Can Growth-enhanced Monetary Policy Improve Welfare?

Hsiu-Yun Lee,[a] Yu-Lin Wang,[a*] and Wen-Ya Chang[b]

[a] *Department of Economics, National Chung-Cheng University, Taiwan*

[b] *Department of Economics, Fu-Jen Catholic University, Taiwan*

Abstract

This paper examines the growth and welfare effects of an increase in the rate of money supply in an endogenous growth model with relative wealth-enhanced social status motive, production externalities, and liquidity constraints on consumption. We find that even though monetary growth normally promotes economic growth, it can not improve welfare when capital stock is over accumulated. An optimal monetary policy minimizes seigniorage in general. Only when the seigniorage revenue is rebated to the public and production exhibits externalities, there exists an optimal rate of seigniorage aimed at equalizing a negative spillover effect and a positive social status effect of capital. Our results conclude the optimal monetary policy is never the *Friedman rule*.

Keywords: Wealth-enhanced social status, Production externalities, Cash-in-advance constraint, Monetary growth

JEL *classification:* O42, E52

* Corresponding author. Tel.: 886-5-2428178, Fax: 886-5-2720816, E-mail: ecdylw@ccu.edu.tw , Mailing address: Department of Economics, National Chung Cheng University, 168 University Rd., Min-Hsiung, Chia-Yi, 621, Taiwan.

1. Introduction

There appears to be no agreement on the effects of an increase in the rate of money growth on output growth and, subsequently, on welfare. One avenue for money growth promoting output growth is through an increase in the rate of return on an asset that is a driving force of growth and inducing more accumulation of that asset. A salient feature that makes our paper able to studying this issue is that we consider wealth-enhanced social status, of which the wealth composes of both physical capital and real balances. Together with the role of capital externality in production and the way increased money being spent, introducing wealth-enhanced social status provides a mechanism through which changes in monetary growth might positively influence economic growth. This paper follows to address an interesting question: can growth-enhanced monetary policy improve welfare? We then determine the optimal rate of money growth and compare it with the Friedman rule.

Friedman (1969) proposes that optimality requires setting the nominal interest rate to zero, so that the return on money holdings was equated to the return on any other interesting-bearing nominal assets. Under the assumptions of homothetic preferences and costless production of money, a money-in-utility model claims the optimality of Friedman rule.[1] Moreover, upon the economy where a higher rate of money growth hinders economic growth, the optimality of Friedman rule is again widely advocated.[2] An interesting question regarding the optimal conduct of monetary policy inevitably arises: if money growth raises the relative return to capital

[1] See, Walah (2003, pp.172-191) for a description of optimal seigniorage.

[2] For example, Palivos and Yip (1995) and Dotsey and Sarte (2000) agree on applying the Friedman rule to generate the optimal growth rate; furthermore, Palivos and Yip (1995) claim combining income taxation and the Friedman rule can maximize social welfare.

and stimulates capital formation and hence growth, can the Friedman rule ever be optimal?

We address this question by employing 'AK' type of models and emphasizing the transactional role of money via a cash-in-advance constraint on consumption. Using 'AK' type of models both with and without capital spillovers, we make a new investigation of relative wealth-induced social status incentive on economic growth and welfare with consumption being liquidity constrained. Regarding the seigniorage revenue, the government can distribute a lump-sum transfer to the public or finance its consumption expenditure. The former use of seigniorage revenue is consistent with the conventional money and growth literature (e.g. Marguis and Reffett, 1991), while the latter one conforms to recent works (e.g. Pelloni and Waldmann, 2000). In this paper we assume that the resource consumed by government neither increases households' utility nor enhances productivity. That is, we consider a useless but typical government spending.

Our results support the Mundell-Tobin effect in the growth sense, that is, a monetary growth stimulates economic growth. The key point lies in, given that the social status motive provides an incentive for individuals to accumulate capital, an increase of money growth increases the cash-in-advance cost, depresses consumption and enhances investment. By shifting the demand from consumption to capital and if there being no additional resource wasted due to the higher rate of money growth, the increase in monetary growth indeed raises output growth.[3]

That a higher monetary growth and a higher rate of inflation can speed economic growth when a liquidity constraint is applied to consumption has been shown by the

[3] For example, in Barro-Rebelo model, the expansion of useless government spending induced by higher money supply causes a complete crowding-out effect, and there is thus no Mundell-Tobin effect.

capital-induced social status models of Chang, Hsieh, and Lai (2000) and Chen and Guo (2008). Seemingly unrelated to this strand, recent empirical works by Ahmed and Rogers (2000) and Benhabib and Spiegel (2009) support the positive relationship between inflation and growth for moderate-inflation economics. Trace back to literature, Marquis and Reffett (1991) introduce money into a two-sector Lucas (1988) model via cash-in-advance constraints and conclude that the steady-state growth rate of the economy is immune to changes in the rate of money growth when only consumption is liquidity constrained. The neutrality of monetary policy has been challenged by the linkage between the accumulated stocks of wealth and agents' preferences as highlighted by Weber (1958). People pursue capital accumulation in order to advertise their wealth and thereby achieve social position and power.[4] Even though it can't be a driving force of economic growth alone, seeking higher social status indeed provides incentives for individuals to perform growth-enhancing activities.

Regarding the social status-seeking incentive in monetary economies, Zou (1998), Gong and Zou (2001), and Chang and Tsai (2003) include both capital stock and real balances in the utility function to investigate a wealth-induced social status incentive.[5] With the assumption that only consumption is liquidity constrained, Gong and Zou (2001) and Chang and Tsai (2003) find higher inflation helps capital accumulation while Zou (1998) adopting "money in the utility function" approach finds higher inflation helps economic growth. In addition, Corneo and Jeanne

[4] A detailed description of the status concern in both the history of economic thought and modern analysis of economic growth is provided by Zou (1994).

[5] For the wealth related to social status, Chang, Tsai and Lai (2004) and Chang, Chen, and Kao (2008) define it in terms of physical capital and human capital, while Kenc and Dibooğlu (2007) include bond, money and capital as well.

(1997), Futagami and Shibata (1998), Long and Shimomura (2004), and Chang (2006) emphasize that individual's utility depends on its relative position in the society rather than the absolute level of its own capital in their real models. Although with wealth-enhanced social status models, many studies have tried to offer new perspectives on economic growth, none of them ever examines welfare implications of higher inflation.[6] It is therefore essential to have a monetary endogenous growth model with wealth-enhanced social status incentives to examine both growth and welfare effects of monetary policy.

A key investigation tries to answer: can the prevailing Mundell-Tobin effect dominate the negative liquidity cost on consumption such that a money expansion improves social welfare? Our findings conclude that through the channel of wealth-enhanced social status, monetary growth stimulating investment results in over-accumulation in capital from a welfare perspective. We confirm the negative relationship between inflation and welfare in general, that is consistent with most of previous studies (see Lucas, 2000, for a survey.) Moreover, an optimal monetary policy is generally to minimize seigniorage, with one exception that there is an optimal rate of seigniorage aimed at equalizing a negative spillover effect and a positive social status effect of capital. In either case, the optimal monetary policy is never the Friedman rule.

The paper is organized as follows. The basic framework is outlined in Section 2. Section 3 includes two subsections, studying the growth effects of money expansion with the seigniorage revenue either being lump-sum transferred to the public or financing useless government spending. Section 4 turns to the welfare

---

[6] Chang (2006) studies the impact of an increase in the consumption tax rate on the social welfare and determines the optimal consumption tax policy.

implications and determines the optimal seigniorage. Section 5 concludes the main findings.

2. The model

Consider an economy consisting of a representative, infinitely-lived agent and a government, modeled in an endogenous growth framework with production externalities and a liquidity constraint on consumption. Labor is inelastically supplied and normalized to unity. The government conducts a constant growth of money supply and uses its seigniorage revenue either to finance government purchases or to allocate the new fiat money to the representative agent of the economy by way of a lump-sum transfer. The representative agent's optimization problem is:

$$\text{Max} \int_0^\infty \left[\ln c + \beta \upsilon \left(\frac{m+k}{\bar{m}+\bar{k}} \right) \right] e^{-\rho t} dt \,, \tag{1}$$

subject to

$$\dot{m} + \dot{k} = y + \theta\tau - c - \pi m \,, \tag{2}$$

$$m = c \,,\text{[7]} \tag{3}$$

where $y =$ real output, $c =$ real consumption, $m =$ real balances, $k =$ the capital stock, $\tau =$ real lump-sum transfers from the government, $\pi =$ the rate of inflation, $\rho =$ a constant rate of time preference, $\beta =$ a non-negative measure of the agent's desire for social status, and $\theta =$ an indicator with the value of either one or zero. An upper bar of a variable indicates the average amount of the variable, and an overdot denotes its time derivative. The instantaneous utility function υ is well behaved, satisfying $\upsilon' > 0, \upsilon'' < 0$.

[7] Even if holding money renders utilities, inflation is detrimental to real balances. Money cannot compete with capital as the ways of accumulating real wealth. This feature makes the cash-in-advance constraint always bind at equality.

The utility function in Eq. (1) embodies the feature of possible benefits stemming from the relative real wealth, representing a relative wealth-enhanced social status. The relative real wealth is defined as the sum of real balances and capital stock of the agent relative to the average amount of aggregate real balances and capital stock in the economy. Eq. (2) is the budget constraint describing how the real wealth is accumulated, given k and m at their initial values. Eq. (3) is the cash-in-advance constraint, requiring consumption goods being purchased by means of real balances.

The production function is assumed to be:

$$y = f(k; \bar{k}) = Ak^{\alpha}\bar{k}^{1-\alpha}, \quad 0 < \alpha \le 1. \tag{4}$$

In the case of $\alpha = 1$, the production function takes the 'Ak' technology form, $y = Ak$, as the engine of sustained growth in Barro (1990) and Rebelo (1991). For more general cases where α lies between zero and one, the technology embodies production externalities as it is assumed in Romer (1986). Note that $\partial f(k; \bar{k}) / \partial k = \alpha A = A$ is true in Barro-Rebelo's 'Ak' technology and $\partial f(k; \bar{k}) / \partial k = \alpha A < A$ holds in Romer-type technology when an equilibrium is reached.

Let λ be the costate variable and together with γ be the multipliers of the current value Hamiltonian associated with Eqs. (2) and (3), respectively. The current value Hamiltonian H is:

$$H = \ln c + \beta \upsilon\left(\frac{m+k}{\bar{m}+\bar{k}}\right) + \lambda\left(Ak^{\alpha}\bar{k}^{1-\alpha} + \theta\tau - c - \pi m\right) + \gamma(m - c).$$

The optimum conditions necessary for the representative agent are:

$$\frac{1}{c} = \lambda + \gamma, \tag{5}$$

$$\beta \upsilon'\left(\frac{m+k}{\bar{m}+\bar{k}}\right)\frac{1}{\bar{m}+\bar{k}} - \lambda\pi + \gamma = -\dot{\lambda} + \lambda\rho, \tag{6}$$

$$\beta \upsilon'\left(\frac{m+k}{\overline{m}+\overline{k}}\right)\frac{1}{\overline{m}+\overline{k}}+\lambda \alpha A k^{\alpha-1}\overline{k}^{1-\alpha} = -\dot{\lambda}+\lambda\rho \,, \tag{7}$$

together with Eqs. (2) and (3) and the transversality conditions of *m* and *k*,

$$\lim_{t\to\infty}\exp(-\rho t)\lambda m = 0 \quad \text{and} \quad \lim_{t\to\infty}\exp(-\rho t)\lambda k = 0.$$

Eq. (5) asserts that the marginal utility of current consumption equals its marginal cost, that is, the marginal utility of having an additional unit of wealth and the cost accompanied by cash-in-advance constraint. Eq. (6) is the Euler condition determining the optimal accumulation of real balances on the effective rate of returns, that is, the utilities from a relative wealth-induced social status obtained from an increase of real balances, minus the inflation cost of holding money, and plus the transaction value of money. Similarly, Eq. (7) implies the optimal accumulation of capital stock on the effective rate of returns which is determined by the rewards from a relative wealth-induced social status due to newly increased capital plus the marginal product of capital. It is worth noting that, with $\beta > 0$, an increase in money growth can increase the rate of return on capital, and thus encourage accumulation of capital. The government simply follows a constant rate of monetary growth (μ) and keeps its budget balanced all the time by spending its seigniorage revenue either on a purchase (*G*) or a lump-sum transfer (τ) to the representative agent. That is:

$$\theta\tau + (1-\theta)G = \mu m \,, \tag{8}$$

where $\theta = 0$ when the increase of money is used to finance government purchases and $\theta = 1$ when it is transferred to the agent. In addition, assume that the government purchase is proportion to output,

$$G = gy \,, \quad 0 < g < 1 \,, \tag{9}$$

and neither increases the agent's utilities nor improves his production.

By definition, the law of motion governing real balances is:

$$\dot{m} = (\mu - \pi)m. \tag{10}$$

With the representative agent assumption, at equilibrium, $m = \overline{m}$ and $k = \overline{k}$. Hereinafter, we focus on the determination and adjustment of an equilibrium.

From Eqs. (3), (5)-(7), the inflation rate is endogenously determined by:

$$\pi = \frac{1}{\lambda m} - (1 + \alpha A). \tag{11}$$

Combining Eqs. (10) and (11) gives the growth rate of real balances:

$$\frac{\dot{m}}{m} = \mu - \frac{1}{\lambda m} + 1 + \alpha A. \tag{12}$$

Putting Eqs. (2), (3) and (10) together, the goods market equilibrium condition implies:

$$\frac{\dot{k}}{k} = A - \left(\mu \frac{m}{k} - \theta \frac{\tau}{k}\right) - \frac{m}{k}$$

$$= A + \theta \frac{\tau}{k} - (1 + \mu)\frac{m}{k}. \tag{13}$$

In addition, due to Eq. (7), the evolution of the shadow price of the real wealth at equilibrium is:

$$-\frac{\dot{\lambda}}{\lambda} = \alpha A - \rho + \beta \upsilon'(1) \frac{1}{\lambda k\left[(m/k) + 1\right]}. \tag{14}$$

Eqs. (12)-(14) constitute a set of dynamic equations with respect to *m*, *k*, and λ in a cash-in-advance endogenous-growth economy. Along a balanced growth path, the following relation for the growth rates of capital, real balances and shadow price holds:

$$\frac{\dot{k}}{k} = \frac{\dot{m}}{m} = -\frac{\dot{\lambda}}{\lambda} = \phi, \tag{15}$$

where ϕ denotes the steady-state growth rate of the economy.

It is worth noting that, from Eqs. (14) and (15) we have:

$$\phi = \alpha A - \rho + \beta \upsilon'(1) \frac{1}{\lambda k\left[\left(m/k\right)+1\right]}. \tag{16}$$

Here, $\beta > 0$ ($\beta = 0$) corresponds to the situation where the effects of relative wealth-induced social status are present (absent). Without the effect of wealth-induced social status ($\beta = 0$), Eq. (16) reduces to

$$\phi = \alpha A - \rho. \tag{17}$$

In the case of $\alpha = 1$, Eq. (17) turns out to be the standard result in Barro-Rebelo 'AK' model. But with social status motives and production externalities, Eq. (16) reveals the assumption that $A > \rho$ is neither sufficient nor necessary for the economy exhibiting sustained growth.

Define $x \equiv 1/(\lambda k)$ and $z \equiv m/k$. Due to the balanced growth feature of the model, x and z will stay constant in the steady state. Furthermore, it is easy to show that there are two positive eigenvalues corresponding to the two jump variables (x and z) so as to guarantee the unique equilibrium of the model.

3. Growth effect of monetary policy

3.1 Lump-sum transfer of the seigniorage

This section examines whether monetary growth will affect the growth rate of the economy when government's seigniorage revenue is transferred in a lump-sum manner to the agent, i.e. $\theta = 1$. This policy makes the government budget constraint become:

$$\tau = \mu m. \tag{18}$$

By using $\theta = 1$ and Eq. (18) the goods market equilibrium condition of Eq. (13) reduces to:

$$\frac{\dot{k}}{k} = A - \frac{m}{k} = A - z\,. \tag{19}$$

With the definition of x and z, from Eqs. (12), (14), and (19), we therefore have the following relationships in the steady state:

$$\frac{\dot{x}}{x} = -\frac{\dot{\lambda}}{\lambda} - \frac{\dot{k}}{k} = \alpha A - \rho + \beta \upsilon'(1)\frac{\hat{x}}{1+\hat{z}} - A + \hat{z} = 0\,, \tag{20}$$

$$\frac{\dot{z}}{z} = \frac{\dot{m}}{m} - \frac{\dot{k}}{k} = \mu - \frac{\hat{x}}{\hat{z}} + 1 + \alpha A - A + \hat{z} = 0\,, \tag{21}$$

where a hat over a variable denotes the steady state value of the variable and will be used hereinafter.

From Eq. (19), the steady state growth rate $\hat{\phi}$ is:

$$\hat{\phi} = A - \hat{z}\,. \tag{22}$$

The economy will exhibit a sustained growth as long as $A > \hat{z}$, the output-capital ratio being higher than the consumption-capital ratio.

Differentiating Eqs. (20) and (21) with respect to μ, together with Eq. (22) , we have:

$$\frac{\partial \hat{\phi}}{\partial \mu} = -\frac{\partial \hat{z}}{\partial \mu} = \frac{\beta \upsilon'(1)}{\Delta} \geq 0, \text{ as } \beta \geq 0\,, \tag{23}$$

where $\Delta = \beta \upsilon'(1)\left(1 + \frac{\hat{x}}{\hat{z}^2(1+\hat{z})}\right) + \frac{1}{\hat{z}}\left(1+\hat{z}\right) > 0$.

In the case that social status does not provide direct benefits ($\beta = 0$), a higher rate of money growth is neutral. This result is consistent with the finding of Marquis and Reffett (1991, pp. 107-108), though we use a Barro-Rebelo (Romer) type of model while Marquis and Reffett (1991) adopt a generalized Lucas-type model. On the other hand, when social status provides direct benefits ($\beta > 0$), an increase in the money growth rate then positively affects the long-run growth rate of the economy.

This conclusion contradicts Marquis and Reffett (1991) but is consistent with Zou (1998).

An intuitive explanation for the above results goes as follow. If the social-status incentive is absent, a permanent rise in the rate of money growth causes a higher rate of inflation but leaves the rate of return on capital unchanged, so there is no intertemporal substitution effect for the choice of consumption path. Moreover, since government returns all its seigniorage revenue to the public in a lump-sum manner, there is no wealth effect for the choice of consumption path, neither. The consumption-capital ratio is completely determined by:

$$\hat{z} \equiv \hat{m}/\hat{k} = \hat{c}/\hat{k} = (1-\alpha)A + \rho, \tag{24}$$

as from Eqs. (15), (17), and (19). From Eq. (23), the only way can change the economic growth is by changing the ratio of consumption over capital, which is impossible under the absence of social status seeking incentives. The monetary policy has therefore no effect on economic growth and its neutrality holds.

Consider the case that an accumulation of wealth promotes higher social status. There is a chance that individuals' choices can switch between consumption and investment because the return of capital stock depends on the rate of money growth. The consumption-capital ratio is determined by:

$$\hat{z} \equiv \hat{m}/\hat{k} = \hat{c}/\hat{k} = (1-\alpha)A + \rho - \beta\upsilon'(1)\frac{\hat{x}}{\hat{z}+1}. \tag{25}$$

The consumption-capital ratio in the case of $\beta > 0$ is thus lower than that in the case of $\beta = 0$. Eq. (25) provides a channel through which an expansion in money growth can raise an economy's output growth: through affecting the steady-state values of x and z, or equivalently, through capital accumulation. As the economy exhibits constant returns to scale with respect to aggregate capital, its growth rate is raised through this stimulated capital accumulation. More formally, we prove the following proposition.

Proposition 1: For 'Ak' type's models with the CIA constraint on consumption, a higher rate of money growth which seigniorage revenue is returned to the public as lump-sum transfer raises the rate of economic growth only when the social status-seeking incentive exists; otherwise, it is neutral.

The explanation is rather intuitive: a permanent rise in the rate of money growth depresses the relative return of real balances to capital stock. When there is a social status incentive in the utility, the return of capital stock is endogenously determined and a speedy money supply increase enhances the capital accumulation and economic growth. However, if there is no social status incentive in the utility, the return of capital stock keeps constant and a speedy money supply increase results in a once-and-for-all increase in inflation and leaves the capital accumulation and economic growth intact.

3.2 Government spending financed by the seigniorage

Now we examine the growth effect of monetary growth when government's seigniorage revenue is spent on public expenditure, i.e. $\theta = 0$. We assume government spending is resource consuming and non-productive as well as not utility-enhanced. It is useless in essence. The government budget constraint reduces to

$$gAk = \mu m, \tag{26}$$

where g is an endogenous government spending ratio to balance budget.

The evolution of real balances and the shadow price remains the same as in Eqs. (12) and (14), but the goods market equilibrium condition of Eq. (13) turns out to be:

$$\frac{\dot{k}}{k} = A - (1+\mu)\frac{m}{k} = A - (1+\mu)z\,. \tag{27}$$

Substituting the definition of x and z into Eqs. (12), (14), and (27) gives the steady state relationships:

$$\frac{\dot{x}}{x} = -\frac{\dot{\lambda}}{\lambda} - \frac{\dot{k}}{k} = \alpha A - \rho + \beta \upsilon'(1)\frac{\hat{x}}{1+\hat{z}} - A + (1+\mu)\hat{z} = 0\,, \tag{28}$$

$$\frac{\dot{z}}{z} = \frac{\dot{m}}{m} - \frac{\dot{k}}{k} = \mu - \frac{\hat{x}}{\hat{z}} + 1 + \alpha A - A + (1+\mu)\hat{z} = 0\,. \tag{29}$$

Differentiating Eqs. (28) and (29) with respect to μ, we have:

$$\frac{\partial \hat{z}}{\partial \mu} = -\frac{\beta \upsilon'(1) + 1}{\widetilde{\Delta}} < 0\,, \tag{30}$$

where $\widetilde{\Delta} = \frac{\beta \upsilon'(1)}{1+\hat{z}}\left(1 + \mu + \frac{\hat{x}}{\hat{z}^2(1+\hat{z})}\right) + \frac{1}{\hat{z}}(1+\mu) > 0$.

Unlike the lump-sum transfer case, a higher rate of money growth unambiguously lowers the ratio of real balances (consumption) to capital in the useless government spending case. The main explanation for the lower consumption-capital ratio is the negative wealth effect caused by the permanent increase in government spending, no matter whether a social status-seeking incentive exists or not.

From Eq. (27), the steady state growth rate $\hat{\phi}$ is:

$$\hat{\phi} = A - (1+\mu)\hat{z}\,. \tag{31}$$

The economy will exhibit a sustained growth as long as $A > (1+\mu)\hat{z}$, the output-capital ratio being higher than the ratio of the sum of consumption and government spending over capital, that is, the absorption-capital ratio.

Differentiating Eq. (31) with respect to μ, together with Eq. (30) we have

$$\frac{\partial \hat{\phi}}{\partial \mu} = -\hat{z} - (1+\mu)\frac{\partial \hat{z}}{\partial \mu}$$

$$= \frac{\beta \upsilon'(1)(1-\alpha)A}{(1+\hat{z})^2 \tilde{\Delta}} \geq 0 \text{, as } \beta(1-\alpha) \geq 0 . \tag{32}$$

Proposition 2: For 'Ak' type's models with the CIA constraint on consumption, a higher rate of money growth which seigniorage revenue is used to finance useless government spending raises the rate of economic growth only when social status-seeking incentives and productivity externalities co-exist; otherwise, it is neutral.

If the capital stock does not provide direct benefits ($\beta = 0$), a higher rate of money supply is neutral which corresponds to Palivos and Yip's (1995) findings when the cash-in-advance restriction applies only on consumption. This is because when there is no social-status incentive, the return of capital stock is constant and a permanent rise in the growth rate of the money supply causes no intertemporal substitution effect for the choice of optimal consumption. In addition, in the case where government wastes all its seigniorage revenue on useless purchases, there is a complete crowding-out effect for the choice of optimal consumption. The obvious decrease of consumption over capital stock has thus been shown from Eq. (30). Nonetheless, consider the economy including the government, the economy's absorption remains the same. The monetary policy thus has no effect on economic growth. This result echoes the case when seigniorage revenue transfers to the public in a lump-sum way, once preferences are lack of social status seeking incentive.

However, if the capital stock provides direct benefits ($\beta > 0$), an increase in the money growth rate can have positive effect on the long-run growth rate of the economy through changing the return of capital stock. Given the negative resource-consuming effect of useless government spending, the existence of the growth enhancing effect of monetary policy depends on whether capital accumulation has an externality of production or not.

When there is externality ($\alpha < 1$), the accumulation of capital is relatively low; a social status incentive helps narrow the capital stock gap between the social optimum and the private optimum. In this case a permanent rise in the rate of money supply which raises inflation causes households to shift their demand from real balances (and, equivalently, consumption) to capital stock, the growth rate of the economy is therefore raised through this stimulated capital accumulation.

On the other hand, suppose that there is no externality in putting capital into production, i.e., $\alpha = 1$, Eqs. (28) and (29) imply that the return of capital stock is a constant which depends only on the marginal product of capital and parameters in utility function:

$$A + \beta \upsilon'(1) \frac{\hat{x}}{1 + \hat{z}} = A + \frac{\rho \beta \upsilon'(1)}{1 + \beta}. \tag{33}$$

Together with (31), it is easy to show:

$$\hat{\phi} = A - \frac{\rho}{1 + \beta \upsilon'(1)} > A - \rho\,. \tag{34}$$

Note that the social status incentive indeed hastens capital accumulation and promotes economic growth. However, this higher growth rate is independent of money supply when production is lack of capital externalities.

4. Optimal seigniorage

Section 3 concludes that when preferences depend on social status motives and technologies exhibit capital externalities, monetary growth enhances output growth regardless whether the seigniorage revenue goes to finance useless government expenditure or transfer back to the public. An immediate question follows: can growth-enhanced monetary policy also improve welfare? Moreover, is there an optimal seigniorage looks like the Friedman rule?

In this section we let a benevolent government set the growth rate of money supply to pursue the objective of the representative agent. Given that there are no transition dynamics for the 'Ak'-type models, the lifetime utility of the representative agent, the social welfare, W is:

$$W = \int_0^\infty \left[\ln c + \beta \upsilon\left(\frac{m+k}{\bar{m}+\bar{k}} \right) \right] e^{-\rho t} dt = \frac{1}{\rho}\left(k_0 + \ln \hat{z} + \frac{\hat{\phi}}{\rho} + \beta \upsilon(1) \right). \qquad (35)$$

Changes in the growth rate of money supply influence social welfare through two channels: one is on the initial consumption and the other is on the growth rate of the economy, $\hat{\phi}$. The effect of an increase in the rate of money growth on social welfare is thus given by:

$$\frac{\partial W}{\partial \mu} = \frac{1}{\rho}\left(\frac{1}{\hat{z}} \frac{\partial \hat{z}}{\partial \mu} + \frac{1}{\rho} \frac{\partial \hat{\phi}}{\partial \mu} \right). \qquad (36)$$

Expediting money supply lowers the initial consumption via compressing real balances, while it raises the growth rate of consumption with one exception: seigniorage revenue is used to finance useless government spending and production does not exhibit capital externalities. It is somewhat contradictory for a social welfare-maximizing government to spend on useless public expenditures. However, Pelloni and Waldmann (2000) claim "waste may improve welfare," in a modified Romer's (1986) model with elastic labor supply. The welfare improvement of useless government spending results from a negative effect of public finance which increases labor supply and thus enhances economic growth. In this paper useless government spending is financed by seigniorage which may as well have a positive growth effect but is channeled through increasing social status. It is thus worthwhile to investigate whether it is possible for seigniorage to improve welfare in our economy in which social status motives and production externalities are emphasized.

4.1 Welfare effects in a Barro-Rebelo 'Ak' model

We first discuss the Barro-Rebelo's 'Ak' growth model. Even if seigniorage is returned to the public, a faster increase in money supply monotonically lowers welfare. This can be shown from that, by Eq. (23), Eq. (36) becomes,

$$\frac{\partial W}{\partial \mu} = \frac{1}{\rho}\underset{(+)}{\left(\frac{1}{\hat{z}} - \frac{1}{\rho}\right)}\underset{(-)}{\frac{\partial \hat{z}}{\partial \mu}} < 0. \tag{37}$$

The first sign, (+), says that the value in the parentheses is positive. Because with $\alpha = 1$ and seigniorage rebated, Eq. (25) implies $\hat{z} = \rho - \beta \upsilon'(1)\hat{x}/(1+\hat{z})$, $\hat{z}$ must lie between zero and ρ. The second sign, $(-)$, says that an increase in the rate of money growth decreases the consumption-capital ratio. It is the result from Eq. (23). Similarly, when seigniorage is spent on government expenditure, the rate of economic growth shown in Eq. (34) is immune to the rate of money growth. Since consumption is crowded out by government spending, it is obvious to obtain:

$$\frac{\partial W}{\partial \mu} = \frac{1}{\rho}\left(\frac{1}{\hat{z}}\right)\frac{\partial \hat{z}}{\partial \mu} < 0. \tag{38}$$

The negative effect of monetary growth on consumption-capital ratio, shown in Eq. (30), transmits to the social welfare as well. Proposition 3 summarizes the welfare effects of a Barro-Rebelo 'Ak' model:

Proposition 3: When relative wealth-enhanced social status exists, a higher rate of money growth (and thus a higher inflation rate) in a Barro-Rebelo 'Ak' model always lowers social welfare no matter whether it raises the rate of economic growth or not, and no matter how the seigniorage revenue is spent.

Proposition 3 not only provides a negative answer to our question regarding the welfare effect of a growth-enhanced monetary policy, but also points out the monotonically negative relationship between the growth rate of money supply and social welfare. It is obvious that Friedman rule is not applicable here. In an economy the seigniorage revenue is intended to rebate to the public, a combination of monetary contraction with negative transfer (lump-sum taxation) will improve the social welfare. However, if the seigniorage revenue has to finance government expenditure, the constrained optimal rate of money growth is therefore zero. From Eqs. (20)-(22), along with $\mu = 0$ and $\alpha = 1$, we get an optimal economic growth rate:

$$\phi^* \Big|_{\mu=0,\,\alpha=1} = A - \frac{\rho}{1 + \beta \upsilon'(1)} > A - \rho . \tag{39}$$

When the constrained optimal rate of money growth is down to null, the corresponding rate of economic growth is greater than the standard result in Barro-Rebelo 'Ak' model. This growth rate increases with the desire for social status.

The intuition behind Proposition 3 is not hard to understand. A competitive economy of Barro-Rebelo 'Ak' models with status-seeking causes over accumulation in capital and grow too fast as compared to the social optimum. Thus, government's best choice is to slow economic growth by limiting the speed of money supply as low as possible. However, it never reaches the optimal resource allocation due to the growth-enhancing effect from social status seeking. Specifically, if there is no capital spillover in production and the economy is already in its private optimal growth path, there is no room for any positive rate of money growth to increase social welfare even if agents are with social status-seeking incentive.

4.2 Welfare effects in a Romer model

We next examine the Romer's growth model. In Romer's model, social status compensates the capital spillover effect. Not surprising, the government has an opportunity to execute monetary policy to reach the social optimum. When seigniorage is rebated to the public, the first-order condition for maximum welfare can be derived by substituting Eq. (23) into (36) and let it be zero:

$$\frac{\partial W}{\partial \mu} = \frac{1}{\rho}\left(\frac{1}{\hat{z}} - \frac{1}{\rho}\right)\frac{\partial \hat{z}}{\partial \mu} = 0 \,. \qquad (40)$$

From Eq. (25), $\hat{z} - \rho = (1-\alpha)A - \beta \upsilon'(1)\frac{\hat{x}}{1+\hat{z}}$, which can be either positive or negative due to $\alpha < 1$. For Romer's models, there exists a unique growth rate of money supply that balances the negative effect on consumption and the positive one on the rate of the economic growth. This optimal growth rate of money supply is set to equate the consumption-capital ratio to the rate of time preference. If the implied optimal growth rate of money is greater than zero, the public receives a lump-sum transfer; otherwise, it pays a lump-sum tax. In either case, the optimal monetary policy recovers the optimal growth rate of 'Ak' model without social status consideration (i.e. $A-\rho$). And in either case, the implied inflation rate, thus the implied nominal interest rate could be greater than or less than zero, hardly being consistent with the Friedman rule.

Proposition 4: When seigniorage revenue (expenditure) is back to the public as lump-sum transfer (tax) and relative wealth-enhanced social status exists, the optimal rate of money supply growth in a Romer's model is set to let the consumption-capital ratio equal to agent's rate of time preference. And the optimal growth rate of money supply leads to the optimal rate of economic growth of Ak model without social status consideration (i.e. $A-\rho$*).*

The intuition is straightforward: capital externalities in production generate negative spillover effects in investment decision while the incentive of wealth-enhanced social status results in over-accumulation in capital. Through balancing the negative spillover of production externalities and the positive one of the social status-seeking incentive, the optimal growth rate of money supply leads to the optimal rate of economic growth of $A-\rho$ if there is no additional resources waste.

When seigniorage revenue in a Romer's model is to finance useless government spending, the first-order condition for welfare maximum can be derived by substituting Eqs. (30) and (32) into (36). Under the premise that a positive output growth requires $\hat{z}<A$, and with economically reasonable values of parameters, we obtain the effect of monetary growth on welfare as below:[8]

$$\frac{\partial W}{\partial \mu}=\frac{1+\beta \upsilon'(1)}{\rho(1+\hat{z})^2\tilde{\Delta}}\left(\frac{\beta\upsilon'(1)(1-\alpha)A}{\rho\left[1+\beta\upsilon'(1)\right]}-\frac{(1+\hat{z})^2}{\hat{z}}\right)<0\,. \tag{41}$$

An optimal seigniorage should be as low as possible as in the Barro-Rebelo 'Ak' model, that is, the practical and optimal μ degenerates to zero. Notice that our results show that monetary growth merely to finance useless government expenditure is welfare worsening. The result is to the contrary of Pelloni and Waldmann (2000).

Proposition 5: When seigniorage revenue is used to finance useless government spending and relative wealth-enhanced social status exists, a higher rate of money growth (and thus a higher inflation rate) in a Romer's model always lowers social welfare. The optimal non-negative rate of money growth is down to null to minimize wasted resources.

As proved by Appendix A, the optimal economic growth will be lower than $A-\rho/[1+\beta\upsilon'(1)]$ with a lower bound of $\alpha A-\rho/[1+\beta\upsilon'(1)]$. Moreover, the optimal nominal interest rate lies between $\rho/[1+\beta\upsilon'(1)]-(1-\alpha)A$ and $\rho/[1+\beta\upsilon'(1)]$, which hardly coincides with the Friedman rule.

---

[8] The inequality sign of Eq. (41) holds for the reasonable ranges of parameters implied by empirical studies: $0.3<\alpha<0.5$, $0.04<A<0.1$, and $0.01<\rho<0.04$.

In summary of this section, when production exhibits capital spillovers and seigniorage is rebated to the public, there exists a unique optimal money growth rate to balance negative and positive effects. However, when production does not exhibit capital spillovers or it does but seigniorage is spent on useless public expenditure, minimizing seigniorage is always an optimal monetary policy. In no case, the optimal monetary policy is the Friedman rule.

5. Conclusions

In this paper, we utilize monetary 'Ak' type models to assess the growth and welfare effects of an increase in seigniorage. One salient feature of our models is the relative wealth (wealth includes capital stock and real balances) in the utility function to capture the "capitalistic spirit." With social status incentives which make the return of capital attractive in response to inflation, a higher growth rate of money supply shifts resources from consumption to investment, reinforcing capital accumulation and economic growth. Our results support the Mundell-Tobin effect in the growth sense.

As for a welfare concern, when relative wealth-enhanced social status exists, there is a problem of capital's over-accumulation for the economy. In the cases where easing monetary policy further withdraws resources from consumption, the optimal rate of money growth is in general down to null. Only where capital externalities cause under-investment and the seigniorage revenue is not wasted on useless government spending, a rate of money growth equating the consumption-capital ratio to the agent's rate of time preference is optimal. Put it differently, in an economy where there is no spillover of capital or seigniorage revenue finances useless government spending, monetary growth can not improve welfare. We also conclude the Friedman rule is rarely implemented in our economy.

Appendix A. Find the economic growth rate and nominal interest rate when $\mu^* = 0$ in the case that $\alpha < 1$ and $\theta = 0$

In the case that $\alpha < 1,\ \theta = 0$, the steady-state economic growth rate equals:

$$\hat{\phi} = \alpha A - \rho + \beta \upsilon'(1)\frac{\hat{x}}{1+\hat{z}} = A - (1+\mu)\hat{z} = \mu - \frac{\hat{x}}{\hat{z}} + (1+\alpha A). \qquad \text{(A.1)}$$

When $\mu^* = 0$, (A.1) becomes:

$$\hat{\phi}^0 = \alpha A - \rho + \beta \upsilon'(1)\frac{\hat{x}^0}{1+\hat{z}^0} = A - \hat{z}^0 = 1 + \alpha A - \frac{\hat{x}^0}{\hat{z}^0}, \qquad \text{(A.2)}$$

where $\hat{\phi}^0$, $\hat{x}^0$, and $\hat{z}^0$ denote the steady-state growth rate, *x*, and *z* under the zero rate of money growth, $\mu^* = 0$.

From Eq. (A.2), we have:

$$(\hat{z}^0)^2 + \left[1 - \frac{\rho}{1+\beta\upsilon'(1)} - (1-\alpha)A\right]\hat{z}^0 - \frac{(1-\alpha)A+\rho}{1+\beta\upsilon'(1)} = 0. \qquad \text{(A.3)}$$

By *mean value theorem*, it is easy to prove the positive root of Eq. (A.3) follows the relationship: $\frac{\rho}{1+\beta\upsilon'(1)} < \frac{\rho+(1-\alpha)A}{1+\beta\upsilon'(1)} < \hat{z}^0 < \frac{\rho}{1+\beta\upsilon'(1)} + (1-\alpha)A$.

Thus $\hat{\phi}^0 = A - \hat{z}^0$ implies $A - \frac{\rho}{1+\beta\upsilon'(1)} > \hat{\phi}^0 > \alpha A - \frac{\rho}{1+\beta\upsilon'(1)}$. Similarly, $R^* = \alpha A + (\mu - \phi) = \hat{z}^0 - (1-\alpha)A,$ therefore $\frac{\rho}{1+\beta\upsilon'(1)} > R^* > \frac{\rho}{1+\beta\upsilon'(1)} - (1-\alpha)A$ holds.

References

Ahmed, S. and Rogers, J.H., 2000, Inflation and the great ratios: Long term evidence from the U.S. *Journal of Monetary Economics* 45, 3-35.

Barro, R.J., 1990, Government spending in a simple model of endogenous growth.

Journal of Political Economy 98, S103-S125.

Benhabib, J. and Spiegel, M.M., 2009, Moderate inflation and the deflation-depression link. *Journal of Money, Credit and Banking* 41, 787-798.

Chang, W.Y., 2006, Relative wealth, consumption taxation, and economic growth. *Journal of Economics* 88, 103-129

Chang, W.Y., Chen, Y.A., Kao, M.R., 2008, Social status, education and government spending in a two-sector model of endogenous growth. *The Japanese Economic Review* 59, 99-112

Chang, W.Y., Hsieh, Y.N., Lai, C.C., 2000, Social status, inflation, and endogenous growth in a cash-in-advance economy. *European Journal of Political Economy* 16, 535-545.

Chang, W.Y., Tsai, H.F., 2003, Money, social status, and capital accumulation in a cash-in-advance model. *Journal of Money, Credit, and Banking* 35, 657-661.

Chang, W.Y., Tsai, H.F., Lai, C.C., 2004. Taxation, growth, and the spirit of capitalism. *European Journal of Political Economy* 20, 1011-1025.

Chen, H.J., Guo, J.T., 2008, Social status and the growth effect of money. *The Japanese Economic Review* 60, 133-141.

Corneo, G., Jeanne, O., 1997, On relative wealth effects and the optimality of growth. *Economics Letters* 54, 87-92.

Dotsey, M., Sarte, P. D., 2000, Inflation uncertainty and growth in a cash-in-advance economy. *Journal of Monetary Economics* 45, 631-655.

Friedman, M, 1969, The optimum quantity of money. The Optimum Quantity of Money, and Other Essays, 1-50, Chicago: Aldine Pub. Co.

Futagami, K., Shibata, A., 1998, Keeping one step ahead of the Joneses: status, the distribution of wealth, and long run growth. *Journal of Economic Behavior and*

Organization 36, 109-126.

Gong, L., Zou, H.F., 2001, Money, social status, and capital accumulation in a cash-in-advance model. *Journal of Money, Credit, and Banking* 33, 284-293.

Kenc, T., Dibooğlu, S., 2007, The spirit of capitalism, asset pricing and growth in a small open economy. *Journal of International Money and Finance* 26, 1378-1402.

Long, N.V., Shimomura, K., 2004, Relative wealth, status-seeking, and catching-up. *Journal of Economic Behavior and Organization* 53, 529-542.

Lucas, R.E. Jr., 1988, On the mechanics of economic development. *Journal of Monetary Economics* 22, 3-42.

Lucas, R.E. Jr., 2000, Inflation and welfare. *Econometrica* 68, 247-274.

Marquis, M.H., Reffett, K.L., 1991, Real interest rates and endogenous growth in a monetary economy. *Economics Letters* 37, 105-109.

Palivos, T., Yip, C.K., 1995, Government expenditure financing in an endogenous growth model: a comparison. *Journal of Money, Credit, and Banking* 27, 1159-1178.

Pelloni, A., Waldmann, R. 2000, Can waste improve welfare? *Journal of Public Economics* 77, 45-79.

Rebelo, S.T., 1991, Long-run policy analysis and long-run growth. *Journal of Political Economy* 99, 500-521

Romer, P.M., 1986, Increasing returns and long-run growth. *Journal of Political Economy* 94, 1002-1037.

Walsh, C.E. 2003, Monetary Theory and Policy. 2nd edition. The MIT Press, Cambridge, Massachusetts, London, England.

Weber, M., 1958, The Protestant Ethic and the Spirit of capitalism. Charles Scribner's

Sons, New York, NY.

Zou, H.F., 1994, ‘The spirit of capitalism’ and long-run growth. *European Journal of Political Economy* 10, 279-293.

Zou, H.F., 1998, The spirit of capitalism, social status, money, and accumulation. *Journal of Economics* 68, 219-233.