Government Budgetary Policies, Economic Growth, and Currency Substitution in a Small Open Economy

Jill A. Holman

December 2000

RWP 00-08

Last Revised: June 2001

Research Division
Federal Reserve Bank of Kansas City

Holman email: jill.a.holman@kc.frb.org.

Abstract

This paper compares the macroeconomic consequences of alternative government budgetary policies in a small open economy where agents transact in both domestic and foreign currencies. An endogenous growth model is used to rank the effects of income-tax-financed and inflation-tax- financed government expenditures on the economy's growth and inflation rates. Currency substitution provides an avenue for inflation-tax evasion and affects the rankings of the two modes of government finance. The analysis reveals that an increase in the size of government reduces the growth rate of the economy regardless of the government's budgetary policy. Inflation taxes hinder growth more than income taxes. Income-tax financing is also the preferred policy in terms of its effect on the economy's inflation rate. Under the growth-maximizing tax mix, the government relies on both forms of finance but receives most of its revenue from income taxes.

JEL classification*:* E63 and F43

Keywords*:* Inflation taxes; income taxes; economic growth; currency substitution

Government budgetary policies, economic growth, and currency substitution in a small open economy*

1. Introduction

Any government has at its disposal two basic methods for financing its expenditures: printing money and imposing taxes. These two broad policy options often have different effects on the macroeconomy. Consequently, assessing the relative costs of alternative forms of government finance is an important issue.

Governments in developing countries frequently rely on inflation taxes to generate a significant portion of their revenue.[1] Moreover, in many developing countries, economic agents conduct at least a portion of their transactions in a currency other than that issued by their domestic government.[2] The ability to use domestic and foreign currencies in variable proportions when making purchases has been coined "currency substitution." Currency substitution allows agents to evade a portion of the domestic government's inflation tax, which erodes the government's inflation-tax base. As a result, currency substitution requires a higher inflation rate to finance a given level of government expenditures with seigniorage. Furthermore, if a country's inflation rate affects its growth rate, currency substitution is certain to play an important role in determining the growth effects of seigniorage-financed government expenditures. How does the presence of currency substitution affect the ranking of income

---

* The author thanks JoAnne Feeney, Phil Graves, Tim Kehoe, Keith Maskus, Rebecca Neumann, Thomas Osang, and Pu Shen for their valuable comments on earlier drafts. The usual disclaimer applies.

[1] Edwards and Tabellini (1991) find empirically that proceeds from the inflation tax in developing economies can be quite substantial.

[2] The International Monetary Fund (1999) provides compelling evidence on the pervasiveness of currency substitution in many developing countries. See also Fisher (1982), Calvo and Végh (1992), Giovannini and Turtelboom (1992), and Bergsten (1999) among others.

taxation and seigniorage as sources of government revenue in a developing economy? This paper addresses this question by comparing the growth and inflation effects of income-tax financed and inflation-tax financed government expenditures in a small open economy that experiences currency substitution.

A small open economy, endogenous growth model is developed to analyze the interaction between currency substitution and the effects of government revenue policies. The model is solved for an expression linking the growth rate of the economy to the rate of income taxation, the rate of inflation taxation, and the rate at which foreign currency is substituted for domestic currency. This expression is used to rank analytically and numerically the two government budgetary policies in terms of their effects on the economy's growth rate and inflation rate.

Currency substitution is introduced into the model via a liquidity-in-advance constraint. The liquidity-in-advance constraint forces agents in the small economy to conduct a portion of their transactions with a mixture of domestic and foreign currencies. Liquidity is required to purchase a domestically-produced good and a foreign-produced good. A fraction of domestic investment expenditures is also included in the liquidity-in-advance constraint. This specification accounts for the fact that many developing countries suffer from limited domestic financial markets, implying that a portion of investment purchases in these economies must be made with cash.

In addition to having access to domestic and foreign currency markets, the small open economy also has access to an international capital market in which it can borrow. International lenders are assumed to charge a country-specific borrowing premium based on the small open economy's debt-capital ratio. This facet of the model captures the fact that developing economies often face constraints on the amount that they can borrow in the international capital market.

The model is used to investigate the relative costs of inflation-tax financed and income-tax financed government expenditures. By contrast, most studies that use an endogenous-growth framework to investigate government financing policies concentrate on *either* monetary or fiscal methods.[3] A few studies have combined these two strands of the endogenous growth literature.[4] For instance, De Gregorio (1993) addresses the interaction between inflation, distortionary income taxation, and economic growth in a closed-economy, AK model where households and firms use cash because it reduces the costs of transactions. As another example, van der Ploeg and Alogoskoufis (1994) analyze the effects of different modes of government finance on the economic growth rate and the inflation rate in a closed economy model where money enters through agents' utility functions. Palivos and Yip (1995) [hereafter PY] compare seigniorage-financed and inflation-tax-financed government expenditures in a closed-economy, AK model

---

[3] See Barro (1990), Rebelo (1991), and Barro and Sala-i-Martin (1992) for examples of studies that investigate the effects of fiscal policy on the growth rate in a closed-economy endogenous growth framework. Kim (1998) provides an analysis of the effects of tax systems (of which inflation is one component) in a closed-economy, endogenous growth model. See Jones and Manuelli (1995), Chari, Jones, and Manuelli (1995, 1996), Ferreira (1999), and Dotsey and Sarte (2000) for examples of studies that focus on the consequences of monetary policy for the endogenous rate of economic growth in a closed economy. In the literature on open economies, several papers address the effects of *either* monetary- or fiscal-financing methods. King and Rebelo (1990) and Turnovsky (1996, 1999) are examples of studies that examine the effects of fiscal policy in open-economy, endogenous growth models. Fisher (1999) is an example of an open-economy, endogenous growth model that addresses the relationship between inflation and economic growth.

[4] Outside the endogenous growth literature, there exist many studies that analyze the effects of using both monetary and fiscal methods to finance government expenditures. See, for example, Cooley and Hansen (1992), Turnovsky (1993), and Bhattacharya, Guzman, Huybens, and Smith (1997).

where inflation acts as a tax because a fraction of investment purchases are subject to a cash-in-advance constraint. Espinosa-Vega and Yip (1999) investigate how monetary and fiscal policies affect the economic growth rate and the inflation rate in a closed-economy model where agents have access to financial intermediaries.

Each of these papers that connect the literature on endogenous growth to the literature on alternative government revenue sources uses a closed-economy framework. However, many economies that rely on inflation taxation to generate a substantial portion of their government revenue are small open economies. These economies are more likely to face serious choices about alternative modes of government finance. Thus, the closed-economy nature of this literature is surprising. Moreover, many of the theoretical studies on seigniorage and endogenous growth have ignored the fact that inflation often leads to currency substitution.[5] Again, this is a serious omission because governments of small open economies that use seigniorage as a revenue source often have to deal with inflation-tax evasion through currency substitution.[6]

This paper extends the existing endogenous growth literature on the relative merits of different forms of government finance. The paper abandons the closed-economy framework employed by other authors, and instead considers the effects of government revenue policies in a small-open-economy framework. Moreover, the paper addresses analytically and numerically the interaction between government budgetary policies and economic growth in the presence of currency substitution.

---

[5] Barnett and Ho (1998) provide a notable exception. They authors address asset substitution in a two-country, endogenous growth framework.

[6] Giovannini and Turtelboom (1992) and Calvo and Végh (1996, 1992) both provide extensive reviews of the very broad theoretical and empirical literature on currency substitution.

The analysis reveals that income taxation leads to a higher growth rate and a lower inflation rate than inflation taxation for most parameter values. Moreover, the less developed the small open economy's domestic financial markets, the worse the distortions associated with inflation taxation become. Furthermore, the distortionary tax mix that maximizes the economy's growth rate consists of both income taxation and seigniorage but is skewed heavily toward income taxation due to inflation-tax evasion through currency substitution.[7]

The paper is organized as follows. Section 2 develops the model. Section 3 analyzes the effects of financing government expenditures with income taxes, while Section 4 analyzes the effects of financing government expenditures with inflation taxes. Section 5 compares the consequences of the two budgetary policies for the economic growth rate and the inflation rate. Section 6 investigates the implications of public spending when both financing policies are available simultaneously to the government. The final section offers conclusions and suggestions for future work.

2. The Model

2.A. Preliminaries

Imagine a world that consists of many countries. Due to their respective comparative advantages, some countries produce good x, while other countries produce good y. In this world economy, there exists a small open economy that produces x and imports y from the rest of the

---

[7] Where possible, the results of the current paper are compared to those in PY, whose closed-economy model (without currency substitution) is somewhat similar to the model used here. By contrast to the findings in this paper, PY find that inflationary financing hinders economic growth *less* than income-tax financing. Moreover, the mix of government revenue sources that maximizes the economy's growth rate consists only of inflation taxation. Income-tax financing, however, leads to a lower inflation rate than inflation-tax financing.

world (collectively referred to as foreign). From the small open economy's perspective, the relative price of y in terms of x is determined in the rest of the world. Thus, the small open economy takes its terms of trade (q) as constant and exogenous. For simplicity, normalize q to unity.

Many identical individuals inhabit the small open economy. The representative agent receives utility from consumption of the home-produced good and the imported good. Assume that the agent's utility function takes the form: $u(c_{xt}, c_{yt}) = \gamma \ln c_{xt} + (1-\gamma) \ln c_{yt}$, where c_x denotes per capita consumption of the home-produced good, c_y denotes per capita consumption of imports, and γ represents the share of domestic goods in the representative agent's total consumption bundle.

The representative firm in the small open economy produces x according to an AK production function, $x_t = Ak_t$, where x denotes per capita output, k denotes capital per worker, and $A \in (0, \infty)$ denotes the (gross) marginal product of capital. Capital in place depreciates at rate δ. Capital accumulation takes place according to the law of motion: $i_t = \dot{k}_t + \delta k_t$, where i is gross investment.[8]

Governmental activities in the small open economy are modeled as follows. Real government expenditures (g) are assumed to be given exogenously.[9] Moreover, they are not productive nor do they provide utility. The size of government ($\Omega = g/x$) is a constant share of

---

8 $\dot{x} = dx/dt$ for any variable x.

9 For examples of closed-economy, endogenous growth models with endogenous governmental activities, see Barro (1990) and Barro and Sala-i-Martin (1992) among others.

domestic output. The government finances its activities through domestic income taxation and/or domestic inflation taxation. The government's budget constraint in any period is

$$g_t = \tau x_t + \mu m_t, \tag{1}$$

where μ is defined as the nominal domestic money-growth rate, m is defined as real domestic currency holdings, and τ is defined as the domestic income-tax rate.[10]

The representative agent holds both domestic and foreign currencies. As in Calvo and Végh (1994), currency substitution enters the model through a constraint on liquidity. The liquidity constraint requires that the agent make certain purchases with a combination of domestic and foreign currencies.

The representative agent in the small open economy also has access to an international capital market in which he may borrow to finance purchases of imports. As in Turnovsky (1997) and Osang and Turnovsky (2000), the small open economy's access to the international capital market is imperfect. Specifically, the cost of international borrowing increases as the country's debt position relative to its capital stock rises.

2.B. The Representative Agent's Problem

In each period, the domestic representative agent faces two constraints: a liquidity constraint and a budget constraint. The liquidity (-in-advance) constraint in nominal terms is

$$P_t c_{xt} + e_t P_t^* c_{yt} + \phi P_t (\dot{k}_t + \delta k_t) \leq M_t^{\alpha} (eN)_t^{1-\alpha}. \tag{2}$$

---

[10] Constant money-growth and income-tax rates are required for the existence of a balanced growth path.

P is the domestic-currency price of the home-produced good, while P^* is the foreign-currency price of the foreign-produced good. The small open economy takes P^* as exogenous and constant. Define the nominal exchange rate (e) as the relative price of home currency in terms of foreign currency ($P = eP^*$).[11] M denotes nominal domestic money balances, and N denotes nominal foreign money balances available in the small open economy.

Equation (2) states that consumption purchases and a fraction (φ) of investment purchases must be financed with a combination of domestic and foreign currencies. φ is a measure of the degree of financial sophistication of the economy. Agents in countries with less-developed financial markets may be forced to rely heavily on cash when making transactions in their domestic capital markets, and thus are likely to be characterized by higher values of φ.[12] The right-hand side of equation (2) should be interpreted as a liquidity-services production function. The share of domestic currency in total liquidity is $\alpha \in (0, 1)$. The specification of the liquidity aggregator indicates that domestic and foreign currencies are imperfect substitutes, implying that there may be legal restrictions on using the foreign currency in the domestic economy or that there may be higher costs associated with transacting in the foreign rather than the domestic currency.[13]

---

[11] This definition assumes that the law-of-one price holds.

[12] Empirical evidence also suggests that countries with lower degrees of financial sophistication tend to have lower rates of economic growth and to experience more negative effects from inflation relative to countries with higher degrees of financial sophistication. See Boyd, Levine, and Smith (1997) and Dotsey and Sarte (2000).

[13] Any liquidity aggregator or a liquidity services production function, $\ell(.)$, must be a linearly homogeneous, twice-continuously differentiable function with the following characteristics: $\ell_m > 0, \ell_n > 0, \ell_{mm} < 0, \ell_{nn} < 0, \ell_{mn} > 0.$ The Cobb-Douglas liquidity aggregator in equation (2), $\ell(M, eN) = M_t^{\alpha}(eN)_t^{1-\alpha}$, has all of these properties. See Calvo and Végh (1994).

The budget constraint in nominal terms is:

$$P_t c_{xt} + e_t P_t^* c_{yt} + P_t(\dot{k}_t + \delta k_t) + \dot{M}_t + e_t \dot{N}_t - e_t \dot{Z}_t \le P_t(1-\tau) A k_t - e_t R_t Z_t. \qquad (3)$$

The stock of international debt held by the domestic representative agent is Z. Z is constrained to be positive and is denominated in foreign currency units. R is the nominal rate of interest that the small open economy faces in the international debt market. This nominal interest rate is given by $R = r + \varepsilon$, where r is the real cost of borrowing in the international marketplace and ε is the rate of depreciation of the small open economy's currency. The rate of depreciation is $\varepsilon = \dot{e}/e = \pi - \pi^* - \dot{q}/q$, where π denotes the domestic inflation rate, π^* denotes the inflation rate in the rest of the world, and $\dot{q}/q$ denotes the change over time in the small open economy's terms of trade. Since the small open economy takes both q and P^* as constant and exogenous, $\dot{q}/q = \pi^* = 0$. Thus, $\varepsilon = \pi$, and $R = r + \pi$.

The international debt market is distorted. Foreign lenders use the small open economy's debt-capital (debt-equity) ratio to determine the *real* interest rate (r) at which they are willing to lend. A higher debt-equity ratio leads to a higher real cost of international borrowing, implying that the supply of international debt to the small open economy is upward sloping. In this context, the capital stock serves as a measure of the domestic economy's ability to service its international obligations. A lower capital stock implies greater difficulty in servicing a given stock of debt. Technically, the specification for the small open economy's borrowing cost is $r(\tilde{z}) = r^* + \xi(\tilde{z})$, where $\tilde{z} = z/k$ is the debt-capital ratio, z is the real stock of debt in home-good units ($z = eZ/P$), r^* is the constant and exogenous world real interest rate, and ξ is the small open economy's borrowing premium.[14] This specification endogenizes part of the interest rate faced by the small open economy in the international debt market. By contrast, in most small open economy models, this interest rate is strictly exogenous. Thus, the small open economy model used here exhibits certain "closed-economy" properties. In particular, the representative agent's decisions impact the interest rate that is charged for international borrowing. The agent, however, does not recognize that his decisions affect this cost.

Real quantities are nominal quantities deflated by the domestic price of the home-produced good. Therefore, real domestic money balances are defined as $m \equiv M/P$, and real foreign money balances are defined as $n \equiv eN/P$. Real domestic money balances grow at the rate of nominal domestic money balances less the rate of domestic inflation ($\dot{m}/m = \mu - \pi.$) As the price level in the rest of the world is constant, foreign real money balances supplied to the small open economy grow at rate μ^*.

The representative agent in the small open economy chooses c_x, c_y, k, m, n, and z to solve the following problem, which is specified in real terms.[15]

$$\max \int_0^\infty e^{-\rho t}(\gamma \ln c_x + (1-\gamma)\ln c_y)dt \tag{4}$$

subject to

the budget constraint:

[14] The homogeneous specification of $r(.)$ is required for the existence of a balanced growth path. ξ exhibits the following characteristics: $\xi' > 0$ and $\xi'' > 0$.

[15] Wherever possible, time subscripts have been eliminated to simplify the notation.

$$c_x + c_y + \dot{k} + \delta k + \dot{m} + \dot{n} - \dot{z} \leq (1-\tau)Ak - \pi m - r(.)z \tag{5}$$

the liquidity-in-advance constraint:

$$c_x + c_y + \phi(\dot{k} + \delta k) \leq m^{\alpha} n^{1-\alpha} \tag{6}$$

and:

$$c_x, c_y, k, m, n, z \geq 0 \tag{7}$$

$$z / k \leq \overline{D} \tag{8}$$

$$k_0 + m_0 + n_0 - z_0 \leq \overline{k_0} + \overline{m_0} + \overline{n_0} - \overline{z_0}. \tag{9}$$

Equation (8) specifies the maximum debt-equity ratio as $\overline{D}$. This equation eliminates the possibility that the representative agent may borrow an unbounded amount and pay off the debt by borrowing even more.[16] Equation (9) is a portfolio balance equation that ensures that the economy achieves the balanced growth path (BGP) instantaneously, implying that there are no transitional dynamics in this economy. Intuitively, if k_0, m_0, and n_0 are not on the BGP path initially, the representative agent adjusts his stock of foreign debt so that k_0, m_0, and n_0 jump to their BGP positions instantaneously. It can be shown that if k_0, m_0, n_0, and z_0 are on the BGP, c_0

[16] To ensure that no ponzi game can start, $\overline{D}$ is chosen to be large enough that equation (8) does not bind in equilibrium.

is as well. To conserve space, the first-order conditions for this problem are presented in Appendix A.

2.C. Solving for the Equilibrium Growth Rate and the Demands for the Two Currencies

To solve for the small open economy's equilibrium growth rate, rewrite equation (A4) as:

$$(\lambda_2 / \lambda_1)\alpha m^{\alpha-1} n^{1-\alpha} = \rho + \pi - \dot{\lambda}_1 / \lambda_1. \tag{10}$$

It can be easily verified that $m^{\alpha-1}n^{1-\alpha}$ is constant on the BGP. Given that *α*, *ρ,* and *π,* are constants, and that $\dot{\lambda}_1 / \lambda_1$ is constant on the BGP, λ_2 / λ_1 is constant on the BGP. Thus, λ_1 and λ_2 grow at the same rate.

Taking the logarithm and the time derivative of equation (A2) reveals that $\dot{c}_x / c_x = -\dot{\lambda}_1 / \lambda_1$. Let c_x grow at rate *θ* on the BGP, implying that c_y, *k*, *x*, *z*, *m*, *n*, and *g* also grow at rate *θ*.[17] Thus,

$$\dot{\lambda}_1 / \lambda_1 = -\theta. \tag{11}$$

Combining equations (A5) and (A8), and recognizing that on the BGP all *λ*s change at the same rate, yields the standard Keynes-Ramsey rule for capital accumulation:

$$\rho - \dot{\lambda}_1 / \lambda_1 = r(\tilde{z}). \tag{12}$$

Equation (12) equates the rate of return on consumption of the home-produced good to the marginal cost of borrowing, and can be rewritten as $r(\tilde{z}) = \rho + \theta$.

---

[17] Define composite consumption as $c_t = c_{xt}^{\gamma} c_{yt}^{1-\gamma}$. For ease of exposition, all of the derivations that follow use composite consumption rather than its separate components.

Both the domestic and foreign currency markets must clear in any equilibrium. Domestic money-market clearing requires that $\dot{m} / m = \mu - \pi = \theta$, and foreign money-market clearing requires that $\dot{n} / n = \mu^* = \theta$. Therefore, while domestic and foreign *real* balances grow at the same rate, domestic *nominal* balances grow at a faster rate than foreign *nominal* balances ($\mu > \mu^*$) to cover domestic inflation.

Combining equations (A6), (A9), (10), and (11) and rearranging gives

$$\rho + \theta = \frac{\alpha m^{\alpha-1} n^{1-\alpha} [(1-\tau)A]}{\alpha m^{\alpha-1} n^{1-\alpha} + \phi R} - \delta, \tag{13}$$

where $R = r(.) + \pi = \rho + \theta + \pi$. Equation (13) is an arbitrage condition that equates the cost of international debt to the net return on domestic capital purchased with domestic currency. Combining equations (A6), (A7), (A9), and (A10) yields an arbitrage condition that equates the cost of international debt to the net return on domestic capital purchased with foreign currency:

$$\rho + \theta = \frac{(1-\alpha) m^{\alpha} n^{-\alpha} [(1-\tau)A]}{(1-\alpha) m^{\alpha} n^{-\alpha} + \phi r} - \delta. \tag{14}$$

Equations (13) and (14) describe the manner in which the growth rate (θ) of the small open economy depends on domestic income taxation, domestic inflation taxation, and currency substitution. Both equations reveal the same information. Thus, when analyzing the effects of government budgetary policies on θ, the discussion employs equation (13).

In addition to characterizing the growth rate of the economy, equations (13) and (14) describe the demands for domestic and foreign currencies and the mechanics of currency substitution. In any equilibrium, the two arbitrage conditions must be equal. Setting equation (13) equal to equation (14) and simplifying yields

$$n/m = [(1-\alpha)/\alpha][(\rho+\theta+\pi)/(\rho+\theta)] = [(1-\alpha)/\alpha]R/r, \tag{15}$$

revealing that the marginal rate of substitution between domestic and foreign currencies equals the ratio of their opportunity costs. According to equation (15), for any positive domestic inflation rate ($\pi > 0$), n exceeds m, implying that the marginal productivity of home currency (m) is higher than that of foreign currency (n). Equation (15) indicates that any increase in the relative opportunity cost of the domestic currency (e.g., an increase in the domestic inflation rate) causes the representative agent to substitute out of the domestic currency and into the foreign currency. Thus, equation (15) captures currency substitution.

Assuming that the liquidity-in-advance constraint holds with equality, and combining the constraint with equation (15), gives the demands for domestic and foreign currencies:

$$m = [c_x + c_y + \phi\theta k]\left[\frac{(1-\alpha)R}{\alpha r}\right]^{\alpha-1}, \tag{16}$$

$$n = [c_x + c_y + \phi\theta k]\left[\frac{(1-\alpha)R}{\alpha r}\right]^{\alpha}. \tag{17}$$

Equations (16) and (17) show that the demands for m and n depend positively on real expenditures that require liquidity; an increase in $(c_x + c_y + \phi\theta k)$ leads to an increase in both m and n. Moreover, the demands for m and n depend negatively on their opportunity costs; an increase in (R / r) reduces the demand for domestic currency and raises the demand for foreign currency.

3. The Growth Effects of Income Taxes

This section investigates the growth effects of income-tax financed government expenditures. Let θ_T denote the growth rate of the small open economy when the government relies solely on income taxes as a source of revenue. To derive the expression for the growth rate under this financing policy, combine equations (13) and (15) and impose the following conditions. First, recognize that when the government derives all of its revenue from income taxation, $\mu = 0$, which implies that $g = \tau x$. Second, note that when $\mu = 0$, $R = \rho$. Third, without loss of generality, assume $\delta = 0$. Thus, the growth rate under income-tax financing is given by:

$$\rho + \theta_T = \frac{(1-\Omega)A\alpha m^{\alpha-1}n^{1-\alpha}}{\alpha m^{\alpha-1}n^{1-\alpha} + \phi\rho} = \frac{\alpha(1-\Omega)A}{\alpha + \phi\rho[(\rho/\rho+\theta_T)(1-\alpha/\alpha)]^{\alpha-1}}. \tag{18}$$

Equation (18) indicates that there are three factors in the model that alter the rate of economic growth relative to an economy without frictions. First, the existence of a distortionary income tax decreases the net marginal product of capital (the right-hand side of equation (18)), lowering the rate of economic growth. Second, the presence of a liquidity constraint on (the fraction φ of) investment expenditures reduces the rate of return on capital, causing the growth rate to be lower. Finally, the presence of currency substitution moderates the effects of the income-tax distortion and the liquidity-constraint distortion.[18]

---

[18] To see this, divide the numerator and the denominator of the second expression in equation (18) by $\alpha(n/m)^{(1-\alpha)}$, which represents the marginal liquidity of domestic currency. Recognize that an exogenous increase in this marginal liquidity raises the net marginal product of

The growth effects of an increase in the size of government, when government expenditures are financed through income taxation, are given by the derivative of θ_T with respect to Ω. *A priori*, an increase in the size of government financed by an increase in the income-tax rate is expected to reduce the growth rate of the small open economy. Tedious algebra shows that $d\theta_T/d\Omega$ is negative at least when the liquidity aggregator is specified as Cobb-Douglas.

4. The Growth Effects of Inflation Taxes

This section analyzes the growth effects of an increase in the size of government financed by a higher domestic inflation-tax rate. Let θ_M denote the growth rate of the small open economy when the government's only revenue source is seigniorage. In this case, $\tau = 0$, implying that $g = \mu m$. Recall that $\Omega = g/x$ denotes the size of the government. Thus, when the government only has access to inflation taxes, $\Omega A = \mu m/k$. Also, recognize that $R = \rho + \mu$ in the seigniorage-financing case. Therefore, under inflation-tax financing, rewriting equation (13) reveals that θ_M is given by:

$$\rho + \theta_M = \frac{A\alpha m^{\alpha-1}n^{1-\alpha}}{\alpha m^{\alpha-1}n^{1-\alpha} + \phi(\rho+\mu)} = \frac{\alpha A}{\alpha + \phi(\rho+\mu)^{\alpha}[(\rho+\theta_M)(\alpha/(1-\alpha))]^{1-\alpha}}. \tag{19}$$

The domestic money-growth rate (μ) that appears in equation (19) responds endogenously to changes in Ω (and hence to changes in θ_M). Combining equations (3), (16), and (17) yields the equation for the endogenous money-growth rate:

---

capital, leading to a higher economic growth rate.

$$\mu = \left[\frac{A\Omega}{A(1-\Omega) - (1-\phi)\theta_M} \right] H$$

where (20)

$$H = \left[\left(\frac{1-\alpha}{\alpha} \frac{\rho+\mu}{\rho+\theta_M} \right)^{1-\alpha} + \theta_M \left(\frac{1-\alpha}{\alpha} \frac{\rho+\mu}{\rho+\theta_M} \right) \right].$$

In equation (20), the presence of currency substitution is captured by H, which indicates how the domestic money-growth rate responds to changes in the opportunity costs of holding the two currencies. H exceeds unity, at least for a Cobb-Douglas liquidity aggregator, implying that the presence of currency substitution raises the domestic money-growth rate required to finance a given level of government expenditures.

The effects of an increase in government expenditures financed by a higher domestic inflation-tax rate are given by the derivative of θ_M with respect to Ω. Solving equation (19) for μ, setting the resulting expression equal to (20), taking the total derivative, and manipulating the resulting expression reveals that $d\theta_M/d\Omega$ is impossible to sign unambiguously. Intuitively, an increase in government expenditures financed by inflation taxes has three effects on θ_M. First, recognize that an increase in the size of government requires an increase in the domestic money-growth rate, which raises the domestic inflation rate and erodes the value of the domestic currency. Abstracting from the fact that agents can substitute between home and foreign currencies, the increase in the domestic money-growth rate causes the liquidity-in-advance constraint to become more restrictive to investment goods. Thus, an increase in the size of government hinders economic growth. Second, the presence of currency substitution permits domestic inflation-tax evasion. Recall that domestic and foreign currencies are imperfect substitutes, implying that the representative agent cannot completely evade the domestic inflation tax by transacting only in the foreign currency. Therefore, *ceteris paribus*, currency substitution moderates any negative effect of an increase in Ω on θ_M. Third, because the representative agent *can* evade a portion of the inflation tax, the government must implement an even higher money-growth rate (relative to a world without currency substitution) in order to finance a given increase in government expenditures. Thus, the liquidity-in-advance constraint is even more restrictive, implying that the negative effect of an increase in Ω on θ_M is even larger than previously described. Given the three effects, it is most likely the case that an increase in the size of government under seigniorage financing reduces θ_M. The numerical analysis in Section 5 reveals that inflation taxation hinders growth under most of the parameterizations examined.

Note that when investment purchases do not require currency of either type ($\varphi = 0$), a change in the domestic money-growth rate does not affect the net marginal product of capital. Consequently, when $\varphi = 0$, an increase in seigniorage-financed government expenditures has no effect on the growth rate of the economy ($d\theta_M/d\Omega = 0$). Thus, when investment is a credit good, liquidity is superneutral regardless of the ability to engage in currency substitution.

5. Comparison of the Two Financing Policies

This section investigates the relative costs of the two government financing schemes by employing two different yardsticks for comparison. This section first compares the growth rates θ_T to θ_M. Then, this section compares the inflation rates that emerge under the different government budgetary policies.

5.A. Comparing the Growth Rates under the Alternative Budgetary Policies

In general, both seigniorage-financed and income-tax-financed government expenditures reduce the growth rate of the small open economy. This subsection investigates which government budgetary policy is more distortionary in terms of hindering economic growth. When investment is a credit good ($\varphi = 0$), the growth effects of the two budgetary policies are compared analytically. When a portion of investment must be purchased with domestic and foreign currencies ($0 < \varphi \leq 1$), the growth effects of the two policies are compared numerically.

5.A.1. Investment is a Credit Good

When investment is a credit good ($\varphi = 0$), government expenditures financed by domestic inflation taxes are less distortionary than government expenditures financed by domestic income taxes. Concentrate first on inflation-tax financed government expenditures. Substituting $\varphi = 0$ into the expression for θ_M (equation (19)) shows that an increase in the size of government leaves the growth rate of the small open economy unchanged ($d\theta_M/d\Omega=0$), implying that liquidity is superneutral. Focus now on income-tax financed government expenditures. Substituting $\varphi = 0$ into the expression for θ_T (equation (18)) and taking the derivative of the resulting expression with respect to Ω reveals that $d\theta_T/d\Omega = -A < 0$. Hence, for any positive size of government ($\Omega > 0$), $d\theta_M/d\Omega = 0 > d\theta_T/d\Omega = -A$. Note that when $\Omega = 0$, θ_M equals θ_T. Starting from $\Omega = 0$, an increase in the size of government leaves θ_M unchanged and decreases θ_T, implying that θ_M exceeds θ_T for any positive value of Ω. Therefore, as liquidity is superneutral when investment purchases do not require cash of either type, inflation-tax financing is a superior policy regardless of whether the representative agent can engage in currency substitution.

5.A.2. Investment is a Cash Good

When investment is a cash good ($0 < \varphi \leq 1$), numerical analysis is used to compare the growth effects of the two government-financing policies. Several steps are involved in conducting the numerical analysis. First, parameter values are assigned. Second, a nonlinear equation solver is applied to equation (18) to generate a value for θ_T and to equations (19) and (20) to generate a value for θ_M. Finally, the relative costs of the two budgetary policies are compared under alternative assumptions about the parameter values.

Table 1 presents the parameter values used in the numerical analysis. The parameterization follows closely that in PY, where parameter values are chosen to be consistent with a time interval [t, t+1] of one year. As Table 1 shows, the size of government (Ω) is set to 0.35. The gross marginal product of capital (A) is 0.10. The rate of time preference (ρ) is 0.03, implying a discount rate of 0.97. The numerical results are reported for several different values of φ (0, 1/3, 2/3, and 1). For simplicity, the share of domestic currency in total liquidity (α) is initially set to ½. As α captures the ability of the economy to substitute between home and foreign currencies, the numerical results are also reported for alternative values of α (3/4 and 1/4).

Panel A of Table 2 compiles the numerical calculations of θ_M and θ_T when domestic currency comprises one half of total liquidity. The values of the growth rates are reasonable in magnitude. As Panel A shows, the numerical results reinforce the analytical results when liquidity is not required to purchase capital goods. In the $\varphi = 0$ case, the numerical results reveal that the effects of income taxation on the economic growth rate are stronger than the effects of seigniorage on the economic growth rate.[19]

As shown in Panel A, when investment expenditures must be financed with cash (of either type), inflation taxation reduces growth more than income taxation, which stands in contrast to the results in PY's closed-economy study. Financing government expenditures with seigniorage distorts growth more when agents can engage in currency substitution to evade the domestic inflation tax. In this case, the domestic money-growth rate required to finance any given size of government must be higher than in a model without currency substitution. This implies that the distortion associated with inflation taxation is stronger in a model with currency substitution than in a model without currency substitution. Moreover, in order to finance a given size of government, inflation-tax evasion causes the growth rate under seigniorage to be less than the growth rate under income taxation.

Panel A of Table 2 also reveals that the difference between the growth rates under the alternative budgetary policies is rather large. For instance, when $\varphi = 2/3$, the difference between the growth rates under income-tax financing and seigniorage financing is 0.0125. Furthermore, $d\theta_M/d\varphi < 0$ and $d\theta_T/d\varphi < 0$. As φ increases toward unity, θ_M falls more rapidly than does θ_T. In fact, θ_T is relatively insensitive to increases in φ. Intuitively, as φ increases, the liquidity-in-

---

19 From the budget constraint, it can be shown that a necessary condition for positive (composite) consumption is that $(1-\Omega)A > \theta_M$. To facilitate comparison, the same parameter values were chosen as in PY, except for the value of the intertemporal elasticity of substitution (σ). In the present study $\sigma = 1$, whereas in PY, $\sigma = 2$. When $\varphi = 0$, the numerical value of θ_M violates the condition for positive consumption. Parameter values can be chosen to ensure that this condition is met without overturning any of the qualitative results in Table 2. Choosing alternative values of the parameters would limit comparisons of the rankings of the growth rates between this study and that of PY.

advance constraint becomes more restrictive to capital goods, and the distortions associated with inflation-tax financing worsen.

Panel B of Table 2 presents the numerical values of θ_M and θ_T when domestic currency comprises the majority of total liquidity ($\alpha = 0.75$), while Panel C presents the values of θ_M and θ_T when domestic currency comprises the minority of total liquidity ($\alpha = 0.25$). The results in Panels B and C are similar to those in Panel A. In general, the growth rate of the economy is higher under income-tax financing than under inflation-tax financing (for $\varphi \neq 0$). Both growth rates fall as φ increases toward unity.

Taken as a whole, Table 2 indicates that, when the government finances its expenditures with seigniorage, the growth rate of the economy is sensitive to the share of domestic currency used in transactions. For example, a comparison of the values for θ_M across the three panels when $\varphi = 2/3$ reveals that θ_M falls from 0.0305 at $\alpha = 0.75$ to 0.0190 at $\alpha = 0.50$ and to 0.0046 at $\alpha = 0.25$.[20] Intuitively, a reduction in the share of domestic currency in total liquidity decreases the domestic inflation-tax base. Consequently, the government must impose a higher inflation-tax rate to raise the same amount of revenue, implying that the growth effects of inflation-tax financing worsen as α declines. In contrast to the results for θ_M, Table 2 reveals that the

[20] As can be seen in Panel B of Table 2, when $\alpha = 0.75$ and $\varphi = 1/3$, θ_M exceeds θ_T. The discussion in the text focuses on α declining toward zero. As α rises toward unity, the "currency-substitution" distortion disappears. Therefore, one should expect inflation taxation to become the superior policy for financing government expenditures in terms of its effects on growth for high enough values of α. That is, the ranking between θ_T and θ_M should revert to that found in PY as currency substitution becomes less viable. Moreover, as φ declines toward zero, the effects of inflation taxes on growth become smaller. Thus, for high values of α and low values of φ, we should expect θ_M to exceed θ_T. Sensitivity analysis was used to confirm this intuition. For instance, when $\alpha = 0.90$ and $\varphi = 1/3$, $\theta_M = 0.0389$ while $\theta_T = 0.0340$.

numerical values for θ_T are relatively insensitive to variations in the share of domestic currency in total liquidity.

Table 3 reports θ_M and θ_T for several different values of Ω when domestic currency comprises one half of total liquidity. The values in the table provide further evidence that inflation taxation reduces growth more than income taxation. For any size of government, $\theta_M < \theta_T$. Notice that θ_M falls more rapidly than does θ_T as the size of government increases ($d\theta_M/d\Omega < d\theta_T/d\Omega < 0$).[21] This suggests that the growth costs of increasing inflation taxes are larger (in absolute value terms) than the growth costs of increasing income taxes. For example, as government expenditures increase from 10 to 20 percent of domestic output, the growth rate under inflation-tax financing falls by 28 percent, whereas the growth rate under income-tax financing falls by 20 percent.

5.B. Comparing the Inflation Rates under the Alternative Budgetary Policies

In addition to comparing the economic growth rates, it is also interesting to rank the inflation rates that occur under the alternative modes of government finance. Let π_T denote the domestic inflation rate under income-tax financing, and let π_M denote the domestic inflation rate under inflation-tax financing. The generic expression for inflation is given by $\pi = \mu - \theta$. The numerical results reported in Table 2 indicate that $\theta_T > \theta_M$ (for $\varphi > 0$). Recognize that $\pi_T = -\theta_T$, because $\mu_T = 0$. Also, recognize that $\mu_T < \mu_M$. Using the numerical result that $\theta_T > \theta_M$, implies $\pi_T < \pi_M$. Thus, the inflation rate under seigniorage financing is higher than the inflation rate

---

21 The result that θ_M falls more rapidly than does θ_T reverses at $\Omega = 0.60$. $\Omega = 0.60$ is most likely the maximum size of government given the other parameter values, which may imply that this is a perverse result. As Ω increases beyond 0.60, the growth rates become negative. Because $\Omega = 0.60$ may be giving a perverse result, the discussion in the text relies on the results when Ω lies between 0.10 and 0.50.

under income-tax financing as long as some liquidity services are required to purchase capital goods.[22]

6. Examining the Growth Effects of Varying the Tax Mix

Up to this point, the paper has focused solely on situations where the government receives its revenue from either inflation taxation or income taxation. This section examines the growth effects of government expenditures when the government has access to both forms of finance simultaneously. Specifically, this section investigates numerically how the growth rate of the small open economy varies as the government changes the mix of revenue sources.

Allowing the government to use both income and inflation taxation to finance its expenditures requires some modification of the equations in the model. The growth rate of the economy is now given by:

$$\rho + \bar{\theta} = \frac{(1-\tau)A\alpha m^{\alpha-1}n^{1-\alpha}}{\alpha m^{\alpha-1}n^{1-\alpha} + \phi(\rho+\mu)} = \frac{\alpha(1-\tau)A}{\alpha + \phi(\rho+\mu)^{\alpha}[(\rho+\bar{\theta})(\alpha/(1-\alpha))]^{1-\alpha}}. \tag{21}$$

Recall that the government's budget constraint is: $g = \mu m + \tau x$. Dividing through by x gives $\Omega = \Omega_M + \tau$. Ω_M denotes the fraction of government expenditures (as a share of domestic output) financed by domestic inflation taxes. Similarly, τ captures the fraction of government expenditures financed by income taxes. The endogenous money-growth rate in equation (21) is now specified as:

[22] When $\varphi = 0$, $\theta_M > \theta_T$. In this case, the ranking between π_M and π_T is ambiguous. See PY for a proof.

$$\mu = \left[\frac{A\Omega_M}{A\Omega_M - (1-\phi)\theta_M} \right] H. \tag{22}$$

A nonlinear equation solver is applied to equations (21) and (22) to calculate $\bar{\theta}$ under alternative tax mixes. The effects of variations in the tax mix are captured by changing the values of τ and Ω_M. To provide a framework for comparing the different growth rates that emerge under the alternative values of τ and Ω_M, the size of government (Ω) is held constant (at 0.35) throughout the numerical exercises.

Table 4 presents the different values of $\bar{\theta}$ that emerge as τ and Ω_M are varied. At least three aspects of the results in Table 4 should be emphasized. First, the growth rate of the economy does not have a monotone response to monotonic variations in the tax mix, implying that the nonlinearities inherent in the system are important for the numerical results. Second, when the government derives all of its revenue from domestic inflation taxes ($\tau = 0$, $\Omega_M = 0.35$), the lowest growth rate occurs. Starting from this point, any replacement of seigniorage with income taxation leads to a higher growth rate. For example, increasing the fraction of the size of government financed by income taxes from 0 to 0.05 raises the economy's growth rate from 0.0267 to 0.0302. Third, for the tax mixes calculated, the maximum growth rate occurs at $\tau = 0.25$ and $\Omega_M = 0.10$. This suggests that the (distorted) growth-maximizing tax mix relies much more heavily on income taxation than on inflation taxation.[23] Intuitively, seigniorage becomes

[23] The small open economy could achieve the optimal growth rate by enacting a set of policies that remove the income-tax distortion, the inflation-tax distortion, and the externality associated with the upward-sloping supply of debt. To achieve this optimal growth rate, the government would have to replace the income tax with a lump-sum tax, set the domestic money-growth rate according to the Friedman rule, tax transactions in the international debt market, and

increasingly distortionary in terms of its effects on growth, because of inflation-tax evasion through currency substitution, as the government relies more heavily on this revenue source. This result stands in contrast to PY's finding that the growth-maximizing tax mix consists solely of seigniorage.

7. Conclusions

Using a small open economy, endogenous growth model, this paper analyzes the relative costs of financing government expenditures with domestic income taxes and domestic inflation taxes. In this economy, agents use both domestic and foreign currencies to purchase goods and a portion of the domestic capital stock. Home and foreign currencies are imperfect substitutes for conducting transactions. By substituting between the two currencies, agents can partially evade the domestic inflation tax.

When neither domestic currency nor foreign currency is required to purchase investment goods, income taxation reduces the economy's growth rate more than does inflation taxation. Income taxes hinder growth more, when investment is a credit good, because liquidity is superneutral.

When liquidity is required to purchase investment goods, inflation taxation is more distortionary than income taxation in terms of its effects on the growth rate of the economy for most of the parameter values considered. As currency substitution permits agents to evade the inflation tax, the government must increase the money-growth rate by more to raise a given amount of revenue than it would in the absence of currency substitution. Consequently, inflation

---

subsidize transactions in the international capital market. A complete analysis of the central planner's problem is available from the author by request.

taxation turns out to hinder growth more than income taxation. The more cash is required to purchase capital goods, the worse the negative growth effects associated with inflation taxation become. For a given size of government, the difference in the growth effects of the two policies is quite large numerically. Furthermore, inflation taxation leads to a higher inflation rate than does income taxation in the presence of currency substitution.

When the government has access to both forms of finance simultaneously, the economy achieves its highest growth rate when the government relies on a mix of income taxation and seigniorage. Due to inflation-tax evasion through currency substitution, however, this growth-maximizing mix consists primarily of income taxation. The numerical analysis of the tax mix also reveals that if the only source of government revenue were seigniorage, the government could increase the growth rate of its economy by replacing even a small percentage of its seigniorage revenue with revenue from an income tax.

The analysis in this paper could be extended in several directions. Some governments resort to inflationary finance because the costs associated with collecting, enforcing, and administering inflation taxes can be lower than the costs associated with more conventional taxes. Incorporating these additional aspects of income taxation into the model could alter the ranking of the two government budgetary policies. Another extension could be to examine the effects of capital controls. Some governments have responded to the erosion of their inflation-tax base through currency substitution by placing limits on the circulation of foreign currency in the domestic economy. Adding impediments to transacting in the foreign currency to the analysis could also prove interesting.

Appendix A
The First-Order Conditions for the Representative Agent's Optimization Problem

The current-value LaGrangian for the optimization problem discussed in Section 2.B is:

$$\begin{aligned} L_c = \gamma \ln c_x + (1-\gamma)\ln c_y + \lambda_1\{[(1-\tau)A-\delta]k - c_x - c_y - h - r(.)z \\ - \pi m - (f-\psi)\} + \lambda_2\{\ell(m,n) - c_x - c_y - \phi(h+\delta k)\} + \lambda_3\psi + \lambda_4 h + \lambda_5 f, \end{aligned} \tag{A1}$$

where $\lambda_1, \lambda_3, \lambda_4$, and λ_5 are costate variables, and λ_2 is a LaGrange multiplier. $\psi = \dot{z}$, $h = \dot{k}$, and $f = \dot{n}$ are slack variables. The first-order conditions for a maximum are

$$\gamma / c_x = \lambda_1 + \lambda_2 \tag{A2}$$

$$(1-\gamma)/c_y = (\lambda_1 + \lambda_2) \tag{A3}$$

$$\dot{\lambda}_1 = \rho\lambda_1 + \pi\lambda_1 - \lambda_2 \alpha m^{\alpha-1} n^{1-\alpha} \tag{A4}$$

$$\dot{\lambda}_3 = \rho\lambda_3 + r(.)\lambda_1 \tag{A5}$$

$$\dot{\lambda}_4 = \rho\lambda_4 - \lambda_1[(1-\tau)A - \delta] + \lambda_2\phi\delta \tag{A6}$$

$$\dot{\lambda}_5 = \rho\lambda_5 - \lambda_2(1-\alpha)m^{\alpha} n^{-\alpha} \tag{A7}$$

$$\lambda_1 = -\lambda_3 \tag{A8}$$

$$\lambda_1 = -\phi\lambda_2 + \lambda_4 \tag{A9}$$

$$\lambda_1 = \lambda_5 \tag{A10}$$

$$\begin{aligned} &\lambda_2 \geq 0, \{m^{\alpha} n^{1-\alpha} - c_x - c_y - \phi(h+\delta k)\} \geq 0, \\ &\lambda_2\{m^{\alpha} n^{1-\alpha} - c_x - c_y - \phi(h+\delta k)\} = 0. \end{aligned} \tag{A11}$$

Equilibrium in the small open economy is described by equations (A2-A11), the private budget constraint, the government budget constraint, liquidity-market clearing, a binding liquidity-in-advance constraint, bond-market clearing, and the following transversality conditions:

$$\lim_{t\to\infty} m_t \lambda_{1t} e^{-\rho t} = \lim_{t\to\infty} z_t \lambda_{3t} e^{-\rho t} = \lim_{t\to\infty} k_t \lambda_{4t} e^{-\rho t} = \lim_{t\to\infty} n_t \lambda_{5t} e^{-\rho t} = 0.$$

To ensure the existence of an equilibrium with a positive economic growth rate and bounded lifetime utility, the following parameter restrictions are imposed: $A > \rho > 0$.[24]

[24] These parameter restrictions are necessary for an equilibrium in a closed-economy barter model with AK technology. As a closed-economy barter model is a limiting case of the current model, these restrictions are sufficient in the present context to guarantee that an equilibrium with positive growth and bounded utility exists. See Barro (1990) and PY (1995).

References

Barnett, R.C., Ho, M.S., 1998. Growth, reserve requirements, and inflationary finance. Working paper at the University of Arkansas.

Barro, R.J., 1990. Government spending in a simple model of endogenous growth. Journal of Political Economy 98, S103--25.

_____, Sala-i-Martin, X., 1992. Public Finance in Models of Economic Growth. The Review of Economic Studies 59, 645--661.

Bergsten, C.F., 1999. Dollarization in emerging market economies and its implications for the United States. Statement before the Committee on Banking, Housing, and Urban Affairs, U.S. Senate, April 22.

Bhattacharya, J. Guzman, M.G., Huybens, E., Smith, B.D., 1997. Monetary, fiscal, and reserve requirement policy in a simple monetary growth model. International Economic Review 38, 321--350.

Boyd, J., Levine, R., Smith, B.D, 1997. Inflation and financial market performance. Federal Reserve Bank of Minneapolis working paper number 573D.

Calvo, G.A., Végh, C.A., 1996. From currency substitution to dollarization and beyond: analytical and policy issues, in: Calvo, G.A. (Ed.), Money, Exchange Rates, and Output. MIT Press, Cambridge, MA, pp. 153--175.

_____, _____, 1994. Credibility and the dynamics of stabilization policy: a basic framework, in: Sims, C.A. (Ed.), Advances in Econometrics, Sixth World Congress, Vol. II, Proceedings from the World Econometric Society. Cambridge University Press, Cambridge, U.K., pp. 377--420.

_____, _____, 1992. Currency substitution in developing countries: an introduction. IMF Working Paper No. 92-42.

Chari, V.V., Jones, L.E., Manuelli, R.E., 1995. The growth effects of monetary policy. Federal Reserve Bank of Minneapolis Quarterly Review 19, 18--32.

_____, _____, _____, 1996. Inflation, growth, and financial intermediation. Federal Reserve Bank of St. Louis Review May/June, 41--58.

Cooley, T.F., Hansen G.D., 1992. Tax distortions in a neoclassical monetary economy. Journal of Economic Theory 58, 290--316.

De Gregorio, J., 1993. Inflation, taxation, and long-run growth. Journal of Monetary Economics 31, 271--298.

Dotsey, M., Sarte, P., 2000. Inflation uncertainty and growth in a simple monetary model. Journal of Monetary Economics 45, 631--655.

Edwards, S., Tabellini, G., 1991. Explaining fiscal policies and inflation in developing countries. Journal of International Money and Finance 10, S16--S48.

Espinosa-Vega, M.A., Yip, C.K., 1999. Fiscal and monetary policy interactions in an endogenous growth model with financial intermediaries. International Economic Review 40, 595--615.

Ferreira, P.C., 1999. Inflationary financing of public investment and economic growth. Journal of Economic Dynamics and Control 23, 539--563.

Fischer, S., 1982. Seigniorage and the case for a national money. Journal of Political Economy 90, 295--313.

Fisher, E.O'N., 1999. On exchange rates and economic growth. Journal of Economic Dynamics and Control 23, 851--872.

Giovannini, A., Turtelboom, B., 1992. Currency substitution. NBER working paper number 4232.

International Monetary Fund, 1999. Monetary policy in dollarized economies. IMF Occasional Paper 171.

Jones, L.E., Manuelli, R.E., 1995. Growth and the effects of inflation. Journal of Economic Dynamics and Control 23, 125--58.

Kim, S., 1998. Growth effects of taxes in an endogenous growth model: To what extent do taxes affect economic growth? Journal of Economic Dynamics and Control 23, 125--158.

King, R.G., Rebelo, S., 1990. Public policy and economic growth. Journal of Political Economy 98, S126--S150.

Osang, T., Turnovsky, S.J., 2000. Differential tariffs, growth, and welfare in a small open economy. Journal of Development Economics 62, 315--342.

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.

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

Turnovsky, S.J., 1999. On the role of government in a stochastically growing open economy. Journal of Economic Dynamics and Control 23, 873--908.

_____, 1997. Equilibrium growth in a small economy facing an imperfect world capital market. Review of Development Economics 1, 1--22.

_____, 1996. Fiscal policy, growth, and macroeconomic performance in a small open economy. Journal of International Economics 40, 41--66.

_____, 1993. Macroeconomic policies, growth, and welfare in a stochastic economy. International Economic Review 34, 953--981.

Van der Ploeg, F., Alogoskoufis, G.S., 1994. Money and endogenous growth. Journal of Money, Credit, and Banking 26, 771--791.

TABLE 1
PARAMETER VALUES

Parameter	**Description**	**Value**
Ω	Size of government	0.35
A	Gross marginal product of capital	0.10
ρ	Rate of time preference	0.03
φ	Share of the capital stock subject to the liquidity-in-advance constraint	0, 1/3, 2/3, 1
α	Share of domestic currency in total liquidity	1/4, 1/2, 3/4

TABLE 2

PANEL A
COMPARISON OF THE GROWTH RATES
WHEN THE DOMESTIC CURRENCY COMPRISES ONE HALF OF TOTAL LIQUIDITY($\alpha = 0.50$)

	$\varphi = 0$	$\varphi = 1/3$	$\varphi = 2/3$	$\varphi = 1$
θ_T	0.0350	0.0332	0.0315	0.0299
θ_M	0.0700	0.0267	0.0190	0.0135

PANEL B
COMPARISON OF THE GROWTH RATES
WHEN THE DOMESTIC CURRENCY COMPRISES THE MAJORITY OF TOTAL LIQUIDITY ($\alpha = 0.75$)

	$\varphi = 0$	$\varphi = 1/3$	$\varphi = 2/3$	$\varphi = 1$
θ_T	0.0350	0.0337	0.0324	0.0312
θ_M	0.0700	0.0378[a]	0.0305	0.0252

PANEL C
COMPARISON OF THE GROWTH RATES
WHEN THE FOREIGN CURRENCY COMPRISES THE MAJORITY OF TOTAL LIQUIDITY ($\alpha = 0.25$)

	$\varphi = 0$	$\varphi = 1/3$	$\varphi = 2/3$	$\varphi = 1$
θ_T	0.0350	0.0331	0.0313	0.0297
θ_M	0.0700	0.0102	0.0046	0.0008

[a] See footnote 20.

TABLE 3
COMPARISON OF THE GROWTH RATES
FOR ALTERNATIVE SIZES OF GOVERNMENT[a]

	Ω = 0.10	**Ω = 0.20**	**Ω = 0.30**	**Ω = 0.40**	**Ω = 0.50**	**Ω = 0.60**
θ_T	0.0570	0.0475	0.0380	0.0284	0.0188	0.0091
% change θ_T		-20.00	-25.00	-33.80	-51.06	-106.59
θ_M	0.0566	0.0442	0.0322	0.0218	0.0134	0.0072
% change θ_M		-28.05	-37.26	-47.70	-62.68	-87.15

[a]The values reported in the table are calculated with $A = 0.10$, $\rho = 0.03$, $\varphi = 0.33$, and $\alpha = 0.50$. When Ω exceeds 60 percent, the growth rates become negative. Thus, the results for $\Omega > 0.60$ are not included.

TABLE 4
EXAMINING THE TAX MIX[a]

	$\bar{\theta}$
Tax Mix	
Ω_M =0.35, τ = 0	0.0267
Ω_M =0.30, τ = 0.05	0.0302
Ω_M =0.25, τ = 0.10	0.0332
Ω_M =0.20, τ = 0.15	0.0355
Ω_M =0.15, τ = 0.20	0.0368
Ω_M =0.10, τ = 0.25	0.0369
Ω_M =0.05, τ = 0.30	0.0358
Ω_M =0, τ = 0.35	0.0332

[a]The values reported in the table are calculated with A = 0.10, Ω =0.35, ρ = 0.03, φ = 0.33, and α = 0.50.