Accounting for Corruption: Taxes, the Shadow Economy, Endogenous Growth and Inflation*

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September 7, 2005

Abstract

Modelling corruption explicitly in this paper produces changes in the predictions about how taxes affect the size of the "underground", non-market, or shadow, economy. Instead of inducing shifts towards the non-market good as in standard models without explicit corruption, here government tax increases raise the value of the corruption services and increase their use, without tending to cause an increase in the size of the shadow sector. These features conform to evidence on tax rates, corruption, and the size of the shadow economy, making a contribution relative to conventional models. Here a representative agent buys the corruption services and provides labor in the corruption sector. The agent acts within an endogenous growth neoclassical monetary model in which cash-only is used to buy the non-market good, while credit also can be used to buy the market good. An increase in inflation raises the price of the corruption service, reduces the non-market good consumption, and tends to lower the balanced-path growth rate by more than in conventional models. The effect of an increased preference for the non-market good, which is interpreted as in increase in corruption, has an ambiguous effect on the growth rate.

JEL Classification: *E13, E31, H26, O42*

*We thank Szilard Benk for excellent research assistance, Tony Nakov for comments, workshop participants at the WIIW and seminar participants at CERGE-EI. This research was supported by the Vienna Institute for International Economic Studies (WIIW) under a grant from the Global Development Network Southeast Europe (GDN-SEE); we are also grateful to CEU and CPS for supporting research and fellowship grants.

Keywords: Corruption, taxes, non-market good, balanced-path growth rate, inflation

Preliminary Draft; Incomplete

1 Introduction

Consensus exists on some of the features that characterize underground economies. Less taxes are paid to the government from the underground sectors as compared to the rest of the economy, on a per unit of output basis. Corruption appears to be integral to the functioning of underground economies. And cash seems to be used more in the underground economy than in the regular tax-paying economy. Further this sector has been estimated to be rather large: Schneider (2000) reports that the shadow output equals 39% of the actual magnitude of reported GDP in developing countries, 23% in transition countries and 14% in OECD countries; and the labor force, as a percent of the official labor force, is estimated to be about 50% in developing and transition countries and 17% in OECD countries (Schneider and Enste, 2000, and Schneider, 2003).

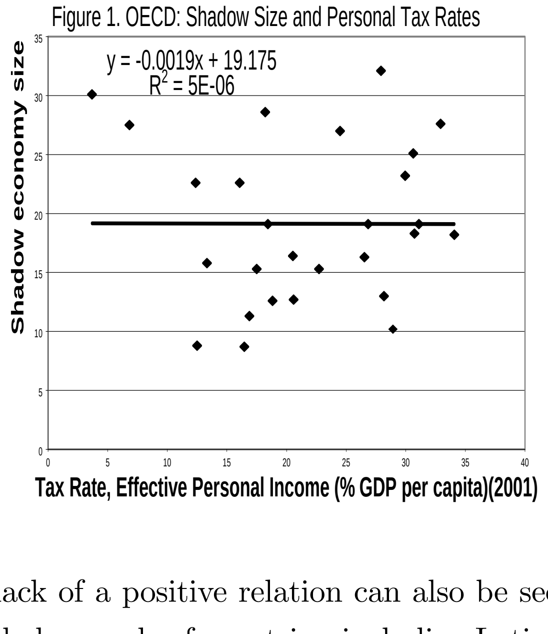
Empirical relations have been presented on the correlation of the underground economy with taxes. For example Johnson, Kaufman and Zoido-Lobaton (1998), Piggott and Whalley (1996) and Moe (2004) suggest that tax rates an the size of the shadow economy move together. And Piggott and Whalley (2001) argue this positive relation in a case example of Canadian tax rate changes. These interpretations of the evidence matter because the models such as in Moe proceed to attempt to explain the data. In particular the standard as in Moe's labor only model is that an increase in the tax rate induces the agent to reallocate resources towards the untaxed non-market sector and away from the market sector, causing the size of the non-market sector to increase. This approach makes perfect sense if in fact the evidence does indicate such a relation and if in fact the non-market sector is untaxed.

A careful look at the most internationally standard measures of tax rates (International Financial Statistics) and corruption (Transparency International Corruption Perceptions Index) does not support the positive relation between tax rates and the size of the shadow sector.

1.1 Evidence on Tax Rates and the Size of the Underground Economy

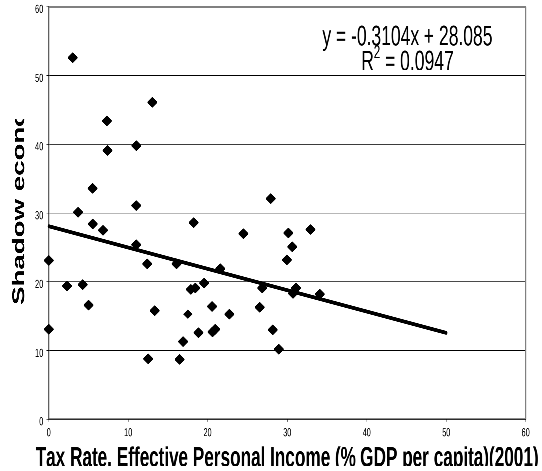
If the size of the underground economy was bigger the higher is the average tax rate, then the standard line of reasoning suggests that high tax countries would tend to have the largest shadow economies and would be the most corrupt; low tax countries would have the smallest shadow economies and be the least corrupt. For example, a priori high-tax Sweden would be extremely corrupt. However its transparency ratings from the Transparency International Corruption Perception Index (TICPI) indicate it as one of the least corrupt. Russia with its 13% income tax should be one of the least corrupt countries; it typically appears in the ratings as one of the more corrupt countries. These may appear to be two outliers but it may also be that tax rate levels, the size of the market economy and corruption do not all move together.

Consider Figure 1. This illustrates the fact (Fact 1) that tax rates are not correlated with the size of the shadow economy. It shows that for the OECD, the effective personal income tax rate is not correlated with the shadow economy size.



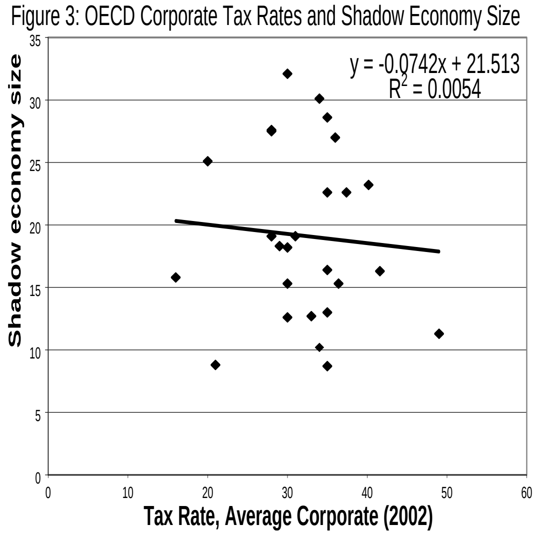
The lack of a positive relation can also be seen in the correlation graph for the whole sample of countries, including Latin America, Asian and transition countries as well as the OECD, where the relation actually looks negative.

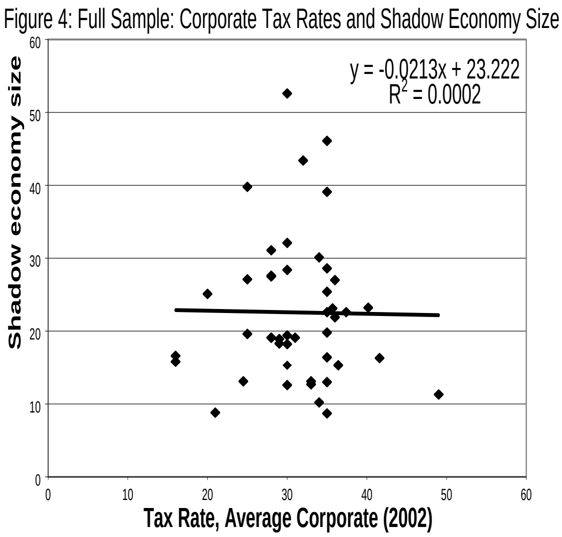
Figure 2. Full Sample: Personal Tax Rates and Shadow Economy Size



Figures 3 and 4 illustrate that the corporate tax rates also have no obvious relation to the shadow economy size, for both industrialized countries and the full sample.

Figure 3: OECD Corporate Tax Rates and Shadow Economy Size





The correlation fact (Fact 2) that does emerge, rather than a positive correlation between the tax rate and the shadow economy size, is that as the corruption perception increases the shadow economy size increases. To see this, first note that the most widely used corruption index, the Transparency International Corruption Perceptions Index TICPI is inversely related with the degree of corruption that is thought to exist. Figures 4 and 5 show that for the OECD and the full sample, as transparency falls and corruption rises, the size of the shadow economy increases.

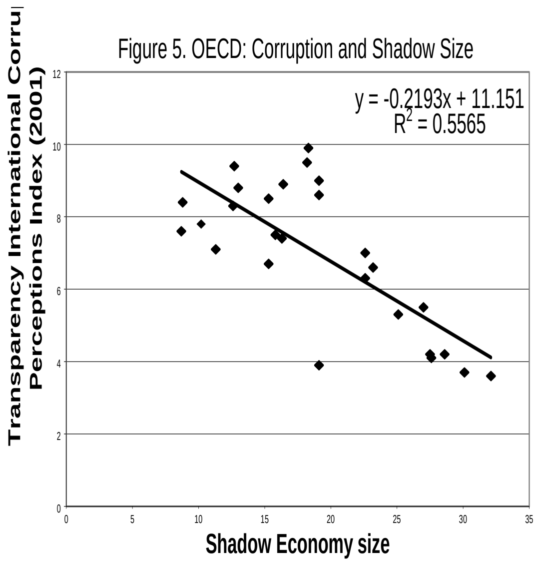
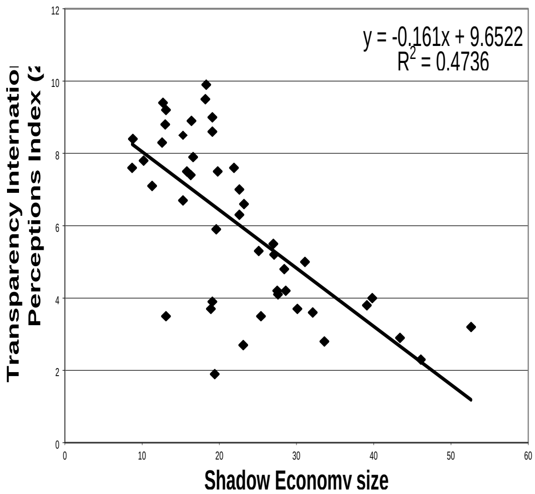
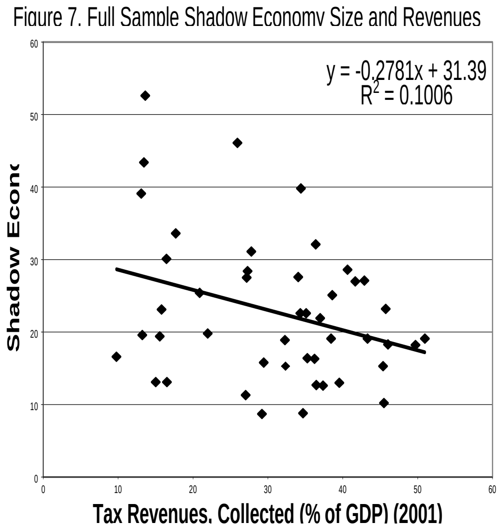


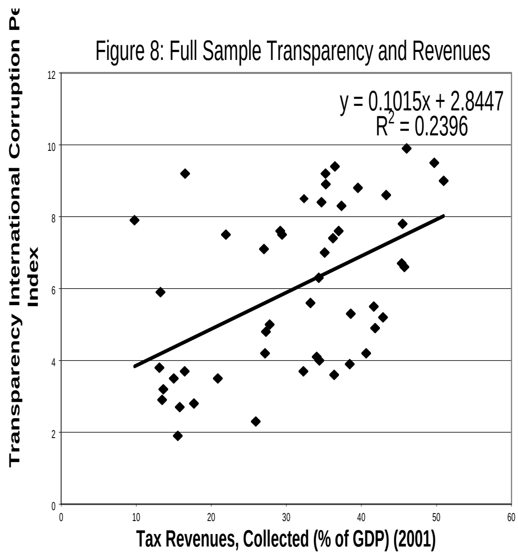
Figure 6: Full Sample Corruption and Shadow Economy Size



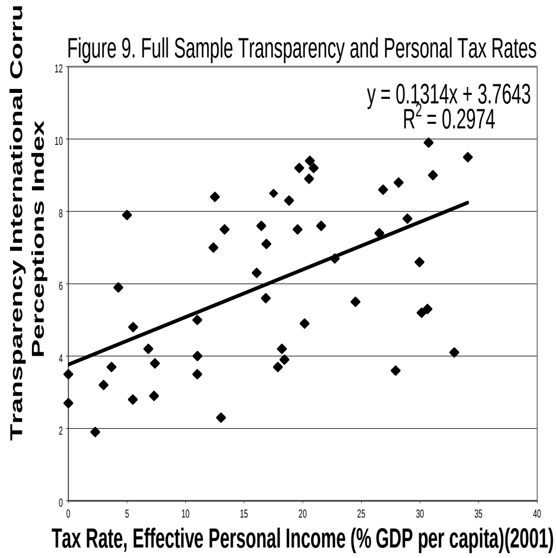
These two facts, the lack of a tax rate relation in Figures 1-4 and the positive corruption and shadow economy size in Figures 5 and 6, together suggest that it can not be inferred that tax rates, corruption and shadow economy size all move together. Instead it is warranted to view the corruption activity as a separate entity linked to the shadow economy, but not necessarily to tax rates; this is an marked change that can effect how the economy is modelled.. For, in contrast, standard models engineer a non-market sector (the shadow economy) that expands as the tax rates rise, and corruption typically is made equivalent to the size of the non-market sector.

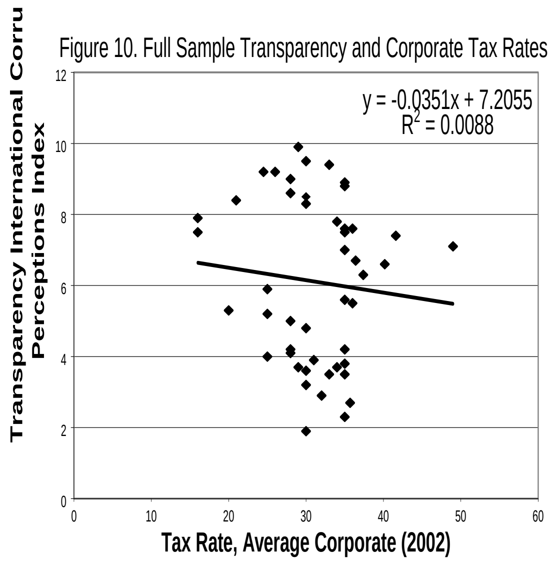
Other facts also need to be considered in attempts to improve the modelling of such phenomenon. Evidence shows what might be called Fact Number 3: tax revenues as a percent of GDP do fall some as the size of the shadow economy rises; also relatedly, Fact Number 4: it appears that these revenues rise as transparency increases, as in Figures 7 and 8.





A fifth correlation Fact is offered for consideration. For personal tax rates, although not for corporate tax rates, the tax rate rises with the degree of transparency, or lack of corruption. This can be seen for the full sample in Figures 9 and 10.





The relation between tax rates and transparency is the only "fact" this paper will not explain, leaving it to discussion of an optimal tax policy in the face of certain corruption. The model also will not explain the existence of the corruption tendencies in themselves, leaving a more endogenous explanation as a possible extension. Here the taste for corruption comes from the preference parameter for the non-market sector in which all taxes are evaded.

1.2 Modelling Approach to Explain Four Correlation Facts

The approach follows Becker (1965), Piggott and Whalley (2001) and Parente, Rogerson and Wright (2000) by using the market/non-market approach However in contrast to previous work, the corruption sector is modelled as a production activity that provides the service of tax evasion in the non-market sector. This service is competitively offered by an "Islands Government" at a certain market determined price per unit of taxes being evaded, and produced using a labor only technology. These services are for labor income, capital income, and/or goods VAT tax evasion. And the Islands Government can be thought of as collecting the fees for the corruption service in a way parallel to how the constitutional government collects taxes in the market sector. Because of the price of the corruption service depends endogenously on the tax rates of the constitutional government, in equilibrium it is found that a rise is legal tax rates drives up the price of the corruption service. This is why substitution does not readily take place towards the non-market sector when taxes increase, establishing a relation as in Fact Number 1.

Instead, corruption activity increases, in terms of the quantity of output of the corruption services, as the government tax rates increase. This happens because of the movement up a supply schedule to a higher output and higher marginal cost as the market price of corruption rises, even as the size of the shadow sector does not unambiguously tend to rise. This increase in corruption activity as government tax rates rise is not shown directly in the correlation evidence displayed above, since the transparency index indicates only a feeling about how corrupt is an economy in general, rather than being about the quantity of such corruption activity specifically. However within this set-up of the model Fact 2 emerges: if the taste for the non-market good increases, which in the model is like a greater taste for corruption, then there is a larger non-market sector in equilibrium. Thus the size of the non-market sector can be shown to rise with the preference for corruption. This establishes Fact Number 2.

If the legal tax rates do rise, it is still true in the economy that revenues as a percent of GDP go down, despite the fact that there is not substitution towards the non-market sector from the market sector. This seeming paradox is easily explained: the tax rates induce less consumption of both market and non-market goods so that, even with a slight shift towards the market good from the non-market good as legal taxes increase, the revenues still fall as a percent of GDP; this establishes in the model Facts Number 3 and 4.

One other key empirically consistent ingredient is to make the economy an exchange economy so that the shadow sector can use cash heavily while the market sector has less such reliance. Credit use typically leaves a "paper trail" that can be incriminating and so is often avoided in the shadow economy (Dabla-Norris and Feltenstein 2003, Faal, 2003). In the model this implies that the inflation tax will effect the shadow sector for the worse as compared to the market sector.

The last important ingredient is to bring out the growth implications. Here evidence between corruption and growth is mixed. The model includes Lucas (1988) endogenous growth within the monetary setting, and here the effect of corruption on growth is in general ambiguous. Altogether the economy is an extension from Gillman and Kejak (2005) to include the non-market sector and to include an explicit corruption service sector. The financial intermediary sector, which supplies the exchange credit that serves as an alternative to money, is also made explicit here in a further extension to previous work.

1.3 Implications of the Modelling Approach: Inflation, Growth Rates and Income Differentials

With the model devised so as to meet the first three correlation facts above, the idea is that the model is properly gauged and can weigh-in better on related issues, such as the balanced-growth path effects of corruption, of the size of the shadow economy, and of inflation within such an economy.

A use of more cash suggests a heavier burden of the inflation tax in economies with bigger underground economies. An increase in the inflation rate causes a shift towards the market good and away from the underground sector. With endogenous growth in this framework, inflation rate increases will tend to lower the growth rate as in more standard economies, but here the negative effect will be even bigger because of more cash reliance.

The balanced-path growth rate is also affected by higher legal tax rates and by a greater preference for the non-market good. Higher legal taxes tend to lower the growth rate as in the standard results, but there are conflicting affects from increasing the preference for the non-market good. Less time is used in avoiding the inflation tax through credit production if the non-market good becomes favored over the market good. While at the same time, more time is used in corruption service provision with a greater preference for the non-market good. The balance of these conflicting time reallocations, the first freeing up time and the second using up more time, make it ambiguous as to what happens to time allocated to leisure and to human capital accumulation. If the leisure time ends up rising, the human capital accumulation time tends to fall, and the growth rate falls. But if there is less leisure and more human capital investment time, then the growth rate rises. And so it depends on the assumed efficiency of time in the credit production sector relative to the corruption services sector, as to whether the growth rate rises or falls because of a greater taste for corruption activity.

The paper also implies results related to the Rogerson, Parente and Wright (1999, 2000) income differentials. In particular that these can be explained within the endogenous growth setting by using different productivity parameters for the human capital investment technology, rather than using different Parente and Prescott (1994) parameters on the cost of new capital investment. The switch to introducing differences in the cost of capital in terms of the human capital accumulation process instead of the physical capital accumulation process follows the literature of Schultz (1964) and Lucas (2002) that emphasizes the return on human capital in explaining a transition from developing to developed economies.

The results are shown through an analytic solution to the economy in the case of no physical capital in Section 3, and through the calibration and simulation of the full economy, in Section 4. Discussion and qualifications appear in Section 5. The next Section 2 presents the representative agent economy.

2 The endogenous growth monetary economy

Notation is summarized in Table 1. The non-market good is combined with the market good in a constant elasticity of substitution fashion. As in Parente, Rogerson and Wright (2000), let the market consumption good be denoted at time t by c_{mt}, and the non-market good by c_{nt}. The aggregate consumption good is denoted by c_t, and with ν and ε utility function parameters, it is given to the representative agent as the following combination of market and non-market goods

$$c_t = \left[\nu c_{mt}^{\varepsilon} + (1-\nu)\, c_{nt}^{\varepsilon}\right]^{1/\varepsilon}. \tag{1}$$

2.1 The Representative Consumer Problem

The consumer has a preference for both the market and the non-market goods, as well as leisure, denoted by x_t. With parameters μ and ε determining the relative preference for the market versus non-market good, the current period utility function is given by

$$u_t = \ln\left(\left[\nu c_{mt}^{\varepsilon} + (1-\nu)\, c_{nt}^{\varepsilon}\right]^{1/\varepsilon}\right) + \varrho \ln x_t \tag{2}$$

2.1.1 Capital and time allocation, and human capital investment

The consumer rents labor and capital for use in the production functions of the market and non-market goods. Let the shares of the physical capital stock in each sector be denoted by s_{mt}, and s_{nt} where

$$s_{mt} + s_{nt} = 1. \tag{3}$$

The agent accumulates physical and human capital, denoted by k_t and h_t, using household production of the human capital investment, denoted by $\dot{h}_t$, with a constant returns to scale function in only effective labor, as in Lucas (1988), where the effective labor is the raw labor multiplied by the human

Table 1: Notation

Symbol	Definition
c_{mt}	market consumption good
c_{nt}	non-market consumption good
y_{ct}	aggregate consumption good
h_t	human capital
i_{ht}	household
k_t	physical capital
s_{mt}	market good
s_{nt}	non-market good
l_{mt}	market labour allocation
l_{nt}	non-market labour allocation
l_{Ft}	labour allocated to credit sector
x_t	leisure
y_{et}	exchange
c_t	consumption good
m_t	real modney
d_t	real credit
V_t	lump-sum transfer to consumers
a_t	fraction of output bought with money
s_{ht}	human capital good
M_t	nominal money
P_t	price level
d_t	demand for credit

capital stock. The real prices of the effective labor and capital are denoted by w_t and r_t.

Let the raw labor allocations to the same sectors be given by l_{mt}, l_{nt}, and l_{ht}, with the labor allocated to the credit (exchange finance) sector and to leisure denoted by l_{dt} and x_t, respectively. There is also labor time used in the corruption activity of the Islands government, in each the labor, capital and goods corruption activities, summarized by $l_{it} = l_{lt} + l_{kt} + l_{ct}$. This makes the Beckerian (Becker, 1965) allocation of time constraint

$$l_{mt} + l_{nt} + l_{ht} + l_{Ft} + x_t + l_{it} = 1. \tag{4}$$

The human capital investment production function with $A_h > 0$ is given by

$$\dot{h}_t = A_h l_{ht} h_t - \delta_h h_t. \tag{5}$$

The consumer receives capital and labor income from working in the sectors of the market good and the non-market good, and receives labor income from working to provide the Islands corruption service; plus their are the receipts of the lump sum transfer from the government V_t and the return of profit (kickbacks) from the Islands corruption service $\Pi_{ct} P_t$. Expenditures are made on the market and non-market good plus physical, money stock, and bond investments. Also the consumer using the non-market sector must pay a fee to the corruption government proportional to the quantity of the corruption services demanded in each of the the corruption government's three sectoral outputs: taxes avoided on the non-market labor income, taxes avoided on non-market capital income and taxes avoided on the sales of the non-market goods. These fees are prices denoted respectively by p_{lt}, p_{kt}, and p_{ct}. Explicit tax rates by the constitutional government on labor income, capital income, and sales of output are denoted by τ_l, τ_k, and τ_c. Also the consumer earns net interest as a residual transfer from the credit supply firm by using credit instead of money for some portion of the goods purchases, and investing these credit funds in bonds over the period; denote this interest in real terms as Π_{dt}. The consumer can also directly buy long-term goverment bonds denoted by B_t and earn the nominal interest rate of R_t, while $\pi_t \equiv \dot{P}_t$ denotes the inflation rate.

The resulting current income budget constraint is

$$\begin{gathered}
0 = (1-\tau_l)\, w_t l_{mt} h_t + (1-\tau_k)\, r_t s_{mt} k_t - (1+\tau_c)\, c_{mt} + V_t/P_t \\
+ w_{it}(l_{lt} + l_{kt} + l_{ct}) + (1 - p_{lt}\tau_{lt})\, w_{nt} h_t l_{nt} + \Pi_{lt}/P_t \\
+ (1 - p_{kt}\tau_{kt})\, r_{nt}\,(1 - s_{mt})\, k_t + \Pi_{kt}/P_t \\
-(1 - p_{ct}\tau_{ct}) p_{nt} c_{nt} + \Pi_{ct}/P_t \\
-\delta_k k_t - \pi_t m_t + (B_t/P_t)(R_t - \pi_t) + \Pi_{dt}.
\end{gathered} \tag{6}$$

2.1.2 Exchange

The goods output forms an input into the Becker (1965)- type household production of each of the two consumption good c_{mt} and c_{nt}. The goods used as an input for producing the consumption goods are denoted by y_{cmt} and y_{cnt} . The other input is exchange, denoted by y_{emt} and y_{ent}, which enters the production function $f_c(\cdot)$

$$c_{mt} = f_c(y_{cmt}, y_{emt}), \tag{7}$$

$$c_{nt} = f_c(y_{cnt}, y_{ent}) \tag{8}$$

The production function for the consumption good is assumed to be Leontieff, whereby the isoquant ray from the origin has a slope of one. This implies, where the relative price of the inputs is between zero and infinity, that

$$c_{mt} = y_{cmt}, \tag{9}$$

$$c_{mt} = y_{emt}; \tag{10}$$

$$c_{nt} = y_{cnt}, \tag{11}$$

$$c_{nt} = y_{ent}. \tag{12}$$

The exchange in turn is produced using two inputs: real money balances, denoted by m_t , and real credit, denoted by d_t. These inputs are perfect substitutes. Let P_t denote the nominal price of the market good, with it serving as the numeraire. Then the total exchange value is given by

$$y_{cmt} + (P_{nt}/P_t)\, y_{cnt} = m_t + d_t. \tag{13}$$

Real money balances are defined as the nominal money stock, denoted by M_t , divided by the nominal price of goods output, denoted by P_t; $m_t \equiv M_t/P_t$. The initial nominal money stock M_0 is given to the consumer. Additional money stock is transferred to the consumer exogenously in a lump sum fashion by an amount V_t. The consumer buys some fraction of the output goods with money, and the rest buys with credit. Let $a_t \in (0, 1]$ denote the fraction of output goods bought with money.[1] Then the agents demand for money is constrained to be this fraction of goods purchased. In real terms,

$$m_t = a_t y_{cmt} + (P_{nt}/P_t)\, y_{cnt}, \tag{14}$$

which by substitution from equation (9) gives a Clower (1967)-type constraint of

$$m_t = a_t c_{mt} + (P_{nt}/P_t)\, c_{nt}; \tag{15}$$

or in nominal terms,

$$M_t = a_t P_t c_{mt} + P_{nt} c_{nt}. \tag{16}$$

Credit demand is the residual fraction of output goods purchases. In real terms,

$$d_t = (1 - a_t) y_{cmt}, \tag{17}$$

or substituting in from equation (9) gives that

$$d_t = (1 - a_t) c_{mt}, \tag{18}$$

where c_t can be viewed as the scale factor of a derived demand for the input.

2.2 Financial Intermediary Problem and the Exchange constraint

There exists a financial intermediary called MerrillAmex, or MA for short. MA takes the income supplied by the consumer, which is intended to pay for the credit purchases at the end of the period, and invests this in short term government bonds called Tbills. MA also supplies credit to the consumer that is acceptable at the store where the consumer buys the goods, but the credit supply involves the use of real resources, labor and capital, as they

[1] An equilibrium with $a = 0$ does not have well-defined nominal prices.

enter a production function for the credit supply. The consumer receives interest back on the income deposited in MA, but this interest is less than the nominal interest rate earned on the bonds because of the cost of the credit supply (bond purchasing by MA is assumed to be costless). The amount of bonds purchased exactly equal the amount of credit to be used for transactions during the period, an equilibrium essentially that of Tobin's (1956) contribution to the Baumol-Tobin model of the transactions demand for money.

The market organization of the financial intermediation follows that of Berk and Green's (2004) partial equilibrium model of investment fund intermediation (rather than credit supply intermediation), as well as Canzoneri and Diba's (2005) focus on the interest differential that results when bonds back up transactions. Berk and Green assume that the agent knows the cost structure of the intermediary and how demand will affect costs, and that the result is competitive, marginal cost, supply and zero profit. More formally, for the general equilibrium setting, it is necessary to be explicit about the industrial structure. We will assume that the consumer acts as a monopsonist buyer of the credit-cum-bond service, and that the intermediary acts as a monopolist seller of this service. In such a bargaining game any outcome is possible and it will be assumed that the competitive outcome results, in which the consumer knows how the cost structure is affected by credit demand. Thereby the consumer chooses the amount of credit to use in transactions (and residually the amount of cash to use in transacations) knowing that there is a rising marginal cost of credit use facing MA. In turn MA sets the marginal cost equal to the marginal revenue, setting the competitive supply, and demand, in the credit market.

In Canzoneri and Diba, the consumer uses credit for transactions with bonds backing up the credit use, similar to Tobin (1956) and related to Banzil and Coleman (1996). Canzoneri and Diba emphasize the interest differential that results if the credit intermediation is costly, although they use an ad hoc transactions cost approach, broadly related to the transactions cost approach also used in Banzil and Coleman. Here a very similar interest differential results, but it derives from MA's profit maximization problem, more as in

Berk and Green.

MA receives the bond interest from the investment in Tbills, in the amount of the credit volume d, and has costs from supplying the credit via a production function that uses effective labor $l_{dt}h_t$ and capital k_{dt}. With R_t denoting the nominal interest rate, this competitive profit maximization problem can be written as

$$\underset{d_t, l_{dt}, k_{dt}}{Max} \ \Pi_{dt} = R_t d_t - w_t l_{dt} h_t - r_{dt} k_{dt}, \tag{19}$$

subject to a production function for d_t, as specified below.

Such profit is returned to the consumer as the interest earned on the bond investment that "backs up" the credit, net of the cost of resources used up in supplying the credit, through the intermediary credit production function. More generally, with the zero profit condition requiring that MA pay to the consumer the interest net of costs, denoted by $R_t^* d_t \equiv \Pi_{dt}$, the zero profit equilibrium condition can be written as

$$0 = \Pi_{dt}^* = (R_t - R_t^*)\, d_t - w_t l_{dt} h_t - r_{dt} k_{dt}. \tag{20}$$

Note that the condition for a positive net interest earnings, of $R_t^* = \Pi_{dt}/d_t > 0$, depends on the production function for credit services.

Consider assumption of the following production specification

$$\left(\frac{d_t}{c_{mt}}\right)^{\phi} c_{mt} = (1 - a_t)^{\phi}\, c_{mt} = \hat{A}_d\, (l_{dt} h_t)^{\psi}\, k_{dt}^{1-\psi}, \tag{21}$$

where $\phi \geq 1$. With $\phi = 1$, the CRS form of producing d_t results and so $R_t^* = 0$. With $\phi > 1$, profit Π_{dt} is positive and $R_t^* > 0$. The ϕ parameter determines the curvature of the marginal cost schedule. Solving for d_r from equation (21) and substituting into the profit maximization problem in equation (19), and taking the first-order conditions with respect to the remaining variables l_{dt} and k_{dt}, the intermediary's problem is fully stated.

Defining $\gamma_1/(\gamma_1 + \gamma_2) \equiv \psi$ (and $\gamma_2/(\gamma_1 + \gamma_2) \equiv 1 - \psi$), and $A_d \equiv \left(\hat{A}_d\right)^{1/\phi}$, then $\phi = [1/(\gamma_1 + \gamma_2)]$ and the share $1 - a_t$ can be written as

$$1 - a_t = A_d (l_{dt} h_t)^{\gamma_1} k_{dt}^{\gamma_2} c_{mt}^{-\gamma_1 - \gamma_2} \tag{22}$$

The model is here simplified by assuming no capital in the production of the credit, for ease in the later computation of the model. Assume only labor in the production and no capital while defining $\gamma \equiv \gamma_1$, so that

$$1 - a_t = A_d (l_{dt} h_t)^{\gamma} c_{mt}^{-\gamma}. \tag{23}$$

The interest differential $R_t - R_t^*$ now is determined solely by γ, in that $R_t^* = (1-\gamma)R_t$, and $R_t - R_t^* = \gamma R_t$. So if there is a 6% nominal interest rate in short term treasury bills, and γ=0.25, then R_t^*=(0.75)(6.0)% = 4.5%. And the interest differential is the 1.5%. This 1.5 can be refined by using data of the mutual fund industry. The differential empirically seems to range between 1 to 2%, so the example above is reasonable.

Substituting into equation (16) for a_t from equation (23), the money and credit constraints can be written in a combined fashion as the following "exchange" constraint:

$$M_t = \left[1 - A_d \left(\frac{l_{dt} h_t}{c_{mt}}\right)^{\gamma}\right] P_t c_{mt} + P_{nt} c_{nt}. \tag{24}$$

Then the consumer's choice of how much labor to supply to the intermediary's credit production process, l_{dt}, in turn determines the consumer's choice of how many real dollars in credit funds, equal to d_t, to supply to the intermediary in order to earn interest during the period. And residually this also determines the amount of Baumol-Tobin cash to hold in equilibrium.

2.3 Market and Non-Market Goods Producer Problems

The output of the market and non-market goods, denoted by y_{mt} and y_{nt}, are each produced by a representative firm using CRS technologies in capital and effective labor. With $A_m > 0$, $A_n > 0$, $\beta \in (0,1)$, and $\alpha \in (0,1)$, the production technologies are

$$y_{mt} = A_m \left(s_{mt} k_{\ t}\right)^{\beta} \left(l_{mt} h_t\right)^{1-\beta}, \tag{25}$$

$$y_{nt} = A_n \left(s_{nt} k_{\ t}\right)^{\alpha} \left(l_{nt} h_t\right)^{1-\alpha}. \tag{26}$$

It is assumed that the output of the non-market sector is equal to the consumption of the non-market sector good. This means that output of the non-market good cannot be used to finance investment in the market sector. The assumption is required in models like this since otherwise, if output from either sector could be used to finance the investment, then all output would take place in only one of the sectors, which ever was the lower cost one. Instead the assumption is that

$$y_{nt} = c_{nt.} \tag{27}$$

This yields a social resource constraint equivalent to that in Parente, Rogerson and Wright (2000).

The firm that produces each the market good and the non-market good face no government taxes nor corruption service fees because these are assumed to fall on the consumer. Thus the standard marginal productivity conditions, with $p_{nt} \equiv P_{nt}/P_t$, result from the first-order conditions of the firms profit maximization problems

$$w_t = (1-\beta) A_n (s_{mt}k_{\ t})^{\beta} (l_{mt}h_t)^{-\beta}, \tag{28}$$

$$r_t = \beta A_n (s_{mt}k_{\ t})^{\beta-1} (l_{mt}h_t)^{1-\beta}, \tag{29}$$

$$w_t = p_{nt} (1-\alpha) A_n (s_{nt}k_{\ t})^{\alpha} (l_{nt}h_t)^{-\alpha}, \tag{30}$$

$$r_t = p_{nt}\alpha A_n (s_{nt}k_{\ t})^{\alpha-1} (l_{nt}h_t)^{1-\alpha}. \tag{31}$$

2.4 Government Budget Constraint

The agent faces proportional taxes on the labor, capital and goods in the market sector, τ_l, τ_k, and τ_c, and receives from the government a nominal lump sum transfer of the tax revenue denoted by V_t. Also the government can supply new money through open market operations in which it buys nominal bonds, denoted by B_t, and pays nominal interest on the bonds of R_t. The government budget constraint is given by

$$V_t = \tau_l w_t P_t l_{mt} h_t + \tau_k r_t P_t s_{mt} k_t + \tau_c P_t c_{mt} + \dot{M}_t + \dot{B}_t - B_t R_t. \tag{32}$$

It is assumed that the money supply grows at a constant rate of σ

$$\dot{M}_t = \sigma M_t. \tag{33}$$

In real terms, dividing equation (33) by P_t implies that the government's investment rate in real money is the supply growth rate minus the inflation-based deprecation of $\dot{P}_t/P_t \equiv \pi$

$$\dot{m}_t = (\sigma - \pi)m_t. \tag{34}$$

Defining $B_t/P_t \equiv b_t$, then $(\dot{B}_t - B_t R_t)/P_t = \dot{b}_t - b_t(R_t - \pi_t)$, and the government constraint in real terms is

$$V_t/P_t = \tau_l w_t l_{mt} h_t + \tau_k r_t s_{mt} k_t + \tau_c c_{mt} + \dot{m}_t + \pi m_t + \dot{b}_t - b_t(R_t - \pi_t). \tag{35}$$

2.5 Islands Government Production Problem

The Islands government produces the corruption that is necessary to enable the consumer to avoid paying explicit labor, capital and goods taxes when supplying labor or capital to the non-market sector, or when buying the non-market good. In particular the Islands government provides the service of turning the labor income in the non-market sector into normal market-like income, indistinguishable from income earned in the market sector. This is like the protection service provided for labor supplied to the illegal sex industry, gambling industry or other illegal industries. The Islands government also provides the service of turning capital income in the non-market sector into normal market-like income. This is like the money laundering service of gambling houses, the non-disclosed bank service of certain national financial industries, and other capital masking activities. In return the Islands government charges corruption service fees of p_{lt}, and p_{kt}, that act as prices per unit of the value of the service rendered. These prices can vary independently of each other and in general are not equal. There is also the service of hiding final sales so that the valued-added tax does not have to be paid on goods bought in the non-market sector. This is also a proportional fee and is denoted by p_{ct}.

It is assumed that the quantity of corruption services in each of the three corruption sectors is denoted as κ_{lt}, κ_{kt}, and κ_{ct}. The quantity κ_{lt} is equal to the value of the taxes on the labor income that is being earned in the non-market sector, since the avoidance of the payment of these taxes is what the corruption service accomplishes. This implies a Leontieff type assumption for the production technology whereby a certain quantity of income does not enter the rest of the economy unless it is combined with an equal quantity of corruption services, in order to produce the consumable income. In other words, it is a Beckerian (1965) household production technology whereby the non-market labor income must be combined in Leontieff isoquant fashion with a corruption service in order to produce useable income. Then non-market income is added as part of the consumers total useable income. This means that the corruption is a value-added service that turns the shadow income into regular income, and

$$\kappa_{lt} = \tau_n w_{nt} l_{nt} h_t. \tag{36}$$

The other two quantities of corruption services are similarly given by

$$\kappa_{kt} = \tau_k r_{nt} s_{nt} k_t; \tag{37}$$

$$\kappa_{ct} = \tau_c p_{nt} c_{nt}. \tag{38}$$

A labor-only production technology is assumed for each corruption service sector. This production technology exhibits diminishing returns to the effective labor per unit of non-market good. The three processes with $\omega \in (0, 1)$ are

$$\begin{aligned}
\kappa_{lt} &= A_l \left(l_{lt} h_t\right)^{\omega} c_{nt}^{1-\omega}, \\
\kappa_{kt} &= A_k \left(l_{kt} h_t\right)^{\omega} c_{nt}^{1-\omega}, \\
\kappa_{ct} &= A_c \left(l_{ct} h_t\right)^{\omega} c_{nt}^{1-\omega}.
\end{aligned}$$

The Islands maximizes real per period profit, for each of the corruption services that it supplies. Denoted as Π_{lt}/P_t, Π_{kt}/P_t, and Π_{ct}/P_t, the profit maximization problems are

$$\Pi_{lt}/P_t = p_{lt}\kappa_{lt} - w_t l_{lt} h_t, \tag{39}$$

$$\Pi_{kt}/P_t = p_{kt}\kappa_{kt} - w_t l_{kt} h_t, \tag{40}$$

$$\Pi_{ct}/P_t = p_{ct}\kappa_{ct} - w_t l_{ct} h_t. \tag{41}$$

The resulting equilibrium demand for corruption labor, or the demand for "thugs", comes from the first-order conditions

$$p_{lt} = (w_t l_{lt} h_t) / (\omega \kappa_{kt}) \equiv w_t h_t / MP_{l_l}, \quad (42)$$

$$p_{kt} = (w_t l_{kt} h_t) / (\omega \kappa_{kt}) \equiv w_t h_t / MP_{l_k}, \quad (43)$$

$$p_{ct} = (w_t l_{ct} h_t) / (\omega \kappa_{ct}) \equiv w_t h_t / MP_{l_c}. \quad (44)$$

These imply that the relative corruption fee prices are equal to the marginal factor cost w_t divided by the marginal product of labor, a standard marginal-cost pricing equilibrium. They can be solved for the demand for the islands government labor in each of its corruption service activites:

$$l_{lt} h_t = \left(\frac{p_{lt} \omega A_c}{w_t} \right)^{1/(1-\omega)} c_{nt}, \quad (45)$$

$$l_{kt} h_t = \left(\frac{p_{kt} \omega A_c}{w_t} \right)^{1/(1-\omega)} c_{nt}, \quad (46)$$

$$l_{ct} h_t = \left(\frac{p_{ct} \omega A_c}{w_t} \right)^{1/(1-\omega)} c_{nt}. \quad (47)$$

The sum of the labor gives the total demand for corruption service labor, or

$$l_{it} \equiv l_{lt} + l_{kt} + l_{ct} \quad (48)$$

$$= \left[\frac{\tau_c \omega A_c (h_t / c_{nt})^{\omega}}{w_t} \right]^{1/(1-\omega)} \left(p_{lt}^{1/(1-\omega)} + p_{kt}^{1/(1-\omega)} + p_{ct}^{1/(1-\omega)} \right). \quad (49)$$

2.6 Definition of Equilibrium

The consumer maximizes the utility function subject to the budget constraint for the change in real wealth, the human capital investment constraint, the exchange technology constraint, and the corruption production technologies. Prices of outputs and corruption services, and the prices of factor inputs, are taken as given by the consumer, the goods producer and the corruption producer. The equilibrium includes the first-oder condditions of the goods and corruption producers, the first-order conditions of the consumer, and money market clearing. Substituting in the quantities demanded of the corruption services for the κ_l, $\kappa_{k,}$ and κ_c, the consumer's current period Hamiltonian can be written as follows, with differentiation with respect to c_{mt}, $c_{nt,}$ x_t, l_{mt}, l_{nt}, l_{dt}, l_{it}, s_{mt}, m_t, b_t, k_t, and h_t :

$$\begin{aligned}
\mathcal{H} &= e^{-\rho t}\left[\ln\left(\left[\nu c_{mt}^{\varepsilon}+(1-\nu)\,c_{nt}^{\varepsilon}\right]^{1/\varepsilon}\right)+\varrho\ln x_t\right] \\
&\quad +\lambda_t\left[\begin{array}{c}
(1-\tau_l)\,w_t l_{mt} h_t+(1-\tau_k)\,r_t s_{mt} k_t-(1+\tau_c)\,c_{mt}+V_t/P_t \\
+w_{it}(l_{lt}+l_{kt}+l_{ct})+(1-p_{lt}\tau_{lt})\,w_{nt}h_t l_{nt}+\Pi_{lt}/P_t \\
+(1-p_{kt}\tau_{kt})\,r_{nt}\,(1-s_{mt})\,k_t+\Pi_{kt}/P_t \\
-(1-p_{ct}\tau_{ct})p_{nt}c_{nt}+\Pi_{ct}/P_t \\
-\delta_k k_t-\pi_t m_t+(B_t/P_t)(R_t-\pi_t)+\Pi_{dt}
\end{array}\right] \\
&\quad +\zeta_t\left[q_t-(M_t/P_t)-(B_t/P_t)-k_t\right] \qquad (50) \\
&\quad +\eta_t\left[A_h\,(1-l_{mt}-l_{nt}-l_{dt}-x_t-l_{it})\,h_t-\delta_h h_t\right] \\
&\quad +\mu_t\left[M_t-(1+\tau_c)\left[P_t c_{mt}-P_t A_d\left(\frac{l_{dt}h_t}{c_{mt}}\right)^{\gamma}c_{mt}\right]-P_{nt}c_{nt}\right].
\end{aligned}$$

A reduced set of equilibrium conditions is as follows.

$$\left(\frac{c_{mt}}{c_{nt}}\right)^{\varepsilon-1}\frac{\nu}{1-\nu}=\frac{1+a_t R_t+(1-a_t)\gamma R_t}{p_{nt}(1+R_t)}, \qquad (51)$$

$$\frac{\frac{\nu c_{mt}^{\varepsilon-1}}{c^{\varepsilon}}}{\varrho\left(\frac{1}{x}\right)}=\frac{1+a_t R_t+(1-a_t)\gamma R_t}{(1-\tau_l)\,w_t h_t} \qquad (52)$$

$$c_t=\left[\nu c_{mt}^{\varepsilon}+(1-\nu)\,c_{nt}^{\varepsilon}\right]^{1/\varepsilon}. \qquad (53)$$

$$R_t=r_t\,(1-\tau_k)-\delta_k+\pi_t, \qquad (54)$$

$$\frac{m_t}{c_{mt}}=\left[a_t+\frac{p_{nt}c_{nt}}{c_{mt}}\right](1+\tau_c)\,, \qquad (55)$$

$$1-a_t=\left(\frac{\gamma R_t(1+\tau_c)}{w_t(1-\tau_l)}\right)^{\gamma/(1-\gamma)}A_d^{1/(1-\gamma)}, \qquad (56)$$

$$(1-a_t)=A_d(l_{dt}h_t/c_{mt})^{\gamma}, \qquad (57)$$

$$g_t = r(1-\tau_k)-\delta_k-\rho, \qquad (58)$$

$$g_t = A_h(1-x_t)-\delta_h-\rho, \qquad (59)$$

$$g_t = A_h l_{ht} - \delta_h, \tag{60}$$

$$g_t = \sigma - \pi_t, \tag{61}$$

$$l_{it} = \left[\frac{\tau_c \omega A_c (h_t/c_{nt})^{\omega}}{w_t}\right]^{1/(1-\omega)} \left(p_{lt}^{1/(1-\omega)} + p_{kt}^{1/(1-\omega)} + p_{ct}^{1/(1-\omega)}\right) \tag{62}$$

$$\left[A_m (s_{mt} k_{\ t})^{\beta} (l_{mt} h_t)^{1-\beta} / k_t\right] = (c_{mt}/k_t) + g_t + \delta_k, \tag{63}$$

$$w_t = (1-\beta) A_m (s_{mt} k_{\ t})^{\beta} (l_{mt} h_t)^{-\beta}, \tag{64}$$

$$r_t = \beta A_m (s_{mt} k_{\ t})^{\beta-1} (l_{mt} h_t)^{1-\beta}, \tag{65}$$

$$w_t = p_{nt} (1-\alpha) A_n (s_{nt} k_{\ t})^{\alpha} (l_{nt} h_t)^{-\alpha}, \tag{66}$$

$$r_t = p_{nt} \alpha A_n (s_{nt} k_{\ t})^{\alpha-1} (l_{nt} h_t)^{1-\alpha}, \tag{67}$$

$$p_{nt} = \left[(1-\beta) A_m (s_{mt} k_{\ t})^{\beta} (l_{mt} h_t)^{-\beta}\right] / \left[(1-\alpha) A_n (s_{nt} k_{\ t})^{\alpha} (l_{nt} h_t)^{-\alpha}\right], \tag{68}$$

$$l_{mt} + l_{nt} + l_{ht} + l_{dt} + x_t + l_{it} = 1, \tag{69}$$

3 Analytic Solution for Human Capital Only Case

The economy with no physical capital can be solved analytically. This solution is useful in that its comparative statics capture the essence of the simulations for the full economy detailed below. The Hamiltonian can be rewritten without physical capital as

$$\begin{aligned}
\mathcal{H} = {} & e^{-\rho t}\left[\ln\left(\left[\nu c_{mt}^{\varepsilon} + (1-\nu) c_{nt}^{\varepsilon}\right]^{1/\varepsilon}\right) + \varrho \ln x_t\right] \\
& + \lambda_t \begin{bmatrix} (1-\tau_l) w_t l_{mt} h_t - (1+\tau_c) c_{mt} + V_t/P_t \\ + w_{it}(l_{lt} + l_{ct}) + (1 - p_{lt}\tau_{lt}) w_{nt} h_t l_{nt} + \Pi_{lt}/P_t \\ -(1 - p_{ct}\tau_{ct}) p_{nt} c_{nt} + \Pi_{ct}/P_t \\ -\pi_t m_t + (B_t/P_t)(R_t - \pi_t) + \Pi_{dt}/P_t \end{bmatrix} \\
& + \zeta_t \left[q_t - (M_t/P_t) - (B_t/P_t)\right] \\
& + \eta_t \left[A_h (1 - l_{mt} - l_{nt} - l_{dt} - x_t - l_{lt} - l_{ct}) h_t - \delta_h h_t\right] \\
& + \mu_t \left[M_t - (1+\tau_c)\left[P_t c_{mt} - P_t A_d \left(\frac{l_{dt} h_t}{c_{mt}}\right)^{\gamma} c_{mt}\right] - P_{nt} c_{nt}\right].
\end{aligned} \tag{70}$$

From the first-order conditions, and along the balanced-growth path, it can be derived that the growth rate depends solely on the solution for leisure, and the human capital sector's productivity and depreciation parameters:

$$g = A_H(1 - x) - \delta_H; \quad (71)$$

this dependence on leisure is standard in the Lucas (1988) model of economic growth when leisure is also included in the utility function. The same equation holds in the Section 2 economy with physical economy as well. The monetary setting affects this basic relation only indirectly through the effect of inflation on the amount of leisure that is used; in particular inflation tends to increase leisure and reduce growth, as focused on in Gillman and Kejak (2005). A closed form solution results here by solving for leisure analytically, and then the rest of the variables in the economy. Then comparative statics on leisure, and hence growth, can be established. It is possible to see the effects of taxes on the size of the shadow sector, and on the economic growth rate, and the effect of increasing the preference for corruption.

Proposition 1: An equal increase in the government tax rates raises the price of the corruption services and causes an ambiguous effect on the consumption of the non-market good (Fact 1), and causes a decrease in the growth rate.

Proposition 2: An increase in the preference parameter ν for the non-market good causes an increase in the consumption of the non-market good (Fact 2) but an ambiguous effect in general on the growth rate.

The standard negative effect of inflation on economic growth, in such models without non-market sectors and corruption, carries through with the non-market sector and corruption added.

Proposition 3: An increase in the inflation rate lowers the growth rate.

And also of interest is the growth effect of inflation when there is more corruption:

Proposition 4: An increase in the inflation rate causes a bigger decrease in the growth rate, the bigger is the preference parameter ν for the non-market good.

Finally an increase in productivity of the human capital sector is investigated in that this affects the growth rate and also can be viewed as related to the cost of investment in a Parente, Prescott and Rogerson sense.

4 Full Economy Simulation

4.1 Benchmark Calibration

Standard values for the standard parameters were chosen: the share of capital in the market sector, $\beta = 0.36$, physical and human capital depreciation rates, $\delta_k = \delta_h = 0.05$, the discount rate, $\rho = 0.04$ and the risk aversion parameter $\theta = 1.5$. The weight of leisure in utility function is set at $\phi = 2.8$ and yields a leisure of $x = 0.5$ (in Parente et al. 2000 is $x = 0.48$) and productivity parameter in human capital sector $A_H = 0.315$, given a growth rate of the economy of $g = 0.02$; here the money growth rate is $\sigma = 0.07$, the inflation rate is $\pi = 0.05$, and the net nominal interest rate is $R = 0.12$. For the values of the preference parameters for consumption, following McGrattan, Rogerson and Wright (1997) and Parente et al. (2000), $\varepsilon = 0.5$ and $\nu = 0.6$. For the credit sector technology, the degree of diminishing returns is set at $\gamma = 0.2$ as based on the estimated value of this parameter that is found for the US in the money demand estimation of Gillman and Otto (2003). The credit productivity parameter is put at $A_d = 0.75$ to yield a share of cash in transaction equal to $a = 0.7$ (as in Gillman, Kejak, 2005 and as is similar to Dotsey and Ireland, 1996). The labor share in the corruption sector is set to be the same as in the credit sector, at $\omega = 0.2$ and the productivity parameter here is assumed to be $A_c = 1$. The market and non-market sector use the Cobb-Douglas production function with the capital shares β and α. The share of capital in the non-market sector is set $\alpha = 0.1$ (similar to Benhabib et.al., 1991). The productivity parameters are $A_m = 1$ and $A_n = 0.1$; a low value for the non-market sector is necessary to obtain the negative effect of higher preference parameters on the growth rate in the range of a very low inflation rate.

The tax rates are set to $\tau_k = \tau_l = \tau_c = 0.15$.

4.2 The Effect of Inflation on the Economy: Growth and Tobin

The first simulations presented in Figure 11a present the baseline parameterization, with the money supply growth rate σ being increased up from the Friedman optimum rate equal to the negative rate of time preference. The top left figure shows that the balanced-path growth rate falls at a decreasing rate as σ increases. This conforms to evidence studied in Gillman, Harris and Matyas (2004) and as further described in Gillman and Kejak (2005). The real interest rate falls as σ increases, in the top row, middle, and does so in a similar fashion to the balanced-path growth rate. Meanwhile the real wage rate rises, in the top row, right, as there is less time spent in work activity and more spent in leisure as σ increases. Or the σ increase can be viewed as a nominal interest rate (R) increase, as seen in the middle row, left. The rise in leisure from the higher shadow cost of goods, from a higher R, reflects the goods to leisure substitution and is seen in the middle row, left.

The rest of the allocation of time is affected as well. Time spent in human capital accumulation, middle row, right, falls as R increases, as do time in goods production (bottom row, left), time in the non-market goods production (bottom row, middle), and time in the corruption service sectors (bottom row, left, and Figure 11b, top row, left and middle).

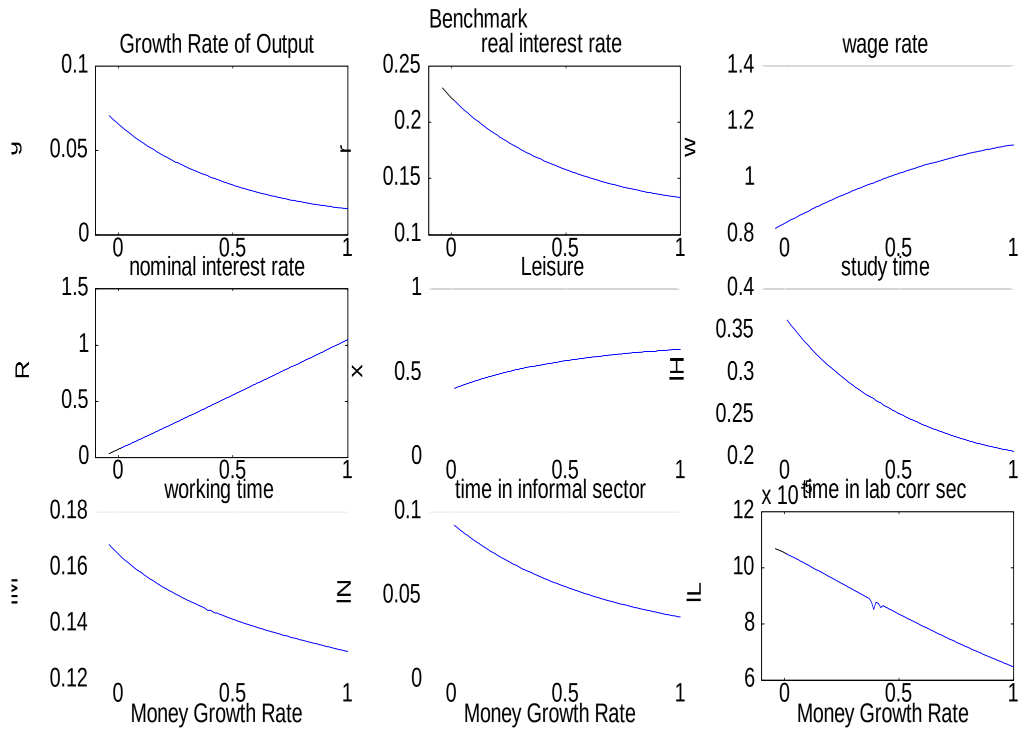


Figure 11a. Baseline Simulations of Changes in the Money Supply Growth Rate

The only time allocation that increases besides leisure is time spent in credit production, as seen in Figure 11b, top row, right. Thus the avoidance of inflation increases time in non-inflation-taxed leisure activity, and in non-inflation-taxed credit use, while reducing time in all activities that are taxed by inflation.

Capital reallocation is shown in Figure 11b, middle row, left. the share of capital in the market sector rises, while the residual share in the non-market sector similarly falls. This shows a reallocation towards the market from the non-market sector as a result of σ, and the inflation rate, rising. It results because the non-market sector uses only money in exchange, while the market good can be bought with money or credit, so that the non-market good is taxed more by inflation than is the non-market good.

The next three simulations are of the effect of σ on the value, or the price times the quantity of output, of the corruption service in each of the three sectors, in the middle row, center, right, and the bottom row, left.

Each shows a parabola shape in which the value of the corruption rises and then falls as σ increases. This can be because inflation is like another legal government tax which adds to the value of tax avoidance in general, through corruption, at least up to some point. This occurs even while the non-market output falls relative to the market output, as in the bottom row, center. And it is a result of the rising real price of the non-market good, in the bottom row, right, and the rising price of the corruption services, as given in Figure 11c, top row, left and center.

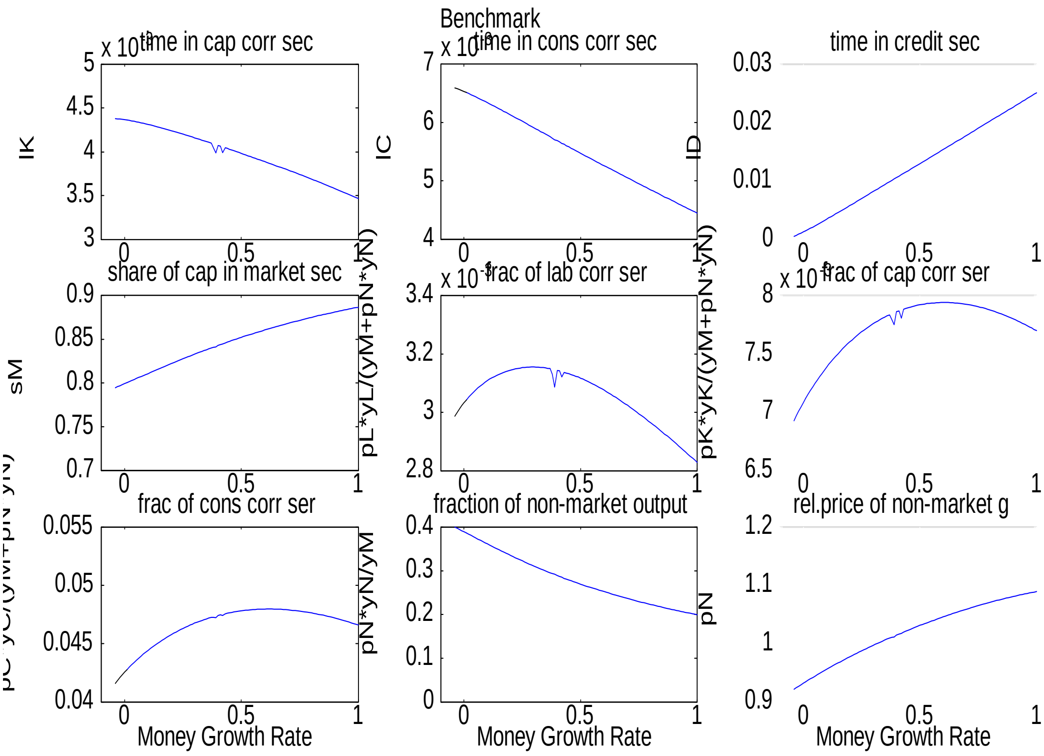


Figure 11b. Baseline Simulations of Changes in σ: Part 2

The absolute value of the non-market consumption relative to the human capital level declines (middle row, left). While the market good consumption relative to human capital rises initially but eventually falls (middle row, center). This results as the substitution effect is towards more market consumption but the income effect of the higher tax takes a toll and eventually leads to a decrease in this ratio. The decline in the non-market consumption as a share of total consumption (middle row, right), and in the non-market output as a share of total output (bottom row, left), confirms this decrease in the non-market sector because of inflation.

The increase in the value of the credit services (bottom row, center) and decrease in money demand per unit of output (bottom row, right) is the standard result of increasing inflation. Total real money demand, rather than per unit of output, also falls with inflation, as in Figure 11d, top row left; and the value of credit production (price times quantity of output) rises with inflation.

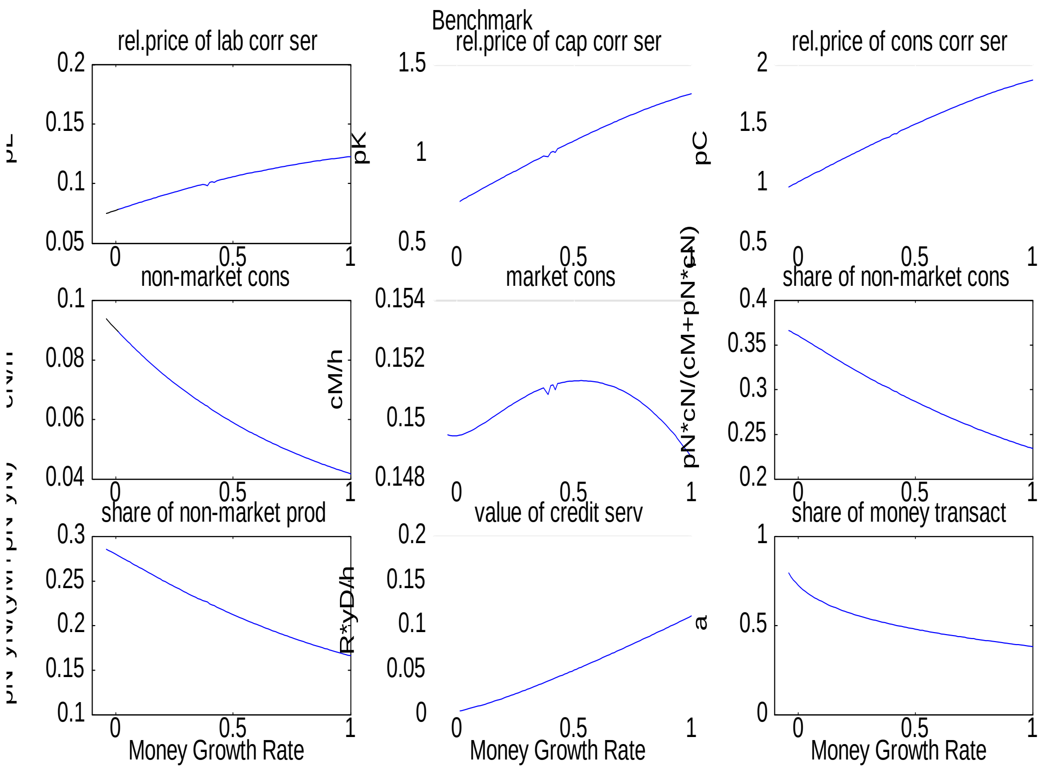


Figure 11c. Baseline Simulations of Changes in σ: Part 3

Last, looking at the three sectors, corruption, market goods, and non-market goods once again, the total output of the corruption sector rises and then falls with σ (top row, right), and the Tobin effect emerges in the other two sectors. The effective labor to capital ratio rises in each sector as the inflation rate rises (bottom row, left and center). This is the standard Tobin effect in the endogenous growth models with money and human capital: a reallignment away from expensive labor towards less expensive capital as a result of the increased inflation distortion.

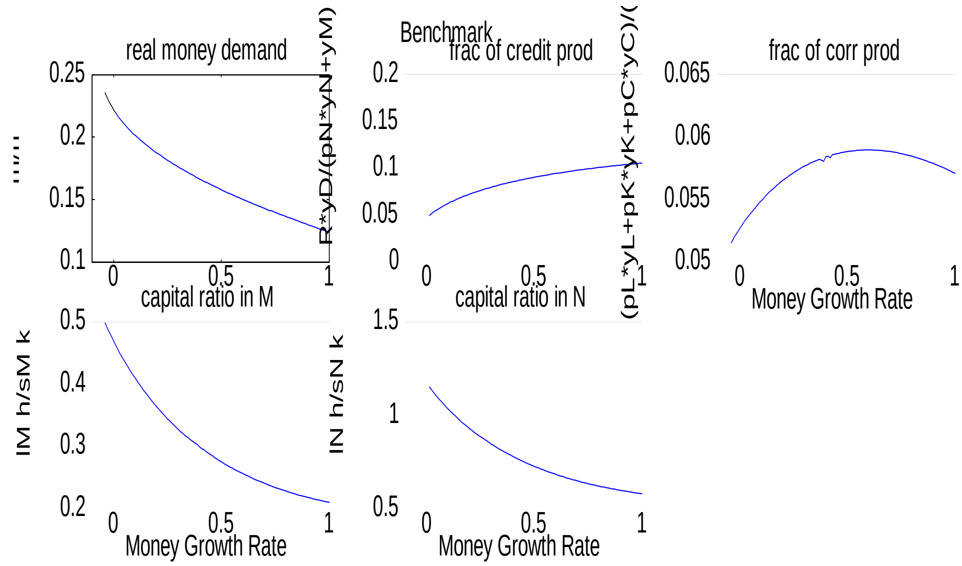


Figure 11d. Baseline Simulations of Changes in σ: Part 4

4.3 Increases in Taxes, Corruption, and Productivity

Three basic changes are made to the baseline economy: 1) tax rates are all simultaneously increased (to 0.165); 2) the taste for corruption in increased (to 0.5); 3) the human capital productivity increased (to 0.35). The results are simulated below. In all graphs the horizontal axis variable is the money supply growth rate.

4.3.1 An Increase in the Common Tax Rate

The experiment here is to increase the tax rate from 15 to 25% for all three legal taxes, on labor, capital, and goods purchases in the market sector. The dotted line in the simulations shows the effect of the across-the-board tax rate increase. Fact 1 is explained in Figure 12c below.

First it is clear in Figure 12a that the balanced-path growth rate declines at all levels of the money supply growth rate σ (top row, left). Similarly the real interest rate falls (top row, center), the real wage rises (top row, right), leisure time rises (middle row, center), time in human capital investment falls (middle row, right). There is some reallocation of time from the non-market sector to the market sector (bottom row, left and center). This is due partly to the higher value of the corruption service. It shows that there is not the increase in non-market time that appears in models that do not model the corruption sector explicitly. A stronger effect is the increase of time in the corruption sectors (bottom row, right; Figure 11b, top row left and center).

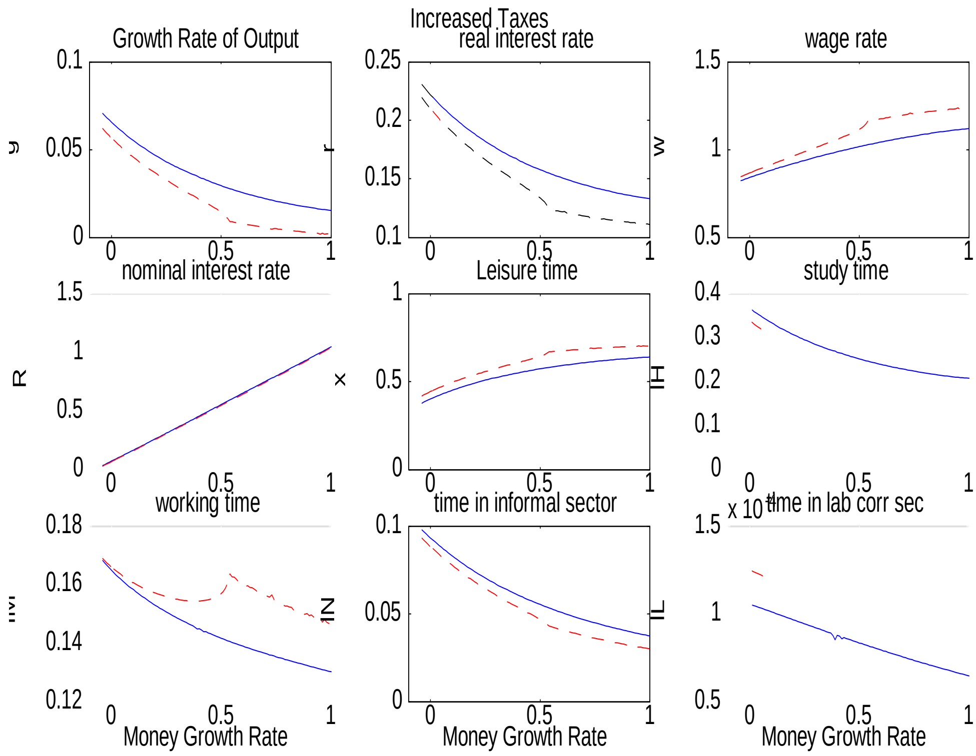


Figure 12a. Simulations of an Increase in the Across-the-Board Tax Rate from 15 to 25%.

The value of the corruption services rises significantly as a result of the legal tax increases (Figure 12b, middle row, center and right, bottom row, left). This increases the relative price of the non-market good and decreases the non-market output relative to market output (bottom row, right and center).

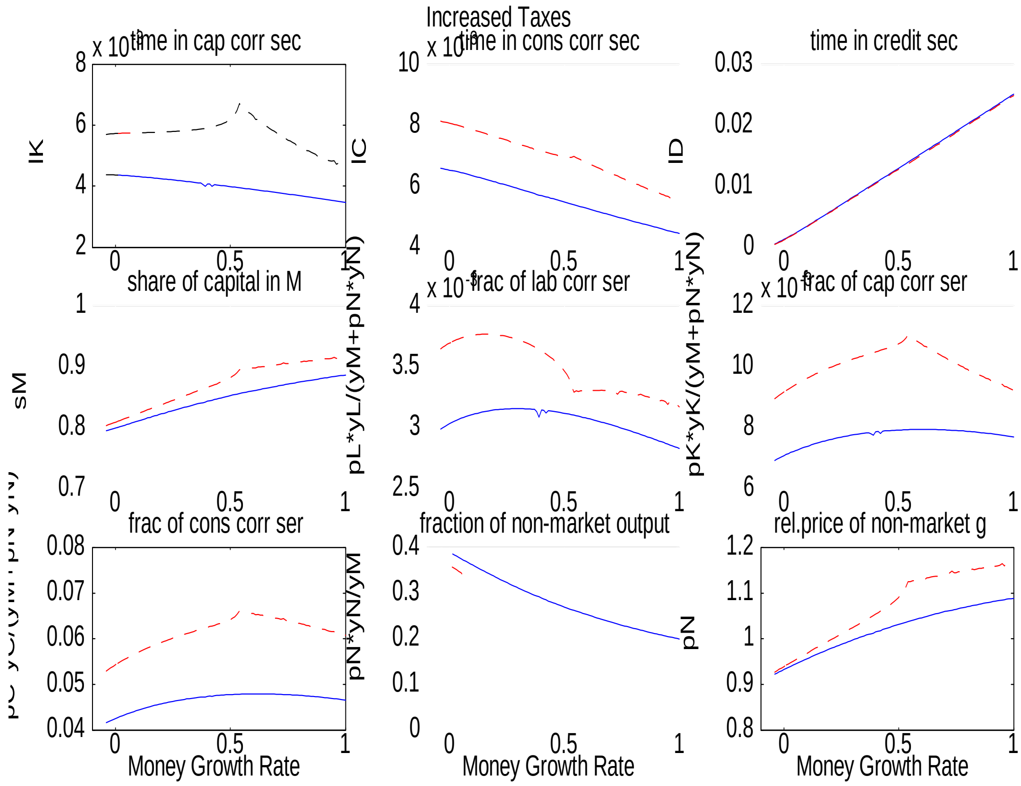


Figure 12b. Simulations of an Increase in the Tax Rate: Part 2

The higher value of the corruption services comes from the higher relative prices of the services, as in Figure 12c (top row). And a higher value of corruption also appears relative to total output, when adding up the value of the output of the three corruption services, in Figure 12d, top row, right.

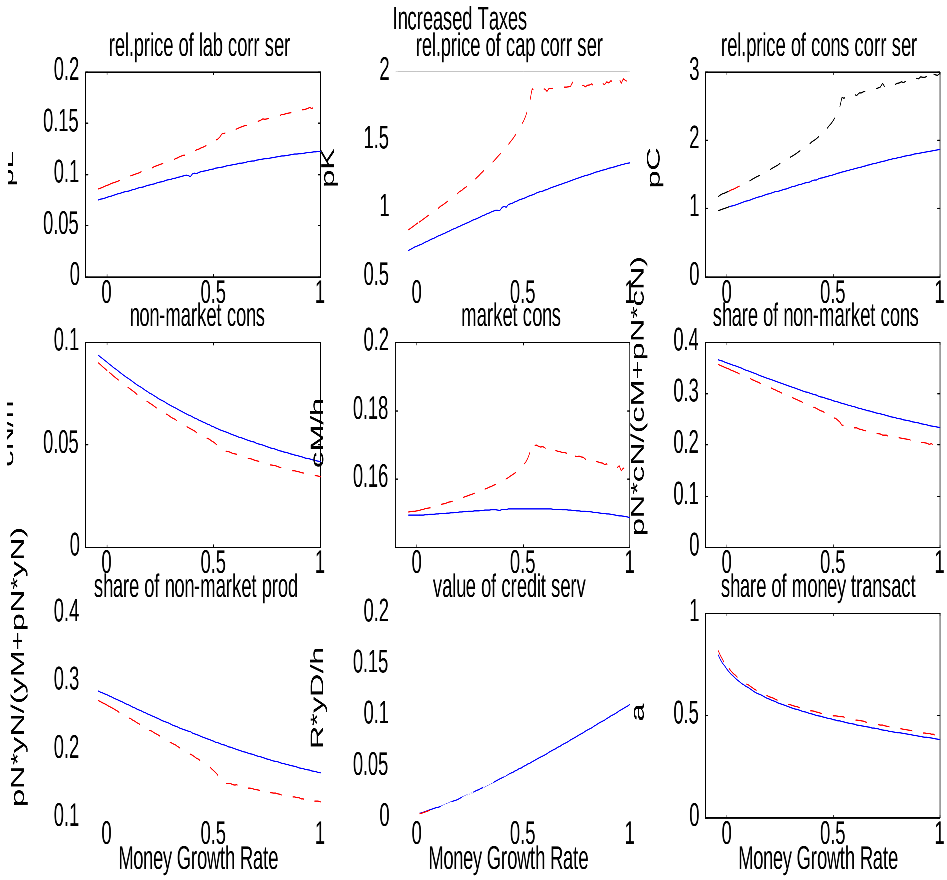


Figure 12c. Simulations of an Increase in the Tax Rate: Part 3

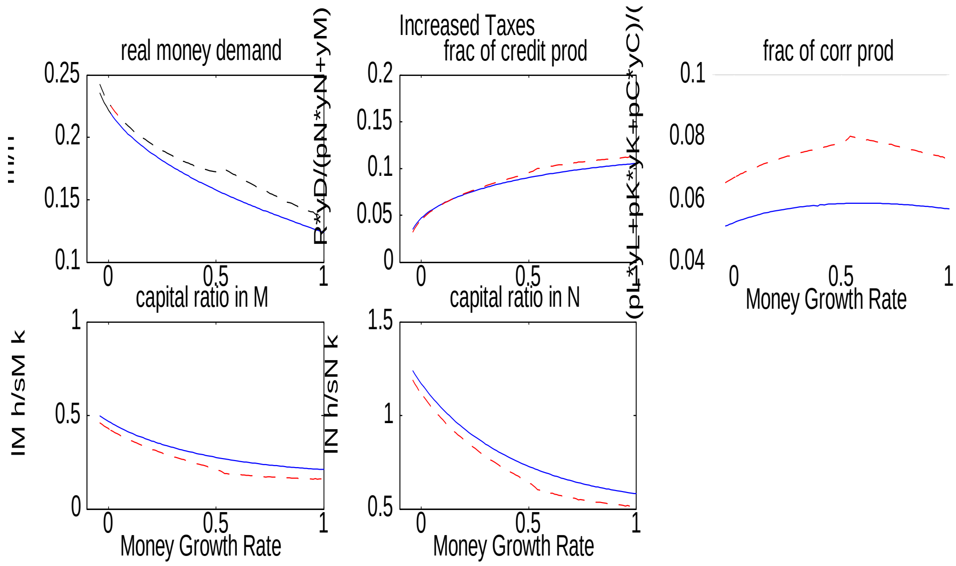


Figure 12d. Simulations of an Increase in the Tax Rate: Part 4

4.3.2 An Increase in the Preference for the Non-Market Good

An increase in the parameter ν causes a greater preference for the non-market good relative to the market good. Fact 2 is explained in the Figure 13c below.

In Figure 13a (top row, left), the effect on the growth rate for the calibration shows a steeper decrease in the growth rate as the inflation rate goes up. Here it is also seen that the level of the growth rate is higher at low levels of the inflation rates and lower at high levels of the inflation rate. The changes in the real interest rate, real wage rate, leisure time and time in human capital accumulation (study time) all reflect the way in which the growth rate is affected. In Figures 13b and 13c, large changes occur to the time spent working in the market sector (a decrease), in the non-market sector (an increase), and in the corruption services sectors (increases). Similar changes are found for the market sector consumption versus non-market sector consumption; see Figure 13c. And there is some increase in money demand and a decrease in credit production, as in Figures 13d.

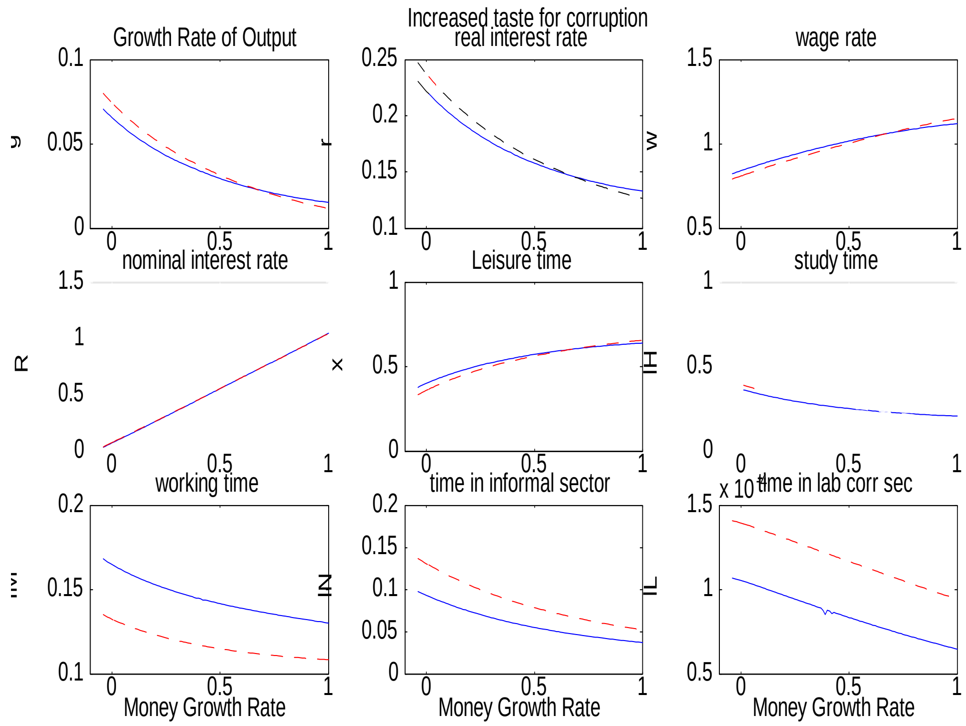


Figure 13a. An Increase in the Preference Parameter ν and for the Non-Market Good.

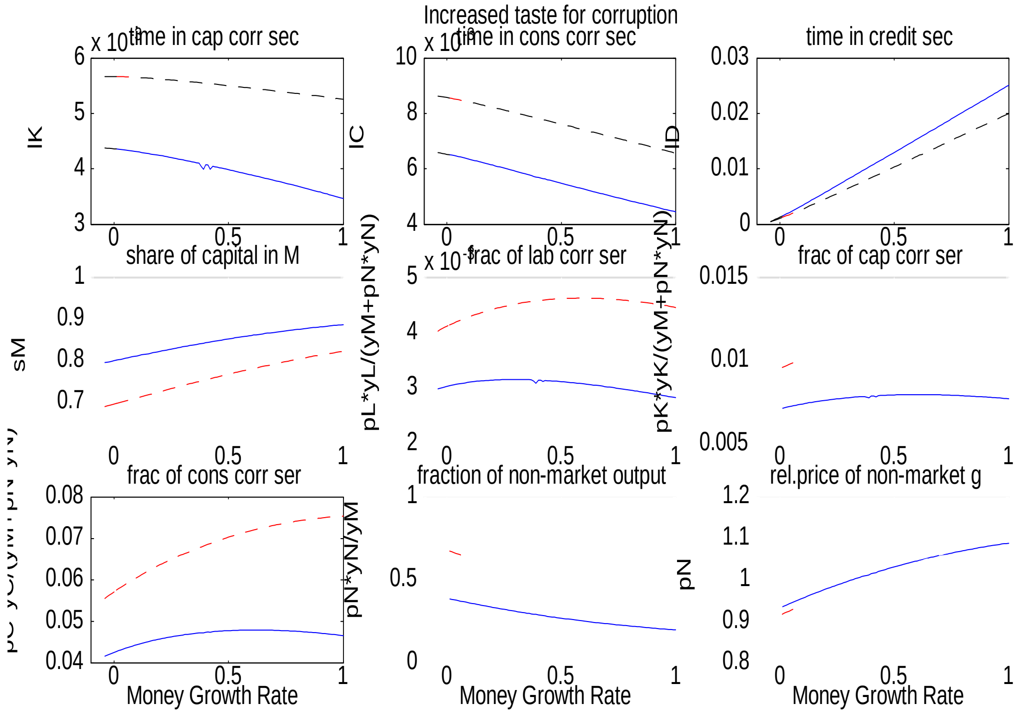


Figure 13b. An Increase in the Preference Parameter ν: Part 2

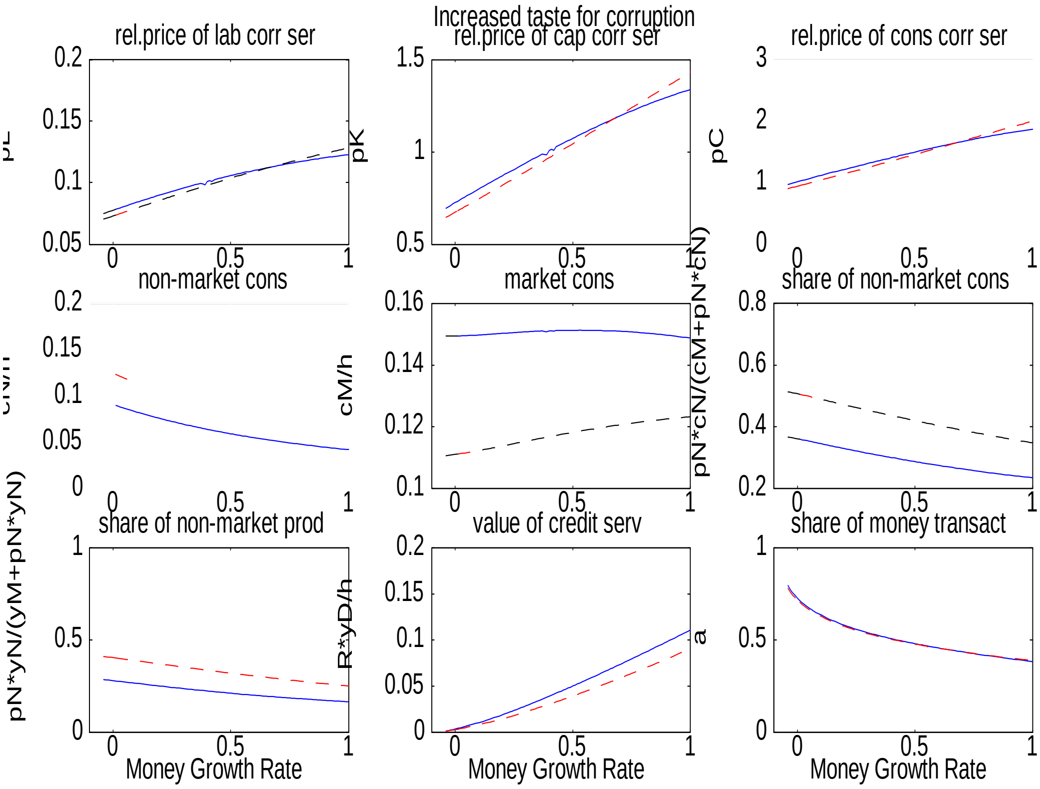


Figure 13c. An Increase in the Preference Parameter ν: Part 3

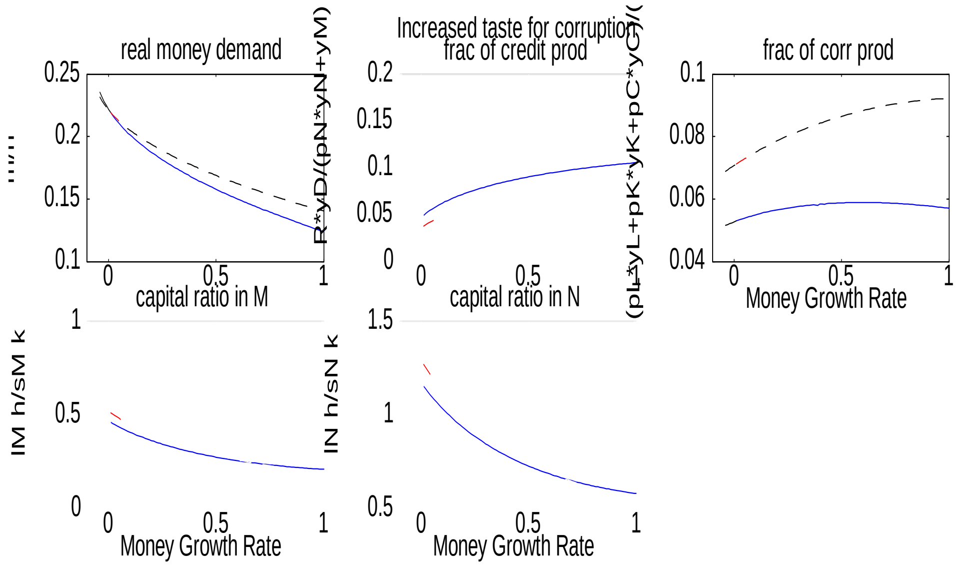


Figure 13d. An Increase in the Preference Parameter ν: Part 4

4.3.3 An Increase in the Productivity of Human Capital Investment

Figures 14a-d show that an increase in the productivity of human capital, through an increase in the productivity shift parameter A_H, causes a reallocation from time spent in the corruption service sectors and from market goods production to time in human capital accumulation. This causes the growth rate to jump up. The non-market good consumption ends up unchanged, while market goods production falls. The fall in market goods production leads to less real money demand and less real credit demand. The wage rate is also higher, which can be part of an explanation of the different income levels in less developed versus more developed countries: differences in the productivity of human capital.

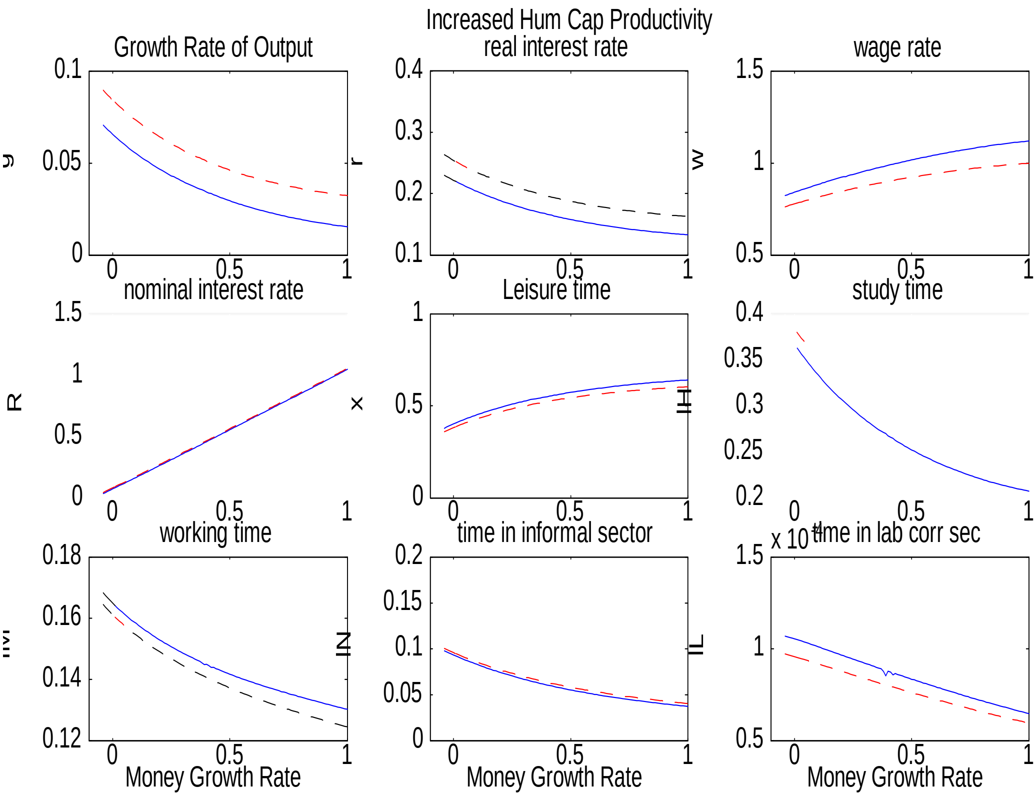


Figure 14a. An increase in the Productivity Parameter for Human Capital Investment, A_H

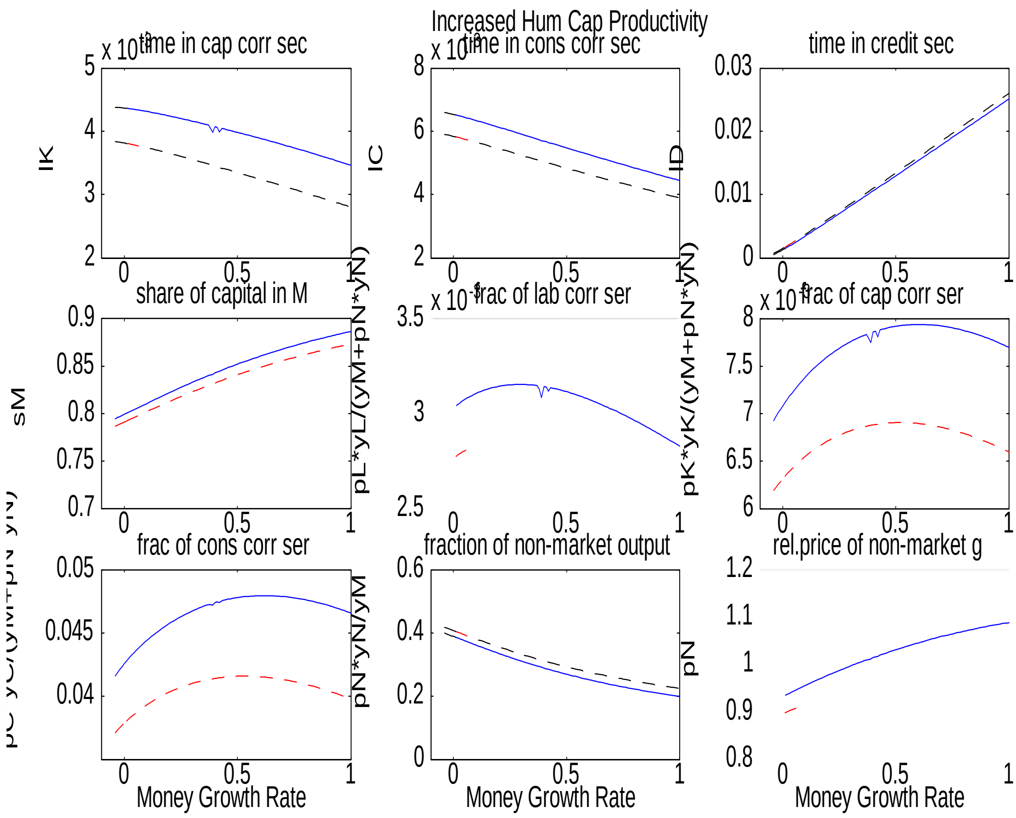


Figure 14b. An increase in the A_H : Part 2

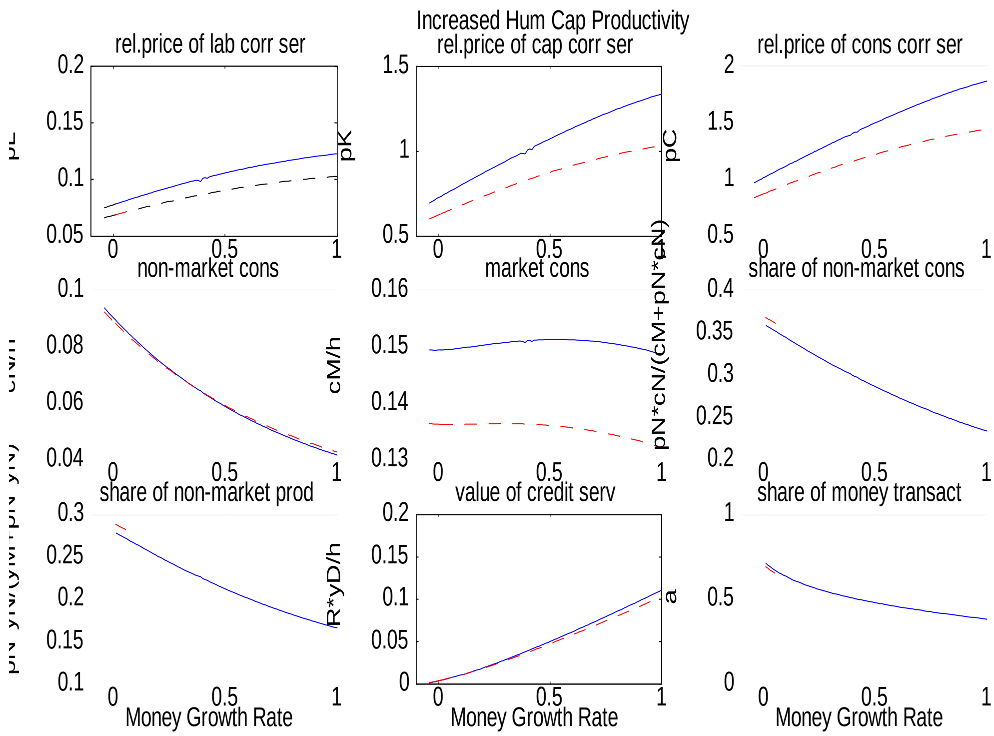


Figure 14c. An increase in the A_H : Part 3

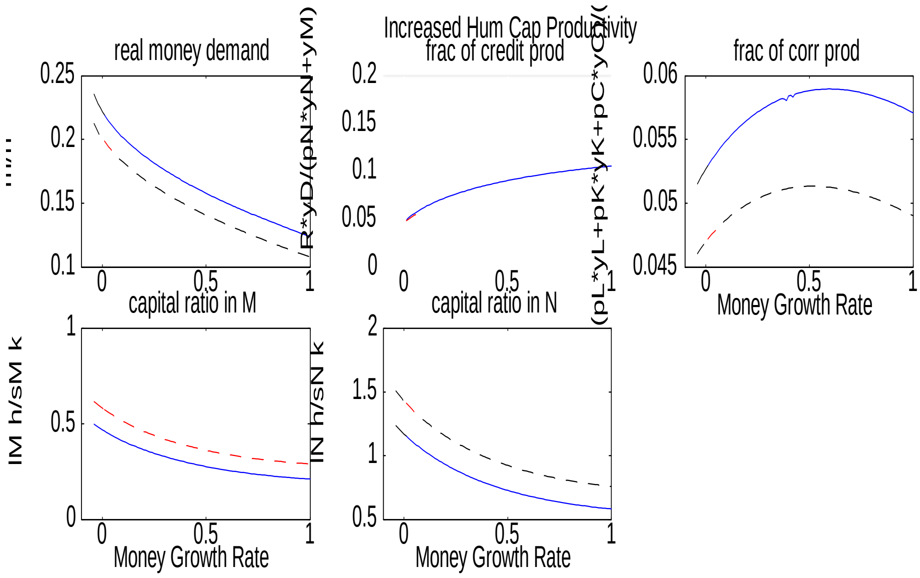


Figure 14d. An increase in the A_H : Part 4

5 Discussion

Results have been presented for a baseline calibration and for three experiments in comparative statics, and these are consistent with the Facts 1-4. What emerges is that the corruption sector leads to the seemingly counter-intuitive result that an increase in legal tax rates does not induce an expansion of the non-market sector relative to the market sector. This is because the implicit tax on non-market income and good purchases must also be paid, here as the price for the corruption services. Now the Islands government collects these fees instead of the regular constitutional government. And these shadow taxes, the competitive prices of these corruption services, go up in market value when the legal tax rates are increased. The time in corruption activity also markedly increases, and time in human capital investment decreases while leisure increases (and the growth rate decreases). Together these factors induce the representative agent to work more in the market sector and to substitute in consumption towards the market good from the non-market good.

A greater preference for the non-market good is similar to a bigger taste for corruption. The taste for a certain scope of corruption is thereby given by preferences rather than endogenously determined. It is conceivable that by putting capital into the production of corruption services, that a transitional dynamics would arise whereby a country with too much corruption use relative to the balanced-growth path equilibrium (as in the Russian and Eastern European countries after the government changes in 1989-1990) would gradually decrease its capital stock in corruption activity.

Taking the preference for corruption for now as given by the utility function specification for the market versus the non-market good, the paper then looks at the changes in the degree of the use of corruption activity, in terms of labor allocation in the corruption activity, given a certain assumed scope of the activity, in terms of the preference parameters. The emergence of an ambiguous effect on growth from an increased preference for the non-market sector is not inconsistent with the evidence. The same type of simple correlation evidence presented in the introduction does not indicate a positive relation between the corruption and growth rates, using the Transparency International Perceptions Corruption Index and standard data on growth rates. Rather the evidence shows no correlation.

The simulations for human capital productivity increases indicate an interesting policy implication. A greater efficacity of human capital production leads to less corruption activity. The result is very strong in the model. It suggests that rather than worrying about corruption activity per se, worry about building human capital so that corruption gradually fades away.

Other policy implications left for future research include the optimal rate of inflation is such an economy. The inflation tax is the only tax that falls effectively on the non-market sector. Therefore the ability to tax the otherwise non-taxed sector suggests that the optimal inflation rate will not reside at the second-best Ramsey-Friedman optimum of $R = 0$, which holds in standard exchange economies with labor, capital and goods taxes (see Gillman and Yerokhin, 2005). Rather the optimum would likely be at some positive level.

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[1]

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