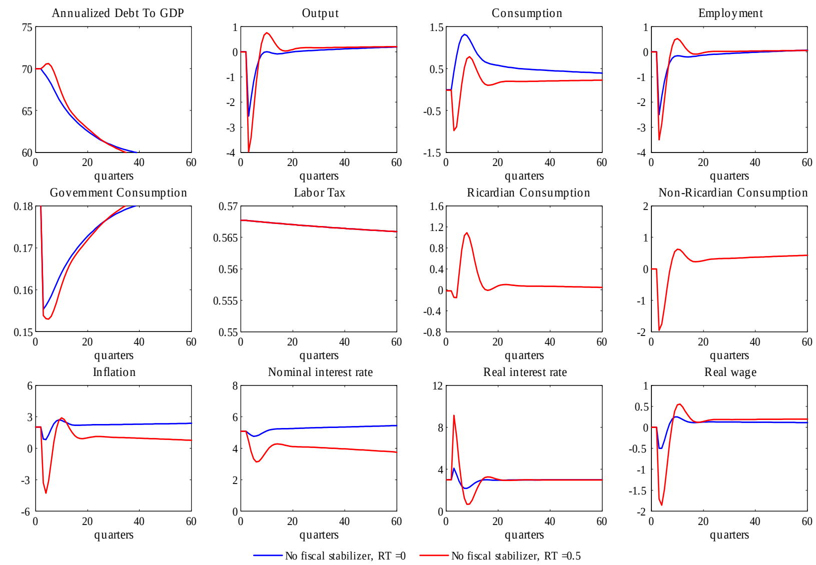

Fig.6. Scenario 1: Short-run effect of fiscal consolidation with no fiscal stabilizer

Scenario 2. Tax stabilizers and pure inflation targeting (Figure 7) The fiscal rule (blue line) driven by (40) reduces consumption volatility for both Ricardian and Non-Ricardian households. In particular, taxes undershoot their long-run fall in response to the short-run output reduction. This boosts RT households' disposable income and consumption. The *gain without pain* result is restored. This result is obtained at the cost of slowing down the speed of debt reduction, which is now achieved in about 44 quarters.

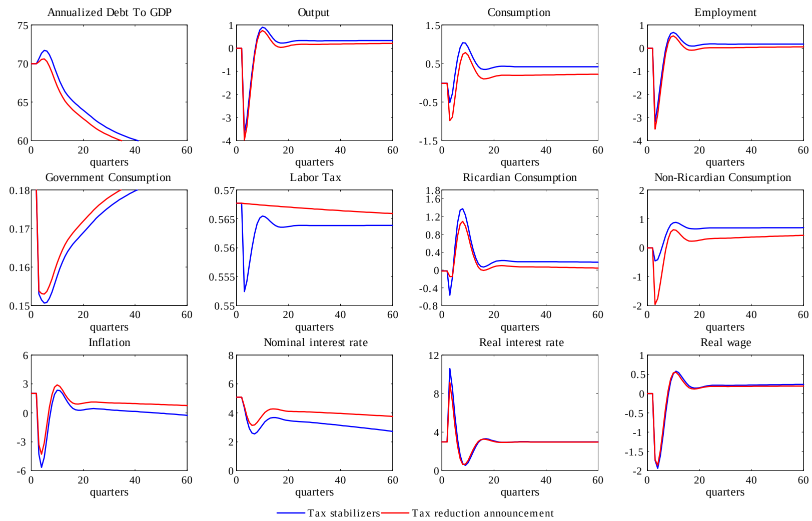

Fig. 7. Scenario 2: Tax reduction announcement vs Tax stabilizers

Scenario 3. Stabilization through redistribution (Figure 8) Stabilization through redistribution allows to both reduce debt and boost consumption. In Figure 8 stabilization by means of transfers policy (red line) only operates through the demand-side effect stemming from RT consumption, whereas use of taxes (blue line - Scenario 2) produces favourable supply side effects that raise output and labor income, thus increasing RT consumption. The pure demand-side fiscal policy generates less volatility for nearly all variables. The other side of the coin is that now stabilization through transfers entails a much faster speed of debt reduction, which is completed in 36 quarters, and a quicker convergence of public consumption to the new steady state level.

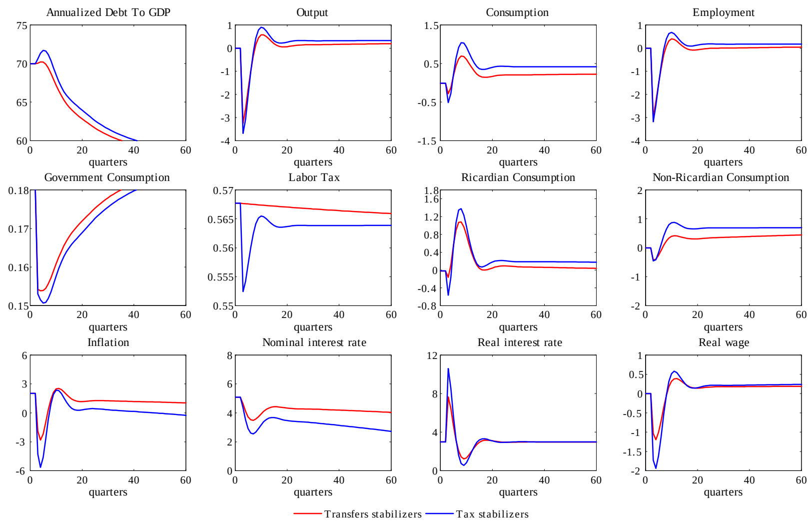

Fig. 8. Scenario 3: Tax stabilizers vs transfers stabilizers

Scenario 4. Monetary policy reacts to the output gap (Figures 9a-9b) We compare the effects of a countercyclical monetary policy complementing fiscal policy under rules (40) and (41), respectively. In both cases, output gap targeting allows to achieve better inflation stabilization and faster convergence of the debt ratio to the debt new target. In addition, the strong reaction of Ricardian consumption to the interest rate stimulus notably reduces the slump, therefore allowing faster growth in RT consumption.

Summing up, the transmission channels are the following. Fiscal policy *directly* stabilizes RT consumption and *indirectly* contributes to reduce the output fluctuations. Monetary policy *directly* dampens the output losses determined by the consolidation phase and *indirectly* raises RT consumers' labor income.

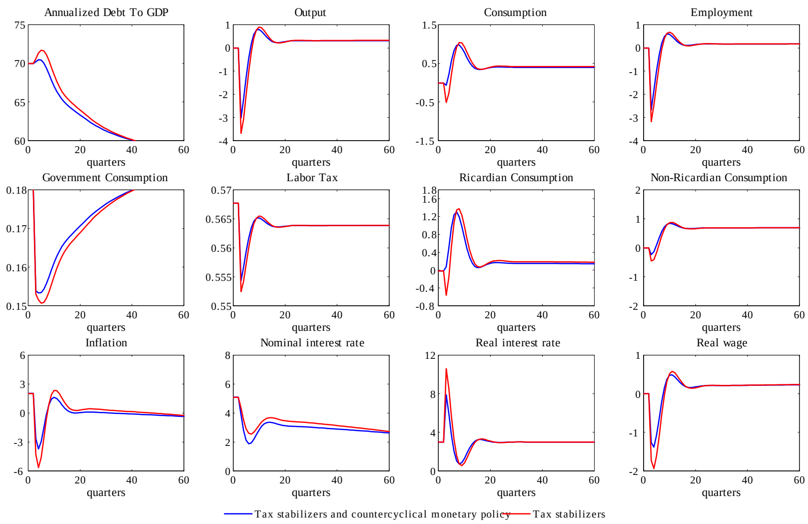

Fig.9a: Tax stabilizers vs Tax stabilizers and countercyclical monetary policy

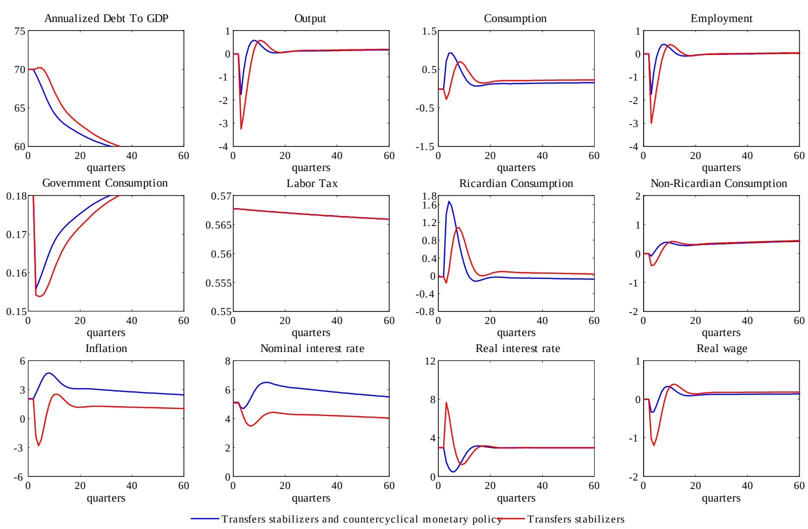

Fig. 9b: Transfers stabilizers vs Transfers stabilizers and countercyclical monetary policy

6 Conclusions

The paper investigates the implications of LAMP for a theoretical DSGE model, drawing implications for monetary and fiscal policies in the Eurozone. A relatively large body of empirical research has pointed out that inflation is particularly harmful for the poor (Easterly et al, 2001).

We show that this needs not be the case when monetary and fiscal policies are optimally designed. In the Eurozone the fiscal implications of the ECB inflation target are purposely neglected to preserve Central Bank independence and where also justified on theoretical results about the optimality of zero inflation in DSGE models. In fact, we show that LAMP calls for positive and potentially non-negligible inflation rates. In our model the optimal inflation rate is 2.48% when the share of constrained households is 80% and the steady state public-debt-to-GDP ratio is 60%. For a 80% debt ratio the optimal inflation rate is above 3%. We also obtain new results concerning optimal stabilization policies. In fact, LAMP generates a trade-off between the efficiency motive to the use of debt, that calls for optimal consumption smoothing through the permanent adjustment of debt, and the equity motive, that induces the planner to front-load tax adjustment in order to limit the redistributive effects of permanent public debt variations.

Turning to the analysis of simple rules, we show that, if the redistributive policies are absent, LAMP causes a large increase in volatility when a monetary policy shock occurs. By contrast, redistributive fiscal policies have a powerful dampening effect on volatility. We have also shown that redistributive policies targeting consumption inequality bring the dynamic performance of the model close to the one generated by RA DSGE models. This suggests an intriguing conjecture: these latter models might apparently succeed in matching business cycle facts when in the real economy the underlying fiscal policy regime compensates for the effects of LAMP, but their performance might not be robust to fiscal reforms that limit discretionary policies and/or reduce the effectiveness of automatic fiscal stabilizers. Further, tighter regulation of financial markets in the aftermath of the 2007 financial crisis should be complemented with more interventionist fiscal policies. We leave this for future research.

Finally, the paper shows that an appropriate mix of fiscal and monetary policies can substantially ease the strain typically associated to fiscal consolidations. The public expenditure reduction should be supported either by a temporary public transfers increase or by a tax rates fall that undershoots their new post consolidation values. Such policies have a strong stabilizing effect on the disposable income of RT consumers. This, in turn, stimulates demand and supports growth. As a result, the pace of debt reduction is substantially preserved because the revenues loss from lower tax rates (larger transfers) is almost entirely compensated by an increase in the tax base. The result is even strengthened when the monetary authority targets both inflation and output gap. In this case the stronger interest rate fall is beneficial because it exploits the complementarity between the consumption of Ricardian households and the disposable income of RT consumers. Once more, in the Eurozone context we call for strong complementarity between the ECB interest rate policy and the Eurozone global fiscal policy stance.

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