Expansionary Fiscal Contraction:

Government Spending Financed by Money Seigniorage

Kim-Heng TAN

Nanyang Technological University

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Abstract

A recent view of the macroeconomic effects of fiscal contractions holds that contractionary fiscal policies have expansionary effects. Barry & Devereux (2003) have provided a theoretical basis for the view that permanent fiscal contractions are expansionary. A permanent reduction in government spending financed by lump-sum taxes in an overlapping generations (OLG) economy would reduce tax liabilities to all households and raise savings, hence raising capital formation and output, provided two conditions hold. The first condition is that consumers must not face effective infinite horizons. If consumers were to face such horizons, then a permanent reduction in government spending would cause private consumption to rise by the same amount, leading to no change in aggregate demand and output. The second condition is that, if labor supply were endogenous, the wealth effect on labor supply due to the reduced tax liabilities accompanying fiscal contractions would have to be negligible. This is because the wealth effect increases leisure and decreases labor supply, hence lowering output, and works against the expansionary effect on output due to the rise in savings and capital accumulation. Tan (2004) has identified a third condition for expansionary fiscal contractions. By incorporating the possibility that government spending may affect the intertemporal allocation of private consumption, he shows that public and private consumption must not be too highly substitutable for permanent fiscal contractions to be expansionary. Special cases of this condition include public and private consumption being complementary or independent. The latter assumption is implicitly assumed in most papers, including Barry & Devereux’s.

None of these works consider the case where government spending is financed by money seigniorage. The objective of this paper is to explore the theoretical basis, and determine the conditions required, for expansionary fiscal contractions when government spending is so financed. The contribution of the paper is threefold. First, it is shown that the expansionary effects of permanent fiscal contractions are influenced by the inflation regime, i.e., by the initial rates of inflation prevailing in the economy. Second, these inflation rates are, in turn, affected by the degree of substitutability between government spending and private consumption. Third, the set of initial inflation rates under which fiscal contractions are expansionary changes drastically with the degree of substitutability between public and private consumption. Starting from the benchmark case where public and private consumption are independent, introducing complementarity between public and private consumption gives rise to a weaker set of conditions for expansionary fiscal contractions. On the other hand, introducing substitutability between public and private consumption into the benchmark case gives rise to a stronger set of conditions for expansionary fiscal contractions. These theoretical results have implications for policy. Economies that resort to the printing press to finance government spending complementary with private consumption are more likely to experience expansions if they pursue fiscal contractions. However, economies that use money seigniorage to finance government spending substitutable for private consumption are more likely to encounter contractionary effects if they are engaged in fiscal contractions.

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1. Introduction

There are two views of the macroeconomic effects of fiscal contraction. The conventional view is that contractionary fiscal policies reduce aggregate demand and, hence, have negative effects on output. This view is based on the Keynesian ISLM model due to Hicks (1937) that is widely used in macroeconomic textbooks. The alternative, non-Keynesian view is that contractionary fiscal policies can lead to expansionary effects. This view is more recent and has been explored by several authors. Blanchard (1990), Drazen (1990), Giavazzi & Pagano (1990, 1996), Bertola & Drazen (1993), Sutherland (1997), Alesina et al. (1999), Perotti (1999) and Barry & Devereux (2003) have all contributed to the literature in this area.

One version of the non-Keynesian view contends that a permanent program of reducing government spending is expansionary. Barry & Devereux (2003) have provided a theoretical basis for this view. A permanent reduction in government spending financed by lump-sum taxes in an overlapping generations (OLG) economy would reduce tax liabilities to all households and raise savings, hence raising capital formation and output, provided two conditions hold. The first condition is that consumers must not face effective infinite horizons. If consumers were to face such horizons so that Ricardian equivalence applies, then a permanent reduction in government spending would cause private consumption to rise by the same amount, leading to no change in aggregate demand and output. The second condition is that, if labor supply were endogenous, the wealth effect on labor supply due to the reduced tax liabilities accompanying fiscal contractions would have to be negligible. This is because the wealth effect increases leisure and decreases labor supply, hence lowering output, and works against the expansionary effect on output due to the rise in savings and capital accumulation.
Tan (2003) has identified a third condition for expansionary fiscal contractions, in addition to the two conditions identified by Barry & Devereux (2003). By incorporating the possibility that government spending may affect the intertemporal allocation of private consumption, he has shown that public and private consumption must not be too highly substitutable for permanent fiscal contractions to be expansionary. Special cases of this condition include public and private consumption being complementary or independent. The latter assumption is implicitly assumed in most papers, including Barry & Devereux’s.

In his study of the long-run burden of the public debt many years ago, Diamond (1965) has shown that increasing the public debt permanently has contractionary effects and lowers the welfare of consumers in the steady state if the real interest rate is greater than the population growth rate. The reason that increasing the public debt permanently is contractionary is that taxes would have to be increased, hence decreasing savings and raising the interest rate with adverse effects on capital accumulation. Although Diamond’s intent was to consider the long-run burden of the public debt, his study has implications for expansionary fiscal contractions: reducing budget deficits permanently would be expansionary if the real interest rate exceeds the population growth rate.

In the aforementioned works, government spending is financed by taxes or by borrowing. None of the works mentioned consider the case where government spending is financed by money seigniorage, a case that applies to several Latin American countries for the period from the mid-1970s to the mid-1990s when high inflation was rife. The objective of this paper is to explore the theoretical basis, and determine the conditions required, for expansionary fiscal contractions when government spending which may affect the intertemporal allocation of private consumption is financed by money seigniorage. The paper
achieves several significant results. First, the expansionary effects of permanent fiscal contractions are influenced by the inflation regime, i.e., by the initial rates of inflation prevailing in the economy. Second, these rates of inflation are, in turn, affected by the degree of substitutability between government spending and private consumption. Third, the set of initial inflation rates under which fiscal contractions are expansionary changes drastically with the degree of substitutability between public and private consumption.

2. Model Formulation

To achieve the objective of the paper, the model used is based on a deterministic version of the OLG model,\(^1\) in which both money and government spending enters into the utility function for consumers.

2.1 Consumers

Consumers live for two periods and form overlapping generations of constant size. In period \(t\), a member of generation \(t\) supplies a unit of labor, earning a real wage rate of \(\omega_t = w_t - \tau_t\), where \(w_t\) is the pre-tax real wage rate and \(\tau_t\) the labor-income tax. He consumes \(c_t\) of a private good and divides his income after consumption between saving \(s_t\) and holding a stock \(m_{t+1}\) of money at the end of period \(t\), in real terms. Money earns no interest, while saving earns a real interest rate of \(r_{t+1}\) in period \(t+1\). The consumer’s first-period budget constraint is

\[
P_t c_t + P_t s_t + P_t m_{t+1} \leq P_t \omega_t,
\]

where \(P_t\) is the money price of the private good in period \(t\). In period \(t+1\), he retires and consumes \(c_{t+1}\). His second period budget constraint is

\[
P_{t+1} c_{t+1} \leq P_{t+1} m_{t+1} + (1 + i_{t+1}) P_t s_t,
\]

where \(i_{t+1}\) is the nominal interest rate. Eliminating \(P_t s_t\) from the budget constraints and using the exact relationship between the nominal and real interest rates, \((1 + i_{t+1}) = (1 + r_{t+1})(1 + \pi_{t+1})\), where \(\pi_{t+1}\) is the inflation rate in period \(t+1\), the
consumer’s intertemporal budget constraint is\[ c_t^i + (1 + r_{t+1})^{-1} c_{t+1}^i + i_{t+1} (1 + i_{t+1})^{-1} m_{t+1} \leq \omega_t. \]

Each member of generation $t$ also consumes a public good of amount $g_t$ and $g_{t+1}$ per capita in periods $t$ and $t+1$ respectively.

Consumer preferences are represented by a continuous, strictly quasi-concave and increasing utility function $U(c^i, g^i, m_{t+1}) = U(c^i, c^i_{t+1}, g_t, g_{t+1}, m_{t+1})$. Consumers maximize utility subject to their budget constraints. Under the consumer regularity condition assumed, consumption, saving and money holdings are uniquely determined:

\[
c^i = c^i(\omega_t, r_{t+1}, \pi_{t+1}, g^i), \quad s^i = s^i(\omega_t, r_{t+1}, \pi_{t+1}, g^i), \quad m_{t+1} = m_{t+1}(\omega_t, r_{t+1}, \pi_{t+1}, g^i). \tag{1}
\]

Assuming $c^i_t$ and $m_{t+1}$ are normal, satisfying \(0 < \frac{\partial c^i_t}{\partial \omega_t} < 1\) and \(0 < m_\omega = \frac{\partial m_{t+1}}{\partial \omega_t} < 1\), respectively, the derivatives of $s^i(\omega_t, r_{t+1}, \pi_{t+1}, g^i)$ and $m_{t+1}(\omega_t, r_{t+1}, \pi_{t+1}, g^i)$ are summarized in:

**Lemma 1**: (a) \(0 < s_\omega = \frac{\partial s^i}{\partial \omega_t} < 1; \quad s_r = \frac{\partial s^i}{\partial r_{t+1}} \) is ambiguous in sign; \(s_\pi = \frac{\partial s^i}{\partial \pi_{t+1}} > 0; \quad s_{g_1} = \frac{\partial s^i}{\partial g_t}, s_{g_2} = \frac{\partial s^i}{\partial g_{t+1}} \leq \) or \(> 0\) according as \(c_{g_1} = \frac{\partial c^i}{\partial g_t}, c_{g_2} = \frac{\partial c^i}{\partial g_{t+1}} \geq \) or \(< 0\). (b) \(m_r = \frac{\partial m_{t+1}}{\partial r_{t+1}} < 0; \quad m_\pi = \frac{\partial m_{t+1}}{\partial \pi_{t+1}} < 0\).

In Lemma 1, $c_{g_1}, c_{g_2} \geq 0$ is interpreted to mean that consumption of the private good in period $t$ is complementary with, or independent of, consumption of the public good in periods $t$ and $t+1$, and $c_{g_1}, c_{g_2} < 0$ to mean that consumption of the private good in period $t$ is substitutable for consumption of the public good in periods $t$ and $t+1$. It is assumed that
money holdings are independent of the consumption of the public good. It is clear that inflation reduces the real return to money holdings, decreases real money holdings and increases saving.

2.2 Producers

Producers are perfectly competitive, and produce a single good using labor and capital. Capital is simply production of the good that is not consumed in the previous period. On a per-capita basis, \( k_t \) units of capital installed at the beginning of period \( t \) are employed together with one unit of labor in period \( t \) to produce \( y_t \) units of output. Production is subject to constant returns to scale. The per-capita production function, \( F(k_t) \), is continuous, strictly concave and increasing.

Following Tan (1995a), define a real unit-labor pre-wage profit function:

\[
\Pi(r_t) \equiv \max \{ y_t - r_t k_t : F(k_t) \geq y_t ; (y_t, k_t) \geq 0 \} \text{ for } r_t > 0 .
\]  

(2)

Assume the profit function is twice differentiable. Under constant returns to scale, profits are assumed to be zero. Hence, the wage rate is:

\[
w(r_t) = \Pi(r_t) .
\]  

(3)

By Hotelling's (1932) Lemma, the demand for capital is

\[
k(r_t) = -\frac{\partial \Pi(r_t)}{\partial r_t} .
\]  

(4)
Under the monotonicity assumption of $F(k_t)$, it is well known that $k_t = \frac{\partial k_t}{\partial r_t} < 0$.

### 2.4 Government

At the beginning of period $t$, the government has a per-capita stock $M_t$ of nominal money supply. During the period, the government issues new money and collects labor-income taxes of $P_t \tau_t$ to finance its expenditure on a public good of $P_t g_t$, per capita. The per-capita stock of money will accumulate to $M_{t+1}$ by the end of period $t$. The per-capita government-budget constraint for period $t$ is

$$M_{t+1} - M_t + \tau_t = P_t g_t. \quad (5a)$$

Dividing $(5a)$ by $P_t$ yields the real per-capita government budget constraint:

$$(1 + \pi_{t+1})m_{t+1} - m_t + \tau_t = g_t. \quad (5b)$$

Assuming equilibrium in the money market and substituting the money demand function in (1) into $(5b)$, bearing in mind that money holdings are independent of consumption of the public good, yields

$$(1 + \pi_{t+1})m_{t+1} [w(r_t) - \tau_t, \pi_{t+1}] - m_t [w(r_{t-1}) - \tau_{t-1}, \pi_t] + \tau_t = g_t. \quad (5c)$$
Let $g_t$ be the exogenous policy variable and $\tau_t$ be fixed at $\tau_t = \tau$. Then the policy variable, $\pi_{t+1}$, is endogenous:

$$\pi_{t+1} = \pi_{t+1}(r_{t+1}, r_t, \pi_t, g_t).$$  \hfill (6a)

It follows that

$$\pi_t = \pi_t(r_t, r_{t-1}, \pi_{t-1}, g_{t-1}).$$  \hfill (6b)

Since $(r_{t-1}, \pi_{t-1}, g_{t-1})$ are predetermined, they can be omitted from (6b):

$$\pi_t = \pi_t(r_t).$$  \hfill (6c)

Substituting (6c) into (6a) yields

$$\pi_{t+1} = \pi_{t+1}(r_{t+1}, r_t, g_t).$$  \hfill (6d)

In the steady state, (5c) simplifies to

$$\pi m[w(r) - \tau, r, \pi] + \tau = g.$$  \hfill (5')

Then (6d) becomes simply

$$\pi = \pi(r, g).$$  \hfill (6')
where

\[ \pi_r \equiv \frac{\partial \pi}{\partial r} = \pi(km - m) / (m + \pi m) , \]

\[ \pi_g \equiv \frac{\partial \pi}{\partial g} = 1 / (m + \pi m) . \] (7')

In general, \( \pi_r \) and \( \pi_g \) are ambiguous in sign. (7') will be used to determine the signs of the derivatives in the next two subsections.

### 2.4 Capital Market

The capital market is in equilibrium at the end of period \( t \) when

\[ s'(\omega_t, r_{t+1}, \pi_{t+1}, g^t) = k(r_{t+1}) . \] (8a)

The equilibrium in (8a) is partial equilibrium. We are, however, interested in general equilibrium. To convert the condition (8a) to one that expresses general equilibrium, use (8a) in conjunction with (6d) to define a (reduced-form) per-capita excess-supply-of-saving function:

\[ \alpha_{t+1}(r_{t+1}, r_t, g^t) \equiv s'[w(r_t) - \tau, r_{t+1}, \pi_{t+1}(r_{t+1}, r_t, \pi_t(r_t), g^t), g^t] - k(r_{t+1}) . \] (9)

This summary function embodies utility maximization by consumers, profit maximization by producers, and compliance with the government budget constraint, and is introduced to simplify the analysis for the rest of the paper.
In the steady state, the function (9) reduces to

\[ \alpha(r, g) = s[w(r) - \tau, r, \pi(r, g), g] - k(r). \quad (9') \]

The partial derivatives of \( \alpha(r, g) \) are, respectively,

\[ \alpha_r \equiv \frac{\partial \alpha}{\partial r} = s_r - k_r - s \pi_r, \]
\[ \alpha_g \equiv \frac{\partial \alpha}{\partial g} = s \pi_g + s_g. \quad (10') \]

The sign of \( \alpha_r \) will be determined in the next subsection. Using (7') and (10'), the sign of \( \alpha_g \) is summarized in:

**Lemma 2**: (a) For \( s_g = 0 \), \( \alpha_g > 0 \) or \( < 0 \) according as \( \pi < \pi^* = -(m/m_x) \). (b) For \( s_g < 0 \), \( \alpha_g > 0 \) if \( \pi_i = -(m/m_x) - (s_{\pi}/s_{g}m_x) < \pi < \pi^* = -(m/m_x) \) and \( \alpha_g < 0 \) if \( \pi < \pi_i \) or \( \pi > \pi^* \). (c) For \( s_g > 0 \), \( \alpha_g < 0 \) if \( \pi^* < \pi < \pi_2 = -(m/m_x) - (s_{\pi}/s_{g}m_x) \) and \( \alpha_g > 0 \) if \( \pi < \pi^* \) or \( \pi > \pi_2 \).

In Lemma 2, three cases are considered: public spending is independent of, complementary with, and substitutable for, private consumption. To explain the effect of government spending on the excess supply of savings, consider the identity of \( \alpha_g \) in (10'). This says that government spending affects the excess supply of savings through two channels, the first in which government spending affects savings through its effect on monetary growth and inflation, and the second in which government spending affects savings through its effect on
private consumption. Call the first channel, the inflation effect of government spending, and the second channel, the intertemporal allocation effect of government spending.

When public and private consumption are independent ($s_g = 0$), government spending has a positive effect on the excess supply of savings for initial inflation rates below the seigniorage-maximizing inflation rate of $\pi^* = -(m/m_\pi)$ and a negative effect for rates above $\pi^*$. The seigniorage-maximizing inflation rate is the inflation rate corresponding to the turning point of the money-seigniorage Laffer curve. In this case, only the first channel of government spending is operative. When the initial inflation rate is below $\pi^*$, the economy is on the upward-sloping portion of the money-seigniorage Laffer curve, along which money seigniorage increases with inflation, so an increase in government spending, which has to be financed by an increase in money seigniorage, entails raising monetary growth and inflation, hence increasing savings. However, when the initial inflation rate exceeds $\pi^*$, the economy is on the downward-sloping portion of the money-seigniorage Laffer curve, along which money seigniorage decreases with increasing inflation, in which case an increase in government spending entails lowering monetary growth and inflation, so decreasing savings.

When government spending and private consumption are complementary ($s_g < 0$), the second channel of government spending becomes operative in addition to the first. In this case, through the second channel, an increase in government spending increases private consumption and decreases savings. Superimposing this intertemporal allocation effect onto the inflation effect of government spending, it is clear that the intertemporal allocation effect reinforces the inflation effect above $\pi^*$ but works against it below $\pi^*$. Below $\pi^*$, therefore, the net effect of government spending on savings depends on which effect
dominates. At low inflation rates (below $\pi_i = -(m/m_n) - (s_z/s_g m_n)$), the inflation effect is weak and the intertemporal allocation effect dominates; hence, an increase in government spending decreases savings. At higher inflation rates, between $\pi_i$ and $\pi^*$, the inflation effect dominates, so an increase in government spending increases savings.

The rationale for the case where government spending and private consumption ($s_g > 0$) are substitutable can be similarly explained.

### 2.5 General Equilibrium

Making use of the excess-supply-of-savings function defined by (9), the evolution of the economy is written simply as

$$\alpha_{t+1}(r_{t+1}, r_t, g_t) = 0. \quad (11)$$

A temporary (general) equilibrium is an $r_{t+1} > 0$ satisfying the capital-market equilibrium condition (11) for given $(r_t, g_t)$. In the steady state, the economy settles down to

$$\alpha(r, g) = 0. \quad (11')$$

A steady-state equilibrium is an $r > 0$ satisfying the equilibrium condition (11') for a given $g$. The condition for stability of the steady-state equilibrium is summarized in

**Lemma 3:** Under consumption normality and local Walrasian stability at a temporary equilibrium, the steady-state equilibrium is locally dynamically stable only if $\alpha_r > 0$.\(^4\)
2.6 Model

For the purpose of this paper, the model comprises

\[ \alpha(r, g) = 0 , \quad (11') \]

\[ k = k(r) . \quad (12') \]

Equation (11') determines the real interest rate for a given \( g \). With \( r \) determined, (12') determines the capital-labor ratio.

The issue to be addressed is the effect of a change in \( g \) on \( k \).

3. Results

Suppose that government spending is increased by a small amount \( dg < 0 \). The model comprising (11')-(12') can be differentiated at the initial equilibrium to yield:

\[ \alpha_r dr = -\alpha_g dg , \quad (13') \]

\[ dk = k_r dr . \quad (14') \]

Using (13'), as a result of increasing government spending by \( dg < 0 \), the real interest rate in the steady state will change by

\[ dr = -(\alpha_r)^{-1} \alpha_g dg . \quad (15') \]
Using (15') to eliminate $dr$ from (14'), the capital-labor ratio in the steady state will change by

$$dk = -k_r (\alpha_r)^{-1} \alpha_r \ dg.$$  (16')

Since $k_r < 0$, $\alpha_r > 0$ by Lemma 3, and $dg < 0$ by assumption, we have $dk > 0$ or $< 0$ according as $\alpha_r < 0$ or $> 0$. Using Lemma 2, we have the following propositions:

**Proposition 1**: Assume $s_g = 0$. Let government spending be increased by a small amount $dg < 0$. Then, subject to the assumptions of the model, the capital-labor ratio satisfies $dk > 0$ or $< 0$ according as $\pi > 0$ or $< \pi^* = -(m/m_\pi)$.

**Proposition 2**: Assume $s_g < 0$. Let government spending be increased by a small amount $dg < 0$. Then, subject to the assumptions of the model, the capital-labor ratio satisfies $dk > 0$ if $\pi < \pi_1 = -(m/m_\pi) - (s_x/s_g m_\pi)$ or $\pi > \pi^* = -(m/m_\pi)$ and $dk < 0$ if $\pi_1 < \pi < \pi^*$.

**Proposition 3**: Assume $s_g > 0$. Let government spending be increased by a small amount $dg < 0$. Then, subject to the assumptions of the model, the capital-labor ratio satisfies $dk > 0$ if $\pi^* < \pi < \pi_2 = -(m/m_\pi) - (s_x/s_g m_\pi)$ and $dk < 0$ if $\pi < \pi^*$ or $\pi > \pi_2$.

When public and private consumption are independent, as in Proposition 1, permanent fiscal contractions are expansionary at initial rates of inflation that exceed the seigniorage-maximizing rate of inflation. The economic rationale is easily explained. Recall from Section 2.4 that, in the case where public and private consumption are independent, only the first channel of government
spending is operative and the inflation effect of government spending satisfies $\alpha_g > 0$ according as the initial inflation rate is below or above $\pi^*$. When the initial inflation rate is above $\pi^*$, the economy is on the downward-sloping portion of the money-seigniorage Laffer curve, along which money seigniorage decreases with increasing inflation. A decrease in government spending entails decreasing money seigniorage and increasing inflation, so increasing savings and capital accumulation. It remains to add the intertemporal allocation effect of government spending to explain the results in Propositions 2 and 3.

When public and private consumption are complementary (Proposition 2), fiscal contractions are expansionary at low inflation rates, rates below a threshold rate defined by $\pi_1$, or at high inflation rates, rates above the seigniorage-maximizing inflation rate of $\pi^*$. Since the set of initial inflation rates for expansionary fiscal contractions is larger compared to that when public and private consumption are independent, the conditions on the initial rates of inflation for expansionary fiscal contractions are weaker than those under the latter case. Since $\pi_1 = -(m_mz) - (s_z/s_zm_z)$, this threshold value of the inflation rate rises with the degree of complementarity between public and private consumption, enlarging the set of initial inflation rates for expansionary fiscal contractions. It follows that if, on average, public and private consumption are highly complementary in an economy, fiscal contractions are more likely to have expansionary effects.

When public and private consumption are substitutable (Proposition 3), fiscal contractions are expansionary only at inflation rates that lie in the range between $\pi^*$ and a higher rate defined by $\pi_2$. Since the set of initial inflation rates for expansionary fiscal contractions is smaller compared to that when public and private consumption are independent, the conditions on the
initial rates of inflation for expansionary fiscal contractions are stronger than those under the latter case. Since \( \pi^2 = -(m/m_n) - (s_n/s_g m_n) \), this threshold value of inflation rate falls as the degree of substitutability between public and private consumption increases, causing the set of initial inflation rates for expansionary fiscal contractions to become smaller. It follows that in any economy with a high degree of substitutability between public and private consumption, fiscal contractions are more likely to have contractionary effects.

4. Concluding Remarks

This paper addresses the issue of expansionary fiscal contractions when government spending, which may affect the intertemporal allocation of private consumption, is financed by money seigniorage. The contribution of the paper is to show that the expansionary effects of permanent fiscal contractions are influenced by the initial rates of inflation and that these rates are, in turn, affected by the degree of ‘substitutability’ between government spending and private consumption. More significantly, the set of initial inflation rates, under which fiscal contractions are expansionary, changes drastically with the degree of substitutability between public and private consumption. Starting from the benchmark case where public and private consumption are independent, introducing complementarity between public and private consumption gives rise to a weaker set of conditions for expansionary fiscal contractions. On the other hand, introducing substitutability between public and private consumption into the benchmark case gives rise to a stronger set of conditions for expansionary fiscal contractions. These theoretical results have implications for policy. Economies that resort to the printing press to finance government spending complementary with private consumption are more likely to experience expansions if they pursue fiscal contractions. However, economies that use money seigniorage to finance government
spending substitutable for private consumption are more likely to encounter contractions if they are engaged in contractionary fiscal policies.

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Notes

1 Samuelson (1958) and Allais are pioneers of the OLG model. See Malinvaud (1987) on Allais’ publication of the OLG model in 1947. Most deterministic versions of the OLG model are usually descendants of Diamond’s (1965) version of the OLG model. Barry & Devereux (2003) use a version of the OLG model that is due to Blanchard (1985).

2 The sign of $\pi^* = -(m/m_s)$ is positive since $m_s$ is negative.

3 Since $m_\pi$ is negative, $s_\pi$ is positive and $g_s$ is negative when public and private consumption are complementary, $\pi_i = -(m/m_\pi) - (s_\pi / s_g m_\pi)$ is less than $\pi^* = -(m/m_s)$.

4 See Tan (1995b) for a proof of the stability condition. The existence and uniqueness of the steady-state equilibrium are also considered in Tan (1995b).

5 Bear in mind that $m_\pi$ is negative, $s_\pi$ is positive and $g_s$ is negative when public and private consumption are complementary.

6 This would be especially true for government spending on public infrastructure such as roads, seaports, airports, etc, as such spending tends to stimulate private consumption.

7 Since $m_\pi$ is negative, $s_\pi$ is positive and $g_s$ is positive when public and private consumption are substitutable, $\pi_i = -(m/m_\pi) - (s_\pi / s_g m_\pi)$ is greater than $\pi^* = -(m/m_s)$.

8 Bear in mind that $m_\pi$ is negative, $s_\pi$ is positive and $g_s$ is positive when public and private consumption are substitutable.