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Money growth pegging, Taylor rule, status-seeking behavior and the "*spirit of capitalism*"

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Abstract

This paper analyzes the impact of "*spirit of capitalism*" on stationary welfare and stability properties of a one-sector Ramsey economy, where the demand of money is motivated by a cash-in-advance constraint on consumption expenditures. Preferences are defined over consumption and capital stock. There is a monetary authority that follows either a money growth pegging rule or an interest rate pegging rule. When a money growth pegging rule is introduced, a unique steady state emerges. A slight desire for status is a sufficient condition for an increase in the money growth rate to exert a local stabilizing effect and to improve stationary welfare. When an interest rate pegging rule is introduced, two steady states may emerge: a "liquidity trap" and an "interior" steady state. Both steady states are locally determinate. Moreover, we show that a slight desire for status is also a sufficient condition to ensure that the stationary welfare at "interior" steady state is higher than the one of the "liquidity trap". It follows that an increase in the policy rate is, then, an efficient way to exit the "liquidity trap" steady state. Under similar conditions, a higher policy rate increases the stationary welfare at the "interior" steady state.

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KEYWORDS
indeterminacy, interest rate pegging, liquidity trap exit strategy, money growth pegging, social-status, stationary welfare

JEL CLASSIFICATION
C61, C62, E41, E43, E58

1 | INTRODUCTION

A huge literature underlines that the economic agents accumulate wealth not only for the sake of consumption but also for wealth-induced status. The role of status in the consumption choices of individuals dates back to Weber (1905) in his "Ethics of Protestantism and the Spirit of Capitalism" and captures the "*spirit of capitalism*". Indeed, such a search brings conspicuous behaviors through interpersonal influence. The existing literature focuses on fiscal policy and leaves aside monetary policy.[1] What has been less investigated, however, is the role played by the different monetary policies on the features of economies displaying social status. In such a case, indeed, one may wonder how the different monetary rules influence the number of steady state, stationary welfare as well as their stability.

To answer these questions, we introduce agents' preference with wealth effects (capital holding) into a monetary Ramsey model where agents face a liquidity constraint.[2] We study an infinite-horizon discrete-time economy populated by agents whose preferences are defined over consumption and capital. Indeed, preference includes wealth-enhanced social status represented by its physical-capital ownership relative to the economy's aggregate level. Agents are accumulating physical capital good, one-period bonds and money balances. The demand of money is motivated by the presence of a liquidity constraint on consumption expenditures, which compels agents to buy a fraction of the value of the consumption good out of the money balances available in the foregoing period. As a consequence, consumption requires a pre-investment in money balances entailing an opportunity cost represented by the nominal interest rate. Fiscal authority issues one-period bonds and levies taxes to finance public expenditures while the monetary authority operates in the bond market by issuing unbacked fiat money. On top of that, the monetary authority pegs the money growth rate or the nominal interest rate. Within these two monetary policies we consider, we carry out a complete steady state analysis and analyze the local stability of the stationary solutions.

Under the assumption that the monetary authority pegs the money growth factor, there emerges a unique steady state that is locally indeterminate for low enough intertemporal

[1] Kurz (1968) addressed the role of optimal income taxation in social aspirations in wealth (labeled by "*spirit of capitalism*").

[2] As an example, wealth effect in preference has been used to understand several economic phenomena: (i) differences in economic growth across countries (Kurz, 1968; Zou, 1994); (ii) business cycle (Karnizova, 2010); (iii) the existence of bubble (Zhou, 2016); (iv) the Equity Premium Puzzle (Bakshi & Chen, 1996); (v) occupational choice (Doepke & Zilibotti, 2008); (vi) savings and wealth accumulation (Cole et al., 1992); (vii) economic growth (Pham, 2005); (viii) Trade convergence (Shimomura & Van Long, 2004). The status effect channel may have important implications for the action done by the monetary authority. Indeed, the "*spirit of capitalism*" approach modifies the modified Golden-rule result in the optimal growth literature, as explained in Kurz (1968) and Zou (1994), which give a different motive for savings and capital accumulation.

elasticity of substitution (IES) of consumption. Moreover, we show at the stationary state that an increase in the money growth factor is welfare improving when the search of status is low enough, and exerts, also, a local stabilizing effect, that is, reduces the likelihood of local indeterminacy. Thus, our results show that an expansionary monetary policy can reduce the emergence of instability and, at a same time, raise stationary welfare.

Under a monetary policy consisting in a pegging the nominal interest factor in response to the inflation gap according to a Taylor feedback rule two stationary solutions may arise: The first one is associated with a positive interest rate, the "interior" steady state, the second corresponding to its Zero Lower Bound, that is, the "liquidity trap" steady state. Specifically, when monetary policy raises interest factor less than one-for-one in response to gross rate of inflation, only one steady state emerges and thus any monetary expansion will be beneficial as soon as the search for status is low enough, that is, even a slight search for social status is sufficient for the monetary expansion to be beneficial. However, when monetary policy raises interest factors more than one-for-one in response to gross rate of inflation, both the "liquidity trap" steady state and the "interior" steady state occur. Monetary expansion has no impact at the "liquidity trap" steady state while it has a positive stationary welfare impact at the "interior" steady state when there is a low desire for status. In our model, the Taylor principle holds, that is, a monetary policy raising interest rates more than one-for-one in response to gross rate of inflation ensures local stability and uniqueness of the equilibrium (e.g. Woodford, 2003). We show that the "interior" steady state is characterized by higher gross rate of inflation and capital stock (hence production) than the "liquidity trap" steady state. Moreover, we show that stationary welfare is higher at the "interior" steady state when there is a slight desire for status. These results provide a rationale for escaping from the "liquidity trap" at the stationary state and for restoring the "interior" steady state.

The rest of the paper is organized as follows. In Section 2 we present the model while in Section 3 and Section 4 we provide the perfect foresight equilibrium and the steady state. We also perform some comparative statics and welfare analysis. Section 5 provides the analysis of the local stability properties. Finally, Section 6 concludes. Proofs are gathered in the Appendix.

2 | THE MODEL

We consider an infinite horizon economy in discrete time ($t = 0, 1, ..., \infty$), which is populated by households, one representative firm producing a consumable capital good, a fiscal authority and a monetary authority. In the sequel, we describe the technology available to the representative firm, the households' behavior, and policies implemented by the fiscal authority and the monetary authority.

2.1 | Production

At each period t, there is a representative firm, using capital, K_t, and labor, l_t, to produce the final good, Y_t, according to a Cobb-Douglas production function: $Y_t = AK_t^s l_t^{1-s}$. Denoting $k_t = K_t/l_t$ and $y_t = Y_t/l_t$, the production in intensive form is

$$y(k_t) = Ak_t^s \tag{1}$$

where $s \in (0, 1)$ denotes the share of capital income in the economy. Under perfect competition, the real interest rate, r_t, and the wage bill, w_t, at period t are given by

$$r_t = Ask_t^{s \quad 1} \equiv r(k_t) \text{ and } w_t = (1 \quad s)Ak_t^s \equiv w(k_t). \tag{2}$$

2.2 | Household

At each period t, there is a unit measure of identical infinitely lived households i. Each household i consumes the final good, $c_{i,t}$, invests in physical capital, $k_{i,t+1}$, in one-period nominal bond, $B_{i,t+1}$, and in money balances, $M_{i,t+1}$. Household i derives utility from current consumption, $c_{i,t}$, and physical capital, $k_{i,t}$. Preferences of household i's preference is described by the following non-separable utility function[3]

$$\sum_{t=0}^{+\infty} \beta^t \frac{\left[c_{i,t} k_{i,t}^{\theta}\right]^{1 \quad \frac{1}{\varepsilon_c}}}{1 \quad \frac{1}{\varepsilon_c}} \tag{3}$$

where ε_c represents the IES of consumption and θ denotes the degree of search for status ("*spirit of capitalism*" see Zou, 1994). Household i derives utility from the wealth based status represented by his search for capital holding, $k_{i,t}$. The dependence of utility on capital holding captures the idea of "*spirit of capitalism*". As θ is positive, the marginal utility of an individual household's own consumption increases with the economy's aggregate capital stock. The size of the parameter θ measures the desire for status. It follows that a small (high) θ corresponds to a slight (strong) desire for elevating their own condition. If $\theta = 0$, the utility Equation (3) recovers a standard preference where households derive utility only from their own consumption.

When maximizing the utility function given by Equation (3), the household i must respect the budget constraint:

[3]This specification is consistent with those of Kurz (1968) and Zou (1994). Note that since the notion of "*spirit of capitalism*" must have status stricly increasing in wealth, that is, capital holding $k_{i,t}$. Moreover, the utility function captures the first-order effect of wealth on status determination and thus on utlity. Such effect is relevant when the wealth distribution for the reference group is constant over time. A more general utility function that contains wealth relative to society's average wealth effect is

$$\frac{\left[c_{i,t}\left(\frac{k_{i,t}}{k_t^{\gamma}}\right)^{\theta}\right]^{1 \quad \frac{1}{\varepsilon_c}}}{1 \quad \frac{1}{\varepsilon_c}}.$$

The parameter $\gamma \in (0, 1)$ indexes the importance of an individual's wealth relative to society's average wealth. When $\gamma = 0$, the model corresponds to the absolute wealth models, we are considering, while when $\gamma = 1$, it corresponds to the relative wealth models of for example, Shimomura and Van Long (2004).

$$p_t c_{i,t} + p_t k_{i,t+1} + B_{i,t+1} + M_{i,t+1} = R_t B_{i,t} + M_{i,t} + p_t \left(1 \quad \delta + r_t\right) k_{i,t} + p_t w_t \tag{4}$$

where p_t is the price of the final good, R_t is the gross interest rate, r_t is the real interest rate, $p_t w_t$ is the wage income, $M_{i,t}$ represents nominal money balances, and $\delta \in (0, 1)$ is the depreciation rate of physical capital. All the other variables have been previously defined. We suppose that the representative agent is subject to a Cash-In-Advance (CIA) constraint on consumption purchases:[4]

$$p_t c_{i,t} \leq M_{i,t}. \tag{5}$$

The household i maximizes his intertemporal utility Equation (3) with respect to $\left\{c_{i,t}, k_{i,t+1}, M_{i,t+1}, B_{i,t+1}\right\}$ subject to the budget constraint Equation (4) and to the liquidity constraint Equation (5). By denoting λ_t and ζ_t the Lagrangian multipliers associated, respectively, to the budget constraint and to the *CIA* constraint, the first-order conditions are.

$$c_{i,t} : \lambda_t = \frac{c_{i,t}^{\frac{1}{\varepsilon_c}} k_{i,t}^{\theta\left(1 \quad \frac{1}{\varepsilon_c}\right)}}{p_t\left(1 + \frac{\zeta_t}{\lambda_t}\right)}, \tag{6}$$

$$k_{i,t+1} : \frac{\lambda_t}{\lambda_{t+1}} = \beta \frac{p_{t+1}}{p_t}\left[\theta \frac{c_{i,t+1}}{k_{i,t+1}}\left(1 + \frac{\zeta_{t+1}}{\lambda_{t+1}}\right) + 1 \quad \delta + r_{t+1}\right], \tag{7}$$

$$B_{i,t+1} : \frac{\lambda_t}{\lambda_{t+1}} = \beta R_{t+1}, \tag{8}$$

$$M_{i,t+1} : \frac{\lambda_t}{\lambda_{t+1}} = \beta\left(1 + \frac{\zeta_{t+1}}{\lambda_{t+1}}\right). \tag{9}$$

Equation (6) characterizes the consumption smoothness. Equation (7) governs the evolution of physical capital over time, which includes the marginal utility benefit from agents' status-seeking capital accumulation represented by $\theta \frac{\zeta_{t+1}}{\lambda_{t+1}} \frac{c_{t+1}}{k_{i,t+1}}$. Equation (8) states that the marginal values of one-period bond holdings are equal to their marginal costs. Equations (8) and (9) together implies that $R_{t+1} = \frac{\zeta_{t+1} + \lambda_{t+1}}{\lambda_{t+1}}$. It follows that to have the gross interest rate to be higher than one, it requires $\zeta_{t+1} > 0$, that is, the nominal interest rate is positive. Such a condition implies that the CIA constraint is binding when the real return of bonds dominates the real return on cash holding, that is, $1/\pi_{t+1}$.

In order to be sure that Equations (6)-(9) do characterize an optimum, one must also take into account the following transversality conditions:

$$TVC : \lim_{t \to +\infty} \beta^t \lambda_t \left(k_{i,t} + M_{i,t} + B_{i,t}\right) = 0. \tag{10}$$

[4]Reader interest to partial liquidity constraint on consumption expenditure, see Bosi and Magris (2003).

Let $\pi_{t+1} = p_{t+1}/p_t$ being the gross rate of inflation and by manipulating Equations (6)–(9), the Euler equation and the arbitrage condition are obtained:[5]

$$\frac{c_{i,t+1}}{c_{i,t}} = \left(\beta \frac{R_t}{\pi_{t+1}}\right)^{\varepsilon_c} \left(\frac{k_{i,t+1}}{k_{i,t}}\right)^{\theta(\varepsilon_c - 1)} \tag{11}$$

$$\frac{R_{t+1}}{\pi_{t+1}} = \underbrace{1 - \delta + r_{t+1}}_{\text{return of capital}} + \underbrace{\theta R_{t+1} \frac{c_{i,t+1}}{k_{i,t+1}}}_{\text{statut effect}}. \tag{12}$$

Condition (11) corresponds to a modified Euler equation for the optimal consumption smoothing behavior taking into account the marginal utility benefit from agents' status-seeking capital accumulation $\left(\frac{k_{i,t+1}}{k_{i,t}}\right)^{\theta(\varepsilon_c - 1)}$. It ensures that the return of decreasing one unit of current consumption allows to increase future consumption of an amount depending upon current gross interest rate, the future gross rate of inflation, reflecting that consumption requires money holding, and marginal utility benefit from agents' status-seeking capital accumulation.

When there does not exist any search for status, that is, θ sets to zero in (12), the real interest rate on one-period bond, R_{t+1}/π_{t+1}, is equal to the real return on capital, $1 - \delta + r_{t+1}$. Conversely, in the presence of search for status, indicated by a positive θ in (12), a gap between the real interest rate on one-period bond and the real return of capital occurs. In such a case, households care about their holding of physical capital. As a matter of fact, the term $\theta R_{t+1} \frac{c_{i,t+1}}{k_{i,t+1}}$ represents the marginal rate of substitution between the individual's consumption and his relative holding of capital, that is, which reflects the search for status.

2.3 | The public sector

There are two authorities exercising policies in this economy: a fiscal authority and a monetary authority.

[5]One could introduce a liquidity constraint on both purchases of consumption goods and purchases of investment goods as $\psi_C c_{i,t} + \psi_K [K_{i,t+1} - (1 - \delta) K_{i,t}] \leq M_{i,t}$ (See Le Riche et al., 2020). Under a binding liquidity constraint ψ_C and ψ_K can be viewed as a proxy of the inverse of the velocity of circulation of money with respect to consumption and physical capital, respectively. In such a case, the Euler equation and the arbitrage condition becomes:

$$\frac{c_{t+1}}{c_t} = \left(\beta \frac{R_{t+1}}{\pi_{t+1}} \frac{1 - \psi_C + \psi_C R_t}{1 - \psi_C + \psi_C R_{t+1}}\right)^{\varepsilon_c}$$

and

$$\frac{R_{t+1}}{\pi_{t+1}} = \frac{\theta(1 - \psi_C + \psi_C) R_{t+1} + 1 - \delta + r_{t+1} + \psi_K (1 - \delta)(R_{t+1} - 1)}{1 - \psi_K + \psi_K R_t}$$

We could see from these two equations that the impact of status could be hard to disentangle from the velocity of money. As we focus only the effect of status on the outcome of different monetary policy, we disregard this case.

Denote R_t the gross interest rate at the beginning of period t. In each period t, the fiscal authority purchases the final good for an amount G_t, and pays previous accumulated debt and the payment of interests, $R_t B_t^F$. In order to finance it, the fiscal authority issues one-period bonds, B_{t+1}^F. The initial amount of nominal debt is B_0^F. The dynamic budget constraint of the fiscal authority is, thus,

$$B_{t+1}^F = R_t B_t^F + p_t G_t. \tag{13}$$

We suppose that the government claims a part g of aggregate output for public spending, that is, $G_t = gY_t$.[6]

In period t, the monetary authority purchases one-period bonds, B_{t+1}^M, and supplies a stock of money, M_{t+1}. M_0 is the amount of money balances available in period zero. The dynamic budget constraint of the monetary authority is

$$B_{t+1}^M = R_t B_t^M + M_{t+1} - M_t. \tag{14}$$

In each period t, the monetary authority creates or withdraws money as a counterpart of its purchases or sales of nominal one-period bonds. The monetary authority either controls the money growth factor or the gross interest rate.

When the monetary authority pegs the money growth rate, denoting M_t the total supply of money in period t and μ the constant factor of money creation, the supply of money balances satisfies:

$$M_t = \mu M_{t-1}. \tag{15}$$

When the monetary authority pegs the gross interest rate, that is, a Taylor feedback rule. The monetary authority reacts as a function of the inflation gap, by mean of a depreciation or appreciation of the current gross interest rate.[7]

$$R_{t+1} = R(\pi_{t+1}) = \max\left\{1, \hat{R}\left(\frac{\pi_{t+1}}{\hat{\pi}}\right)^{\varepsilon_R}\right\} \tag{16}$$

[6] Government purchases constitute an important share of the aggregate demand. Moreover, the amount of such expenditure varies a great deal across developed countries, ranging from around 15%–30% of gross domestic product (see UNPAN statistical database, www.unpan.org).

[7] Note also that in the Taylor rules we do not include the output gap since in our model it is by construction equal to zero (see, e.g., Woodford, 2003) and, in addition, according to several empirical estimates (see, e.g., Clarida et al., 1998), its coefficient falls within a range including very small values for many monetary authorities.

where $\hat{R}$ is the implicit target for the gross interest rate, $\hat{\pi}$ the implicit target for the gross rate of inflation and $\varepsilon_R \in (0, 1) \cup (1, +\infty)$ the elasticity of the gross interest rate with respect to gross rate of inflation. The two targets $\hat{R}$ and $\hat{\pi}$ of the monetary authority are not independent since in order to be attainable at the steady state of the economy. Indeed, these targets must satisfy the Fisher equation.[8] Following Schmitt-Grohé and Uribe (2000), we refer to increases in inflation factor with a more than one-for-one increase in the gorss interest rate ($\varepsilon_R > 1$). As a consequence, a passive interest rate feedback rule is such that the nominal interest factor reacts in a less than one-for-one increase in the gross rate of inflation ($\varepsilon_R < 1$). Conversely, when the economy is at the "liquidity trap" equilibrium, the gross interest rate does not react anymore to increases in gross rate of inflation but sticks to zero, or close to it.

3 | EQUILIBRIUM

We now analyze the properties of the competitive equilibrium under the assumption that the monetary authority pegs the money growth factor, see Equation (15), or pegs the nominal interest factor, see Equation (16). There is a unit measure of identical infinitely lived household, $l_t = 1$.

3.1 | Money growth pegging

The monetary authority follows Equation (15). At the symmetric equilibrium, $c_{i,t} = c_t$ and $k_{i,t} = k_t$. Using Equations (2) and (12), we derive that the gross interest rate is a function of the capital stock, the consumption and the gross rate of inflation:

$$R_{t+1} = \frac{\pi_{t+1}[1 \quad \delta + r(k_{t+1})]}{1 \quad \theta\pi_{t+1}\dfrac{c_{t+1}}{k_{t+1}}} \equiv R(k_{t+1}, c_{t+1}, \pi_{t+1}). \tag{18}$$

Remark that R_{t+1} should be positive implying that the gross rate of inflation has to be low enough, that is, $\pi_{t+1} < \frac{k_{t+1}}{\theta c_{t+1}} \equiv \bar{\pi}_{t+1}$.[9] We now rewrite the Euler Equation (11) by taking into account (18).[10]

$$\frac{c_{t+1}}{c_t} = \left[\beta \frac{R(k_t, c_t, \pi_t)}{\pi_{t+1}}\right]^{\varepsilon_c} \left(\frac{k_{t+1}}{k_t}\right)^{\theta(\varepsilon_c \quad 1)}. \tag{19}$$

[8] See Section 4.2.

$$\frac{\hat{R}}{\hat{\pi}} = \frac{1}{\beta}. \tag{17}$$

[9] Note that when $\theta = 0$, we obtain that $R_{t+1} = \pi_{t+1}[1 \quad \delta + r(K_{t+1})]$ and thus $\bar{\pi}_{t+1}$ tends to infinity.

[10] When $\theta = 0$, the Euler equation and such an equation becomes $\frac{c_{t+1}}{c_t} = \left(\beta \frac{R_t}{\pi_{t+1}}\right)^{\varepsilon_c}$.

We consider that the return of the physical capital is higher than the profitability of money holdings. This requires a nominal interest factor higher than one. Using Equation (18) such a condition puts a lower bound on the gross rate of inflation $\pi_{t+1} > \frac{1}{1 \quad \delta + r_{t+1} + \frac{\theta c_{t+1}}{k_{t+1}}} \equiv \underline{\pi}_{t+1}$. Coupled with the fact that the interest factor needs to be positive, we have the following assumption:

Assumption 1 $\pi_{t+1} \in \left(\underline{\pi}_{t+1}, \overline{\pi}_{t+1}\right)$.

Since we assume that the monetary authority pegs the growth of money at the factor μ, one equilibrium condition is to ensure that the money market clears. By using Equations (15) and (5), the money market equilibrium is given by

$$c_{t+1}\pi_{t+1} = \mu c_t. \tag{20}$$

In the good market, total government expenditures, g_t, and total households consumption, c_t, must, in each period, equalize total production y_t, that is,

$$k_{t+1} = (1 \quad g)y(k_t) + (1 \quad \delta)k_t \quad c_t. \tag{21}$$

It is, now, possible to define intertemporal equilibrium with perfect foresight:

Definition 1 Let Assumption 1 satisfied. Then, for any given $(M_0, k_0, B_0) > 0$, an intertemporal equilibrium with perfect foresight is a sequence $\{k_t, c_t, \pi_t\}_{t=0}^{\infty}$ satisfying Equations (19), (20) and (21) with $R(k_t, c_t, \pi_t)$, which is given in Equation (18). Moreover, the intertemporal equilibrium should satisfy the transversality conditions given by Equation (10).

The system defined by (19), (20) and (21) represents a three non-linear difference equations system in the variables lagged once (k_{t+1}, c_{t+1}, π_{t+1}, k_t, c_t, π_t) with one predetermined variable the current capital stock.

3.2 | Taylor rule

The monetary authority follows Equation (16). At the symmetric equilibrium, $c_{i,t} = c_t$ and $k_{i,t} = k_t$, the dynamic of the economy is determined by the Euler equation and the market clearing condition of the final good. We assume that public spending is a share $g \in (0, 1)$ of the final good, that is, $g_t = gy_t$, so that, together with Equation (1) the final good market clearing condition can be written as Equation (21). By plugging the definition of the Taylor rule given in (16) and the arbitrage condition defined by (12), we get

$$\frac{R(\pi_{t+1})}{\pi_{t+1}} = 1 \quad \delta + r(k_{t+1}) + \theta R(\pi_{t+1}) \; \frac{c_{t+1}}{k_{t+1}}. \tag{22}$$

Applying the Implicit Function Theorem to the previous expression, we are able to solve locally for the gross rate of inflation in order to obtain a smooth function $\pi_{t+1} = \pi(k_{t+1}, c_{t+1})$.[11] As the Taylor rule is only a function of the gross rate of inflation, the gross interest rate is also a function of the physical capital and the consumption, see Equation (16). Hence, under Assumption 1, for any given the initial capital stock, $k_0 > 0$, an intertemporal equilibrium with perfect-foresight is a sequence $\{k_t, c_t\}_{t=0}^{\infty}$ satisfying

$$\frac{c_{t+1}}{c_t} = \left[\beta \frac{R(k_t, c_t)}{\pi(k_{t+1}, c_{t+1})}\right]^{\varepsilon_c} \left(\frac{k_{t+1}}{k_t}\right)^{\theta(\varepsilon_c - 1)} \quad \text{and} \quad k_{t+1} = (1 - g)y(k_t) + (1 - \delta)k_t - c_t. \tag{23}$$

together with the transversality conditions given by (10). System defined by (23) represents a two-dimensional system in the variables lagged once (k_{t+1}, c_{t+1}, k_t, c_t) where k is a variable predetermined by the past and c is a variable not predetermined. θ appears in the Euler equation through the gross interest rate, R_{t+1}, as stated in (22).

4 | STEADY STATE

In this section, we study steady state uniqueness/multiplicity and analyze how a monetary policy expansion and a fiscal policy expansion affect stationary welfare. We consider that, first, the monetary authority pegs the money growth factor according to Equation (15), and, then, pegs the gross interest rate according to Equation (16).

4.1 | Money growth pegging

A steady state of system Equations (19)-(21) is defined as a constant sequence $\{k_t, c_t, \pi_t\}_{t=0}^{\infty} = \{k^*, c^*, \pi^*\}_{t=0}^{\infty}$ for all t satisfying.

$$\frac{1}{\beta} = \frac{R^*}{\pi^*} = 1 - \delta + s\frac{y(k^*)}{k^*} + \theta R^* \frac{c^*}{k^*}, \tag{24a}$$

$$c^* = (1 - g)y(k^*) - \delta k^*, \tag{24b}$$

$$\pi^* = \mu. \tag{24c}$$

Denote $\nu = \frac{1}{\beta} - 1 + \delta$ and using Equation (1), one remarks that system Equation (24a)–(24c) only have one solution:

$$\pi^* = \mu, \quad R^* = \frac{\mu}{\beta}, \quad k^* = \left[\frac{A[s + \theta R^*(1 - g)]}{\nu + \theta\delta R^*}\right]^{\frac{1}{1-s}} \quad \text{and} \quad c^* = \frac{(1 - g)\nu - \delta s}{s + \theta(1 - g)R^*} k^*. \tag{25}$$

[11] By differentiating Equation (22), we get for the "liquidity trap" Equation (A9) in Appendix E while for the "interior" equilibrium Equation (A12)-(A13) in Appendix E

According to Equation (25), Assumption 1 is always true since $\mu > \beta$, that is, $R^* > 1$.

4.2 | Taylor rule

A steady state of the dynamic system Equation (23), by taking into account Equation (22), is defined as a constant sequence $\{k_t, c_t, \pi_t, R_t\}_{t=0}^{\infty} = \{k^*, c^*, \pi^*, R^*\}_{t=0}^{\infty}$ for all t, such that

$$\frac{1}{\beta} = \frac{R^*}{\pi^*} = 1 \quad \delta + s\,\frac{y(k^*)}{k^*} + \theta R^* \frac{c^*}{k^*} \quad \text{and} \quad c^* = (1 \quad g)y(k^*) \quad \delta k^*. \tag{26}$$

We can determine the solution of (π^*, R^*), by inspecting Equation (26) together with the Taylor rule given in (16). Indeed, when the Taylor rule is passive, $\varepsilon_R < 1$, there exists a unique value of steady state gross rate of inflation characterized by a gross interest rate higher than one. We refer to such stationary solution as the "interior" steady state. Conversely, when the Taylor rule is active, $\varepsilon_R > 1$, multiple solutions exist. In fact, besides the existence of an "interior" stationary solution, the emergence of a steady state where the gross interest rate equals one, which we refer as the "liquidity trap" steady state, arises. Such a result is standard in the literature, see for example, Benhabib et al. (2001), and comes from the Fisher equation associated to the Taylor rule. Finally, by looking at (26), we can see that each equilibrium, the "liquidity trap" and the "interior" one, is associated with a different stationary capital stock and stationary consumption. Thus, this system has at most two solutions (π^*, R^*, k^*, c^*) as claimed in the following Proposition.

Proposition 1 *Suppose that Assumption* 1 *holds. There exists at least one stationary solution* ($\pi*$, $R*$, $k*$, $c*$) *of the dynamic system* Equation (26). *Specifically*:

⌊*i*⌋ *When the Taylor rule is passive,* $\varepsilon_R < 1$, *there exists an "interior" steady state characterized by* $(R^*, \pi^*) = (\hat{R}, \hat{\pi})$. *Moreover, the associated physical capital and consumption are given by* (k^*, c^*) = (k^I, c^I);

⌊*ii*⌋ *When the Taylor rule is active,* $\varepsilon_R > 1$, *there exist two stationary solutions. A "liquidity trap" steady state characterized by* (R^*, π^*) = (1, β); *An "interior" steady state characterized by* $(R^*, \pi^*) = (\hat{R}, \hat{\pi})$. *Moreover, the associated physical capital and consumption at the "liquidity trap" are given by* (k^*, c^*) = (k^{LT}, c^{LT}), *while the associated physical capital and consumption at the "interior" equilibrium are given by* (k^*, c^*) = (k^I, c^I).

See Appendix A.

Proposition 1 shows that, beside having at most two possible solutions for π^* and R^*, there is, also, at most two solutions for consumption and capital. Consider, first, the case of the "liquidity trap" steady state, that is, (R^*, π^*) = (1, β). By letting $\nu = 1/\beta \quad (1 \quad \delta) \in (0, 1)$, we obtain from Equation (26):

$$k^{LT} = \left\{ \frac{A[s + \theta(1 \quad g)]}{\nu + \delta\theta} \right\}^{\frac{1}{1 \quad s}} \quad \text{and} \quad \frac{c^{LT}}{k^{LT}} = \frac{(1 \quad g)\nu \quad \delta s}{s + (1 \quad g)\theta}. \tag{27}$$

Let us, now, consider the case of the interior steady state, that is, $(R^*, \pi^*) = (\hat{R}, \hat{\pi})$. We obtain from Equation (26):

$$k^I = \left\{ \frac{A\left[s + \theta(1-g)\hat{R}\right]}{\nu + \delta\theta\hat{R}} \right\}^{\frac{1}{1-s}} \quad \text{and} \quad \frac{c^I}{k^I} = \frac{(1-g)\nu - \delta s}{s + (1-g)\theta\hat{R}}. \tag{28}$$

At the "liquidity trap" steady state and at the "interior" steady state, the capital stock and the consumption at the "interior" equilibrium depends upon θ. Remark that when there is no "*spirit of capitalism*", we obtain that consumption and capital are the same at both equilibria, see Equations (27) and (28).[12] As soon as one considers "*spirit of capitalism*", represented by a positive θ, there exists a gap between the return of one-period bond and the return of physical capital (see Equation 24) and thus consumption and capital are different at each stationary state.

It is worthwhile to remark that only at the "interior" steady state, the target of the monetary authority for the gross interest rate affects both consumption and capital.

Once established the existence of at most two stationary solutions of the dynamic system defined in (23), one may wonder at this point whether one of them welfare dominates the other one. To answer this question, we compare the consumption, capital, Gross Domestic Product (GDP) and utility between the two stationary states and we summarize the results in the following Proposition:

Proposition 2 *Suppose that Assumption* 1 *holds. Let* $\bar{\theta} = \frac{s[\nu(1-g)-\delta]}{(1-s)\delta}$. *Then, there exists one critical bound for the implicit target of the gross interest rate* $\hat{R}$, $1 < \bar{R}^I$, *such that the following results hold*:

⌊i⌋ The stationary capital stock and the GDP at the "interior" steady state are higher than those of the "liquidity trap";

⌊ii⌋ The stationary consumption and stationary welfare at the "interior" steady state is higher than the one of the "liquidity trap" when $\hat{R} \in \left(1, \tilde{R}^I\right)$ *and* $\theta \in \left(0, \bar{\theta}\right)$.

Proof. See Appendix B.

This Proposition shows that both capital and GDP are always higher at the "interior" equilibrium. On the contrary consumption and stationary welfare are higher at the "interior" equilibrium if and only if the implicit target for the gross interest rate and θ are low enough. Such a result shows that the monetary authority has a motive to set an implicit target $\hat{R}$ higher than one, when there exists "*spirit of capitalism*". Remark that in other configurations the stationary welfare and consumption level will be higher at the "liquidity trap".

Taking a simple example for ⌊*iii*⌋ using the following parameter values: $s = 0.3$, $A = 1$, $\beta = 0.99$, $\delta = 0.01$, $g = 0.3$, $\varepsilon_c = 1.2$ and $\theta = 0.01$, we could look under which consideration a monetary expansion is stationary welfare improving.[13] We obtain that $\bar{\theta} = 0.17$ and $\bar{R}^I = 66$. Then for any $\hat{R}$ between 1 and 66, the stationary welfare at the "interior" steady state is higher than the one of the "liquidity trap". It follows that any $\hat{R}$ in such an interval implies that

[12] Such a result has been found in Le Riche et al. (2017).

[13] Note that there is no consensus in the literature on the empirical value of IES of consumption. While Campbell (1999) and Kocherlakota (1996) suggest values smaller than 1, Vissing-Jørgensen and Attanasio (2003), Gruber (2013) and Kapoor and Ravi (2017) estimate values high than 1. We set s to satisfy empirical plausible value (Cecchi & Garcia Peñalosa, 2010).

stationary welfare at the "interior" steady state is higher than the one at the "liquidity trap" and thus, the monetary authority has a motive to set $\hat{R}$ higher than one and thus to select the "interior" equilibrium. Our model thus makes it possible to theoretically consolidate and rehabilitate the initial interest rate based "liquidity trap" exit strategy at the stationary state, first proposed by Keynes (1936). Moreover, it enables to assess the trade-off between cash holdings and capital holdings and identify the appropriate policies aimed at eliminating hoarding of money.

4.3 | Impact of economic policies expansion on stationary welfare

In the following we analyze how fiscal policy and monetary could alter stationary welfare. First, remark that when $\theta = 0$, we obtain, regardless of the monetary policy implemented, a unique level of capital $k^* = [As/\nu]^{\frac{1}{1-s}}$ and a unique level of consumption $c^* = [[(1-g)\nu-\delta s]/s]k^*$, that is, the modified Golden Rule.[14] As it is immediate to see monetary policy instrument does not affect both stationary capital and stationary consumption and thus such a policy has no role, that is, money is superneutral. On the contrary, an expansionary fiscal policy, an increase in g, reduces both stationary capital and stationary consumption and thus stationary welfare.

In presence of "*spirit of capitalism*", households have a motive to hold capital, so that there exist a gap between the return of one-period bond and the return of capital.

Let us turn to a monetary expansion. In our setup, the monetary authority could follows either: a money growth pegging rule; or a Taylor rule. For each rule, we will refer to an increase gross interest rate as a monetary expansion. Indeed, in the case of the money growth pegging, the instrument is the money growth factor, μ^*, but since the gross interest rate is $R^* = \mu/\beta$, an increase in μ corresponds to an increase in R^*. On what concern the Taylor rule, the instrument is the target for the gross interest rate, $\hat{R}$. In the following our aim is to show how a change in the gross interest rate affects stationary welfare.

In the next Proposition we report these results.

Proposition 3 *Suppose that Assumption* 1 *holds. Define* $x^* \in \left\{\frac{\mu}{\beta}, \hat{R}\right\}$. *Let* $\bar{\theta} = \frac{s[\nu(1-g)-\delta]}{(1-s)\delta}$ *and* $\tilde{x}^* = \frac{s[(1-g)\nu-\delta]}{(1-g)(1-s)\delta\theta}$. *Then, the following results hold*:

⌊*i*⌋ *An increase in* x^* *raises the level of capital stock and the GDP*;

⌊*ii*⌋ *An increase in* x^*:

⌊*ii a*⌋ *raises the level of consumption and welfare if* $\theta \in (0, \bar{\theta})$ *and* $x^* \in (1, \tilde{x})$;

⌊*ii b*⌋ *reduces the level of consumption in any other configurations*;

⌊*iii*⌋ *An increase in g reduces both the level of capital stock and consumption and thus GDP and welfare.*

Proof. See Appendix C.

[14]It holds that there is the same the level of capital and consumption at the "liquidity trap" and the "interior" equilibrium. These results are derived from Le Riche et al. (2017), where the "liquidity trap" always dominates the Leeper equilibrium, since the opportunity cost of cash holdings is zero.

This Proposition shows that when θ is low enough, an increase in the instrument of the monetary authority, $x^* \in (1, \tilde{x})$, is welfare improving at the stationary state. Remark also that a reduction in the instrument of the monetary authority, should be implemented in any other configurations to increase both consumption and stationary welfare.

When the monetary authority follows a money growth pegging rule, a unique steady state occurs, see Equation (25). In this case a higher welfare at the stationary state is attained with a higher x^* under the case $\lfloor ii \quad a \rfloor$ of Proposition 3.

When the monetary authority follows an interest rate pegging rule, it is worth to recall that in the case of passive Taylor rule, $\varepsilon_R < 1$, only an "interior" steady state exists meanwhile in the case of active Taylor rule, $\varepsilon_R > 1$, both a "liquidity trap" and an "interior" steady state exist, see Proposition 1. Regarding the "interior" equilibrium, a monetary expansion has a positive impact under the case $\lfloor ii \quad a \rfloor$ of Proposition 3. On the contrary, the "liquidity trap" is not affected by any change in gross interest rate. At the stationary state, taking into account Proposition 2, an exit strategy corresponding to an increase of the target for the gross interest rate will attain the maximum level of welfare at $\hat{R} = \bar{R}$, see $\lfloor ii \quad a \rfloor$ of Proposition 3.

Taking a simple example for $\lfloor ii \quad a \rfloor$ using standard parameters values: $s = 0.3$, $A = 1$, $\beta = 0.99$, $\delta = 0.01$, $g = 0.3$, $\varepsilon_c = 1.2$ and $\theta = 0.01$, we obtain that any increase in R^* between 1 and 19 is welfare improving at the stationary state.

5 | LOCAL STABILITY

In this section we analyze the local stability under, respectively, a money growth pegging rule and a Taylor rule.

We introduce the following Assumption.

Assumption 2 $\theta \in \left(0, \frac{s[\nu(1 \quad g) \quad \delta]}{(1 \quad s)\delta}\right)$ and $x^* \in \left(\frac{s[\nu(1 \quad g) \quad \delta] + \theta[(1 \quad g)\nu \quad \delta s]}{(1 \quad s)\theta\delta}\right)$, with $x^* \in \left\{\frac{\mu}{\beta}, \hat{R}\right\}$.

The restrictions on θ and x^* stipulate that the degree of search for status and the instruments of the monetary policy are not too high. Moreover, we restrict our analysis to configuration in which an increase of the money growth factor (or of the implicit target for the gross interest rate) is welfare improving, see Proposition 3.

5.1 | Money growth pegging

We examine the local stability properties when the monetary authority follows a money growth pegging rule. In order to carry out such a proposal, we follow the standard procedure consisting in examining the linearized dynamic system around the unique steady state of Equations (19), (20) and (21) and obtaine the Jacobian matrix, J:[15]

[15] The Jacobian matrix is given in Appendix D Equation (A3).

$$\begin{pmatrix} \hat{k}_{t+1} \\ \hat{c}_{t+1} \\ \hat{\pi}_{t+1} \end{pmatrix} = J^{MGP} \begin{pmatrix} \hat{k}_{t} \\ \hat{c}_{t} \\ \hat{\pi}_{t} \end{pmatrix} \tag{29}$$

where $\hat{k}_t \equiv (k_t - k^*)/k^*$, $\hat{c}_t \equiv (c_t - c^*)/c^*$ denote, respectively, percentage deviations from the steady state k^*, c^* and π^*.

In order to study the local stability properties, we need to compute the characteristic roots associated with the Jacobian matrix. At any period t we have one predetermined variable, the current capital stock, k_t. Since it is the unique predetermined variable, local indeterminacy requires the dimension of the stable manifold to be higher than one, that is, at least two eigenvalues lie inside the unit circle. Were this the case to occur, one would face more than one possibility to locate the initial conditions for the non-predetermined variables, (c_0, π_0).

The dynamic monetary model here considered is based on Carlstrom and Fuerst (2003). In order to ease the presentation we begin with a brief exposition of their local stability results. The results are presented for later reference. We do not claim originality here. Denote

$$\tilde{\varepsilon}_c^{\mathrm{MGP}} = \frac{2s(2-\delta+\nu)}{4s(2-\delta+\nu)+(1-s)(\nu-\delta s)\nu\beta}. \tag{30}$$

Then, under Assumption 1, the steady state is locally determinate if $\varepsilon_c < \tilde{\varepsilon}_c^{MGP}$.[16] Note that neither a fiscal or a monetary expansion alter the occurrence of local indeterminacy.

We now present our framework with "*spirit of capitalism*" and show the main differences in terms of local stability with respect to the monetary model of Carlstrom and Fuerst (2003). Next Proposition presents the result.

Proposition 4 *Assume that Assumptions* 1 *and* 2 *are satisfied. Then, there exists a threshold for the IES of consumption,* $0 < \tilde{\varepsilon}_c^{\mathrm{MGP}} < \infty$, *such that the following results hold*:

⌊*i*⌋ *the steady state is locally indeterminate when* $\varepsilon_c < \tilde{\varepsilon}_c^{\mathrm{MGP},\theta}$.

⌊*ii*⌋ *the steady state is locally determinate when* $\varepsilon_c > \tilde{\varepsilon}_c^{\mathrm{MGP},\theta}$.

See Appendix E.

This Proposition shows that the unique steady state is locally indeterminate as soon as the IES of consumption is small enough. It is interesting to discuss the θ on local stability. The

[16] When $\theta = 0$, $P(-1)/P(0)$ and $P(1)/P(0)$ are respectively given by

$$\frac{P(1)}{P(0)} = \frac{(\nu-\delta s)(1-s)\nu\beta^2}{s} \quad \text{and} \quad \frac{P(-1)}{P(0)} = \frac{2s(1+\beta)-\left[4s(1+\beta)+(\nu-\delta s)(1-s)\nu\beta^2\right]\varepsilon_c}{s\varepsilon_c}.$$

As shown by Bosi et al. (2010), local indeterminacy requires that both $P(-1)/P(0)$ and $P(1)/P(0)$ are negative which corresponds to $\varepsilon_c < \tilde{\varepsilon}_c^{\mathrm{MGP}}$.

critical value of ε_c is an increasing function of θ. This implies, other thing being equal, that a higher θ enlarges the local indeterminacy region, which would increase the likelihood of local sunspot fluctuations, and reduce the region where local determinacy is obtained exerting therefore a local destabilizing effect.

It is also interesting to understand how the introduction of "*spirit of capitalism*" modifies the local stability.[17] Indeed, although local indeterminacy holds for a low enough IES of consumption with or without θ, critical values of ε_c are different. Remark that by comparing Equations (30) and (A6) in Appendix E, we get that $\tilde{\varepsilon}_c^{MGP} < \tilde{\varepsilon}_c^{MGP,\theta}$ implying that in the presence of θ, the likelihood of local indeterminacy increases. However, the critical bound $\tilde{\varepsilon}_c^{MGP,\theta}$ is an decreasing function of μ implying that a higher money growth factor reduces the local indeterminacy region and thus exerts a local stabilizing effect. All together, an increase in the money growth factor is improves stationary welfare and exert a local stabilizing effect, see Proposition 3.

To establish the intuition for our results, let us explain why the expectations of a lower future nominal interest rate may be self-fulfilling. Using Equation (20), let us rewrite the Euler Equation (11) in such a way:

$$\frac{k_t^{\theta(\varepsilon_c\ \ 1)}}{R_t^{\varepsilon_c}} = \frac{\beta}{\mu}\pi_{t+1}^{1\ \ \varepsilon_c} k_{t+1}^{\theta(\varepsilon_c\ \ 1)} \tag{31}$$

Suppose that system Equation (31) is at the steady state in period t and that the representative agent anticipates that the future gross interest rate will reduce. Since $\varepsilon_{R,\pi} = \frac{R_{t+1}}{\pi_{t+1}} \frac{\partial \pi_{t+1}}{\partial R_{t+1}} > 0$, a decrease in the future gross interest rate also reduces the future gross rate of inflation. The representative agent reacts by increasing future consumption and current investment. Then, the current gross interest rate, R_t, must increase to compensate the cost of current consumption with the benefit of higher investment. The reestablishment of Equation (31) depends on the IES of consumption, ε_c. Then the right-hand-side of Equation (31) increases heavily and in order to reestablish Equation (31), the left-hand-side must also increases which is the case when the IES of consumption is low enough. Then, expectations can be self-fulfilling.

5.2 | Taylor rule

In this section the local dynamics of the equilibrium dynamic system defined by (23) is characterized when the monetary authority follows a Taylor Rule. Denoting percentage deviations from the steady state respectively by $\hat{k}_t \equiv (k_t\ \ k)/k$ and $\hat{c}_t \equiv (c_t\ \ c)/c$ and loglinearizing Equation (23) we obtain:

[17]Other works have considered the implications on local stability of balanced-budget fiscal rules into a similar model without "*spirit of capitalism*". Fu and Le Riche (2021) consider an endogenous growth model with progressive consumption tax rate. Fu and Le Riche (2022) analyzes the role of a flat income tax rate together with public spending externality incompressible public spending and variable public spending while Le Riche (2022) analyses balanced-budget fiscal rules with distortionary income tax rate. All these works show that balanced-budget rules may enhance self-fulfiling expectations.

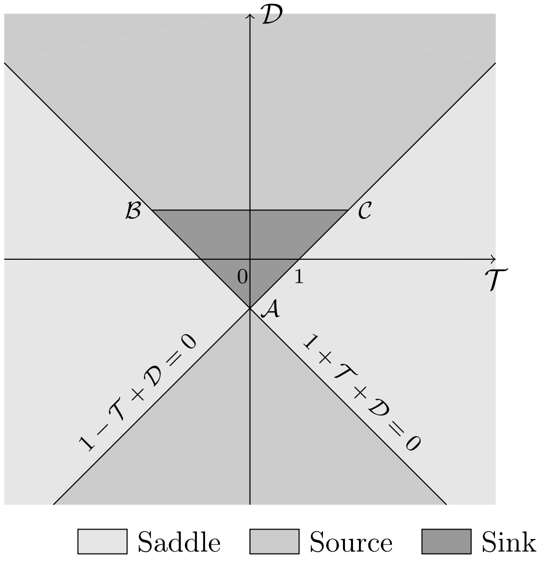

FIGURE 1 Stability triangle.

$$\begin{pmatrix} \hat{k}_{t+1} \\ \hat{c}_{t+1} \end{pmatrix} = J^T \begin{pmatrix} \hat{k}_t \\ \hat{c}_t \end{pmatrix} \tag{32}$$

where J is the Jacobian matrix of the dynamic system evaluated is given in Appendix E by (A7). Following Grandmont et al. (1998), we study the local stability properties of our model, which are determined by the eigenvalues of the characteristic polynomial $P(\lambda) = \lambda^2 \quad \lambda T + D$, using a geometrical method represented in Figure 1.

One eigenvalue is equal to one on the line AC ($D = T \quad 1$). On the line AB ($D = \quad T \quad 1$) one eigenvalue is equal to 1. On the segment BC the two eigenvalues are complex conjugates with modulus equal to 1. Therefore the steady state is a sink (both eigenvalues with modulus lower than one) when (T, D) is inside the triangle ABC. Since only capital is a predetermined variable, when the steady state is a sink, it is locally indeterminate and there are infinitely many stochastic endogenous fluctuations (sunspots) arbitrarily close to the steady state. The steady state is a source (both eigenvalues with modulus higher than one) if (T, D) is above AB, AC and BC or below AB and AC. It is saddle stable (one eigenvalue with modulus higher than one and one eigenvalue with modulus lower than one) in the remaining cases.

In Proposition 5 below we present conditions on the parameters under which the steady state(s) is(are) locally determinate or indeterminate.

Proposition 5 *Assume that Assumptions* 1 *and* 2 *are satisfied. Then, the following results hold*:

$\lfloor i \rfloor$ *Let* $\varepsilon_R < 1$. *Then, the unique "interior" equilibrium is locally determinate.*

$\lfloor ii \rfloor$ *Let* $\varepsilon_R > 1$. *Two steady states exist, the "liquidity trap" steady state and the "interior" steady state. Then, the liquidity trap steady state and the "interior" steady state are locally determinate.*

See Appendix E.

This Proposition shows that when a Taylor rule is followed by the monetary authority, local stability depends on whether ε_R is lower or higher than one. When it is lower than one, only the "interior" steady state occurs, see Proposition 1, and it is bound to be locally determinate whenever capital externality is small enough. When it is higher than one, two steady states emerge, that is, a "liquidity trap" steady state and an "interior" steady state, and both of are locally determinate.[18] These results extend the work of Benhabib et al. (2001) to small capital externality.[19] Moreover, case $\lfloor ii \rfloor$ of Proposition 5 shows that the Taylor Principle holds, that is, a monetary policy raising interest rates more than one-for-one in response to gross rate of inflation, ensures local stability of the "interior" equilibrium (e.g. Woodford, 2003).

It is worth mentioning the link between local stability and stationary welfare. When monetary policy raises interest rates less than one-for-one in response to gross rate of inflation, only one steady state emerges and thus any monetary expansion will be beneficial. However, when monetary policy raises interest rates more than one-for-one in response to gross rate of inflation both the "liquidity trap" steady state and the "interior" steady state occur. A monetary expansion has no impact at the "liquidity trap" steady state while it has a positive impact on stationary welfare at the "interior" equilibrium.

We have seen that in case $\lfloor ii \rfloor$, the dynamic system describing intertemporal equilibrium possesses two steady states corresponding, respectively, the "liquidity trap" steady state and the "interior" steady state. We have also proved that under such hypothesis both steady states could be locally determinate. Remark that the dimension of their respective stable manifolds is equal to one as the number of predetermined variable. It follows that if we were limiting our attention on a pure local analysis, we would obtain the result that, in order the economy to converge to each steady state, there would exist a unique set for the initial conditions for the non-predetermined variable that would allow to jump since the beginning on the stable branch converging to the "liquidity trap" steady state or on that converging to the "interior" one. Actually, under such an occurrence, agents would be bound to coordinate themselves in a unique way without violating the transversality condition. However, since there exists two steady states some comments on global analysis are important. In our cases, since both equilibria are locally determinate, two possibilities arises. Indeed, the "liquidity trap" steady state and the "interior" steady state could be linked through a heteroclinic connection[20] or the "liquidity trap" steady state and the "interior" steady state are separated by a singular point.[21] Deriving one or the other configuration has drastically different consequences regarding global dynamics.[22]

It should be clear that this work is not "a mere theoretical curiosity". The motivation of the paper is not only to propose a stationary liquidity-trap exit strategy under the assumption that households accumulate physical capital, but to show that in this more general and more elaborate framework than the standard one, when the utility function includes wealth effect, then the expectations of the standard exit strategy may be invalidated. By "standard framework" we mean, in the vein of Fisher (1933) and the classical monetarist tradition, the analysis of the

[18]Remark that the intuition at the basis of the saddle path stability is the same as the standard Ramsey model.

[19]Analyzing the global dynamics is beyond the scope of this paper. As both the "liquidity trap" steady state and the "interior" steady state are locally determinate, we expect that the result on global dynamics of Benhabib et al. (2001) applies, that is, a saddle connection occurs between the two steady states.

[20]See Le Riche et al. (2020) for more details.

[21]See footnote 14 in Brito and Venditti (2010) and also Brito et al. (2017). For a more recent treatment see Abad et al. (2020).

[22]Analyzing the global dynamics is beyond the scope of this paper.

"liquidity trap" as a phenomenon that affects, through the persistence of deflationary expectations, the real economic sphere unlike the Keynesian explanation, does not pass through monetary and financial channels (Parent, 2019).

In this paper we turn to theoretical foundations that provide the basis for a re-assessment of the "liquidity trap" as a monetary phenomenon, as in Keynes (1936) original view, not that of Fisher (1933) of "liquidity trap" as deflation spiral. Our contribution to this literature is to demonstrate that status-seeking behavior may be a means of facilitating "liquidity trap" exit: indeed, we demonstrate that any increase in the interest rate is an incentive to weight status more heavily in the agents' utility function. Additionally, in our model, status generates a "wedge" between the real interest rate on one-period bonds and the real return of capital.

6 | CONCLUSION

In this paper, we have studied an economy populated by a representative agent with preference defined over consumption and "*spirit of capitalism*". In each period, besides consuming, the representative agent invests in physical capital, one-period bonds and money balances. There is one representative firm producing a final good. The demand of money is motivated by the presence of a liquidity constraint. The fiscal authority issues one-period bond and levies lump-sum tax while the monetary authority implements either a money growth pegging or a gross interest rate pegging. This paper studies the "*spirit of capitalism*" on the stationary welfare and local stability properties.

Our model makes it possible to theoretically consolidate and rehabilitate the initial interest rate based "liquidity trap" exit strategy, first proposed by Keynes (1936). Our outcomes depart from conventional wisdom of recent neo-Keynesian and new-Classical synthesis (Parent, 2019) on money based "liquidity trap" exit strategies according to which expansionary monetary policy is the only relevant and effective policy and extend and consolidate the initial result of Schmitt-Grohé and Uribe (2014) to the case of an economy with liquidity preference, "*spirit of capitalism*", final good and capital. We consolidate theoretically the channel of an interest-based "liquidity trap" exit strategy. Our result is easily interpretable, once one keeps in mind that the "*spirit of capitalism*" generates a gap between the price of liquidity preference and the rental rate of physical capital. Introducing "*spirit of capitalism*" nonetheless makes the model more plausible but also generates an explanation for a micro founded motive for saving and holding capital. By introducing a liquidity constraint together with "*spirit of capitalism*" in our model, agents have now an incentive to hold assets rather than cash. By that way, we demonstrate that the "liquidity trap" equilibrium is dominated by another equilibrium that is growth enhancing. Increasing the gross interest rate fosters the incentive to hold financial assets rather than hoarding of money, which in turn improves the stationary welfare of agents.

Ultimately, there may exist factors other than the "*spirit of capitalism*" playing a similar role in the "liquidity trap" equilibrium. Wealth accumulation above consumption rewards is important. Once individuals reach a certain level of consumption and save enough for their descendants, wealth accumulation for status may be a good reason to accumulate more capital. There may be other motives for wealth accumulation than the status-seeking behavior, which may affect a higher share of the population, for example, longevity risk.[23] It is possible that this

[23] We wish to thank an anonymous referee for this suggestion.

other aspect comes into play, but it is clearly out of the scope of the present article. This will be the subject of further research, notably to determine, on an empirical level, the share of factors that can affect capital accumulation by households throughout their life cycle.

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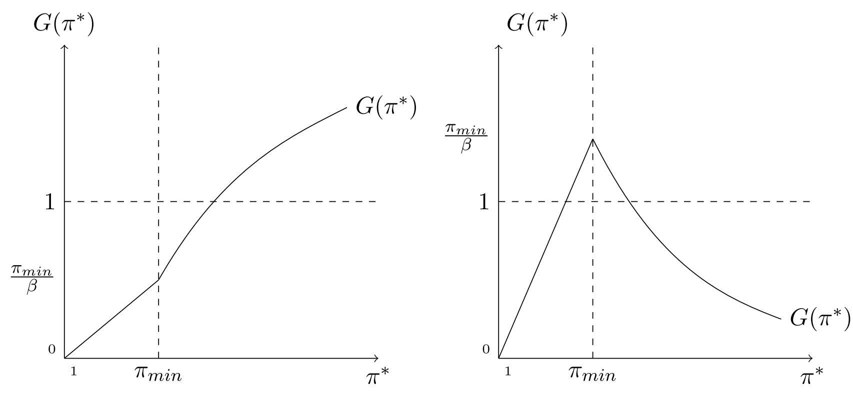
APPENDIX

A | Proof of Proposition 1

Notice first that the Taylor rule given by (16) puts a lower value on the gross rate of inflation, that we will denote as $\pi_{\min} = \frac{\hat{\pi}}{\hat{R}^{\frac{1}{\varepsilon_R}}}$, such that when $\pi \leq \pi_{\min}$ the gross interest rate is one, that is, it is at the zero lower bound, and when $\pi > \pi_{\min}$ the gross interest rate is higher than one and



(a) $\varepsilon_R < 1$ and $\pi_{min} < \beta$. (b) $\varepsilon_R > 1$ and $\pi_{min} > \beta$.

FIGURE A1 Existence of π^*.

set by the Taylor rule $R(\pi^*)$. By combining Equations (16) and (26) we can define a function $G(\pi^*) \equiv \frac{(\hat{\pi})^{\varepsilon_R}(\pi^*)^{1-\varepsilon_R}}{\beta\hat{R}}$ which at steady state must satisfy the following condition: $G(\pi^*) = 1$. If $\pi \leq \pi_{\min}$, then $G(\pi^*) = \frac{\pi^*}{\beta}$. In the opposite case, $G(\pi^*) = \frac{(\hat{\pi})^{\varepsilon_R}(\pi^*)^{1-\varepsilon_R}}{\beta\hat{R}}$. Remark that such a function is increasing for $\varepsilon_R < 1$ and decreasing for $\varepsilon_R > 1$. When $\varepsilon_R < 1$, we get $\lim_{\pi^*\to+\infty} G(\pi^*) = +\infty$ while when $\varepsilon_R > 1$, we obtain $\lim_{\pi^*\to+\infty} G(\pi^*) = 0$. Finally, when $\varepsilon_R \gtrless 1$, $\pi_{\min} \gtrless \beta$. All this information is summarized by Figure A1.

At steady state, the monetary authority's target values $(\hat{\pi}, \hat{R})$ must satisfy at steady state the Fisher equation defined in (17), the Taylor rule defined in (16) and the steady state system defined in (26). When $\varepsilon_R \in (0, 1)$, there exists a unique value of the steady state gross rate of inflation and the gross interest rate higher than one admit given by $\pi^* = \hat{\pi}$ and $R^* = \hat{R}$. On the contrary, when $\varepsilon_R > 1$, two steady state values of the gross rate of inflation and the gross interest rate arise. One is such that $\pi^* = \hat{\pi}$ and $R^* = \hat{R}$ and the other is characterized by a gross interest rate equals to one and an gross rate of inflation equals to β, see Equation (26). Using (26), it is easy to obtain the capital stock and the consumption at the "liquidity trap" and at the interior steady state, respectively given in (27) and (28).

B | Proof of Proposition 2

Denote $\bar{\theta} = \frac{s[\nu(1-g)-\delta]}{(1-s)\delta}$, $\tilde{R} = \frac{s[\nu(1-g)-\delta]}{(1-s)\delta\theta}$ and $\bar{R} = \frac{s[\nu(1-g)-\delta]+\theta[(1-g)\nu-\delta s]}{(1-s)\delta\theta}$.

By comparing Equation (27) and (28), we find that $\frac{k^{LT}}{k^I} < 1$ since $\theta(\hat{R}-1)[\nu(1-g)-\delta s] < 0$. Let $C \equiv \frac{c^{LT}}{c^I} = \left[\left(\frac{s+\theta(1-g)}{s+\theta(1-g)\hat{R}}\right)^s \left(\frac{\nu+\delta\theta\hat{R}}{\nu+\delta\theta}\right)\right]^{\frac{1}{1-s}}$. It is easy to see that when $\hat{R} = 1$, $C = 1$ and thus $c^{LT} = c^I$ while when $\hat{R}$ tends to ∞, c^I tends to zero. Remark that the derivative of c^I with respect to $\hat{R}$ is given by $\frac{dc^I}{d\hat{R}} = \frac{c^*\theta[s[\nu(1-g)-\delta]-(1-s)\delta\theta\hat{R}]}{(1-s)[s+\theta(1-g)\hat{R}][\nu+\delta\theta\hat{R}]} \gtrless 0$ when $\theta < \bar{\theta}$ and $\hat{R} \lessgtr \tilde{R}$. Then, by letting $\theta < \bar{\theta}$, there exists a $\hat{R} > 1$, denoted $\hat{R}^I_c$, implying that $C = 1$, that is, $c^{LT} = c^I$. It follows that $c^I > c^{LT}$ when $\hat{R} \in (1, \hat{R}^I_c)$. Remark also that in any other configurations $\frac{dc^I}{d\hat{R}} < 0$ implying that $c^{LT} > c^I$.

Considering now the level of utility, Equation (3): $\frac{\left[c(\hat{R})k(\hat{R})^{\theta}\right]^{1\;\;\frac{1}{\varepsilon_c}}}{1\;\;\frac{1}{\varepsilon_c}}$. Using similar argument as above, it is easy to see that $u^{LT}=u^{I}$ when $\hat{R}=1$, while when $\hat{R}$ tends to ∞, u^{I} tends to zero. Remark that the derivative of u^{I} with respect to $\hat{R}$ is given by

$$\frac{du^{I}}{d\hat{R}}=\frac{\theta\left[c^{*}(k^{*})^{\theta}\right]^{1\;\;\frac{1}{\varepsilon_c}}\left[s[\nu(1\;\;g)\;\;\delta]+\theta[(1\;\;g)\nu\;\;\delta s]\;\;(1\;\;s)\theta\delta\hat{R}\right]}{(1\;\;s)\left[s+\theta(1\;\;g)\hat{R}\right]\left[\nu+\delta\theta\hat{R}\right]}.$$

Then, $\frac{du^{I}}{d\hat{R}}\gtrless 0$, when $\theta<\bar{\theta}$ and $\hat{R}\lesseqgtr\bar{R}$, there exists a $\hat{R}>1$, denoted $\hat{R}_{u}^{I}$, so that $u^{LT}=u^{I}$. It follows that $u^{I}>u^{LT}$ when $\hat{R}\in\left(1,\hat{R}_{u}^{I}\right)$. Remark also that in any other configuration $\frac{du^{I}}{d\hat{R}}<0$ implying that $u^{LT}>u^{I}$. By denotin $\tilde{R}^{I}=\min\left\{\hat{R}_{u}^{I},\hat{R}_{c}^{I}\right\}$ results follow.

C | Proof of Proposition 3

Looking at an expansionary fiscal policy, we remark that both k^{*} and c^{*} decrease when g increases and thus an expansionary fiscal policy will lower welfare, see Equations (25), (27) and (28). Let us turn to a monetary expansion. In our setup, the monetary authority could follows either: a money growth pegging rule; or a Taylor rule. In the case of the money growth pegging, the instrument is the money growth factor, μ, but keeping in mind that the gross interest rate is $R^{*}=\mu/\beta$. On what concern the Taylor rule, the instrument is the target for the gross interest rate, $\hat{R}$. For each rule, we will refer to an increase in $x^{*}\in\left\{\frac{\mu}{\beta},\hat{R}\right\}$ as a monetary expansion. Our aim is to show how a change in x^{*} affects consumption, capital, GDP and welfare. First remark that, an increase in x^{*} raises capital stock implying that GDP is also increasing.[24] Regarding consumption, x^{*} has a positive or negative impact depending on θ. Indeed, the sign derivative of c^{*} with respect to x^{*} is given by[25]

$$s[(1\;\;g)\nu\;\;\delta]\;\;(1\;\;g)(1\;\;s)\delta\theta x^{*}\gtrless 0\quad\text{if and only if}\quad x^{*}\lesseqgtr\frac{s[(1\;\;g)\nu\;\;\delta]}{(1\;\;g)(1\;\;s)\delta\theta}\equiv\tilde{x}^{*}.\qquad\text{(A1)}$$

It implies that x^{*} has a positive impact on c^{*} when $x^{*}<\tilde{x}^{*}$ meanwhile it has a negative impact on c^{*} if $x^{*}>\tilde{x}^{*}$. However, a positive impact of a monetary expansion occurs only if $\tilde{x}^{*}>1$ which requires a small enough θ, that is, $\theta<\frac{s[(1\;\;g)\nu\;\;\delta]}{(1\;\;g)(1\;\;s)\delta}\equiv\bar{\theta}$. It follows that when θ is small enough an expansionary monetary policy raises consumption if $x^{*}\in(1,\tilde{x}^{*})$, meanwhile in any other configurations consumption reduces.

It is worthwhile to remark that according to Equation (3), the level of welfare at steady state depends on both consumption and capital: $\frac{\left[c(x^{*})k(x^{*})^{\theta}\right]^{1\;\;\frac{1}{\varepsilon_c}}}{1\;\;\frac{1}{\varepsilon_c}}$. As a monetary expansion always increases capital and has an ambiguous impact on consumption, the final impact of such an

[24]Using Equations (25) or (28), the partial derivatives of k^{*} with respect to x^{*} is given by $\frac{dk^{*}}{dx^{*}}=\frac{\theta k^{*}[(1\;\;g)\nu\;\;\delta s]}{(1\;\;s)[s+\theta(1\;\;g)x^{*}][\nu+\delta\theta x^{*}]}$.

[25]Using Equations (25) or (28), the partial derivatives of c^{*} with respect to x^{*} is given by $\frac{dc^{*}}{dx^{*}}=\frac{c^{*}\theta[s[\nu(1\;\;g)\;\;\delta]\;\;(1\;\;s)\delta\theta x^{*}]}{(1\;\;s)[s+\theta(1\;\;g)x^{*}][\nu+\delta\theta x^{*}]}$.

expansion on welfare will depend on θ. As the matter of fact the sign of the partial derivative of the utility with respect x^* is given by[26]

$$s[\nu(1-g)-\delta]+\theta[(1-g)\nu-\delta s]-(1-s)\theta\delta x^* \gtrless 0$$

$$\text{if and only if} \quad x^* \lessgtr \frac{s[\nu(1-g)-\delta]+\theta[(1-g)\nu-\delta s]}{(1-s)\theta\delta} \equiv \bar{x}^*.$$

It implies that x^* has a positive impact on utility if $x^* < \bar{x}$ meanwhile it has a negative impact on utility if $x^* > \bar{x}^*$. Remark that a positive impact on stationary welfare occurs when $\bar{x}^* > 1$ which occur when $\theta < \bar{\theta}$. In such a case a monetary expansion is welfare improving if x^* belongs to the interval $(1, \bar{x}^*)$. Note that $\tilde{x} < \bar{x}^*$. In any other configuration, such an expansion will be welfare reducing.

Results follow.

D | Proof of Proposition 4

Using Equation (2) and (18), we obtain the elasticities of R with respect to k, c and π:

$$\varepsilon_{R,k} \equiv \frac{k^*}{R^*}\frac{\partial R}{\partial k} = \frac{(1-s)\beta\nu + s\theta\mu\frac{c^*}{k^*}}{1-\theta\pi^*\frac{c^*}{k^*}}, \quad \varepsilon_{R,c} \equiv \frac{c^*}{R^*}\frac{\partial R}{\partial c} = \frac{R^*}{c^*}\frac{\theta\pi^*\frac{c^*}{k^*}}{1-\theta\pi^*\frac{c^*}{k^*}}$$
$$\varepsilon_{R,\pi} \equiv \frac{\pi^*}{R^*}\frac{\partial R}{\partial \pi} = \frac{R^*}{\pi^*}\frac{1}{1-\theta\pi^*\frac{c^*}{k^*}} \tag{A2}$$

Denoting percentage deviations from the steady state k^*, c^* and π^* respectively by $\hat{k}_t \equiv (k_t - k^*)/k^*$, $\hat{c}_t \equiv (c_t - c^*)/c^*$ and $\hat{\pi}_t \equiv (\pi_t - \pi^*)/\pi^*$ and loglinearizing Equations (19), (20) and (21), and taking into account Equation (A2), we obtain:

$$\underbrace{\begin{pmatrix} A_{11} & 1 & A_{13} \\ 0 & 1 & 1 \\ 1 & 0 & 0 \end{pmatrix}}_{A}\begin{pmatrix} \hat{k}_{t+1} \\ \hat{c}_{t+1} \\ \hat{\pi}_{t+1} \end{pmatrix} = \underbrace{\begin{pmatrix} B_{11} & B_{12} & B_{13} \\ 0 & 1 & 0 \\ B_{31} & B_{32} & 0 \end{pmatrix}}_{B}\begin{pmatrix} \hat{k}_t \\ \hat{c}_t \\ \hat{\pi}_t \end{pmatrix}$$

where $A_{11} = -\theta(\varepsilon_c - 1)$, $A_{13} = \varepsilon_c$, $B_{11} = -\theta(\varepsilon_c - 1) + \varepsilon_c\varepsilon_{R,k}$, $B_{12} = 1 + \varepsilon_c\varepsilon_{R,c}$, $B_{13} = \varepsilon_c\varepsilon_{R,\pi}$, $B_{31} = 1 - \delta + \nu(1-g) - \frac{\theta\mu(1-g)}{\beta}\frac{c^*}{k^*}$, $B_{32} = -\frac{c^*}{k^*}$ and $\frac{c^*}{k^*}$ is defined in (25). The Jacobian matrix, $J = A^{-1}B$, is then

[26] Using Equations (3) and (25), the partial derivatives of the utility with respect to R^* is given by $\frac{dU}{dx^*} = \frac{\theta\left[c^*(k^*)^{\theta}\right]^{1-\frac{1}{\varepsilon_c}}[s[\nu(1-g)-\delta]+\theta[(1-g)\nu-\delta s]-(1-s)\theta\delta x^*]}{(1-s)[s+\theta(1-g)x^*][\nu+\delta\theta x^*]}$.

$$J^{MGP} = \begin{pmatrix} B_{31} & B_{32} & 0 \\ \frac{B_{11}-B_{31}A_{11}}{1-A_{13}} & \frac{B_{12}-A_{13}-A_{11}B_{32}}{1-A_{13}} & -\frac{B_{13}}{1-A_{13}} \\ \frac{A_{11}B_{31}-B_{11}}{1-A_{13}} & \frac{A_{11}B_{32}+A_{12}-B_{12}}{1-A_{13}} & \frac{B_{13}}{1-A_{13}} \end{pmatrix} \tag{A3}$$

The characteristic polynomial of the Jacobian matrix is $P(\lambda) = \lambda^3 - T\lambda^2 + S\lambda - D$ where the trace, T, the sum of the principal minors of order two, S, and the determinant, D, are given by

$$T = \frac{B_{31}(1-A_{13}) + B_{12} - B_{13} - A_{13} - B_{32}A_{11}}{1-A_{13}}$$

$$S = \frac{B_{31}(B_{12}-B_{13}-A_{13}) - B_{11}B_{32} - B_{13}}{1-A_{13}} \quad \text{and} \quad D = \frac{B_{13}B_{31}}{1-A_{13}}.$$

Denote $P(0) = P(\lambda = 0)$, $P(1) = P(\lambda = 1)$ and $P(-1) = P(\lambda = -1)$. Local indeterminacy occurs when both $P(1)/P(0)$ and $P(-1)/P(0)$ are negative.[27] $P(1)/P(0)$ and $P(-1)/P(0)$ are given by

$$\frac{P(1)}{P(0)} = \frac{(1-B_{12})(1-B_{31}) + B_{32}(A_{11}-B_{11})}{B_{13}B_{31}}$$

and

$$\frac{P(-1)}{P(0)} = \frac{(1+B_{31})[2(A_{13}+B_{13}) - 1 - B_{12}] + (A_{11}+B_{11})B_{32}}{B_{13}B_{31}}.$$

Replacing the terms A_{11}, A_{13}, B_{11}, B_{12}, B_{13}, B_{31} and B_{32} by taking into account Equation (A2), we get:

$$\frac{P(1)}{P(0)} = -\frac{\frac{c^*}{k^*}[(1-s)\beta\nu + \theta\mu[s\beta\delta(1-s) + \theta\mu[g\nu(1-g) + \delta(1-g-s)]]]}{B_{31}} \tag{A4}$$

and

$$\frac{P(-1)}{P(0)} = -\frac{X_0 - \varepsilon_c X_1}{\varepsilon_c B_{31}} \tag{A5}$$

with

[27] See Bosi et al. (2010).

$$B_{31} = 1 \quad \delta + \nu(1 \quad g) \quad \frac{\theta\mu}{\beta}\frac{c^*}{k^*} = \frac{\beta s[1 \quad \delta + \nu(1 \quad g)] + \theta\mu(1 \quad g)[1 \quad \delta(1 \quad s)]}{\beta s + (1 \quad g)\mu\theta} > 0,$$

$$X_0 = 2\left(1 \quad \theta\mu\,\frac{c^*}{k^*}\right)[1 + B_{31} + \theta],$$

and

$$X_1 = \left(4 \quad 3\theta\mu\,\frac{c^*}{k^*}\right)(1 + B_{31}) + 2\theta\left(1 \quad \theta\mu\,\frac{c^*}{k^*}\right) + \beta\nu(1 \quad s) + s\theta\mu\,\frac{c^*}{k^*}.$$

It is immediate to see that $P(1)/P(0)$ is negative. Consider $P(\quad 1)/P(0)$. In order for $P(\quad 1)/P(0)$ to be negative, $X_0 \quad \varepsilon_c X_1$ must be positive. Using Equation (25), $1 \quad \theta\mu\,\frac{c^*}{k^*} = \frac{\beta s(1+\delta\mu\theta)+\mu\theta(1 \quad g)(1 \quad \beta\nu)}{\beta s+(1 \quad g)\mu\theta}$ and $4 \quad 3\theta\mu\,\frac{c^*}{k^*} = \frac{\beta s(4+3\delta\mu\theta)+\mu\theta(1 \quad g)(4 \quad 3\beta\nu)}{\beta s+(1 \quad g)\mu\theta}$. As $1 \quad \beta\nu \in (0, 1)$, both $1 \quad \theta\mu\,\frac{c^*}{k^*}$ and $4 \quad 3\theta\mu\,\frac{c^*}{k^*}$ are positive and thus X_0 and X_1 are positive. Then $P(\quad 1)/P(0) < 0$, if and only if $\varepsilon_c < \tilde{\varepsilon}_c^{\theta,MGP}$. $\tilde{\varepsilon}_c^{\theta,MGP}$ is defined as

$$\tilde{\varepsilon}_c^{\theta,MGP} = \frac{X_0}{X_1} = \frac{2\left(1 \quad \theta\mu\,\frac{c^*}{k^*}\right)[1 + B_{31} + \theta]}{\left(4 \quad 3\theta\mu\,\frac{c^*}{k^*}\right)(1 + B_{31}) + 2\theta\left(1 \quad \theta\mu\,\frac{c^*}{k^*}\right) + \beta\nu(1 \quad s) + s\theta\mu\,\frac{c^*}{k^*}}. \tag{A6}$$

Result follows.

E | Proof of Proposition 5

Let us denote $\hat{k}_t$ and $\hat{c}_t$ percentage deviations of k^* and c^* from the steady state. Linearizing Equation (23), we obtain

$$\underbrace{\begin{pmatrix} A_{11} & A_{12} \\ 1 & 0 \end{pmatrix}}_{J_1}\begin{pmatrix} \hat{k}_{t+1} \\ \hat{c}_{t+1} \end{pmatrix} = \underbrace{\begin{pmatrix} B_{11} & B_{12} \\ B_{21} & B_{22} \end{pmatrix}}_{J_0}\begin{pmatrix} \hat{k}_t \\ \hat{c}_t \end{pmatrix}.$$

The Jacobian matrix, J, is then

$$J^T = J_1^{\quad 1} \cdot J_0 = \begin{pmatrix} 0 & 1 \\ \dfrac{1}{A_{12}} & \dfrac{A_{11}}{A_{12}} \end{pmatrix}\begin{pmatrix} B_{11} & B_{12} \\ B_{21} & B_{22} \end{pmatrix} = \begin{pmatrix} B_{21} & B_{22} \\ \dfrac{B_{11}A_{11}B_{21}}{A_{12}} & \dfrac{B_{12} \quad A_{11}B_{22}}{A_{12}} \end{pmatrix}. \tag{A7}$$

The trace, T, and determinant, D, of matrix J, correspond respectively to the sum and product of the two roots (eigenvalues) of the associated characteristic polynomial $P(\lambda) \equiv \lambda^2 \quad \lambda T + D$.

$$D = \frac{B_{12}B_{21} \quad B_{11}B_{22}}{A_{12}} \quad \text{and} \quad T = \frac{B_{21}A_{12} \quad A_{11}B_{22} + B_{12}}{A_{12}}. \tag{A8}$$

In the case of the “liquidity trap”, it holds that $R_t = 1$ for all t. Using Equation (22), it follows that:

$$\varepsilon_{\pi,k} \equiv \frac{k^*}{\pi^*}\frac{\partial \pi_t}{\partial k_t} = \beta\left[(1 \quad s)r + \theta\frac{c^*}{k^*}\right] \quad \text{and} \quad \varepsilon_{\pi,c} \equiv \frac{c^*}{\pi^*}\frac{\partial \pi_t}{\partial c_t} = \quad \beta\theta\frac{c^*}{k^*} \tag{A9}$$

Then, the jacobian terms are given by:

$$A_{11} = \varepsilon_c\varepsilon_{\pi,k} + B_{11}, \quad A_{12} = 1 + \varepsilon_c\varepsilon_{\pi,c}, \quad B_{11} = \quad \theta(\varepsilon_c \quad 1) \tag{A10}$$

$$B_{12} = 1, \quad B_{21} = 1 \quad \delta + (1 \quad g)r \quad \text{and} \quad B_{22} = \quad \frac{c^*}{k^*}. \tag{A11}$$

In the case of the interior equilibrium, it holds that R_t is given by Equation (16). Using Equation (22), it follows that:

$$\varepsilon_{\pi,k} \equiv \frac{k^*}{\pi^*}\frac{\partial \pi_t}{\partial k_t} = \frac{\beta\left[(1 \quad s)r + \theta\hat{R}\frac{c^*}{k^*}\right]}{(1 \quad \theta\hat{\pi}\frac{c^*}{k^*})\varepsilon_R \quad 1} \quad \text{and} \quad \varepsilon_{\pi,c} \equiv \frac{c^*}{\pi^*}\frac{\partial \pi_t}{\partial c_t} = \frac{\beta\theta\hat{R}\frac{c^*}{k^*}}{(1 \quad \theta\hat{\pi}\frac{c^*}{k^*})\varepsilon_R \quad 1} \tag{A12}$$

$$\varepsilon_{R,k} = \frac{k^*}{R^*}\frac{\partial R_t}{\partial k_t} = \varepsilon_R\varepsilon_{\pi,k} \quad \text{and} \quad \varepsilon_{R,c} = \frac{k^*}{R^*}\frac{\partial R_t}{\partial k_t} = \varepsilon_R\varepsilon_{\pi,c} \tag{A13}$$

Then, the jacobian terms are given by:

$$A_{11} = \varepsilon_c\varepsilon_{\pi,k} \quad \theta(\varepsilon_c \quad 1), \quad A_{12} = 1 + \varepsilon_c\varepsilon_{\pi,c}, \quad B_{11} = \varepsilon_c\varepsilon_{R,k} \quad \theta(\varepsilon_c \quad 1) \tag{A14}$$

$$B_{12} = 1 + \varepsilon_c\varepsilon_{R,c}, \quad B_{21} = 1 \quad \delta + (1 \quad g)r \quad \text{and} \quad B_{22} = \quad \frac{c^*}{k^*}. \tag{A15}$$

Local indeterminacy emerges when the steady state is a sink, that is, when $D < 1$, $1 + T + D > 0$ and $1 \quad T + D > 0$. Local determinacy will arise for any other configuration. Let us, first, consider the “liquidity trap” equilibrium. Using Equations (A9), (A10) into (A8), we get:

$$D = \frac{1 \quad \delta + (1 \quad g)r \quad \theta\frac{c^*}{k^*}(\varepsilon_c \quad 1)}{1 \quad \theta\beta\frac{c^*}{k^*}\varepsilon_c} \quad \text{and} \quad T = 1 + D + \frac{\beta(1 \quad s)(\nu + \delta\theta)\frac{c^*}{k^*}\varepsilon_c}{1 \quad \theta\beta\frac{c^*}{k^*}\varepsilon_c}. \tag{A16}$$

Remark first that $1 \quad T + D \gtrless 0$ if and only if $\varepsilon_c \gtrless \frac{1}{\beta\theta\frac{c^*}{k^*}} \equiv \varepsilon\_c^{LT}$. Using T and D from In the case of the “liquidity trap”, Equation (A16), we can compute $1 + T + D$:

$$1 + T + D = \frac{2\left[2 \quad \delta + (1 \quad g)r + 2\theta\frac{c^*}{k^*}\right] + \varepsilon_c\beta\frac{c^*}{k^*}\left[\nu(1 \quad s) \quad \theta\left(2 + \frac{2}{\beta} \quad \delta(1 \quad s)\right)\right]}{1 \quad \theta\beta\frac{c^*}{k^*}\varepsilon_c}.$$

Under Assumption 2, it holds that $1 + T + D \gtrless 0$ if and only if $\varepsilon_c \lessgtr \varepsilon\_c^{LT}$. It follows that either $1 \quad T + D > 0$ and $1 + T + D < 0$ or $1 \quad T + D < 0$ and $1 + T + D > 0$, and thus local determinacy always prevail.

Consider, now, the interior equilibrium. Using Equations (A13), (A14) into (A9), we get:

$$D = \frac{1 - \delta + (1 - g)r - \theta \frac{c^*}{k^*}(\varepsilon_c - 1) + \varepsilon_c \varepsilon_R \left[[1 - \delta + (1 - g)r]\varepsilon_{\pi,c} - \frac{c^*}{k^*}\varepsilon_{\pi,k}\right]}{1 + \varepsilon_{\pi,c}\varepsilon_c}$$

and

$$T = 1 + D + \frac{(\varepsilon_R - 1)\left[r + \theta \hat{R}\frac{c^*}{k^*} + \delta\theta\hat{R}\right]\varepsilon_c \beta \frac{c^*}{k^*}(1 - s)}{\left(1 - \hat{\pi}\theta\frac{c^*}{k^*}\right)\varepsilon_R - 1 + \beta\theta\hat{R}\frac{c^*}{k^*}\varepsilon_c}$$

At steady state it holds that $\hat{R} = \frac{\hat{\pi}(1 - \delta + r)}{1 - \theta\hat{\pi}\frac{c^*}{k^*}}$ and thus $\hat{\pi} < \frac{1}{\theta \frac{c^*}{k^*}}$. We obtain that $1 - T + D > 0$ if and only if $\varepsilon_R \in \left(1, \frac{1}{1 - \theta\hat{\pi}\frac{c^*}{k^*}}\right)$ and $\varepsilon_c < \frac{1 - \varepsilon_R\left(1 - \theta\hat{R}\frac{c^*}{k^*}\right)}{\theta\hat{R}\frac{c^*}{k^*}}$ or if and only if $\varepsilon_R < 1$ and $\varepsilon_c > \frac{1 - \varepsilon_R\left(1 - \theta\hat{R}\frac{c^*}{k^*}\right)}{\theta\hat{R}\frac{c^*}{k^*}}$. It implies that when $\varepsilon_R > \frac{1}{1 - \theta\hat{\pi}\frac{c^*}{k^*}}$, the interior steady state is always locally determinate. We now restrict $\varepsilon_R < \frac{1}{1 - \theta\hat{\pi}\frac{c^*}{k^*}}$. Using the expression of D and $(1 - g)r = s\left[\frac{c^*}{k^*} + \delta\right]$, $D - 1$ is given by

$$D - 1 = \frac{\left[\left(1 - \hat{\pi}\theta\frac{c^*}{k^*}\right)\varepsilon_R - 1\right]\left[\frac{c^*}{k^*}[s + \theta] - \delta(1 - s)\right] + \varepsilon_c \frac{c^*}{k^*} W}{\left(1 - \hat{\pi}\theta\frac{c^*}{k^*}\right)\varepsilon_R - 1 + \beta\theta\hat{R}\frac{c^*}{k^*}\varepsilon_c}$$

With

$$W = \theta(1 - \hat{\pi}) + \varepsilon_R\left[\theta\left[\hat{\pi}[1 - \delta(1 - s)] - \left[1 - \hat{\pi}\theta\frac{c^*}{k^*}\right]\right] - (1 - s)\beta\nu\right]$$

Remark that under $\varepsilon_R < \frac{1}{1 - \theta\hat{\pi}\frac{c^*}{k^*}}$, $W < 0$ so that the numerator of $D - 1$ is negative. It implies, by considering the denominator, that $D \gtrless 1$ when $\varepsilon_c \lessgtr \frac{1 - \varepsilon_R\left(1 - \theta\hat{R}\frac{c^*}{k^*}\right)}{\theta\hat{R}\frac{c^*}{k^*}}$. Thus when $\varepsilon_R \in \left(1, \frac{1}{1 - \theta\hat{\pi}\frac{c^*}{k^*}}\right)$, it holds that $D \lessgtr 1$ and $1 - T + D \gtrless 0$. So that local indeterminacy is ruled in this case. However, when $\varepsilon_R < 1$ both $1 - T + D > 0$ and $D < 1$ for $\varepsilon_c > \frac{1 - \varepsilon_R\left(1 - \theta\hat{R}\frac{c^*}{k^*}\right)}{\theta\hat{R}\frac{c^*}{k^*}}$. Using the expression of T and D, we obtain $1 + T + D$:

$$1 + T + D = \frac{2\left[\left(1 - \hat{\pi}\theta\frac{c^*}{k^*}\right)\varepsilon_R - 1\right]\left[2 - \delta(1 - s) + \frac{c^*}{k^*}[s + \theta]\right] + \varepsilon_c \beta \frac{c^*}{k^*}(\varepsilon_R - 1)\left[(1 - s)\nu - \theta\hat{R}[2 - \delta(1 - s)]\right]}{\left(1 - \hat{\pi}\theta\frac{c^*}{k^*}\right)\varepsilon_R - 1 + \beta\theta\hat{R}\frac{c^*}{k^*}\varepsilon_c}$$

Under $\varepsilon_R < 1$, $\varepsilon_c > \frac{1 - \varepsilon_R\left(1 - \theta\hat{R}\frac{c^*}{k^*}\right)}{\theta\hat{R}\frac{c^*}{k^*}}$, the denominator of $1 + T + D$ is positive while the numerator of $1 - T + D$ is negative if $\hat{R} < \frac{(1 - s)\nu}{\theta[2 - \delta(1 - s)]}$. It follows that when $D < 1$ and $1 + T + D > 0$, $1 + T + D < 0$ and thus local determinacy holds.

Results follow.