# Social Status and the Growth Effect of Money*

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**Abstract**

It has been shown that in a standard one-sector $AK$ model of endogenous growth with wealth-induced preferences for social status, the economy's growth rates of real output and nominal money supply are positively related when the cash-in-advance constraint is applied solely to the household's consumption purchases. However, a positive output-growth effect of money/inflation is not consistent with the existing empirical evidence. We show that when gross investment must be financed by real money balances as well, this result is overturned, *i.e.* higher inflation is detrimental to economic growth, because of a dominating portfolio substitution effect.

*Keywords*: Social Status, Endogenous Growth, Cash-in-Advance Constraint.

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# 1 Introduction

Recently, there has been a growing literature that examines the macroeconomic effects of wealth-induced preferences for social status within dynamic general equilibrium models.[1] This is a valuable research subject not only for its theoretical significance, but also for its wide-ranging policy implications on promoting economic growth or improving social welfare. In the existing literature, Chang, Hsieh and Lai (CHL, 2000) show that in a prototypical one-sector $AK$ model of endogenous growth where the representative household derives utilities from consumption as well as from its ownership of physical capital in the log-log specification, the economy's growth rates of real output and nominal money supply are positively related when the cash-in-advance (CIA) or liquidity constraint is applied solely to consumption purchases.[2] However, the result of a positive output-growth effect of money (or inflation) is not consistent with many existing econometric studies. For example, using random-effect regressions on two panel data sets of 170 countries from 1960 to 1992, Gylfason and Herbertsson (2001) present strong and robust evidence that higher inflation is detrimental to economic growth at all income levels, both across countries and over time. Moreover, the same empirical finding has been obtained by other researchers such as Kormendi and Meguire (1985), Grier and Tullock (1989), Levine and Renelt (1992), Roubini and Sala-i-Martin (1992), De Gregorio (1993), Barro (1995), Bruno and Easterly (1998), and Rousseau and Wachtel (2001), among others.

Motivated by this inconsistency with international data, the CHL model is modified along two dimensions in our analysis. First, we consider a generalized CRRA utility function where the intertemporal elasticity of substitution in both consumption and capital is not strictly higher than unity – a parametric restriction that is consistent with most macroeconomic empirical research. Second, in addition to consumption goods, the entire expenditures of gross investment are also subject to the CIA constraint (Stockman, 1981). We show that with Stockman's liquidity formulation, CHL's finding of a positive relationship between output growth and money/inflation is overturned, regardless of the coefficient of relative risk aversion in the household utility under consideration.

Intuitively, the growth effect of money depends crucially on the relative strength of two opposing forces dubbed as the *portfolio substitution effect* and the *intertemporal substitution*

[1] See, for example, Zou (1994, 1995, 1998), Bakshi and Chen (1996), Corneo and Jeanne (1997, 2001*a*, 2001*b*), Gong and Zou (2001), Chang and Tsai (2003), Clemens (2004), Chang, Tsai and Lai (2004), and Fisher and Hof (2005), among many others.

[2] Under the consumption-only liquidity constraint, it is well known that money is "superneutral" in the growth-rate sense when households have no desire for social status.

*effect*. On the one hand, an increase in the growth rate of nominal money supply leads to a higher inflation, which in turn raises the cost of money holdings. As a result, the representative household substitutes out of real balances and into capital (the portfolio substitution effect). This will generate a rise in the relative shadow price of capital because of a higher demand, thereby reducing its net rate of return and thus the growth rate of GDP. On the other hand, a higher inflation *ceteris paribus* causes the representative household to consume less and invest more today in exchange for higher future consumption (the intertemporal substitution effect). This expands the supply of capital, hence lowering its relative shadow price. Moreover, the presence of agents' status-seeking motive further strengthens this supply effect through additional capital accumulation. It follows that the economy's output growth rate will rise. Our analysis shows that when money holdings are required for all the consumption and investment purchases, an increase in the monetary growth rate generates a dominating portfolio substitution effect, which in turn raises the relative shadow price of capital and reduces its net rate of return. As a consequence, the economy's output growth rate will fall, hence producing a negative growth effect of money/inflation that exhibits strong empirical support.

This paper is also related to recent work of Chang and Tsai (2003) who study the equilibrium effect of money/inflation on the steady-state level of capital stock in a no-sustained-growth monetary real business cycle (RBC) model where the utility from social status depends on the household's total wealth defined as the sum of physical capital and real money balances. Similar to this paper, these authors find a negative relationship between the economy's inflation rate and capital accumulation at the steady state when money is introduced through Stockman's CIA constraint. Therefore, our analysis makes a parallel contribution to the monetary endogenous growth literature as Chang and Tsai (2003) does to the monetary RBC or exogenous growth literature.[3]

The remainder of this paper is organized as follows. Section 2 examines an $AK$ model of endogenous growth with fixed labor supply, wealth-induced preferences for social status and a generalized cash-in-advance constraint. Section 3 analyzes the existence and uniqueness of the economy's balanced growth path, together with the associated local stability properties. Section 4 studies the output-growth effect of changing the growth rate of nominal money supply. Section 5 concludes.

[3]As it turns out, all the findings in this paper will not be affected qualitatively if real money balances, in addition to physical capital, are incorporated into the household's utility function. The results for this case are available upon request.

## 2 The Economy

We incorporate a generalized CRRA preference formulation and Stockman's (1981) cash-in-advance constraint into the one-sector $AK$ model of endogenous growth with wealth-enhanced social status developed by Chang, Hsieh and Lai (CHL, 2000, section 4). Moreover, partial capital depreciation is considered for completeness of the analysis. To facilitate comparison, we maintain all other features as in CHL, including the assumption that the household's wealth does not consist of real money balances,[4] and follow their notation as much as possible.

The economy is populated by a unit measure of identical, infinitely-lived households. Each household provides fixed labor supply and maximizes its discounted lifetime utility

$$U = \int_0^\infty \left[ \frac{c_t^{1-\sigma} - 1}{1-\sigma} + \beta \frac{k_t^{1-\sigma} - 1}{1-\sigma} \right] e^{-\rho t} dt, \quad \beta > 0, \quad \sigma \geq 1, \tag{1}$$

where $c_t$ and $k_t$ are the individual household's consumption and capital stock, respectively, and $\rho \in (0,1)$ denotes the time discount rate. In addition to consumption goods, the household derives utilities from its social status represented by the level of capital ownership, and the parameter $\beta$ measures the degree for "the spirit of capitalism".[5] On the other hand, to guarantee the existence of a balanced-growth equilibrium, we require that consumption and capital exhibit the same inverse of the intertemporal elasticity of substitution $\sigma$. Based on the empirical evidence for this preference parameter in the mainstream macroeconomics literature, the restriction of $\sigma \geq 1$ is imposed. Notice that CHL restrict their analysis to the specification in which $\sigma = 1$, thus the household utility is logarithmic in $c_t$ and $k_t$.

The budget constraint faced by the representative household is given by

$$c_t + i_t + \dot{m}_t = y_t - \pi_t m_t + \tau_t, \tag{2}$$

where $i_t$ is gross investment, $\pi_t$ is the inflation rate, $m_t$ denotes the real money balances that are equal to the nominal money supply $M_t$ divided by the price level $P_t$, and $\tau_t$ represents the real lump-sum transfers that households receive from the monetary authority. Moreover, output $y_t$ is produced by the technology

$$y_t = Ak_t, \ A > 0, \tag{3}$$

[4] This assumption is justified by the transactions role of money, rather than its function as store of value, emphasized by the cash-in-advance constraint (see CHL's footnote 6, p. 537).

[5] All the results in this paper are qualitatively robust to the modification that introduces the relative (not the individual) wealth $\frac{k_t}{K_t}$, where $K_t$ the economy-wide level of capital stock, to the household's utility function (1).

and the law of motion for the capital stock is

$$\dot{k}_t = i_t - \delta k_t, \;\; k_0 \; > 0 \text{ given,} \tag{4}$$

where $\delta \in [0, 1]$ is the capital depreciation rate.

As in Stockman (1981), the representative household also faces the following cash-in-advance (CIA) or liquidity constraint:

$$c_t + i_t \leq m_t, \tag{5}$$

that is, all consumption and investment purchases must be financed by the household's real balances $m_t$. Notice that when $\sigma = 1$, together with $\delta = 0$ and the consumption-only liquidity constraint $c_t \leq m_t$, we recover the model that CHL have analyzed.

The first-order conditions for the representative household with respect to the indicated variables and the associated transversality conditions (TVC) are

$$c_t \quad : \quad c_t^{-\sigma} = \lambda_{mt} + \gamma_t, \tag{6}$$

$$i_t \quad : \quad \lambda_{kt} = \lambda_{mt} + \gamma_t, \tag{7}$$

$$k_t \quad : \quad \dot{\lambda}_{kt} = (\rho + \delta)\lambda_{kt} - \beta k_t^{-\sigma} - A\lambda_{mt}, \tag{8}$$

$$m_t \quad : \quad \dot{\lambda}_{mt} = (\rho + \pi_t)\lambda_{mt} - \gamma_t, \tag{9}$$

$$\text{TVC}_1 \quad : \quad \lim_{t \to \infty} e^{-\rho t} \lambda_{kt} k_t = 0, \tag{10}$$

$$\text{TVC}_2 \quad : \quad \lim_{t \to \infty} e^{-\rho t} \lambda_{mt} m_t = 0, \tag{11}$$

where $\lambda_{mt}$ and $\lambda_{kt}$ are the shadow prices (or utility values) of real money balances and physical capital, respectively; $\gamma_t$ denotes the Lagrange multiplier associated with the CIA constraint (5) that is postulated to be strictly binding in equilibrium. Equation (6) equates the marginal benefit and marginal cost of consumption, which is the marginal utility of having an additional unit of real dollar. In addition, equations (7) and (8) together govern the evolution of physical capital over time, where the term $\beta k_t^{-\sigma}$ represents the marginal utility benefit of capital accumulation. Finally, equation (9) states that the marginal values of real money holdings are equal to their marginal costs.

We postulate that the nominal money supply is growing at a constant rate $\mu > 0$, hence the resulting seigniorage returned to households as lump-sum transfers is $\tau_t = \mu m_t$. Furthermore, clearing in the goods and money markets implies that

$$c_t + i_t = y_t, \tag{12}$$

and

$$\dot{m}_t = (\mu - \pi_t)\, m_t. \tag{13}$$

# 3 Balanced Growth Path

As in CHL, we focus on the economy's balanced growth path (BGP) along which output, consumption, physical capital and real money balances all grow at a common positive rate denoted as $g$. To facilitate the subsequent dynamic analyses, we adopt the following variable transformations: $p_t \equiv \frac{\lambda_{kt}}{\lambda_{mt}}$ and $z_t \equiv \frac{c_t}{k_t}$. Using (3), (4), (12) and (13), the economy's inflation rate $\pi_t$ is given by

$$\pi_t = \mu - A + z_t + \delta. \tag{14}$$

With these transformations and (14), the model's equilibrium conditions can be re-written as the following autonomous dynamical system:

$$\frac{\dot{p}_t}{p_t} = p_t - \frac{A}{p_t} - \beta z_t^{\sigma} - z_t + A - \mu - 1, \tag{15}$$

$$\frac{\dot{z}_t}{z_t} = \frac{1}{\sigma}\left(\frac{A}{p_t} + \beta z_t^{\sigma} - \rho - \delta\right) - A + \delta + z_t. \tag{16}$$

A balanced-growth equilibrium is characterized by a pair of positive real numbers $(p^*, z^*)$ such that $\dot{p}_t = \dot{z}_t = 0$. Moreover, equation (7) implies that the transformed variable $p_t$ can be expressed as $p_t = 1 + \frac{\gamma_t}{\lambda_{mt}}$, which is not strictly smaller than one because $\gamma_t$, which is the Lagrange multiplier associated with the CIA constraint, should be non-negative. It follows that $p^* \geq 1$ on the economy's balanced growth path(s).

It is straightforward to derive from (15) and (16) that $p^*$ and $z^*$ are the solution(s) to

$$p^* = \frac{A}{p^*} + \beta\,(z^*)^{\sigma} + z^* + \mu + 1 - A, \tag{17}$$

$$\frac{\beta\,(z^*)^{\sigma}}{\sigma} + z^* = -\frac{A}{\sigma p^*} + \frac{(\rho + \delta)}{\sigma} + A - \delta. \tag{18}$$

To examine the existence and number of the economy's balanced growth path(s), we first note that the right-hand-side of (18) is an increasing function of $p^*$, and that evaluating this expression at $p^* = 1$ gives $\frac{1}{\sigma}\left[(A-\delta)(\sigma-1)+\rho\right] > 0$ as long as $\sigma \geq 1$ and $A > \delta$ to ensure positive after-depreciation marginal product of capital. Hence, the right-hand-side of (18) is strictly positive when $p^* \geq 1$. It follows that for each $p^* \geq 1$, there exists a value of $z^*$ that satisfies (18), where this positive valued function is represented by $z^* = g(p^*)$ with $g(1) > 0$ and

$$g'(p^*) \equiv \frac{dz^*}{dp^*} = \frac{A}{\sigma (p^*)^2 \left[1+\beta (z^*)^{\sigma-1}\right]} > 0. \tag{19}$$

Substituting $z^* = g(p^*)$ into (17) leads to the following non-linear equation that determines $p^*$ along a balanced growth path:

$$p^* = \frac{A}{p^*} + \beta \left[g(p^*)\right]^{\sigma} + g(p^*) + \mu + 1 - A \equiv f(p^*), \tag{20}$$

where $f(1) = \beta\left[g(1)\right]^{\sigma} + g(1) + \mu + 1 > 1$ because $g(1) > 0$ and $\mu > 0$. Next, equilibrium $p^*$ can be found from the intersection(s) of $f(p^*)$ in (20) and the 45-degree line. Using $\frac{dz^*}{dp^*}$ from (19), we obtain that

$$f'(p^*) = \frac{A(1-\sigma)}{\sigma (p^*)^2 \left[1+\beta (z^*)^{\sigma-1}\right]} \lesseqq 0 \quad \text{when} \quad \sigma \gtreqq 1, \tag{21}$$

and

$$f''(p^*) = -f'(p^*) \underbrace{\left\{ \frac{2}{p^*} - \frac{\beta f'(p^*)\left[(z^*)^{\sigma-2}\right]}{1+\beta (z^*)^{\sigma-1}} \right\}}_{\text{positive}} \gtreqq 0 \quad \text{when} \quad \sigma \gtreqq 1. \tag{22}$$

As a result, $f(p^*)$ is either a downward-sloping and convex curve (when $\sigma > 1$), or a horizontal line (when $\sigma = 1$), that intersects the 45-degree line once in the positive quadrant with $p^* > 1$, thereby leading to the associated $z^* = g(p^*) > 0$. It follows that there exists a unique balanced growth path in our model economy.

In terms of the BGP's local dynamics, we compute the Jacobian matrix $J$ of the dynamical system (15) and (16) evaluated at $(p^*, z^*)$. The trace and determinant of the Jacobian are given by

$$Tr = p^* + \frac{A}{p^*} + \beta (z^*)^{\sigma} + z^* > 0, \tag{23}$$

$$Det = p^* z^* \left[1 + \beta (z^*)^{\sigma-1}\right] \underbrace{\left\{1 - \frac{A(1-\sigma)}{\sigma (p^*)^2 \left[1 + \beta (z^*)^{\sigma-1}\right]}\right\}}_{\left[1 - f'(p^*)\right] > 0} > 0. \tag{24}$$

The local stability properties of the BGP equilibrium are determined by comparing the eigenvalues of $J$ that have negative real parts to the number of initial conditions in the dynamical system (15)-(16), which is zero because $p_t$ and $z_t$ are both jump variables. It turns out that our model's Jacobian matrix possesses a positive trace and a positive determinant, as in equations (23) and (24), indicating that none of two eigenvalues has negative real part. Consequently, the economy's balanced growth path exhibits saddle-path stability and equilibrium uniqueness.

# 4 Growth Effect of Money

In this section, we derive and examine the analytical expression that governs the output-growth effect of money or inflation.[6] Combining (3), (4) and (12) yields the common rate of economic growth $g$ as follows:

$$g = A - \delta - z^*, \tag{25}$$

thus the BGP's growth rate is negatively related to the transformed jump variable $z^* \left(\frac{dg}{dz^*} < 0\right)$. We then take total differentiation on (25), and use the chain rule together with (17), (19) and (21) to find that the growth effect of money/inflation is given by

$$\frac{dg}{d\mu} = \underbrace{\frac{dg}{dz^*}}_{(-)} \underbrace{\frac{dz^*}{dp^*}}_{(+)} \frac{dp^*}{d\mu}, \tag{26}$$

where

$$\frac{dp^*}{d\mu} = \frac{\sigma (p^*)^2 \left[1 + \beta (z^*)^{\sigma-1}\right]}{\sigma (p^*)^2 \left[1 + \beta (z^*)^{\sigma-1}\right] + (\sigma - 1) A} = \frac{1}{1 - f'(p^*)} > 0. \tag{27}$$

[6] On the balanced growth path, its inflation rate $\pi^*$ is *ceteris paribus* positively related to the monetary growth rate $\mu$ because equation (13) implies that $\mu = \pi^* + g$.

It follows that in contrast to CHL, our model economy displays a negative relationship between the BGP's output growth and money/inflation $\left(\frac{dg}{d\mu} < 0\right)$. This result turns to be consistent with the international evidence reported in Gylfason and Herbertsson (2001), and many other empirical studies mentioned in the Introduction.

Generally speaking, within dynamic general equilibrium macroeconomic models, the sign for the growth effect of money depends crucially on the relative strength of two opposing forces. On the one hand, a rise in the monetary growth rate $\mu$ leads to a higher inflation, which in turn raises the cost of money holdings. As a result, the representative household substitutes out of real balances and into physical capital (the portfolio substitution effect). This will cause an increase in the relative shadow price of capital $p^*$ because of a higher demand, thereby reducing its net rate of return and thus the BGP's growth rate. On the other hand, a higher monetary growth rate $\mu$ *ceteris paribus* induces the representative household to consume less and invest more today in exchange for higher future consumption (the intertemporal substitution effect).[7] This expands the supply of physical capital, hence reducing its relative shadow price $p^*$. In addition, agents' status-seeking motive further strengthens this supply effect through additional capital accumulation (see the term $\beta k_t^{-\sigma}$ in equation 8). It follows that the economy's output growth rate will rise. Our preceding analysis shows that when consumption and gross investment are both liquidity-constrained, the BGP's output growth and money/inflation are inversely related $\left(\frac{dg}{d\mu} < 0\right)$ in that the portfolio substitution effect outweighs the intertemporal substitution effect. A corollary is that the same "negative relationship" result will be obtained when households have no desire for social status ($\beta = 0$) because the intertemporal substitution effect is now weakened (see Suen and Yip (2005), section 2).

However, the presence of social status in the household utility plays an important role in affecting the growth effect of money/inflation when the CIA constraint is applicable only to the purchases of consumption goods, as in Clower (1967) and Lucas (1980), among others. Specifically, it is straightforward to show that the BGP's relative utility value of physical capital to real money balances $p^*$ is always equal to one in the absence of status seeking ($\beta = 0$). As a result, neither the portfolio substitution effect nor the intertemporal substitution effect will take place when there is a change to the monetary growth rate $\mu$. It follows that the economy's output growth rate, $g = \frac{1}{\sigma}(A - \rho - \delta)$, is independent of money/inflation $\left(\frac{dg}{d\mu} = 0\right)$ due to a time-invariant equilibrium real rate of return to investment. On the contrary, CHL show

[7] Equation (14) shows that holding the inflation rate constant, an increase in $\mu$ leads to a lower consumption-capital ratio $z_t$. This requires an intertemporal substitution from current to future consumption, thus raising today's investment.

that when $\sigma = 1$, status preference ($\beta > 0$) generates a dominating intertemporal substitution effect (from consumption to investment) in response to an increase in $\mu$. Therefore, the net rate of return on capital will rise because of a decline in its relative shadow price. This in turn leads to a positive relationship between the growth rates of real output and nominal money supply $\left(\frac{dg}{d\mu} > 0\right)$, a result that is not consistent with the existing econometric evidence.[8]

## 5 Conclusion

We have systematically examined the interrelations between wealth-induced preferences for social status, the formulation of the cash-in-advance constraint, and the output-growth effect of money/inflation within the context of a standard $AK$ model of endogenous growth. It turns out that in contrast to CHL, when real balances are required for all the purchases of consumption as well as investment goods, the economy's growth rates of real output and nominal money supply are inversely related due to a dominating portfolio substitution effect, provided the household's intertemporal elasticity of substitution in both consumption and capital takes on an empirically plausible value that is smaller than or equal to one. This result of a negative growth effect of money/inflation is strongly supported by the empirical evidence.

Finally, with regard to a possible extension of our analysis, it would be worthwhile to incorporate the household's status-seeking motive into Itaya and Mino's (2003) monetary endogenous growth model in which variable labor supply is considered and money is used to reduce pecuniary transaction costs or time spent for shopping. This will allow us to examine the robustness of our results, and further identify other channels that can affect the interrelations between social status and the growth effect of money. We plan to pursue this research project in the near future.

[8] It can be easily shown that this "positive relationship" result continues to hold when $\sigma > 1$.

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