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Monetary/Fiscal Policy Mix And The Size Of Government Spending Multiplier

Rym Aloui

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This paper analyzes the size of government spending multiplier in two policy mix cases: Active Monetary/Passive Fiscal policy (regime M) in the first instance and Passive Monetary/Active Fiscal policy (regime F), in the sense of Leeper (1991), in the second. I develop a New-Keynesian model where preferences are subject to external deep habits and where some households do not have access to financial markets. I show that these two specifications allow for the crowding in of private consumption in both regimes. However, the private investment falls in regime M while it rises in regime F as a response to a government spending shock. In addition, I show that the impact multiplier increases with the degree of deep habits in regime M, while it decreases in regime F. In this framework, in a low nominal interest rate environment, the government spending multiplier is not too large as vast studies show. However, I find that the global effectiveness of government spending is larger in regime F than in regime M, even though the impact multiplier is greater than unity in both regimes.

Keywords:
Wealth Effects, Government Spending Multiplier, Zero Lower Bound, Fiscal Theory of the Price Level, Monetary and Fiscal Rules, Public Debt.

JEL codes:
E63; E52; E62;E32

Working Paper

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July 4, 2022

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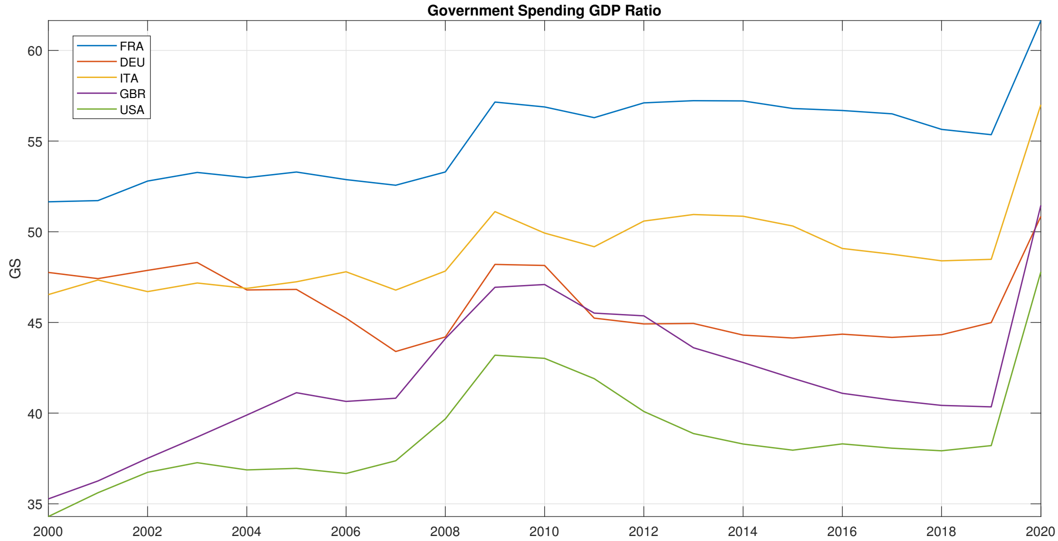

Figure 1: Government Spending GDP Ratio

1 Introduction

Since the great recession, a succession of events, such as sovereign debt crisis in Europe, the COVID-19 pandemic, and recently the war in Ukraine, drives governments in many developed economies to considerably rely on fiscal and monetary measures. The 2009 American Recovery and Reinvestment Act (ARRA), which amounts to $787 billion and the American Rescue Plan (ARP), which values $1.9 trillion, are examples of fiscal stimulus packages introduced to fight the great recession and the COVID-19 pandemics, respectively. According to the IMF (2021), EU Member States have provided an average crisis support amounting to 24.8% of their 2020 GDP.[1] Figure1 reports the change in total government spending GDP ratio in some OECD countries over the two last decades, which is positive and persistent. Therefore, how large is the size of government spending multiplier remains an important and timely question in macroeconomic debates. In fact, if fiscal stimulus through an increase in government spending raises real GDP by more than one-for-one then such a stimulus is highly desirable from a policymaking perspective.

Despite considerable theoretical and empirical studies, there is still no clear consensus whether the multiplier is greater or smaller than one. However, the idea that the size of the multiplier heavily depends on the macroeconomic policies prevailing when fiscal measures are implemented appears to be accepted by the economic profession. Therefore, I want to add another stone to the edifice by analyzing the size of government spending multiplier in two specific cases of policy mix: the conventional policy mix

[1] 9.6 percentage points of this amount are in direct budgetary support and 15.2 percentage points in liquidity assistance (such as loans, guarantees and equity injections)

(regime M, hereinafter) where Monetary Policy is ‘active’ and Fiscal Policy is ‘passive’ and an alternative policy mix (regime F, hereinafter) where monetary policy is ‘passive’ and fiscal policy is ‘active’; the Fiscal Theory of the Price, Leeper (1991). These two regimes diverge in the way monetary and fiscal policy work. In regime F, the fiscal policy is ‘active’ so the real value of government debt is stabilized by a price level adjustment allowed by a ‘passive’ monetary policy. This contrasts with regime M, in which fiscal policy throughout taxes and spending adjustments must ensure that the real government debt stock is stabilized for any path of prices.[2]

In the current context of inflation, the Fed and ECB have not reacted as quickly and forcefully as they should. This fact shows that the Fed and ECB monetary policy are still passive even though there is an increase in their interest rates. The regime F is thus not some theoretical fantasy, but could be the new standard. Therefore, it is worth analyzing the effectiveness of government spending in regime F.[3] This paper analyzes and compares government spending multipliers in regime M and regime F. I show that despite the dissimilarities between the two regimes, regarding monetary and fiscal policy, this framework exhibits an impact government spending multiplier greater than one in both regimes.

More precisely, I build a New-Keynesian model (Galí (2015), Woodford (2003a)) augmented by external deep habits in consumption (Ravn et al. (2006)) and where some households do not have access to financial markets (Galí et al. (2004)).[4] It has been shown that each of these assumptions when incorporated in a standard New-Keynesian model allow for a crowding in of private consumption and therefore the government spending multiplier is greater than one. To our knowledge, no study has been made to analyze the consequences of these assumptions in regime F so far.[5] I show that including deep habits in consumption together with rule-of-thumb consumers generates opposite effects in regime F than in regime M. It decreases the government spending multiplier in regime F.[6] This result contrast with vast studies that show a very large multiplier when the nominal interest rate hits the Zero Lower Bound (ZLB), e.g; Christiano et al. (2011), Eggertsson (2011) and Woodford (2011). Why does deep habits in consumption have opposite outcomes on the spending multiplier in these regimes?

Under deep habits, households do not simply form habits from a benchmark consumption level, but rather feel the need to keep up with the Joneses on a good-by-good basis.[7] This feature alters the demand side as well as the supply side. Households that

[2] The government’s intertemporal budget constraint is an equilibrium condition in the regime F

[3] Some papers have already focused on this issue. See e.g. Kim (2003), Leeper et al. (2017), Davig & Leeper (2011), Beck-Friis & Willems (2017) Kim (2003), Leeper et al. (2017), Davig & Leeper (2011), Zubairy (2014b) and Beck-Friis & Willems (2017)

[4] I will henceforth refer by deep habits to the external deep habits as in Ravn et al. (2006).

[5] To our knowledge, Cho & Kim (2013) is the only study where the two assumptions are incorporated at the same time in a New-keynesian model (regime M). I will explain their findings later.

[6] I consider that in regime F the nominal interest rate is constant and is at the zero lower bound

[7] This catching up with Joneses feature dates back to Abel (1990) or the customer market model of Bils (1989)

Table 1: Effects On Consumption Of A Government Spending Increase

			Regime M	Regime F
Wealth effect			negative	positive
		Rule-of thumb	lowered	lowered
Substitution effects	Intratemporal effects		negative	negative
		Deep Habits	positive	positive
	Intertemporal effects		negative	positive
		Deep Habits	positive	negative

consume a large amount of a particular good today are more likely to buy this kind of good in the future by force of habit. Accordingly, the demand for goods faced by firms becomes dynamic, implying countercyclical mark-ups. Higher markups today leads to higher profits per unit sold today, but lowers the quantity sold today reducing, thus, the customer capital in the future. Two channels trigger the countercyclicality of mark-ups: elasticity effect and intertemporal substitution effect. The first effect is driven by a change in the current aggregate demand, which implies an increase (decrease) of the price elasticity of demand if the change is positive (negative). As a consequence, firms have the incentive to drop (raise) mark-ups today. The second effect arises because firms that expect high future demand have the incentive to lower mark-ups today to increase customer capital.

These channels interact with wealth and substitution effects triggered by government spending shocks and could raise (drop) the multiplier in regime M (regime F). Table 1 details the sign of short-run effects that are in place after a government spending increase. In standard New-Keynesian model, an increase in government spending leads to a wealth effect, an intra- and intertemporal effect as explained in Leeper et al. (2017). The sign of these effects depend on the feature of monetary and fiscal policy. Taking into account deep habits in consumption adds a positive intratemporal effect in both regimes and a positive (negative) intertemporal effect in regime M (regime F). The size of government spending multiplier is, thus, conditional to the weight of each effect. I demonstrate that for plausible calibration, positive effects prevail over negative effects in both regimes.

Taking an in-depth look at the response of private consumption and investment to a positive government spending shock, I find that consumption goes up in both regimes, while investment falls in regime M and rises in regime F. This result is in line with empirical studies. In fact, several studies highlight the positive response of private consumption to a positive government spending shock, (e.g. Blanchard & Perotti (2002), Fatàs & Mihov (2001), Galí et al. (2007), Ravn et al. (2012), Fisher & Peters (2009), Mountford & Uhlig (2009), Monacelli & Perotti (2008)) some of them find a positive effect on private investment (Fatàs & Mihov (2001) and Zeev & Pappa (2017)) and others a negative effect (Blanchard & Perotti (2002) and Mountford & Uhlig (2009)).

After highlighting the importance of deep habits in this framework, I would like to explain the role of rule-of-thumb assumption *à la* Galí et al. (2004). First, this assumption means that a fraction of households cannot access financial and capital markets and thus cannot smooth consumption and spend their current labor income in each period (Rule-of-thumb consumers). This assumption weakens the wealth effect of a government spending increase, in both regimes. In fact, optimizing consumers in regime M decrease their consumption because they expect high future taxes, reflecting in a decline of their future after-tax-income (*negative wealth effect*). On the other hand, optimizing consumers in regime F increase their consumption because debt used to fund extra government spending will not be paid back with taxes (*positive wealth effect*). Galí et al. (2007) argue that, in a standard New Keynesian Model, considering a fraction of rule-of-thumb consumers implies that government spending multiplier is greater than one. However, this result relies on a high fraction of rule-of-thumb consumers, 0.5, compared to some empirical studies, $0.246 - 0.37$ Coenen & Straub (2005), $0.34 - 0.37$ Forni et al. (2009) and 0.36 Rebei (2021).

Cho & Kim (2013) establish that incorporating rule-of-thumb consumers and deep habits in consumption in a New-Keynesian framework improves the capacity of the model to assess government spending shocks. As pointed out by Jacob (2013), models with deep habits and sticky prices do not guarantee the crowding in of private consumption as in Ravn et al (2006). He finds that if the degree of price stickiness is high enough, consumption is crowded out by government spending. Cho & Kim (2013) offer a framework where some of the limits of deep habits and rule-of-thumb models are overcome. More precisely, they find a more realistic fall in markup compared to a positive response of consumption.[8] In addition, the threshold value of rule-of-thumb share necessary to crowd in consumption is reduced.

This paper shows that the combination of deep habits and rule-of-thumb-consumers assumptions guarantee the positive response of private consumption to government spending increase for plausible values of parameters in regime M and regime F. Despite being lower than in a more standard framework, the multiplier in regime F is still more effective than in regime M. The remainder of the paper is organized as follows.

The next section develops the model. Section 3 gives the symmetric equilibrium and the parameter choice, section 4 focuses on quantitative analyses. Section 5 concludes.

[8]Standard deep habits models have been criticized for the sharp decrease in markup in response to a positive demand shock.

2 THE MODEL

In this section, I develop a New Keynesian model extended to incorporate deep habits and hand-to-mouth consumers. The economy consists of two types of households, a continuum of firms producing differentiated goods, indexed by $m \in [0,1]$, and setting nominal prices which are costly to change, a continuum of unions setting nominal wages and aggregating labor supply, the monetary authority, and the fiscal authority. There is uncertainty in the economy generated by government spending shocks. I assume that markets are complete, therefore, there are enough financial assets to be able to handle the uncertainty arising from these shocks. In addition, as in most of the recent New Keynesian literature, I assume a cashless economy à la Woodford (2003b).[9]

2.1 Households

The economy is populated by a continuum of households of measure 1. A fraction $1-\lambda$ of households, with $\lambda \leq 1$, have access to markets for physical capital and financial assets. Each period, they make consumption decisions based on lifetime incomes composed of profits, wages, capital returns and asset returns coming from their ownership of monopolistically-competitive firms, their supply of labor and their participation in financial and capital markets, respectively. This kind of households, indexed by $j \in (\lambda, 1]$, are called *Ricardian or optimizing.* The remaining fraction λ of households, indexed by $i \in [0, \lambda]$, do not own any assets nor have any liabilities, and just consume their after-tax current wage. I may explain the behavior of this latter fraction of households by myopia, lack of access to capital markets, fear of saving, ignorance of intertemporal trading opportunities, etc. I refer to them as *rule-of-thumb* or *Non-Ricardian* households (henceforth ROTC) as Galí et al. (2004) and Bilbiie (2008).

2.1.1 Optimizing households

Ricardian households have preferences that exhibit external habit formation in consumption at the differentiated good level, rather than at a basket of good level, as in Ravn et al. (2006). I adopt the following CES habit-adjusted consumption index,

$$X_{j,t}^{c} = \left(\int_{0}^{1} \left(C_{j,t}(m) - \theta \bar{C}_{j,t-1}(m) \right)^{\frac{\varepsilon_p - 1}{\varepsilon_p}} dm \right)^{\frac{\varepsilon_p}{\varepsilon_p - 1}}, \tag{1}$$

$C_{j,t}(m)$ is the Ricardian agent's consumption of good m, $\bar{C}_{j,t}(m) \equiv \int_0^\lambda C_{j,t}(m)\, dj$ denotes the external cross-sectional average consumption of variety m, in period t, $\varepsilon_p > 1$ is the intratemporal elasticity of substitution of habit-adjusted consumption across varieties, and $\theta \in [0,1)$ measures the degree of external habit formation in consumption of each variety. When $\theta = 0$, consumption externalities disappear and the consumption aggregator is a standard CES function.[10]

[9] Here, money is only a unit of account.

[10] This is the case of rule-of-thumb households because they do not engage in intertemporal choices

For any given level of $X_{j,t}$, solving the cost minimization problem, $min \int_0^1 P_t(m) C_{j,t}(m)\, dm$, subject to the aggregate constraint (1), where $P_t(m)$ denotes the nominal price of the differentiated good m at time t, yields the following demand functions of private consumption[11]

$$C_{j,t}(m) = \left(\frac{P_t(m)}{P_t}\right)^{-\varepsilon_p} X_{j,t}^c + \theta \bar{C}_{j,t-1}(m), \quad \text{for all } m \in [0,1]. \tag{2}$$

The total expenditure on habit-adjusted consumption is given by

$$P_t X_{j,t}^c = \int_0^1 P_t(m) \left[C_{j,t}(m) - \theta \bar{C}_{j,t-1}(m)\right] dm. \tag{3}$$

Notice from (2) that the consumption demand for each variety m is a decreasing function of the relative price of variety m, $P_t(m)/P_t$, and an increasing function of both the level of habit adjusted consumption, $X_{j,t}^c$, and the past aggregate consumption of the variety m, $\bar{C}_{j,t-1}(m)$. This demand function features a dynamic component, as it depends not only on the current period habit-adjusted consumption but also on the aggregate consumption of good m. The price elasticity of demand becomes an increasing function of the aggregate demand.[12]

Each household j derives utility from habit-adjusted consumption, $X_{j,t}^c$ and disutility from labor supply, $L_{j,t}^s$. The lifetime utility of household j is given by

$$\mathbb{E}_t \sum_{s=t}^{\infty} \beta^{s-t} \left(\ln X_{j,t}^c - \frac{L_{j,t}^{1+\upsilon}}{1+\upsilon}\right), \tag{4}$$

where $\mathbb{E}_t$ denotes the mathematical expectation operator conditional on information available at time t, $\beta \in (0,1)$ is a discount factor, $\vartheta > 0$ is the inverse of the Frisch elasticity of labor supply. The optimizing agent j is assumed to own physical capital, which accumulates according to

$$K_{j,t+1} = (1-\delta)K_{j,t} + \left[1 - \frac{\varphi_I}{2}\left(\frac{I_{j,t}}{I_{j,t-1}} - 1\right)^2\right] I_{j,t}, \tag{5}$$

where δ is the depreciation rate of physical capital, $K_{j,t}$, φ_I is a positive parameter, and $I_{j,t}$ denotes investment by household j, which is assumed to be a composite of differentiated investment goods:

$$I_{j,t} = \left(\int_0^1 (I_{j,t}(m))^{\frac{\varepsilon_p - 1}{\varepsilon_p}} dm\right)^{\frac{\varepsilon_p}{\varepsilon_p - 1}}.$$

Similarly to private consumption, expenditure minimization leads to the following opti-

[11] The corresponding price index of goods at date t is defined by $P_t \equiv \left(\int_0^1 P_t(m)^{1-\varepsilon_p} dm\right)^{1/(1-\varepsilon_p)}$.

[12] The government consumption index and the government's demand function are defined in a similar way as for the private consumption.

mal demand for differentiated private investment good m

$$I_{j,t}(m) = \left(\frac{P_t(m)}{P_t}\right)^{-\varepsilon_p} I_{j,t} \quad \text{for all } m \in [0,1]\,. \tag{6}$$

At the beginning of period t, household j receives a nominal labor income $W_{j,t}L_{j,t}$, where $W_{j,t}$ is the nominal wage. Then, in order to insure their consumption pattern against random shocks at time t, they spend $Q_{t,t+1}V_{j,t+1}$ in nominal state-contingent securities, where $Q_{t,t+1}$ is the price of a state contingent security that will pay a unit nominal payoff in a particular state of nature occurring in period $t+1$.[13] In addition, they spend $B_{j,t}$ of government bonds in period t and receive $R_tB_{j,t}$ in period $t+1$. Household j rents capital stock accumulated in $t-1$ to firms at a real rental rate r_t^k, resulting in an income given by $r_t^kK_{j,t}$. Household j's total income includes also nominal lump-sum transfers $P_tZ_{j,t} = P_tD_{j,t} - P_tT_{j,t} - F_{j,t}$, which are the sum of profits received from firms, the lump-sum taxes paid to the Government, and a union membership fee, respectively.[14] Now using (3), one can write the optimizer j's intertemporal budget constraint as follows

$$P_t\omega_{j,t} + P_tX_{j,t}^c + P_tI_{j,t} + \mathbb{E}_tQ_{t,t+1}V_{j,t+1} + B_{j,t} \leq W_{j,t}L_{j,t} + V_{j,t} + R_{t-1}B_{j,t-1} + P_tr_t^kK_{j,t} + P_tZ_{j,t}, \tag{7}$$

where $\omega_{j,t} = \theta\int_0^1 (P_t(m)/P_t)\,\bar{C}_{j,t-1}(m)\,dm$.

The optimizer j chooses sequence for $X_{j,t}^c$, $K_{j,t+1}$, $I_{j,t}$, $B_{j,t}$ and $V_{j,t+1}$ so as to maximize (4), subject to (7), (5) and a constraint that prevents from engaging in Ponzi games. The first-order conditions for this maximizing problem can be reduced to,

$$X_{j,t}^c = \frac{\varrho_{t,t+1}}{\beta}X_{j,t+1}^c, \qquad \forall s^t \tag{8}$$

$$\mathbb{E}_t\left\{\frac{\varrho_{t,t+1}}{\Pi_{t+1}}\right\} = \frac{1}{R_t} \tag{9}$$

$$X_{j,t}^c + \omega_{j,t} + \mathbb{E}_t\varrho_{t,t+1}v_{j,t+1} + b_{j,t} + I_{j,t} = w_{j,t}L_{j,t} + v_{j,t} + R_{t-1}\frac{b_{j,t-1}}{\Pi_t} + r_t^kK_{j,t} + Z_{j,t}, \tag{10}$$

and

[13] More generally, the stochastic discount factor can be written $Q_{t,T} = Q_{t,t+1} \times Q_{t+1,t+2} \times \ldots \times Q_{T-1,T}$, with $Q_{t,t+1} = 1$.

[14] In line with most of the literature on rule of thumb consumer, I assume that transfers are chosen such that at the steady state the two types of agents consume and supply the same amount of labor.

$$1-\left[1-\frac{\varphi_I}{2}\left(\frac{I_{j,t}}{I_{j,t-1}}-1\right)^2-\varphi_I\frac{I_{j,t}}{I_{j,t-1}}\left(\frac{I_{j,t}}{I_{j,t-1}}-1\right)\right]q_{j,t}$$
$$=\varphi_I\mathbb{E}_t\varrho_{t,t+1}\left(\frac{I_{j,t+1}}{I_{j,t}}\right)^2\left(\frac{I_{j,t+1}}{I_{j,t}}-1\right)q_{j,t+1}, \quad (11)$$

$$q_{j,t}=\mathbb{E}_t\varrho_{t,t+1}\left[(1-\delta)q_{j,t+1}+r^k_{t+1}\right], \quad (12)$$

where $\varrho_{t,t+k}=Q_{t,t+k}P_{t+k}/P_t$ is the real stochastic discount factor for k-periods ahead payoffs, $\Pi_t\equiv P_t/P_{t-1}$ denotes the gross inflation rate, $v_{j,t}\equiv V_{j,t}/P_t$, $b_{j,t}\equiv B_{j,t}/P_t$,$w_{j,t}\equiv W_{j,t}/P_t$ are real levels of $V_{j,t}$, $B_{j,t}$,and $W_{j,t}$,respectively. Eq.(8) corresponds to the Euler equation for consumption, (9) is the fisher equation and stems from an arbitrage condition for the asset market, and (10) stands for the real budget constraint of the optimizer.[15] The last two equations (11) and (12) describe the relation of the Tobin's Q denoted by $q_{j,t}$ to investment and its dynamics, respectively. Notice that the household j does not maximize its utility with respect to labor because I assume that the wage is set by unions and the hours worked are determined by labor demand. In this framework the wage markup should be sufficiently high to ensure that households be willing to supply any quantity of labor to unions.

2.1.2 Rule-of-Thumb (ROT) households

As stressed above, ROT households do not participate to financial markets nor do they hold physical capital. Therefore, each period, they are forced to spend their total disposable income on consumption of a basket of differentiated goods m according to,

$$P_tC_{i,t}=W_{i,t}L_{i,t}-P_tT_{i,t}-F_{i,t}, \quad (13)$$

where $W_{i,t}L_{i,t}$, $T_{i,t}$ and $F_{i,t}$ denote the labor income, lump-sum taxes paid to the government and union membership fee, respectively. Each period, household i delegates wage decisions to unions. Similar to the optimizer, ROT households demand for variety m is given by

$$C_{i,t}(m)=\left(\frac{P_t(m)}{P_t}\right)^{-\varepsilon_p}C_{i,t}. \quad (14)$$

2.2 Aggregation

The aggregate expressions for consumption and labor are simply the weighted average of the single consumer-type variables. Therefore, aggregate consumption demand and

[15]Notice that there are as many Euler equations as state of nature because markets are complete in this economy. In adddition, at the equilibrium a transversality condition holds, which means that the financial wealth of agent j tends to zero as time goes to infinity.

aggregate labor supply are respectively[16]

$$C_t = \int_0^{\lambda} C_{i,t} di + \int_{\lambda}^{1} C_{j,t} dj = \lambda C_{i,t} + (1-\lambda) C_{j,t}; \tag{15}$$

$$L_t = \lambda L_{i,t} + (1-\lambda) L_{j,t};\ F_t = \lambda F_{i,t} + (1-\lambda) F_{j,t};\ T_t = \lambda T_{i,t} + (1-\lambda) T_{j,t}. \tag{16}$$

Since ROT households do not have access to financial markets then aggregate demand for government bonds, state-contingent securities, capital, lump-sum taxes and profits are defined by

$$B_t = (1-\lambda) B_{j,t};\ V_t = (1-\lambda) V_{j,t};\ D_t = (1-\lambda) D_{j,t}; \tag{17}$$

$$K_t = (1-\lambda) K_{j,t};\ I_t = (1-\lambda) I_{j,t} \tag{18}$$

2.3 Unions

Following Colciago (2011) and Furlanetto & Seneca (2012), I assume a continuum of unions, indexed by $z \in [0,1]$, representing a continuum of workers of which a fraction λ is of type ROT and $1-\lambda$ is of type optimizer. Each period each union z chooses nominal wage, $W_{z,t}$ and aggregates labor as follow: $L_t = \left(\int_0^1 [L_{z,t}]^{\frac{\varepsilon_w - 1}{\varepsilon_w}} dz \right)^{\frac{\varepsilon_w}{\varepsilon_w - 1}}$, which leads to the following demand function for labor variety z (=i or j),

$$L_{z,t} = \left(\frac{W_{z,t}}{W_t} \right)^{-\varepsilon_w} L_t^d, \tag{19}$$

where W_t is an index of the wages prevailing in the economy at time t given by $W_t = \left(\int_0^1 W_{z,t}^{1-\varepsilon_w} dz \right)^{1/(1-\varepsilon_w)}$, and $\varepsilon_w > 1$ is the elasticity of substitution across different types of labor inputs. Each union maximizes the present value of an average of current and future utility of its members,

$$\mathbb{E}_t \sum_{s=t}^{\infty} \beta^{s-t} \left[(1-\lambda) \left(\ln X_{j,t}^c - \frac{L_{j,t}^{1+\upsilon}}{1+\upsilon} \right) + \lambda \left(\ln C_{i,t} - \frac{L_{i,t}^{1+\upsilon}}{1+\upsilon} \right) \right],$$

subject to the labor demand function (19) and the budget constraints of its members, (7) and (13). In addition, I assume that adjusting nominal wages is costly, which is reflected by the following Rotemberg-wage adjustment cost function

$$AC_t^W = \frac{\varphi_w}{2} \left(\frac{W_t(z)}{W_{t-1}(z)} - \Pi^w \right)^2, \tag{20}$$

[16]The steady-state lump-sum taxes are given by

$$T = \lambda T_r + (1-\lambda) T_o$$

where $\Pi_t^w(z) = W_t(z)/W_{t-1}(z)$ is the gross wage inflation rate, Π^w denotes its steady state level, φ_w determines the size of the nominal wage adjustment costs. Wage adjustments are costly because I take into account the fact that unions have to negotiate wages each period, which requires real resources to do so. The bigger the efforts put into the negotiation, the larger the wage increase is. Following Furlanetto & Seneca (2012), I assume that these adjustment costs are *in fine* equally shared among households through the payment of union membership fees. Therefore, each member of union z pays the following nominal fee; $F_t(z) = AC_t^W W_t L_t$. I also assume that firms do not distinguish between the two types of workers in their labor demand, which implies that all the households work the same number of hours and have the same wage, $L_{j,t} = L_{i,t} = L_t$, and $W_{j,t} = W_{i,t} = W_t$.

The optimality condition stemmed from the union's problem is given by

$$(1-\varepsilon_w) - \varphi_w \Pi_t^w \left(\Pi_t^w - \Pi^w\right) + \varepsilon_w \frac{L_t^{\upsilon}}{\varLambda_t w_t} + \varphi_w \beta \mathbb{E}_t \left\{ \frac{\varLambda_{t+1}}{\varLambda_t} \right\} \Pi_{t+1}^w \left(\Pi_{t+1}^w - \Pi^w\right) \frac{L_{t+1}}{L_t} \frac{w_{t+1}}{w_t} = 0, \quad (21)$$

where $\varLambda_t = \frac{(1-\lambda)}{X_{j,t}^c} + \frac{\lambda}{C_{i,t}}$ denotes the weighted average of the marginal utilities of consumption across the two types of households, and $L_t^{\upsilon}/\varLambda_t w_t$ is the inverse of the wage markup, which equals the marginal rate of substitution between consumption and labor divided by the real wage. Notice that in a flexible nominal wage framework, that is $\varphi_w = 0$, Eq.(21) reduces to $\frac{L_t^{\upsilon}}{\varLambda_t w_t} = \frac{\varepsilon_w - 1}{\varepsilon_w}$, that is nominal wages are flexible and are set as a constant markup of the marginal rate of substitution between consumption and leisure.

2.4 Government

The government allocates spending over the differentiated good m so as to maximize the quantity of composite good produced using good m as input according to

$$X_t^g = \left(\int_0^1 \left(G_t(m) - \theta_g G_{t-1}(m)\right)^{\frac{\varepsilon_p - 1}{\varepsilon_p}} dm \right)^{\frac{\varepsilon_p}{\varepsilon_p - 1}},$$

where $G_t(m)$ denotes the government's consumption of good m and $\theta_g \in [0,1)$ measures the degree of external habit formation in government consumption of each variety. Ravn et al. (2006), motivate the external deep habit formation in public spending by the fact that if the households consume public goods then it may exhibits a catching up with a Joneses behavior as it is the case with private consumption.[17] Alternatively, this assumption may be justified by the fact that the government may prefer transactions with vendors who provided public goods in the past. Accordingly, the government's

[17] They give the example of the situation in which the provision of public services in one community creates the desire in other communities to have access to the same type of service.

demand of the variety $m \in [0,1]$ is given by

$$G_t(m) = \left(\frac{P_t(m)}{P_t}\right)^{-\varepsilon_p} X_t^g + \theta_g G_{t-1}(m), \quad \text{for all } m \in [0,1]. \tag{22}$$

Letting B_t be promised nominal debt repayments by the government due at the beginning of period t, and $T_t = \lambda T_i + (1-\lambda) T_j$ stands for aggregate lump-sum taxes levied on households, the government budget constraint in nominal term is therefore given by

$$B_t + P_t T_t = R_{t-1} B_{t-1} + \int_0^1 P_t(m) G_t(m)\, dm. \tag{23}$$

Letting $b_t = B_t/P_t$, and $\Pi_t = P_t/P_{t-1}$, denote the real government bond, the gross inflation rate and the real wage, respectively, the government budget constraint in real terms reads as

$$b_t = \frac{R_{t-1}}{\Pi_t} b_{t-1} + \int_0^1 \frac{P_t(m)}{P_t} G_t(m)\, dm - T_t. \tag{24}$$

Fiscal Rule First, I assume that the fiscal policy follows a feedback fiscal debt targeting rules which aim at stabilizing public debt at some target $\bar{b}$.

$$T_{j,t} = \tau_j Y_t + \phi_b \left(b_{t-1} - \bar{b}\right), \tag{25}$$

$$T_{i,t} = \tau_i Y_t + \phi_b \left(b_{t-1} - \bar{b}\right), \tag{26}$$

where ϕ_b measures the degree of responsiveness of the fiscal instrument. Second, government spending, G_t, assumed to be exogenous and stochastic, evolves according to an autoregressive process (AR-1)

$$G_t = (1-\rho^g) G + \rho^g G_{t-1} + \xi_t^g, \tag{27}$$

where ξ_t^g is a white noise disturbance with standard deviation σ^g, and G is the steady state level of government spending. The parameter $\rho^g \in [0,1]$ reflects the autocorrelation of budget decisions.

Monetary Policy

Using the assumption introduced by Leeper (1991) and then generalized and popularized by Taylor (1993), the monetary policy adjusts, in a systematic manner, its nominal interest rate denoted by R_t, and equal to $E_t\left(Q_{t,t+1}\right)^{-1}$, in response to the ratio of the gross inflation, $\Pi_t = P_t/P_{t-1}$, to its long-run target, $\bar{\Pi}$. Let ϕ_π be the measure of the degree of responsiveness of the monetary instrument,

$$R_t = R\left(\frac{\Pi_t}{\bar{\Pi}}\right)^{\phi_\pi}. \tag{28}$$

Parameters ϕ_π, and ϕ_b are key to define regime M and F. In regime M, $\phi_\pi > 1$ and

$\phi_b > 1-\varrho$ and in regime F, $\phi_\pi < 1$ and $\phi_b < 1-\varrho$ in line with Leeper (1991).[18]

2.5 Firms

This section describes the problem of a firm m appeared before $t-1$.[19] Each monopolistically-competitive firm produces a quantity, $Y_t(m)$, of a single variety of good $m \in [0,1]$ using labor, $L_t(m)$, and physical capital via the following Cobb-Douglas production function

$$Y_t(m) = AK_t^\alpha(m) L_t^{1-\alpha}(m), \tag{29}$$

where $0 < \alpha < 1$, A is a constant level of technology. Firms are assumed to be price setters and are subject to costs associated with changing nominal prices. Price stickiness is introduced in the model, as Rotemberg (1982), in the form of a quadratic price adjustment costs,

$$AC_t^p(m) = \frac{\varphi_p}{2}\left(\frac{P_t(m)}{P_{t-1}(m)} - \Pi\right)^2, \tag{30}$$

where $\varphi_p \geq 0$ measures the degree of nominal price stickiness and Π is the steady state gross inflation rate.[20]

Using (15), and (18), the total aggregate demand for good m faced by the monopolistically-competitive firm m is given by

$$Y_t(m) \geq C_t(m) + G_t(m) + I_t(m), \tag{31}$$

where C_t, I_t and G_t denote aggregate levels of consumption, private investment and government spending, respectively.

Letting $D_t(m)$ be the period-t real profit of firm m, which is detailed in the following formula,

$$D_t(m) = \frac{P_t(m)}{P_t} Y_t(m) - w_t L_t(m) - r_t^k K_t(m) - AC_t^p(m) Y_t, \tag{32}$$

firm m maximizes the flow of its discounted profits,

$$\mathbb{E}_t \sum_{k=t}^{+\infty} \varrho_{t,k} D_k(m),$$

subject to (29), (31), (2), (14), (6), and (22). It results the following optimality condi-

[18] Zubairy (2014a) shows that deep habit assumption alters the standard determinacy conditions. We calibrate the model such as the determinacy conditions are verified. A sensitivity check will be made for different values of these parameters.

[19] Later on, I will assume that new firms behave in the same way as old firms.

[20] Virtually all papers featuring deep habits in consumption use a price adjustment costs à la Rotemberg (1982). The main reason is that it is a straightforward way of adding nominal price rigidities.

tions

$$w_t = (1-\alpha)\frac{Y_t(m)}{L_t(m)} mc_t(m), \tag{33}$$

$$r_t^k = \alpha \frac{Y_t(m)}{K_t(m)} mc_t(m), \tag{34}$$

$$(1-\lambda)\frac{P_t(m)}{P_t} = (1-\lambda) mc_t(m) + \mu_t^c(m) - \theta \mathbb{E}_t \varrho_{t,k} \mu_{t+1}^c(m), \tag{35}$$

$$\frac{P_t(m)}{P_t} = mc_t(m) + \mu_t^g(m) - \theta \mathbb{E}_t \varrho_{t,k} \mu_{t+1}^g(m), \tag{36}$$

and

$$\begin{aligned} &\frac{P_t(m)}{P_t}\left[(1-\lambda) C_{j,t}(m) + G_t(m)\right] - \varphi_p \Pi_t(m) \hat{\Pi}_t(m) Y_t + \varphi_p \mathbb{E}_t \varrho_{t,k} \Pi_{t+1}(m) Y_{t+1} \hat{\Pi}_{t+1}(m) \\ &\varepsilon_p \left(-\mu_t^c(m) X_{j,t}^c - \mu_t^g(m) X_t^g + \lambda \left[\frac{P_t(m)}{P_t}\left(\frac{1}{\varepsilon_p} - 1\right) + mc_t(m)\right] C_{i,t} + \right. \\ &\left. + (1-\lambda)\left[\frac{P_t(m)}{P_t}\left(\frac{1}{\varepsilon_p} - 1\right) + mc_t(m)\right] I_{j,t}\right)\left(\frac{P_t(m)}{P_t}\right)^{-\varepsilon_p} = 0, \end{aligned} \tag{37}$$

where $\Pi_t(m) \equiv P_t(m)/P_{t-1}(m)$, $\hat{\Pi}_t(m) \equiv \Pi_{t+1}(m) - \Pi$ and $mc_t(m)$, $\mu_t^c(m)$, $\mu_t^g(m)$, are Lagrangian multipliers associated with constraints (31), (2) and (22), respectively.

When prices are flexible ($\varphi_p = 0$), Eq. (37) implies that the markup is still non constant due to the nonlinearity brought about by deep habits. Two effects emerge: the elasticity effect and the inter-temporal substitution effect. Equations (35) and (36) show that if $\mu_t^c(m)$ and/or $\mu_t^g(m)$ increase, the markup rises (elasticity effect), *ceteris paribus*. Similarly, if $\mathbb{E}_t \varrho_{t,k} \mu_{t+1}^c(m)$ and/or $\mathbb{E}_t \varrho_{t,k} \mu_{t+1}^g(m)$ fall, the markup goes up, *ceteris paribus*. It is worth noting, that taking into account deep habits together with price stickiness tends to weaken these effects. Jacob (2015) argues that in response to a positive demand shock, the price elasticity increases exerting a downward pressure on the markup, but since prices are sticky, the expected path of inflation applies an opposite pressure on the markup.

3 SYMMETRIC EQUILIBRIUM AND CALIBRATION

3.1 Symmetric Equilibrium

Assuming that all firms, and optimizing households make the same decisions, in period $t-1$, implies that firms and households display the same behavior and make the same decisions also in period t. Accordingly, $P_t(m) = P_t$, $C_{j,t}(m) = C_{j,t}$, $L_t(m) = L_t$, $K_t(m) = K_t$, etc. I assume zero supply of state-contingent securities, that is $V_t = 0$. In the deterministic steady state all expectation operators are removed for each variable

$x_t = x_{t+1} = x$ and the stochastic shocks are absent. [21]

Aggregating the household budget constraints, (10) and (13), using (15), (16), (17), and (18) and combining them with the government budget constraint, (24), and firms' profits, (32), lead to the following market clearing condition, [22]

$$C_t + G_t + I_t = Y_t - AC_t^p Y_t - AC_t^W w_t L_t.D_{j,t} - P_t T_{j,t} - F_{j,t}. \tag{38}$$

3.2 Calibration

In this section, the values assigned to the parameters will be briefly discussed. Most parameter values are reported in table 2. The model is solved using Dynare.[23] I chose the parameter to be consistent with the calibration used in most papers embodying deep habit assumption (Ravn et al. (2006), Zubairy (2014b), Jacob (2015), and Leith et al. (2015)). Each period is considered to be a quarter. I set the discount factor β equal to 0.995 implying an annualized interest rate of 2% in the steady state. The capital elasticity of output, α, is assumed to be one third and the depreciation rate, δ, equals 0.025, that is an annual depreciation rate of 10%. The investment adjustment cost parameter, φ_I is set to 2.5 in line with Christiano et al. (2005). The two substitution elasticity parameters, ε_p and ε_w, are set to 11, which implies a steady-state markup of 10 % in the absence of deep habits. The deep habit consumption and government spending parameters, θ and θ_g are set to 0.86, which is consistent with the estimate in Ravn et al. (2006). The value of nominal price and wage rigidity parameters (φ_w and φ_p) and the share of rule-of-thumb consumers (λ) are set at 64.9, 69.4, 0.15 respectively. These values are taken from Batini et al. (2021) who build and estimate a model-based dynamic monetary and fiscal conditions index. They find, for Euro Area, values for φ_w, φ_p, and λ that range between $[51.6; 86.3]$, $[47.0; 82.6]$, and $[0.1; 0.21]$, respectively. A sensitivity analysis will be conducted for these parameters. The steady state share of government spending in GDP is $g_y = 0.2$. The steady state level of government debt to annual GDP is 60%, which is in line with debt target in the Maastricht Treaty. Regime M and F differ in monetary and fiscal policy parameters. Taylor-rule inflation response parameter is set at $\phi_\pi = 1.5$ in regime M, such as the Taylor principle is satisfied, while it is $\phi_\pi = 0$ in regime F, implying a constant-zero nominal interest rate. Tax-rule parameter, ϕ_b equals 0.1 and 0 in regime M and F, respectively. Accordingly, lump-sum taxes to GDP do not respond to government debt change and are constant in regime F.

[21] Details about the steady state are given in appendix D

[22] The full system of equilibrium equations is detailed in appendix B

[23] see Adjemian et al. (2011)

Table 2: Baseline parameter values

Discount factor	$\beta = 0.995$
Deep habit parameter	$\theta = \theta_g = 0.86$
Inverse of the Frisch elasticity of labor supply	$\upsilon = 1$
Steady state depreciation rate of capital	$\delta = 0.025$
Capital elasticity of output	$\alpha = 1/3$
Investment adjustment cost parameter	$\varphi_I = 2.5$
Steady-state price mark-up	$\varepsilon_p / (\varepsilon_p - 1) = 1.1$
Steady-state wage mark-up	$\varepsilon_w / (\varepsilon_w - 1) = 1.1$
Rotemberg price adjustment cost	$\varphi_p = 64.9$
Rotemberg wage adjustment cost	$\varphi_w = 69.4$
Steady state gross inflation rate	$\bar{\Pi} = 1.02$
Government debt to annual GDP	$b/(4y) = 0.6$
Government spending to GDP	$g_y = 0.2$
Share of Rule-of-Thumb households	$\lambda = 0.15$
Tax rule parameter	$\phi_b = \{0, 0.1\}$
Taylor rule, response to inflation	$\phi_\pi = \{0, 1.5\}$
Persistence of government spending	$\rho_g = 0.8$

4 GOVERNMENT SPENDING SHOCK

In this section, I will focus on government spending shocks. First, I will start by investigating the level of government spending multiplier at different horizons for each regime. Second, I will analyze the responses to a 1% government spending shock around the steady state in regime M and F.

4.1 Government spending multipliers

While the impact multiplier is an important measure of the effectiveness of fiscal policy, it is also important to look at longer horizons, which gives an indicator of the overall effectiveness of fiscal policy. I will consider the present-value multiplier at different horizons, which is defined as the discounted cumulative increase in output over T periods that results from the discounted cumulative increase in public spending over T periods after a spending shock in period 1:

$$PVM_T = \frac{\sum_{j=1}^{T} \beta^j \left(y_{t+j} - y_t\right)}{\sum_{j=1}^{T} \beta^j \left(g_{t+j} - g_t\right)}. \tag{39}$$

Table 3 and figure 2 report the impact multiplier ($T = 0$) and the present-value multipliers at 2 years ($T = 8$) and 5 years ($T = 20$) when the shock hits at the steady state of regime M and F. I investigate the sensitivity of my result to the degree of price rigidity, nominal wage rigidity, deep habits and the share of rule-of-thumb consumers.

The results are detailed in table 3.

Figure 2 shows that in regime M, the higher the degree of deep habits the higher the multiplier at any horizon. Notice that this relationship is stronger for the impact multiplier. In addition, the impact multiplier is greater than one for high values of θ (> 0.8). On the other hand, the impact multiplier decreases with the degree of deep habits, while it is the opposite for multipliers at horizon 2 and 5 years, in regime F.

It is noteworthy that the interaction of deep habits, rule-of-thumb consumers and nominal rigidities are key to having an impact multiplier greater than one in regime M. Actually, combining deep habits, rule-of-thumb consumers and at least nominal wage rigidity allows for a greater-than-one multiplier in regime M. In fact, in table 3 only row 6 and 10 exhibit values greater than one. It is interesting to notice that the value in row 6, where price rigidity is absent, is higher than the value in row 10. This result is in line with Jacob (2015) who argues that while deep habits and price stickiness assumption independently implies a fiscal multiplier greater than one, used together they exert opposing pressure on wage and markup that tends to lower the consumption-leisure substitution effect.

In regime F, it seems that nominal rigidity is a key assumption to having an impact multiplier greater than one. In fact, in table 3 the highest value is when $\theta = 0$ (row 9). Longer horizon multipliers (2 years and 5 years) are positive but have low levels in regime M, whereas they are greater than one in regime F when nominal stickiness are included. Accordingly, the global effectiveness of government spending multiplier is stronger in regime F than in regime M. In the next section, I will explain the mechanisms in play that generate these results.

Table 3: Multipliers at different horizons and different cases.

			0 year	2 years	5 years	0 year	2 years	5 years
	Parameters			Regime M			Regime F	
1	$\theta = 0$ $\lambda = 0$	$\varphi_p = 0$ $\varphi_w = 0$	0.414	0.273	0.162	0.414	0.273	0.162
2	$\theta = 0.86$ $\lambda = 0$	$\varphi_p = 0$ $\varphi_w = 0$	0.798	0.314	0.17	0.798	0.314	0.17
3	$\theta = 0$ $\lambda = 0.15$	$\varphi_p = 0$ $\varphi_w = 0$	0.401	0.263	0.199	0.402	0.243	0.120
4	$\theta = 0.86$ $\lambda = 0.15$	$\varphi_p = 0$ $\varphi_w = 0$	0.975	0.316	0.154	0.979	0.339	0.174
5	$\theta = 0$ $\lambda = 0.15$	$\varphi_p = 0$ $\varphi_w = 69.4$	0.444	0.418	0.352	1.234	0.822	0.657
6	$\theta = 0.86$	$\varphi_p = 0$	1.133	0.434	0.272	1.542	0.931	0.711

Table 3: Multipliers at different horizons and different cases.

			0 year	2 years	5 years	0 year	2 years	5 years
	$\lambda = 0.15$	$\varphi_w = 69.4$						
7	$\theta = 0$ $\lambda = 0$	$\varphi_p = 64.9$ $\varphi_w = 69.4$	0.631	0.487	0.376	1.672	1.316	1.114
8	$\theta = 0.86$ $\lambda = 0$	$\varphi_p = 64.9$ $\varphi_w = 69.4$	0.881	0.590	0.433	1.296	1.476	1.246
9	$\theta = 0$ $\lambda = 0.15$	$\varphi_p = 64.9$ $\varphi_w = 69.4$	0.723	0.548	0.462	1.826	$1,352$	$1,101$
10	$\theta = 0.86$ $\lambda = 0.15$	$\varphi_p = 64.9$ $\varphi_w = 69.4$	1.02	0.661	0.485	1.493	1.579	1.277

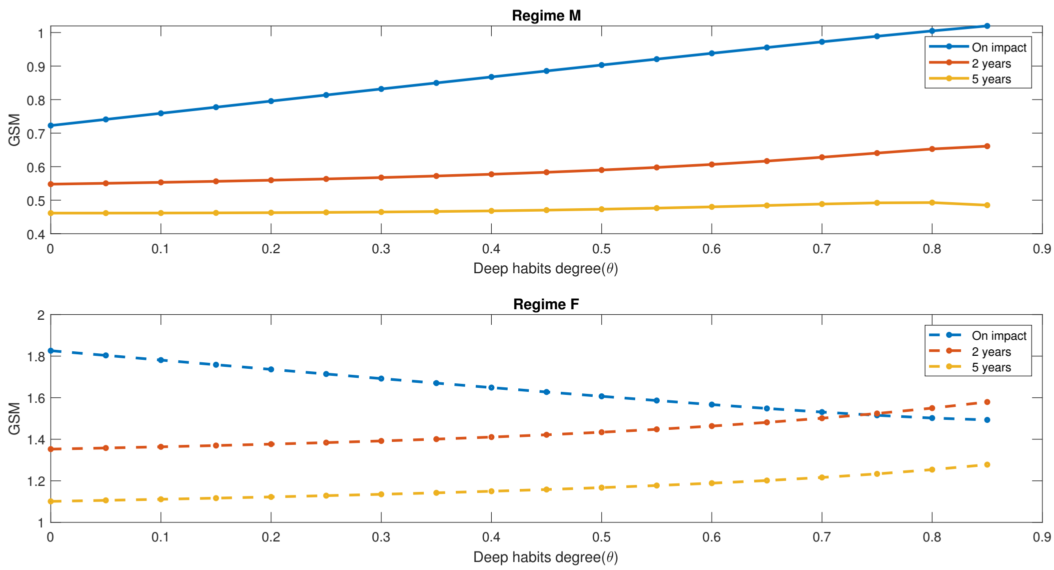

Figure 2: Size of Government Spending Multiplier

4.2 Impulse response functions

Figure 3, figure 4 and figure 5 display the response to a 1% government spending shock with a focus on the role of deep habits, rule-of-thumb consumers and nominal stickiness in regime M. Three scenarios are presented: without deep habits ($\theta = 0$), a mild level of deep habits ($\theta = 0.5$) and a high level of deep habits ($\theta = 0.86$)[24]. Similarly, figure 6,

[24] This level is in line with the estimation of Ravn et al. (2006) and Zubairy (2014b)

figure 7, and figure 8 display the response to a 1% government spending shock in regime F.

It is noticeable that the three features (deep habits, rule-of-thumb, and price and wage stickiness) are important to the effectiveness of an increase in government spending in both regimes, more particularly in regime M. Figure 3 and figure 6 show that in the absence of these three features, consumption and investment decrease, in both regimes, reflecting the crowding out effect of government spending mentioned by the neoclassical literature. On the other hand, this result contradicts with the theoretical literature that finds that government spending multipliers are bigger than unity in a low interest rate environment. In order to understand what causes these results, I will focus on the channels in place in this framework.

An increase in government spending has a direct and positive effect on the aggregate demand, causing a jump in the price level (depending on the degree of price rigidity) and the labor demand goes up. At the same time, high government spending means an increase in the present value of future taxes (if fiscal policy is passive), which reduces the present value of the household's net-of-tax income (*negative wealth effect*), leading to a fall in current consumption and a rise in labor supply (*intratemporal substitution effect*). As a consequence, the real wage decreases. Active monetary policy reacts to inflation by increasing proportionately more the nominal interest rate, raising thus the real interest rate. As a result, the investment drops, generating a fall in the initial increase of output.

In regime F, monetary and fiscal policy behave differently. In fact, monetary policy is passive and fiscal policy is active, which means that the nominal interest rate does not adjust to inflation changes and fiscal rule is unresponsive to public debt changes. As a consequence, the price level adjust to balance the government budget constraint and taxes remain constant which offsets the negative wealth effect. It results an increase in inflation and the real interest rate falls, producing a boost in investment and consumption. This is the standard finding in the common literature. However, figure 6 displays an increase in the real interest rate and a drop in investment and consumption. In this framework, the negative wealth effect is partially (not totally) offset. In fact, I assume that the fiscal rule has an automatic stabilizer term, which means that an increase in output produces higher taxes and thus reduces the present value of the household's net-of-tax income, leading to a consumption drop. In addition, the shock causes inflation to jump up more than in regime M, because it has to balance the government budget constraint (see Eq.40). The automatic stabilizer component induces a fall in public debt. Next period, inflation falls to balance the government budget constraint since public debt has decreased. Since the current real interest rate depends on the expected level of future inflation, the real interest rate falls, resulting in a decrease in investment and consumption.

$$b_{t+1} = \frac{b_t}{\Pi_{t+1}} + G_{t+1} - \tau y_{t+1}. \tag{40}$$

Figure 5 and figure 8 display the response to a 1% government spending shock when the three features are taking into account. In both regimes, consumption and output increase, while investment falls in regime M and rises in regime F. The explanation lies in the interaction of the channels detailed previously with the additional channels raised by deep habits and rule-of-thumb consumers. Under deep habits, households who consume a large amount of a particular good today are more likely to buy this kind of good in the future by force of habit. Accordingly, an increase in the demand for good caused by an increase in government spending leads to an increase in the price elasticity of demand, implying an decrease in markup today. As a result, consumption goes up because of the real wage increase. In regime M, the real interest rate rises, which implies a decrease in the present value of future demand. Expecting higher demand in the future, firms decrease the current markup in order to build customer capital. The real wage decrease and consumption goes up. In regime F, the real interest rate decreases, implying opposite effects on the markup, which rises, and consumption goes down through these two channels. Notice that in figure 8 the higher the degree of deep habits, the lower the consumption increase.

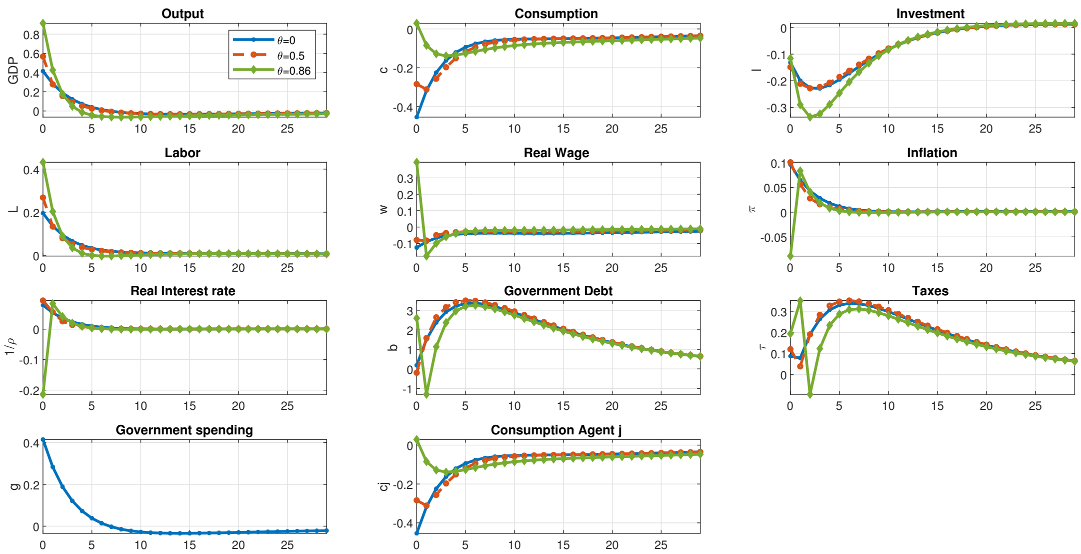

Figure 3: Government Spending Shock in Regime M, $\varphi_p = 0$, $\varphi_w = 0$, $\lambda = 0$

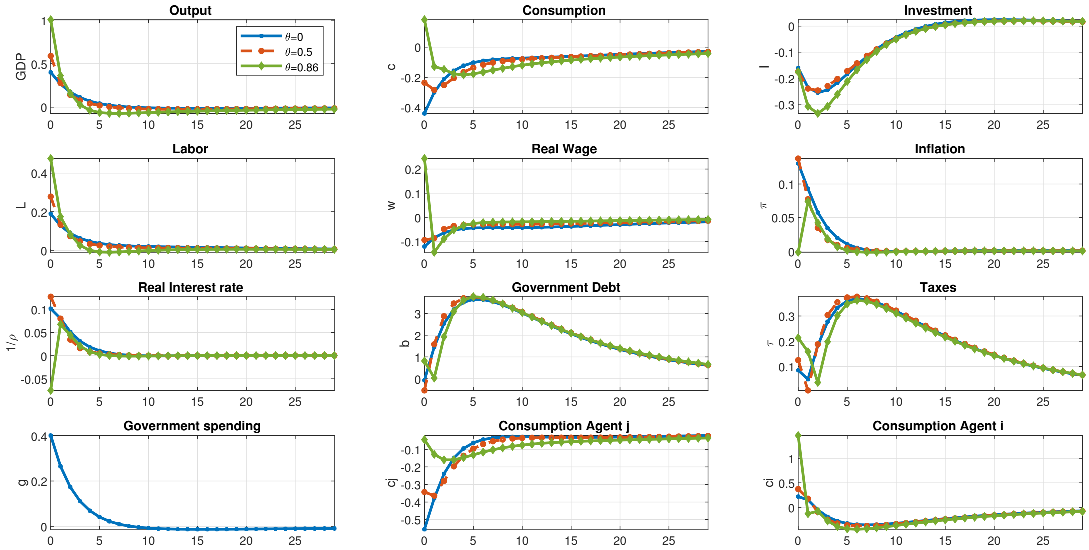

Figure 4: Government Spending Shock in Regime M, $\varphi_p = 0$, $\varphi_w = 0$, $\lambda = 0.15$

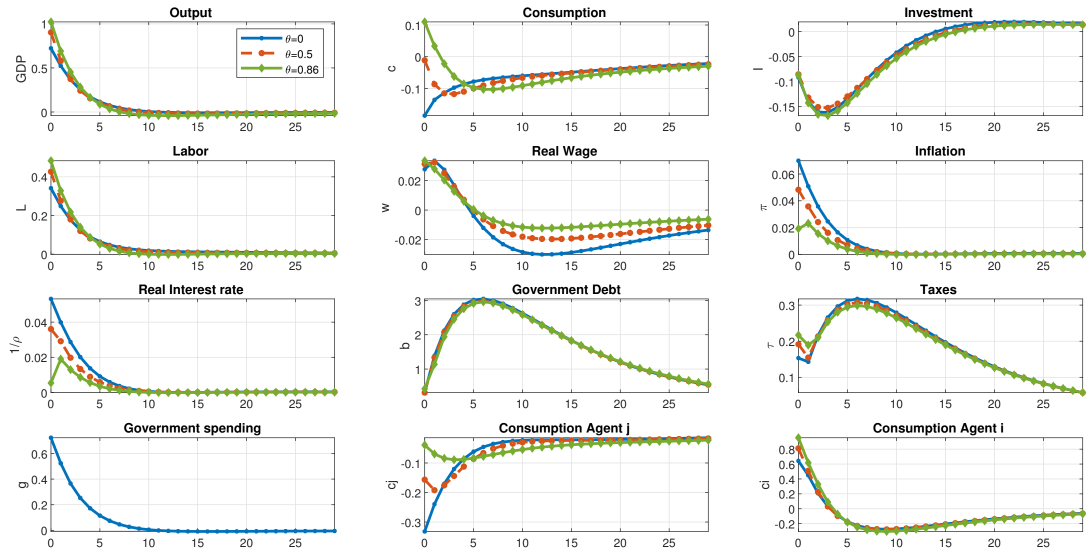

Figure 5: Government spending shock in regime M, $\varphi_p = 64.9$, $\varphi_w = 69.4$, $\lambda = 0.15$

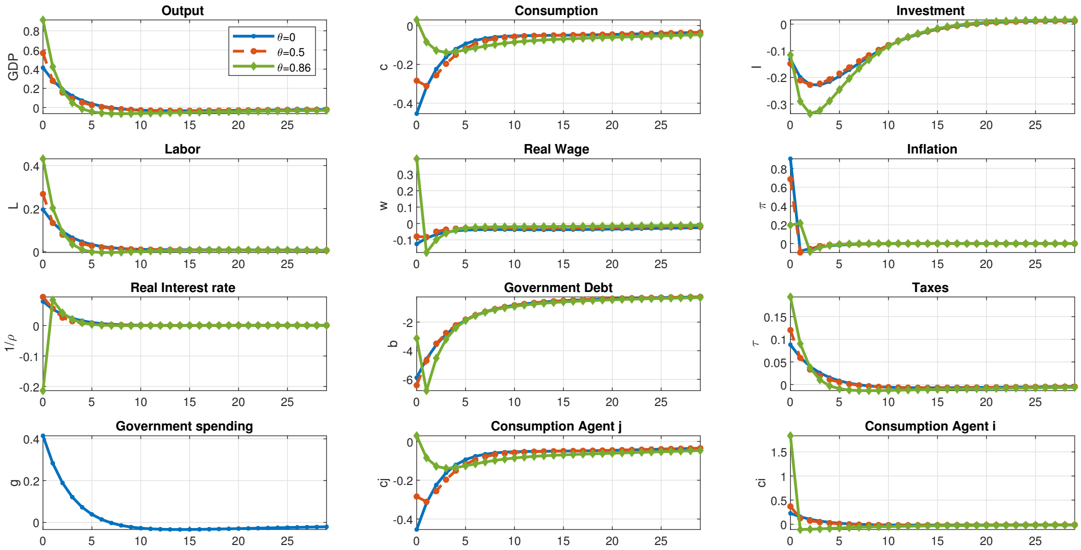

Figure 6: Government Spending Shock in regime F, $\varphi_p = 0$, $\varphi_w = 0$, $\lambda = 0$

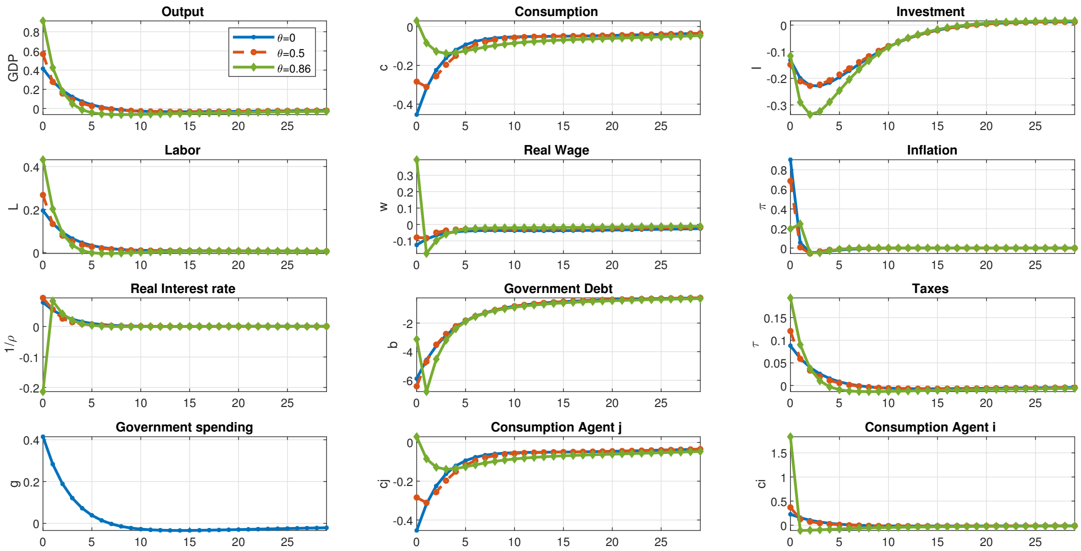

Figure 7: Government Spending Shock in regime F, $\varphi_p = 0$, $\varphi_w = 0$, $\lambda = 0.15$

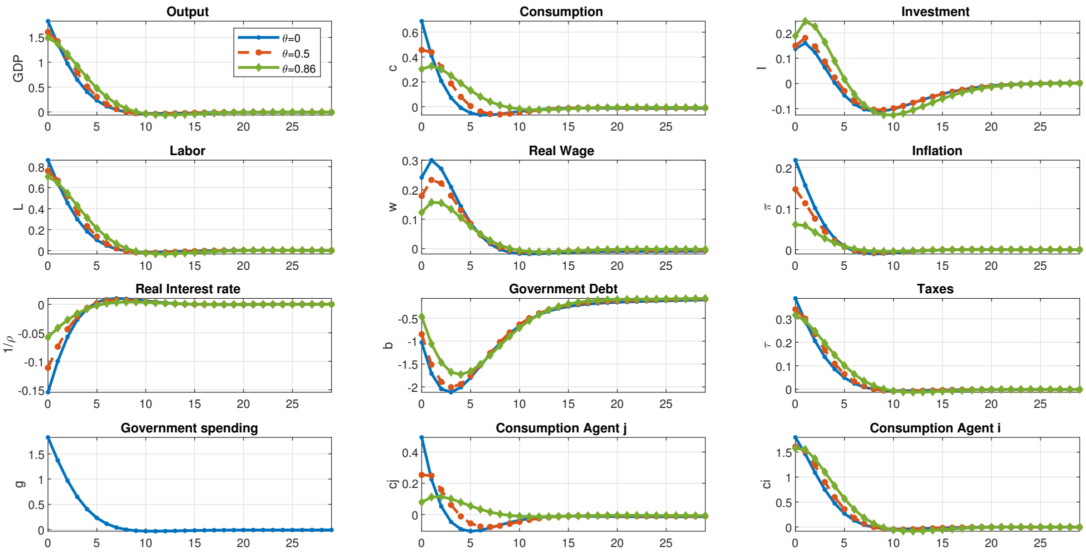

Figure 8: Government spending shock regime F, $\varphi_p = 64.9$, $\varphi_w = 69.4$, $\lambda = 0.15$

5 CONCLUSION

This paper investigates the effectiveness of government spending shocks in regime M, where monetary policy is active and fiscal policy is passive, and in regime F, where monetary policy is passive and fiscal policy is active. I build a New-Keynesian model incorporating external deep habits and rule-of-thumb consumers. I find that three features are key to have a greater-than-one multiplier in regime M: deep habits, rule-of-thumb consumers and at least one nominal rigidity. specifically, I show that government spending multiplier is an increasing function of deep habits. On the other hand, in regime F, government spending multiplier is a decreasing function of deep habits. I show that, in regime F, the key feature for a greater-than-one multiplier is nominal rigidity.

I analyze the global effectiveness of government spending shocks by computing the present-value multipliers at longer horizons (2 years and 5 years). I find that government spending is more effective in regime F than in regime M, even though the impact multiplier is greater than unity in both regimes. The explanation lies on the interaction between traditional channels triggered by wealth and substitution effects and the additional substitution effects caused by deep habits.

Appendices

A Detailed derivative of wage setting equation

The union z chooses nominal wage, $W_t(z)$, to maximize the present value of an average of current and future utility of its members, that is,

$$\mathbb{E}_t \sum_{s=t}^{\infty} \beta^{s-t} \left[(1-\lambda) \left(\ln X_{j,t}^c - \chi \frac{L_{j,t}^{1+\upsilon}}{1+\upsilon} \right) + \lambda \left(\ln C_{i,t} - \chi \frac{L_{i,t}^{1+\upsilon}}{1+\upsilon} \right) \right],$$

subject to the demand functions,

$$L_{i,t} = \left(\frac{W_{i,t}}{W_t} \right)^{-\varepsilon_w} L_t^d, \tag{A.1}$$

$$L_{j,t} = \left(\frac{W_{j,t}}{W_t} \right)^{-\varepsilon_w} L_t^d, \tag{A.2}$$

and budget constraints

$$X_{j,t}^c = \frac{W_{j,t}}{P_t} \left(\frac{W_{j,t}}{W_t} \right)^{-\varepsilon_w} L_t^d - \frac{\varphi_w}{2} \left(\frac{W_{j,t}}{W_{j,t-1}} - \Pi^w \right)^2 \frac{W_t}{P_t} L_t + \Upsilon_{j,t}, \tag{A.3}$$

$$C_{i,t} = \frac{W_{i,t}}{P_t} \left(\frac{W_{i,t}}{W_t} \right)^{-\varepsilon_w} L_t^d - \frac{\varphi_w}{2} \left(\frac{W_{i,t}}{W_{i,t-1}} - \Pi^w \right)^2 \frac{W_t}{P_t} L_t - T_{i,t}, \tag{A.4}$$

where $\Upsilon_{j,t} = v_{j,t} + R_{t-1} b_{j,t-1}/\Pi_t + r_t^k K_{j,t} + D_{j,t} - T_{j,t} - b_{j,t} - \mathbb{E}_t \varrho_{t,t+1} v_{j,t+1} - I_{j,t} - \omega_{j,t}$

The first order condition with respect to $W_{z,t}$, with $z = i, j$ is

$$(1-\lambda) \frac{\partial U_{j,t}}{\partial X_{j,t}^c} \frac{\partial X_{j,t}^c}{\partial W_{j,t}} + \lambda \frac{\partial U_{i,t}}{\partial C_{i,t}} \frac{\partial C_{i,t}}{\partial W_{i,t}} + (1-\lambda) \frac{\partial U_{j,t}}{\partial L_{j,t}} \frac{\partial L_{j,t}}{\partial W_{j,t}} + \lambda \frac{\partial U_{i,t}}{\partial L_{i,t}} \frac{\partial L_{i,t}}{\partial W_{i,t}}$$
$$+ \beta \mathbb{E}_t \left\{ (1-\lambda) \frac{\partial U_{j,t+}}{\partial X_{j,t+1}^c} \frac{\partial X_{j,t+1}^c}{\partial W_{j,t}} + \lambda \frac{\partial U_{i,t+1}}{\partial C_{i,t+1}} \frac{\partial C_{i,t+1}}{\partial W_{i,t}} \right\} = 0. \tag{A.5}$$

More precisely,

$$(1-\lambda) \frac{1}{X_{j,t}^c} \left[\frac{(1-\varepsilon_w)}{W_t} L_{j,t} - \varphi_w \frac{1}{W_{j,t-1}} \left(\frac{W_{j,t}}{W_{j,t-1}} - \Pi^w \right) L_t \right] \frac{W_t}{P_t}$$
$$+ \lambda \frac{1}{C_{i,t}} \left[\frac{(-\varepsilon_w + 1)}{W_t} L_{i,t} - \varphi_w \frac{1}{W_{i,t-1}} \left(\frac{W_{i,t}}{W_{i,t-1}} - \Pi^w \right) L_t \right] \frac{W_t}{P_t}$$
$$+ (1-\lambda) \chi \varepsilon_w \frac{L_{j,t}^{\upsilon+1}}{W_{j,t}} + \lambda \chi \varepsilon_w \frac{L_{i,t}^{\upsilon+1}}{W_{i,t}}$$
$$+ \beta \mathbb{E}_t \left\{ (1-\lambda) \frac{1}{X_{j,t+1}^c} \varphi_w \frac{W_{j,t+1}}{W_{j,t}^2} \left(\frac{W_{j,t+1}}{W_{j,t}} - \Pi^w \right) \frac{W_{t+1}}{P_{t+1}} L_{t+1} \right.$$
$$\left. + \lambda \frac{1}{C_{i,t+1}} \varphi_w \frac{W_{i,t+1}}{W_{i,t}^2} \left(\frac{W_{i,t+1}}{W_{i,t}} - \Pi^w \right) \frac{W_{t+1}}{P_{t+1}} L_{t+1} \right\} = 0 \tag{A.6}$$

Assuming symmetry, that is, $L_{j,t} = L_{i,t} = L_t$ and $W_{j,t} = W_{i,t} = W_t$, and letting $\Pi_t^w = \frac{W_t}{W_{t-1}}$ be the gross nominal wage inflation, (A.6) reduces to

$$\left(\frac{(1-\lambda)}{X_{j,t}^c} + \frac{\lambda}{C_{i,t}} \right) \frac{W_t}{P_t} \left[(1-\varepsilon_w) - \varphi_w \Pi_t^w \left(\Pi_t^w - \Pi^w \right) \right] + \chi \varepsilon_w L_t^\upsilon$$
$$+ \beta \mathbb{E}_t \left\{ \frac{(1-\lambda)}{X_{j,t+1}^c} + \frac{\lambda}{C_{i,t+1}} \right\} \varphi_w \Pi_{t+1}^w \left(\Pi_{t+1}^w - \Pi^w \right) \frac{L_{t+1}}{L_t} \frac{W_{t+1}}{P_{t+1}} = 0 \quad \text{(A.7)}$$

B Market clearing condition

To find the market clearing condition, I need first to specify the aggregate budget constraint. Hence, I aggregate (10) and (13), using (15), (16), (17), and (18). Notice that because of the symmetry in our model, $L_{j,t} = L_{i,t} = L_t$, and $W_{j,t} = W_{i,t} = W_t$. The aggregate budget constraint is given by

$$C_t + b_t + I_t = \frac{R_{t-1}}{\Pi_t} b_{t-1} + r_t^k K_t + D_t - T_t + w_t L_t - AC_t^W w_t L_t. \quad \text{(B.1)}$$

I used $C_t = (1-\lambda) C_{j,t} + \lambda C_{i,t}$, where

$$C_{j,t} + \frac{G_t - T_t}{1-\lambda} + \frac{I_t}{1-\lambda} = w_t L_t + \frac{Y_t - w_t L_t - AC_t^p Y_t}{1-\lambda} - \tau_j Y_t - \phi_b \left(b_{t-1} - \bar{b} \right) - AC_t^W w_t L_t,$$

and

$$C_{i,t} = \left(1 - AC_t^W \right) w_t L_t - \tau_i Y_t - \phi_b \left(b_{t-1} - \bar{b} \right).$$

Combining (32), and (24) with (B.1), yields the following market clearing condition

$$C_t + G_t + I_t = Y_t - AC_t^p Y_t - AC_t^W w_t L_t$$

C The system of equilibrium equations

The full system of equilibrium equations is summarized in this appendix. I have 23 equations and 23 variables (AC_t^W,Π_t,w_t,AC_t^p,Y_t,K_t, L_t,C_t,G_t,I_t,b_t,R_t,mc_t,r_t^k,μ_t^c,μ_t^g,$C_{j,t}$,$\varrho_{t,t,+1}$,$X_{j,t}^c$,X_t^g,$C_{i,t}$, Π_t^w, and $q_{j,t}$)

$$AC_t^W = \frac{\varphi_w}{2} \left(\Pi_t^w - \Pi^w \right)^2 \quad \text{(C.1)}$$

$$AC_t^p = \frac{\varphi_P}{2} \left(\Pi_t - \Pi \right)^2, \quad \text{(C.2)}$$

$$Y_t = A K_t^\alpha L_t^{1-\alpha}, \quad \text{(C.3)}$$

$$C_t + G_t + I_t = Y_t - AC_t^p Y_t - AC_t^W w_t L_t \tag{C.4}$$

$$b_t = \frac{R_{t-1}}{\Pi_t} b_{t-1} + G_t - \left[\lambda \tau_i + (1-\lambda)\,\tau_j\right] Y_t - \phi_b \left(b_{t-1} - \bar{b}\right) \tag{C.5}$$

$$w_t = (1-\alpha)\,\frac{Y_t}{L_t} mc_t, \tag{C.6}$$

$$r_t^k = \alpha \frac{Y_t}{K_t} mc_t, \tag{C.7}$$

$$\begin{aligned}
(1-\lambda) &= (1-\lambda)\, mc_t + \mu_t^c - \theta \mathbb{E}_t \varrho_{t,t+1} \mu_{t+1}^c, && \text{(C.8)} \\
1 &= mc_t + \mu_t^g - \theta_g \mathbb{E}_t \varrho_{t,t+1} \mu_{t+1}^g, && \text{(C.9)}
\end{aligned}$$

$$\begin{aligned}
(1-\lambda)\, C_{j,t} + G_t - \varphi_P \Pi_t \left(\Pi_t - \Pi\right) Y_t + \varphi_P \mathbb{E}_t \varrho_{t,t+1} \Pi_{t+1} Y_{t+1} \left(\Pi_{t+1} - \Pi\right) \\
-\varepsilon_p \left(\mu_t^c X_{j,t}^c + \mu_t^g X_t^g\right) + \lambda \left[(1-\varepsilon_p) + \varepsilon_p mc_t\right] C_{i,t} \\
+ \left[(1-\varepsilon_p) + \varepsilon_p mc_t\right] I_t = 0
\end{aligned} \tag{C.10}$$

$$\begin{aligned}
\left[(1-\varepsilon_w) - \varphi_w \Pi_t^w \left(\Pi_t^w - \Pi^w\right)\right] + \varepsilon_w \frac{L_t^{\upsilon}}{\left(\frac{(1-\lambda)}{X_{j,t}^c} + \frac{\lambda}{C_{i,t}}\right) w_t} \\
+\beta \mathbb{E}_t \left\{ \frac{\frac{(1-\lambda)}{X_{j,t+1}^c} + \frac{\lambda}{C_{i,t+1}}}{\frac{(1-\lambda)}{X_{j,t}^c} + \frac{\lambda}{C_{i,t}}} \right\} \varphi_w \Pi_{t+1}^w \left(\Pi_{t+1}^w - \Pi^w\right) \frac{L_{t+1}}{L_t} \frac{w_{t+1}}{w_t} = 0
\end{aligned} \tag{C.11}$$

$$\Pi_t^w = \frac{w_t}{w_{t-1}} \Pi_t \tag{C.12}$$

$$G_t - \theta_g G_{t-1} = X_t^g, \tag{C.13}$$

$$C_{j,t} - \theta C_{j,t-1} = X_{j,t}^c \tag{C.14}$$

$$C_t = \lambda C_{i,t} + (1-\lambda)\, C_{j,t} \tag{C.15}$$

$$C_{i,t} = \left(1 - AC_t^W\right) w_t L_t - \tau_i Y_t - \phi_b \left(b_{t-1} - \bar{b}\right) \tag{C.16}$$

$$X^c_{j,t} = \frac{\varrho_{t,t+1}}{\beta} X^c_{j,t+1}, \qquad \forall s^t \tag{C.17}$$

$$\mathbb{E}_t \left\{ \frac{\varrho_{t,t+1}}{\Pi_{t+1}} \right\} = \frac{1}{R_t} \tag{C.18}$$

$$1 = \left[1 - \frac{\varphi_I}{2} \left(\frac{I_t}{I_{t-1}} - 1 \right)^2 - \varphi_I \frac{I_t}{I_{t-1}} \left(\frac{I_t}{I_{t-1}} - 1 \right) \right] q_{j,t} \tag{C.19}$$

$$+ \quad \varphi_I \mathbb{E}_t \varrho_{t,t+1} \left(\frac{I_{t+1}}{I_t} \right)^2 \left(\frac{I_{t+1}}{I_t} - 1 \right) q_{j,t+1}, \tag{C.20}$$

$$q_{j,t} = \mathbb{E}_t \varrho_{t,t+1} \left[(1-\delta) q_{j,t+1} + r^k_{t+1} \right]$$

$$K_{t+1} = (1-\delta) K_t + \left[1 - \frac{\varphi_I}{2} \left(\frac{I_t}{I_{t-1}} - 1 \right)^2 \right] I_t, \tag{C.21}$$

$$R_t = R \left(\frac{\Pi_t}{\bar{\Pi}} \right)^{\phi_\pi}, \tag{C.22}$$

$$G_t = (1 - \rho^g) G + \rho^g G_{t-1} + \xi^g_t, \tag{C.23}$$

D The steady state

In this appendix, I detail the steady state equilibrium. At the steady state, all dynamic variables are constant, therefore the subscript is removed.

$$AC^W = 0 \tag{D.1}$$

$$AC^p = 0 \tag{D.2}$$

$$\varrho = \beta \tag{D.3}$$

$$1 = q_j, \tag{D.4}$$

$$\frac{1}{\varrho} - 1 + \delta = r^k \tag{D.5}$$

$$(1-\theta_g)\, G = X^g \tag{D.6}$$

$$(1-\theta_c)\, C_j = X_j^c \tag{D.7}$$

$$\Pi^w = \Pi \tag{D.8}$$

$$\Pi = \bar{\Pi} \tag{D.9}$$

$$b = \bar{b} \tag{D.10}$$

$$R = \frac{\Pi}{\varrho} \tag{D.11}$$

$$\delta K = I, \tag{D.12}$$

$$(1-mc)\,\frac{(1-\lambda)}{1-\theta\varrho} = \mu^c \tag{D.13}$$

$$\frac{(1-mc)}{(1-\theta_g\varrho)} = \mu^g \tag{D.14}$$

$$\frac{C}{Y} = 1-\frac{G}{Y}-\frac{\delta K}{Y} \tag{D.15}$$

$$Y = AK^{\alpha}L^{1-\alpha} \tag{D.16}$$

$$\left(1-\frac{R}{\Pi}\right)\frac{b}{Y} = \frac{G}{Y}-\left((1-\lambda)\,\tau_j+\lambda\tau_i\right) \tag{D.17}$$

$$w = (1-\alpha)\frac{Y}{L}mc, \tag{D.18}$$

$$r^k = \alpha\frac{Y}{K}mc, \tag{D.19}$$

$$(1-\lambda)C_j + G - \varepsilon_p\left((1-mc)\frac{(1-\lambda)}{1-\theta\varrho}(1-\theta)C_j + \frac{(1-mc)}{(1-\theta\varrho)}(1-\theta_g)G\right) + \lambda\left[(1-\varepsilon_p)+\varepsilon_p mc\right]C_i + \left[(1-\varepsilon_p)+\varepsilon_p mc\right]\delta K = 0 \tag{D.20}$$

$$\left(\frac{(1-\lambda)}{(1-\theta)C_j} + \frac{\lambda}{C_i}\right)\left[(1-\varepsilon_w)\right] + \chi\varepsilon_w\frac{L^{\upsilon}}{w} = 0 \tag{D.21}$$

$$C = \lambda C_i + (1-\lambda)C_j \tag{D.22}$$

τ_j and τ_i are determined such as $C_i = C_j = C$. Therefore, using household i and household j budget constraints, 10 and 13, respectively, leads to the following result

$$\frac{C_j}{Y} = \frac{1-\left(1-\frac{1}{\beta}\right)\frac{b}{Y} - \delta\frac{K}{Y} - \lambda wL}{1-\lambda} - \tau_j,$$

$$\frac{C_i}{Y} = w\frac{L}{Y} - \tau_i,$$

The condition required is

$$\tau_j - \frac{1}{1-\lambda}\left[1-\left(1-\frac{1}{\beta}\right)\frac{b}{Y} - \delta\frac{K}{Y} - \frac{wL}{Y}\right] = \tau_i.$$

Using D.17, τ_j and τ_i must satisfy

$$\tau_i = \frac{G}{Y} + \delta\frac{K}{Y} + \frac{wL}{Y} - 1, \tag{D.23}$$

and

$$\tau_j = \frac{G}{Y} + \frac{\lambda}{(1-\lambda)}\left(1-\delta\frac{K}{Y} - \frac{wL}{Y}\right) - \frac{1}{(1-\lambda)}\left(1-\frac{1}{\beta}\right)\frac{b}{Y}. \tag{D.24}$$

Assuming $\theta = \theta_g < 1$ and using$C_i = C_j = C$, D.20 reduces to

$$\left[1-\varepsilon_p\Theta + \varepsilon_p\Theta mc\right]\left[1-(g+\Xi mc)\right] + \left[1-\varepsilon_p+\varepsilon_p mc\right](g+\Xi mc) = 0, \tag{D.25}$$

where $g = \lambda - \lambda \frac{G}{Y}$, $\Xi = (1-\lambda)\frac{\delta\alpha}{r^k}$ and $\Theta = \frac{(1-\theta)}{1-\theta\varrho}$. Notice that (D.25) is is a polynomial of degree 2. Without deep habits, we find the standard result that the markup solely depends on the elasticity of substitution across varieties ε_p ,

$$mc = \frac{\varepsilon_p - 1}{\varepsilon_p}$$

I calibrate the level of ε_p such as the price markup equals 10% that is $mc = 1/1.1$ then $\varepsilon_p = 1/(1-mc) = 11$. The same assumption is made for the wage markup, which implies $\varepsilon_w/(\varepsilon_w - 1) = 1.1$, that is $\varepsilon_w = 11$. I solve (D.25) numerically using DYNARE.

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