

Misalignment In The Growth-Maximizing Policies Under Alternative Assumptions Of Tax Evasion

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ABSTRACT

Using an overlapping generations monetary endogenous growth model, we analyze the possible misalignment in the growth-maximizing policies if tax evasion is assumed to be exogenous instead of being treated as a behavioral decision of the agents. By allowing for government transfers to affect young-age income, and, hence, a role for monetary policy, besides fiscal policy, in the determination of the agents reported income, we show that the failure on part of the government to realize tax evasion as endogenous, results in higher tax rates, reserve requirements and money growth rate. This, in turn, implies that the economy would end up experiencing lower (higher) steady-state growth (inflation).

Keywords: Tax Evasion; Monetary Overlapping Generations Model; Endogenous Growth; Growth-Maximizing Policies

INTRODUCTION

Using an overlapping generations monetary endogenous growth model, we analyze the possible misalignment in the growth-maximizing fiscal and monetary policies, if tax evasion is assumed to be exogenous instead of being treated as a behavioral decision of the agents, and, hence, determined endogenously.

The motivation for our analysis emanates from two categories of study dealing with optimal policy decisions under tax evasion. The first group of studies, such as Roubini and Sala-i-Martin (1995), Gupta (2005, 2006), Holman and Neanidis (2006), analyzes the optimal mix of fiscal and monetary policies under tax evasion. However, these studies treat tax evasion as an exogenous fraction of income that is not reported for taxation. The second group of studies, for example Gupta (2008) and Gupta and Ziramba (2008), points out that all the above-mentioned analyses suffer from the "Lucas Critique" in the sense that they treat tax evasion as exogenous.¹ The authors stress that the optimal degree of tax evasion is a behavioral decision made by the agents of the economy and is likely to be affected by not only the structural parameters of the economy, but also the policy decisions of the government. Given that, the first group of studies looked at the optimal policy decisions of the government, following an increase in the exogenous rate of tax evasion, without specifying what is causing the change in the degree of evasion in the first place, the optimal policy choices made by the government is likely to be non-optimal. This is simply because the degree of tax evasion, following such policy choices, would have changed the actual level of the tax evasion further, once one realized that tax evasion is endogenous. This second group of studies looks at the optimal monetary policy response of the government following a change in the degree of tax evasion, resulting from changes in structural parameters and policy variables, such as the tax and penalty rates.

¹ With regard to endogenous tax evasion, four other studies that deserve mentioning are Lin and Yang (2001), Chen (2003), Arana (2004) and Atolia (2007). All these studies looked into the impact of tax evasion on economic growth, also determined endogenously either due to production externalities, productive public expenditures or due to the role of human capital.

In this paper, using a framework similar to Atolia (2007), Chen (2003) and Gupta and Ziramba (2008), we study the difference in the size of growth-maximizing policies, both fiscal and monetary, that would arise if the government treats tax evasion as exogenous, when ideally it should have been considered to be endogenous. To put it differently, by allowing the growth process to be determined endogenously, resulting from productive public expenditures, we point out to the possible misalignment in the growth-maximizing policies under alternative assumptions regarding the formulation structure of tax evasion. To the best of our knowledge, this is the first attempt to highlight the difference between growth-maximizing (optimal) policies under exogenous and endogenous tax evasion. Thus far, the literature has mainly considered the effects of tax rates, penalty rates and probability of monitoring on the degree of tax evasion. We, however, by allowing for government transfers, and, hence, a role for monetary policy, besides fiscal policy, in the determination of the agents' reported income, extend the previous set of studies. The remainder of the paper is organized as follows: Section 2 lays out the economic environment and solution of the model. Section 3 defines the competitive equilibrium, while Section 4 discusses the growth-maximizing policy choices. Section 5 concludes.

ECONOMIC ENVIRONMENT

Time is divided into discrete segments and is indexed by $t = 1, 2, \dots$. There are four types of economic activities: (i) each two-period lived overlapping generations household (consumer/worker) is endowed with one unit of labor when young, but the agent retires when old. Thus, at time t , there are two coexisting generations of young and old. N people are born at each time point $t = 1$. At $t = 1$, there exist N people in the economy, called the initial old, who live for only one period. The population N is normalized to 1. The young inelastically supplies one unit of the labor endowment to earn wage income, a part of the tax-liability is evaded with evasion being determined endogenously to maximize utility, and the rest is invested in firms, via the banks, for future consumption; (ii) the banks operate in a competitive environment and perform a pooling function by collecting the deposits from the consumers and lending it out to the firms after meeting an obligatory cash reserve requirements; (iii) each producer is infinitely lived and is endowed with a production technology to manufacture a single final good, using the inelastically supplied labor and physical and public capitals; (iv) there is an infinitely lived government which meets its expenditure by taxing income, seigniorage and setting penalty for tax evasion when caught. There is a continuum of each type of economic agent with unit mass.

Consumers

Consumers have the same preferences so that there exists a representative consumer in each generation. Each consumer of generation t possesses a unit of labor when young. This unit of labor is supplied inelastically to the firms and is paid a wage rate w_t . In period $t + 1$, when old, he derives income from savings made in period t . The consumer consumes in both periods.

The government levies a tax at rate τ_t on labor income earned in period t which households can evade with an exogenous probability of q . For the potential evader, there are (ex ante) two possible situations: "success" (i.e. getting away with evasion) and "failure" (i.e., getting discovered and being convicted). Assuming, that β_t is the fraction of income that is reported in period t and τ_t is the income tax rate at t , if the consumer is found guilty of concealing an amount of income $(1 - \beta_t)w_t$, then the agent has to pay a penalty on the unreported income in period t itself at higher rate of θ_t .

On receiving the income, the young agent not only makes his consumption-saving decision, but also chooses the fraction of labor income on which to evade taxes. The agent cannot diversify away the risk of being caught, even though he is aware of the probability of being caught and the size of the penalty rate. Based on this information, the young agent decides on the size of the income to report, β_t and the deposits, d_t . After making his

decisions, the agent also realizes whether he has been caught. If he fails to evade taxes, he pays the penalty out of his savings.

Formally, the consumer solves the following problem:

$$\max_{c_{yt}, d_t, \beta_t, c_{ot+1}^1, c_{ot+1}^2} U = u(c_{yt}) + \rho_1 q u(c_{ot+1}^1) + \rho_1 (1-q) u(c_{ot+1}^2) \tag{1}$$

subject to

$$p_t c_{yt} + p_t d_t \leq [(1 - \beta_t + \beta_t (1 - \tau_t))] p_t w_t + p_t a_t \tag{2}$$

$$p_{t+1} c_{ot+1}^1 \leq (1 + i_{dt+1}) p_t d_t \tag{3}$$

$$p_{t+1} c_{ot+1}^2 \leq (1 + i_{dt+1}) (p_t d_t - \theta (1 - \beta_t) p_t w_t) \tag{4}$$

$$0 \leq \beta_t \leq 1 \tag{5}$$

where, $u(\cdot) = \log(\cdot)$, a_t is the government transfer to young consumers of period t , w_t is the real wage at t , $1 + i_{dt+1}$ is the (gross) nominal interest rate received on the deposits at $t + 1$, d_t are the real deposits, c_{yt} is the real consumption when the household is young, c_{ot+1}^1 and c_{ot+1}^2 are the real consumption levels in the second period when the consumer can evade taxes with success and failure, respectively, and ρ_1 is the discount factor. As the utility function is strictly increasing in consumption in each period, all budget constraints hold with equality in equilibrium.

Defining $1 + r_{dt+1} = \frac{1 + i_{dt+1}}{p_t}$, the Kuhn-Tucker conditions for maximization by a typical agent are:

$$d_t : u'(c_{yt}) = \Omega [q u'(c_{ot+1}^1) + (1 - q) u'(c_{ot+1}^2)] [1 + r_{dt+1}] \tag{6}$$

$$\beta_t : \tau_t u'(c_{yt}) \leq \rho_1 (1 - q) \theta_t u'(c_{ot+1}^2) [1 + r_{dt+1}] \text{ if } \beta_t = 1, \tag{7}$$

$$\tau_t u'(c_{yt}) = \rho_1 (1 - q) \theta_t u'(c_{ot+1}^2) [1 + r_{dt+1}] \text{ if } 0 \leq \beta_t \leq 1,$$

$$\tau_t u'(c_{yt}) \geq \rho_1 (1 - q) \theta_t u'(c_{ot+1}^2) [1 + r_{dt+1}] \text{ if } \beta_t = 0.$$

In the first order conditions for β_t , the left-hand side is the marginal benefit of evading taxes on labor income and the right-hand side is the marginal cost. Thus, at corner solution corresponding to no tax evasion; i.e., $\beta_t = 1$, the marginal cost is higher than the marginal benefit. An interior solution; i.e., when there is tax evasion in the economy, is obtained when $(1 - q) \theta_t < \tau_t$.²

² See Atolia (2007) for further details.

Financial Intermediaries

The financial intermediaries, in this economy, behave competitively but are subject to cash reserve requirements. In period t , banks accept deposits and make their portfolio decision, loans and cash reserves choices, with a goal of maximizing profits. The banks provide a simple pooling function by accumulating deposits of small savers and loaning them out to firms after meeting the cash reserve requirements. Bank deposits are assumed to be one period contracts for simplicity, guaranteeing a nominal interest rate of i_{dt} with a corresponding nominal loan rate of i_{lt} . At the end of the period, they receive their interest income from the loans made and meet the interest obligations on the deposits. Note the intermediaries are constrained by legal requirements on the choice of their portfolio (that is; reserve requirements), as well as by feasibility. Given such a structure, the real profit of the intermediary can be defined as follows:

$$\max_{l_t, d_t, m_t} \Pi_{Bt} = i_{lt}l_t - i_{dt}d_t \tag{8}$$

subject to

$$l_t + m_t \leq d_t \tag{9}$$

$$m_t \geq \gamma d_t \tag{10}$$

where Π_{Bt} is the profit of the bank in real terms at period t and l_t are the loans in real terms at period t . Equation (9) ensures the feasibility condition and m_t is the banks' holding of fiat money in real terms. The banks are also subject to reserve requirements on cash, given by (10).

The solution to the bank's profit maximization problem results from the zero profit condition and is given by

$$i_{lt}(1 - \gamma) = i_{dt} \tag{11}$$

Simplifying, in equilibrium, the following condition must hold:

$$1 + r_{dt} = (1 - \gamma)(1 + r_{lt}) + \frac{\gamma}{1 + \pi_t} \tag{12}$$

where $1 + \pi_t = \frac{p_{t+1}}{p_t}$ is the gross rate of inflation. As can be observed from (11), the solution to the bank's problem yields a loan rate higher than the interest rate on the deposits since reserve requirements tend to induce a wedge between borrowing and lending rates for the financial intermediary.

Firms

All firms are identical and produce a single final good using the following production technology:

$$y_t = Ak_t^\alpha (n_t \phi g_t)^{(1-\alpha)} \tag{13}$$

where $A > 0$; $0 < \alpha((1 - \alpha)) < 1$ is the elasticity of output with respect to capital (labor), with k_t , n_t and g_t ,

respectively, denoting capital, labor, and government expenditure inputs at time t . $0 < \phi < 1$ denotes the proportion of government expenditure that is productive. At time t , the final good can either be consumed or stored. We assume that the loans by the banks into the firms can be converted into fixed capital formation. Note, the production function in (13) is subject to constant returns to scale in k_t and n_t , while there are increasing returns to scale in all the three inputs taken together. We follow Barro (1990) in assuming that g_t is a non-rival and non-excludable input in the production process. Each firm takes the level of g_t as given while solving its own optimization problem. The production function thus exhibits private diminishing returns. We follow Diamond and Yellin (1990) and Chen, Chiang and Wang (2000) in assuming that the goods producer is a residual claimer; that is, the producer uses up the unsold consumption good in a way which is consistent with lifetime value maximization of the firms. This assumption regarding ownership avoids the “unnecessary” Arrow-Debreu redistribution from firms to consumers and simultaneously retains the general equilibrium structure of the models.

The representative firm maximizes the discounted stream of profit flows subject to the capital evolution and loan constraints. Formally, the problem of the firm can be outlined as follows:

$$\max_{k_{t+1}, n_t} \sum_{i=0}^{\infty} \rho_2^i [p_t y_t - p_t w_t n_t - (1 + i_{lt}) p_t i_{kt}] \tag{14}$$

subject to

$$k_{t+1} \leq (1 - \delta_k) k_t + i_{kt} \tag{15}$$

$$i_{kt} \leq l_t \tag{16}$$

$$l_t \leq (1 - \gamma) d_t \tag{17}$$

where ρ_2 is the firm owner’s (constant) discount factor and δ_k is the (constant) rate of capital depreciation. The firm solves the above problem to determine the demand for labor and investment. The firm’s problem can be written in the following recursive formulation:

$$V(k_t) = \max_{n, k} [p_t A k_t^\alpha (\phi n_t g_t)^{(1-\alpha)} - p_t w_t n_t - (1 + i_{lt}) p_t (k_{t+1} - (1 - \delta_k) k_t)] + \rho_2 V(k_{t+1}) \tag{18}$$

The upshot of the above dynamic programming problem are the following first order conditions:

$$k_{t+1} : (1 + i_{lt}) p_t = \rho_2 p_{t+1} [A\alpha (\phi \frac{g_{t+1}}{k_{t+1}})^{1-\alpha} + (1 + i_{lt+1})(1 - \delta_k)] \tag{19}$$

$$n_t : w_t = A(1 - \alpha) (\phi \frac{g_t}{k_t})^{(1-\alpha)} k_t \tag{20}$$

Equation (19) provides the condition for the optimal investment decisions of the firm. The firm compares the cost of increasing investment in the current period with the future stream of benefits generated from the extra capital invested in the current period, and equation (20) states that the firm hires labor up to the point where the marginal product of labor equates the real wage.

Government

The government is assumed to be infinitely-lived. It purchases g_t units of the consumption good. The government revenues in excess of public investment are rebated lump-sum to the current young from whom they are collected. This rules out inter-generational transfers. Expenditures on the government good are financed through income taxation and seigniorage. Note the government also earns a per capita revenue to the order of $(1-q)\theta_t(1-\beta_t)w_t$ when tax evaders are caught evading. However, the government faces monitoring costs $((1-q)v w_t$, with $v > 0$ measuring the cost parameter) as well. For the sake of simplicity, and as in Del Monte and Papagni (2001), we assume that the revenue raised from fines is exactly matched by the cost involved in monitoring the households. The government budget constraint then can simply be represented as follows:

$$g_t = \beta \tau_t w_t + \frac{M_t - M_{t-1}}{P_t} \tag{21}$$

where $g_t = \phi g_t + (1-\phi)g_t$, with $(1-\phi)g_t = a_t$, given that $N = 1$ and $M_t = \mu_t M_{t-1}$, where μ_t is the gross growth rate of money.

EQUILIBRIUM

A competitive equilibrium for this economy is a sequence of interest rate $\{i_t, i_{dt}\}_{t=0}^\infty$, allocations $\{c_{yt}, c_{ot+1}^1, c_{ot+1}^2, \beta_t, n_t, i_{kt}\}_{t=0}^\infty$, and policy variables $\{\tau_t, \gamma_t, \theta_t, \mu_t g_t\}_{t=0}^\infty$ such that:

- Given $\tau_t, a_t, \theta_t, i_{dt}$ and w_t , the consumer optimally chooses β_t and savings, d_t ;
- The real allocations solve the firm’s date- t profit maximization problem, given prices and policy variables, such that (19) and (20) hold;
- The money market equilibrium conditions $m_t = \gamma_t d_t$ is satisfied for all $t \geq 0$;
- The loanable funds market equilibrium condition $i_{kt} = (1-\gamma_t)d_t$ where the total supply of loans $l_t = (1-\gamma_t)d_t$ is satisfied for all $t \geq 0$;
- The goods market equilibrium condition requires $c_t + i_{kt} + g_t = y_t$ is satisfied for all $t \geq 0$. Note $c_t = c_{yt} + q c_{ot}^1 + (1-q)c_{ot}^2$;
- The labor market equilibrium condition $(n_t)^d = 1$ for all $t \geq 0$;
- The government budget constraint, equation (21), is balanced on a period-by-period basis;
- d_t, m_t, i_{dt}, i_{lt} and P_t must be positive at all dates.

MISALIGNMENT IN THE GROWTH-MAXIMIZING POLICIES IN THE PRESENCE OF TAX EVASION

In this section, we study the differences between the growth-maximizing reserve requirements, money growth rates, and tax rates under the assumptions of exogenous and endogenous tax evasion. For the sake of tractability, we assume that the government follows time-invariant decision rules; i.e., $\tau_t = \tau, \gamma_t = \gamma, \mu_t = \mu$ and $\theta_t = \theta$. Using $u(.) = \log(.)$ and imposing the loanable funds and the money market equilibrium, as well as

assuming the government budget to hold on a period-by-period basis, we obtain the steady-state gross growth rate of the economy (λ) as follows:

$$\lambda = \left\{ A(1-\alpha)(1-\gamma) \left[(q-1)(1-\beta)\theta + \frac{q\rho_1 \left(-\tau + \frac{\left((q-1)(1-\beta)\gamma\theta\left(1-\frac{1}{\mu}\right) - \frac{q\gamma\theta\rho_1\left(1-\frac{1}{\mu}\right)}{(\rho_1+1)(\theta-\tau)} + \frac{q\gamma\theta\rho_1\left(1-\frac{1}{\mu}\right)}{(\rho_1+1)(\theta-\tau)} + \beta\tau \right) (1-\phi)}{1 - \frac{q\gamma\theta\left(1-\frac{1}{\mu}\right)\rho_1(1-\phi)}{(\rho_1+1)(\theta-\tau)}} + 1 \right) \theta \right] \right\} \quad (23)$$

$$\times (24)$$

$$\phi \left[\frac{A(1-\alpha) \left((q-1)(1-\beta)\gamma\theta\left(1-\frac{1}{\mu}\right) - \frac{q\gamma\theta\rho_1\left(1-\frac{1}{\mu}\right)}{(\rho_1+1)(\theta-\tau)} + \frac{q\gamma\theta\rho_1\left(1-\frac{1}{\mu}\right)}{(\rho_1+1)(\theta-\tau)} + \beta\tau \right) \phi^{1-\alpha}}{1 - \frac{q\gamma\theta\left(1-\frac{1}{\mu}\right)\rho_1(1-\phi)}{(\rho_1+1)(\theta-\tau)}} \right]^{\frac{1}{\alpha}} - \delta + 1$$

Note, if tax evasion is exogenous, β_t is simply treated as a constant. However, when it is endogenous, we replace the optimal reported income into the solution of the growth rate. The proportion of reported income is given by the following equation:

$$\beta^* = 1 - \frac{\rho_1}{1+\rho_1} \left[\frac{1}{\theta} - \frac{1-q}{\tau} \right] \frac{(1-\tau) + \frac{a_t}{w_t}}{1 - \frac{\tau}{\theta}} \quad (24)$$

where $\frac{a_t}{w_t} = \frac{(1-\phi)g_t}{w_t}$ is the ratio of the per capita transfer to the real wage rate. Clearly, a rise in the size of the transfer resulting from increases in the reserve requirement and money growth rate would tend to reduce reported income, given that $\tau > (1-q)\theta$. Though not quite obvious from the above expression, it is easy to show that a rise in the tax rate reduces reported income as well. Figures 1 through 3, respectively, show the negative relationships of reported income with the reserve requirements, the money growth rate, and the tax rate.³

Replacing out $\frac{(1-\phi)g_t}{w_t}$ from the government budget constraint and solving for β^* yields the ultimate solution for the reported income and is given as follows:

³ We used standard parameterizations, outlined in Gupta and Ziramba (2008), for $\alpha = 0.75$; $\beta = 0.20$; $\gamma = 0.25$; $\delta = 1.1$; $\theta = 0.98$, and calibrated $\tau = 0.6523$ to match a λ of 0.80 for all the figures. The relationships of the reported income with the tax rate, reserve requirement and the money growth rate are, understandably, qualitatively invariant to alternative parameterizations.

$$\beta^* = \left(\frac{\mu\rho_1((q-1)\theta + \tau)(\tau\phi - 1)}{\gamma\theta(\mu - 1)\rho_1(\theta(q-1)^2 + (2q-1)\tau)(\phi - 1) + \mu\tau(\theta(\rho_1\phi + q(\rho_1 - \rho_1\phi) + 1) - \tau(\rho_1\phi + 1))} + 1 \right) \quad (25)$$

Figure 1: The Relationship between Reserve Requirements and the Proportion of Reported Income

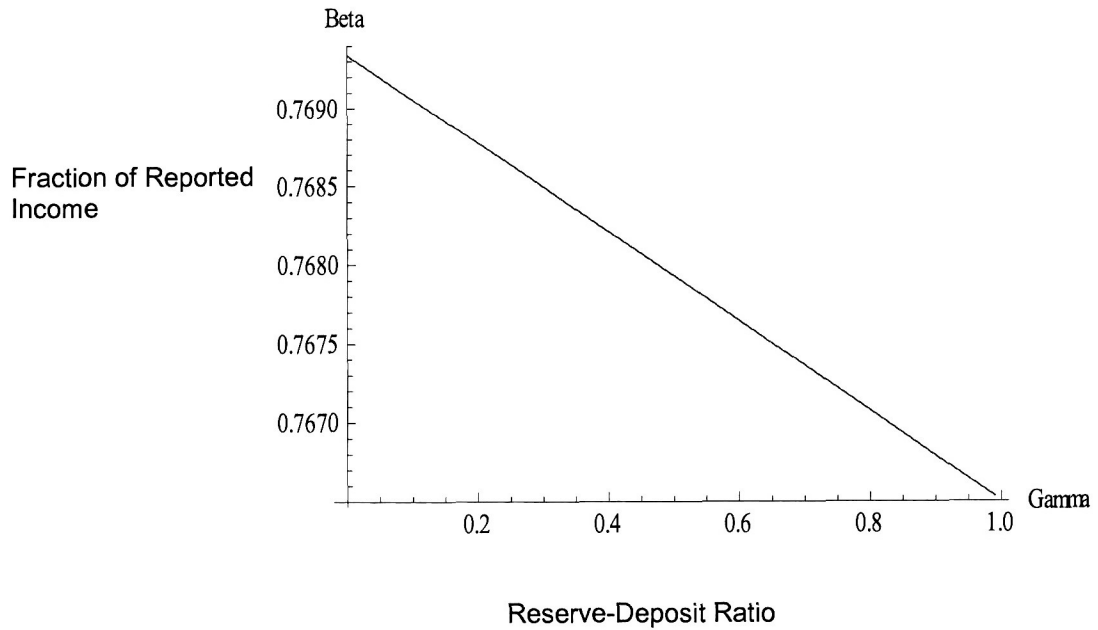


Figure 2: The Relationship between Money Growth Rate and the Proportion of Reported Income

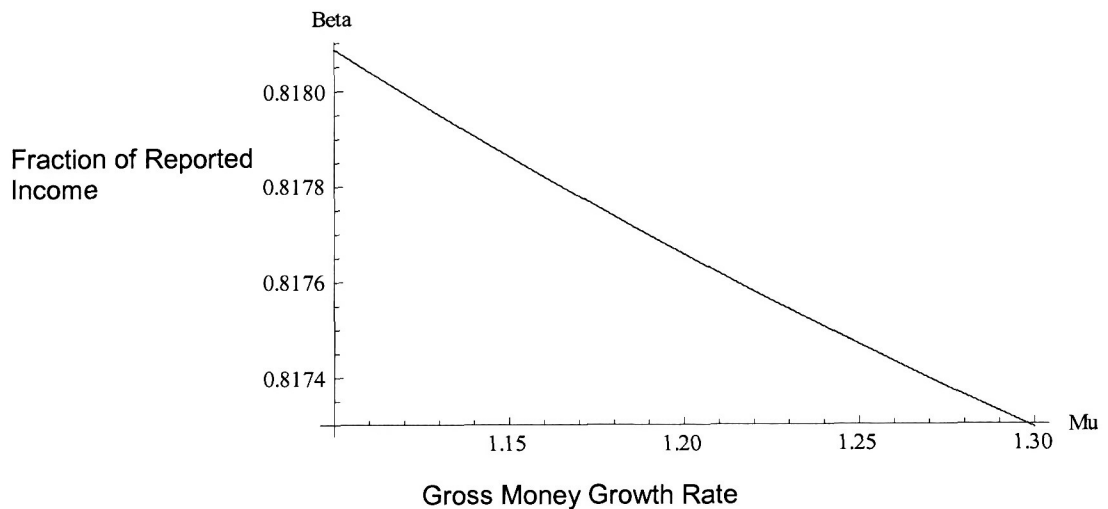
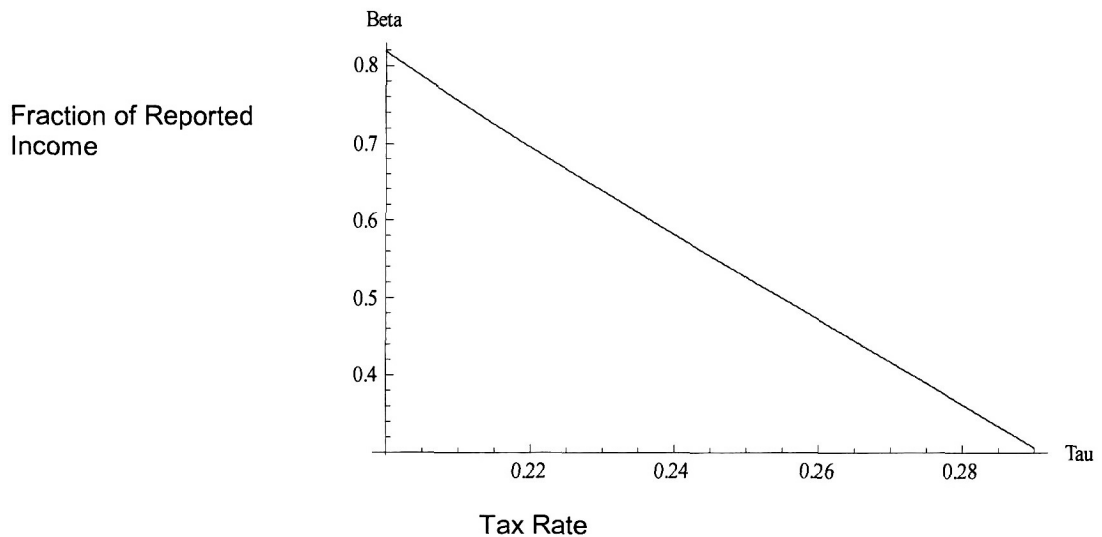


Figure 3: The Relationship between Tax Rate and the Proportion of Reported Income



As is standard in Barro (1990)-type endogenous growth models, the relationship between the growth rate and reserve requirements and growth rate and the tax rate produces Laffer-curve type of relationships. Clearly, then there exists growth-maximizing levels of tax rate and reserve requirement. The growth-maximizing (optimal) reserve requirement and tax rate would, however, be higher in the case of exogenous tax evasion, when compared to the endogenous case. The intuition of these results is as follows: An increase in the reserve requirement or the tax rate will reduce deposits which, in turn, would lower the growth rate. However, increases in the reserve requirement or the tax rate increases government transfers, and hence, deposits, besides public capital investment. Both these effects would tend to increase the growth rate. In the case of endogenous tax evasion, the increase in reserve requirement and the tax rate has an additional effect. These increases reduce the proportion of reported income as shown in Figures 1 and 3, respectively, via the increase in the ratio of transfers to the real wage rate. This, in turn, has an additional negative influence on growth, besides the standard channel described above under exogenous tax evasion. Thus, the growth rate will reach its maximum at lower levels of the reserve requirement and the tax rate, under endogenous tax evasion.

In the case where tax evasion is exogenous, an increase in the money growth rate will always have a positive influence on growth both through higher transfers and larger public capital investment. However, with endogenous tax evasion, increasing the money supply growth rate would reduce the proportion of reported income as illustrated on Figure 2. A fall in the proportion of reported income β^* will have a negative impact on the economy's growth path. This, in turn, causes the positive effect on growth of the increase in the money growth rate via increases in the public expenditures to be outweighed at some stage, and results in a Laffer-Curve type of relationship. So unlike, in the case of exogenous tax evasion, where the optimal money growth rate is infinity, with endogenous tax evasion, the optimal money growth rate would surely be some finite value.⁴

So, in summary, we highlight the fact that government policies, both fiscal and monetary, will be misaligned if it fails to realize the behavioral nature tax evasion. The government not only chooses a higher tax rate,

⁴ It must be realized that in our model with deposits and, hence, growth rate being independent of the rate of interest, higher money growth rate always results in higher growth rate under exogenous tax evasion. However, it is important to understand, that whether the growth rate is interest inelastic or not, given that tax evasion is negatively related to the money growth rate, the optimal value of the same will always be lower under endogenous tax evasion when compared to the exogenous case. The only difference, being that now, under exogenous tax evasion, the growth-maximizing money growth rate will be some finite value as well, since we would also obtain an inverted u-shaped relationship between the growth rate and the money growth rate.

but also represses the financial sector more by choosing higher reserve requirements. Moreover, with optimal money growth rate being higher, unbounded in this case, the economy experiences higher inflation than it should ideally. Finally, with reported income now dependent on monetary instruments, tax evasion can also be controlled through appropriate choice of monetary policies.⁵ In fact, if the government wants to reduce tax evasion, it should reduce both reserve requirements and money growth rate. This, however, would come at the cost of lower growth rate.

CONCLUSIONS

Using an overlapping generations monetary endogenous growth model, we analyze the possible misalignment in the growth-maximizing fiscal and monetary policies, if tax evasion is assumed to be exogenous instead of being treated as a behavioral decision of the agents. We extend the previous set of studies by allowing for government transfers to affect young-age income and, hence, provide a role for monetary policy, besides fiscal policy, in the determination of the agents reported income.

We show that the failure on part of the government to realize tax evasion as endogenous results in higher tax rates, reserve requirements, and money growth rate. Since tax evasion is positively related to the tax rate, reserve requirement and the money growth rate, the growth-maximizing policies set by the government, by assuming tax evasion to be exogenous, would be at levels beyond the "actual" growth-maximizing levels (that should prevail under endogenous tax evasion). This, in turn, implies that the economy would end up experiencing lower (higher) steady-state growth (inflation). Clearly then, if tax evasion is assumed to be exogenous, when it should ideally be treated as endogenous, it results in misaligned fiscal and monetary policies.

AUTHOR INFORMATION

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⁵ A direct implication of tax evasion being dependent on monetary policy is that, once transferred is allowed in the model, the recent studies by Gupta (2008) and Gupta and Ziramba (2008), discussed above, are also not immune to the Lucas critique.

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