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OPTIMAL INFLATIONARY AND RESERVE REQUIREMENT POLICIES: A STUDY OF AN ECONOMY WITH AN INFORMAL SECTOR

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Abstract

Governments in developing economies often resort to taxing bank money balances through imposition of high reserve requirements and also by relying on seigniorage to finance their deficits. In the context of those practices, this research attempts to answer the following questions. First, why do developing economies with an informal sector resort to inflationary measures to finance their activities? Second, how does a government induce an agent to choose the formal economy? As to the first question on the trade-off between inflation and reserve requirements, it is shown that of maximum inflation and minimum reserve requirements will increase the steady-state utility of an optimizing agent. Regarding the second question, the agents prefer the informal economy if policy relies on a maximum reserve requirement.

Keywords: Informal market, Financial development, Financial repression, Seigniorage
JEL Classification: J33, J61, H2

1. Introduction[1]

This paper addresses the unintended consequences of the regulations on bank reserve and inflation financing on the informal and formal sectors of an economy. Such regulations are often observed in several developing countries. As a matter of public policy, the terms "informal sector" and "informal economy"

[1] I am greatly indebted to Professor Scott Freeman and Professor Bruce Smith for their academic tutelage and intellectual nourishment. I express my deepest gratitude for their many constructive comments and for fine-tuning my thoughts with extensive discussions. My thanks also go to my colleague, Dilip K. Ghosh, to the editors of this journal and to the anonymous referees for their critical suggestions that have resulted in this revised version of the paper. This author is solely responsible for any errors that may remain.

are synonymous, and they refer to a marginally unregulated economy that sometimes not only subordinates itself to the formal economy, but also provides income and a safety net for the economic agent (ILO, 2003; ILO, 2005; Castells & Portes, 1989). These informal economic arrangements are a rational response by micro-entrepreneurs to defeat over-regulation by the government (de Soto, 2000). Moreover, greater shares of national wealth in developing countries are uncounted; the average size of the informal sector in developing economies is 41 percent of gross national income (GNI) (Schneider, 2002). Effectively, it can be noted that there is an increasing interdependence between the formal and the informal sectors, because the policy designed to target the formal sector has broader implications for the social welfare of the economic agents in the informal sector.

In addition, governments in developing economies with informal sectors often resort to taxing money balances through imposition of high reserve requirements on bank deposits; they also rely on seigniorage to finance their deficits.[2] So, to finance its expenditures, the government uses either bank reserves or seigniorage. However, a higher reserve requirement implies crowding-out of private capital while by using seigniorage the government creates money from thin air, which drives inflationary pressure. In such policy trade-offs, there is a continuous tension between the macroeconomic stability programmes advised by the IMF and the domestic needs of the developing economies to meet their social and economic obligations. Consequently, countries are trapped in cycles of severe reserve requirements and anti-inflationary measures that have unintended consequences for economic growth and development. Therefore, the conventional prescriptions derived from neo-liberal policies have failed to address the existence of the informal economy and the ways in which it complicates a government's fiscal and monetary options and further represses the financial sector.

The first attempt to address this financial repression was made by McKinnon and Shaw (1973), who defined financial repression as the set of regulatory restrictions that limited the capacity of the financial intermediaries to achieve their full potential. However, financial development is important in promoting economic growth (Stiglitz & Uy, 1996; Levine, 1997; Beck, Levine & Loayza, 2000). For example, based on the findings from surveys of formal and informal financial institutions in Ghana, Malawi, Nigeria, and Tanzania, Nissanke and Aryeetey (2006) stated that the continuous poor performance of financial systems could be *partly* explained by the high degree of financial market fragmentation. On the basis of the evidence in a recent study by Lu and Yao (2009), it has been argued that the rise of privileged and unprivileged sectors in the economy can be regarded as a consequence of financial repression. Any government action has implications for the welfare of the agent when the government finances its deficits through money creation and reserve

[2] Deficits are part of government expenditures, since the government will pay for debt services. Using the terms "deficits" or "expenditures" will not alter the underlying results. With that caveat or clarification, the term "deficits" instead of "expenditures" is used consistently throughout the paper. Also, for simplicity, we allow the government to finance deficits through money creation, holding taxes constant.

requirements. Steel, Aryeetey, Hetige and Nissanke (1997) have contended that informal financial institutions are an important vehicle for mobilizing household savings, and this study has recommended that informal finance be better integrated into financial development strategies.

Freeman (1987), and Freeman and Haslag (1993), have used an overlapping generation framework in a financially-repressed environment, which provides an important baseline for subsequent theoretical research on optimal reserve requirements. This paper extends Freeman's and Haslag's models into the financially repressive dual economy model to answer the following questions: First, why do developing economies with informal sectors resort to inflationary measures to finance their activities? Secondly, how does a government induce the agent to choose the formal economy? In our case, the model is applied to an environment in which homogenous agents hold different assets in two markets—formal and informal—allowing the government to finance deficits through a reserve requirement and money creation or seigniorage.

Consistent with the findings of Freeman and Haslag (1993), we demonstrate that for the first question, on the trade-off between inflation and reserve requirements, the optimal policy is maximum inflation and minimum reserve requirements that will increase the steady-state utility of an optimizing agent. Regarding the second question, the agents prefer the informal economy if the policy relies on a maximum reserve requirement. Therefore, the government is not only optimizing the inflationary policy but also inducing the agent to favour the formal economy by minimizing the reserve requirement. The agent uses the storage technology in the informal sector because the optimizing agent predicts that the government is inclined to regulate and suppress financial intermediaries.

The best response of the agent in the informal sector is to hide some goods, because the agents do care about the weighted average rate of return on the assets. In a dual economy with formal and informal sectors with an expanding nominal stock of money, the reserve requirement not only serves as a tax on deposits, but also keeps the agent from using the most productive capital to match the return from the informal sector. The reserve requirements will not induce growth in the financial sector. Instead, it does the opposite and promotes the informal sector. The heavier the degree of financial regulation, the bigger the scope of the informal economy, and the less seigniorage the government can collect.

We use a relatively simple model expounded in section 2 to arrive at the conclusions. Section 3 describes the maximization of welfare, and examines policy analysis. Section 4 discusses the steady states under different policy regimes, and section 5 is the conclusion of this paper.

2. The Model

This model is an overlapping-generation model following Eastman *op cit*. We provide an appendix that includes further details on the model derivation. There are three types of assets: money, capital, and informal goods. Assets are held

either because they are required (money balances) or because they have a high rate of return (capital). We describe the evolution of the economy from time t = 1 onwards. The economy is populated by agents who each live for two periods. In each period $t \geq 1$, N_t two-period-living agents are born. We assume that $N_t = nN_{t-1}$ for each period t, where *n* is population growth with a positive constant and implying that total endowment of the economy grows at this rate. Agents maximize the twice–continuously differentiable additive utility function $U(c_1)+V(c_2)$, where c_i denotes the agent's consumption in i period of life of the economy's sole consumption goods. The function $U(c_1)+V(c_2)$, is strictly concave and strictly increasing in each argument. Let U' denote the derivative of $U(c_1)+V(c_2)$, with respect to c_i. The marginal rate of substitution $\frac{U'}{V'}$ approaches 0 as $\frac{c_1}{c_2}$ approaches infinity, and approaches infinity as $\frac{c_1}{c_2}$ approaches 0. An agent born in period $t \geq 1$ is endowed with y units of consumption goods when young, and with nothing when old.

2.1 Asset Allocation Decisions

There is storage technology in the informal sector. An agent stores h_{2t} of his savings in the informal sector at time t and returns $f(h_{2t})$ units of goods at $t+1$. The minimum requirement to invest in capital technology is $k > y$. This assumption forces the agent to use intermediation; if the rate of return on capital is x and by assumption $(x > n)$, the return on capital is higher than the money rate of return. If the economy is growing, then money supply should grow and the rate of return of intermediated capital x should grow even faster as well (Champ & Freeman, 1994).

We assume that the current old generation holds the fiat money, which is an intrinsically worthless piece of paper. The monetary authority can determine the growth of the money supply:

$$M_t = zM_{t-1}$$

z is the rate of growth of the fiat money. The government uses seigniorage to finance its expenditures. The government requires that a fixed fraction γ of all deposits at financial intermediaries must be held as a reserve of fiat money. $(1-\gamma)$ is a fraction of the agent's investment in the intermediated capital market with rate of return x.

2.2 Behaviour of Young Agents

Taking the price level sequence $\{p_t\}$, as given, we define h_{1t}, h_{2t} as the value of agents (fiat money and intermediated capital) and stored goods in the informal sector respectively. Young agents at each date t choose h_{1t}, h_{2t} to maximize:

$$U(c_{1t}) + V(c_{2t})$$

subject to

$$c_{1_t} + h_{1_t} + h_{2_t} \leq y \tag{1}$$

$$c_{2t} \leq \rho h_{1t} \ + f(h_{2_t}) \tag{2}$$

The stock of fiat money available in this intermediated economy is

$$M \ = N_t \gamma h_{1t} p_t \tag{3}$$

where gh_{1t} is required reserve and $N_t gh_{1t}$ is aggregate reserve. The price sequence evolves over time to keep up with inflation. Given that the intermediated stock of fiat money is nominal, it was multiplied by the price sequence to obtain the real value of money (Champ and Freeman 1994). M is the nominal stock of fiat money.

2.3 Competitive Equilibrium

The agent's problem can be transformed as follows; the young agent allocates his endowment, and diversifies the allocation of assets in formal and informal markets, because the agent cares about the weighted rate of returns. The entire endowment is allocated for current consumption when young, and saving when old, in the informal and formal markets**.** Let h_{1t}, h_{2t} denote the total savings of a young agent at time t in the formal and informal sectors, so that the young agent chooses $h_{it}, E[0, y]$ to maximize:

$$U(y - h_{1t} - h_{2t}) + V(\rho h_{1t} + f(h_{2t})) \tag{4}$$

The first-order condition:

$$\max_{h_1, h_2} U(y - h_{1t} - h_{2t}) + V(\rho h_{1t} + f(h_{2t})) \tag{5}$$

$$\frac{U'(y - h_{1t} - h_{2t})}{V'(\rho h_{1t} + f(h_{2t})} = \rho \tag{6}$$

$$\frac{U'(y-h_{1t}-h_{2t})}{V'(\rho h_{1t}+f(h_{2t})} = f'(h_{2t}) \tag{7}$$

In the competitive equilibrium, the agent equalizes the marginal rate of substitution to the rate of return in both economies. Given $h_{1t}(\rho)$, any policy that lowers the rate of return has a negative implication for the welfare of the agent, which requires further characterization to the welfare property of our model.

2.4 Characterization of Stationary Equilibrium

The market-clearing condition is the real rate of return on fiat money using equation (3):

$$\frac{p_t}{p_{t+1}} = \left(\frac{m_t}{N_t h_{t1}}\right) \Big/ \left(\frac{m_{t+1}}{N_t h_{1t}}\right) = \frac{n}{z} \tag{8}$$

Under the assumption ($n < x.$), if money is not dominated in the rate of return, then the agent has no reason to use the storage technology in the informal sector. Moreover, no agent or intermediary will choose to hold more fiat money than legally required. The rate of return on saving is the weighted average of the rates of return on money and capital in the formal economy:

$$\rho = \gamma \frac{n}{z} + (1-\gamma)x \tag{9}$$

We can deduce from this equation the following rules:[3]

i) Formal sector, if ƶ = o → p = (1-ϒ) x

ii) Informal sector, if ƶ = o → p = $f'(h_{2t})$

Results (i) and (ii) imply that if ƶ = o → $f'(h_{2t})$ = (1-ϒ) x. This simply means that if z = 0, the rates of return in the formal and informal sectors are the same. If the fiat money is not growing, then the government is running a balanced budget, and the agent is indifferent and will allocate its endowment to either market. However, the government does create money as a device to alter the welfare and asset allocation between the formal and informal markets. Also from equations (7), and (9) we define the rate of return in the informal sector:

$$f'(h_{2t}) = \gamma \ \frac{n}{z} + (1-\gamma\ )x \tag{10}$$

Finally, the government's budget constraints require that

$$g = \left(1-\frac{1}{z}\right)\gamma h_{1t} \tag{11}$$

The deduction from the government budget constraints has greater public policy implications as the result of corner solutions.[4] For equation (11), the deduction, if $z = 0 \rightarrow g = -\infty$ is unrealistic, so we make further assumptions to maximize the welfare of the future generation of the current young by setting $\frac{1}{z} = \phi$ to optimize in equation (12) as a counter-reaction of the agent to the government's action. The government is always faced with trade-offs between inflation and reserve requirements, as a matter of public policy. Our response to our research question—which policy maximizes the welfare of the economic agent?—is that excessive inflationary policy is preferred to extreme reserve requirements. It is true that the extreme cases remain as extreme, and they rarely occur; the bottom line is that inflationary policy is the second-best public policy.

3. Maximizing the Welfare of the Future Generation

The future generation chooses $\frac{1}{z} = \phi$, γ to maximize its welfare.

$$\max_{\gamma,\phi} U\left(y - h_1(\rho) - h_2(\rho)\right) + V\left(\rho h_1(\rho) + f\left(h_2(\rho)\right)\right) + \qquad (12)$$

$$\lambda\left((1-\phi)\gamma\ h_1(\rho) - g\right)$$

$$\lambda = \frac{\left(x - n\phi\right)V'}{\left(1-\phi\right)\left(h_1 - \gamma\ (x - n\phi)\frac{\partial h_1}{\partial \rho}\right)} > 0 \qquad (13)$$

The economy on the right side of the Laffer curve, conducting monetary policy through reserve requirements to gain seigniorage, will lower the rate of return in money.

Given that the government finances its expenditures through money creation, equation (13) shows the steady-state utility of the agent under an inflationary policy regime. Since we define $\frac{1}{z} = \phi$, for simplicity, we need to define $\frac{\partial \rho}{\partial \phi}$ to determine the sign of equation (13). After cancelling the terms out in further equations, we get equation (15):

$$\frac{\partial \rho}{\partial \phi} = (n\gamma) \qquad (14)$$

$$\frac{\partial \ell}{\partial \phi} = n\gamma h_1 V' - \lambda\left(\gamma h_1 - (1-\phi)\gamma^2 n\frac{\partial h_1}{\partial \rho}\right) \qquad (15)$$

Using λ from equation (13) in equation (15), we obtain equation (16):

$$\frac{\partial \ell}{\partial \phi} = \frac{h_1^2 \gamma (n-x)}{(1-\phi)\left(h_1 - (x-n\phi)\gamma \frac{\partial h_1}{\partial \rho}\right)} < 0 \qquad (16)$$

For the government to finance its expenditures, the optimal repression is to set ϕ as low as possible, which is to say, zero, i.e., $\frac{1}{z} = \phi = 0$. Given that the level of current government expenditure is constant, the optimal policy is to set $z \to \infty$, which will relax the constraint on reserve requirements and create more opportunity for the agent to obtain the most productive capital in the formal sector. The optimal seigniorage should be obtained by the policy that minimizes the reserve requirements and maximizes inflation, which is consistent with the findings of Freeman and Haslag.

3.1 Policy to Induce Agents into the Formal Sector

The agent's criteria to choose either sector depend on the rate of return ρ and $f'(h_{2t})$, so if $\rho > f'(h_{2t})$, the agent will prefer the formal sector to the informal economy. If $\rho < f'(h_{2t})$, the agent will prefer the storage technology in the informal economy to saving in the formal economy. Conducting the policy experimentation as shown in Table 1, we consider the extreme case of conducting monetary policy and its implication for the rate of return in both sectors. The government monetary policy will change the composition of the assets held by the agent in both markets through the rate of return.

Using the rate of return in the informal economy in equation (10) we obtain equation (17):

$$\frac{f'(h_{2t}) - x}{n\phi - x} = \gamma \qquad (17)$$

Solving for government expenditure in terms ϕ, γ and setting either maximum reserves or minimum reserves, we obtain the comparative results in Table 1 below:

$$\phi = (1 - \frac{g}{h_1}) \qquad (18)$$

4. The Steady State under Policy Regimes

From Table 1 we conclude that for the government to induce agents to hold assets in the formal sector, the optimal policy is a combination of infinite inflation and minimum reserve requirements. However if the government conducts its policy

towards maximum reserve requirements, such a policy promotes the informal sector, because the agent will favour storing his/her goods rather than allocating one's portfolio in the formal economy with a lower rate of return.

Table 1: Comparative static under extreme policy regimes

	Rate of return in the formal sector	Rate of return in the informal sector
Policy of infinite inflation	$\rho = x - \frac{gx}{h_1}$	$f'(h_2) = x - \frac{gx}{h_1}$
Policy of maximum reserve requirement	$\rho = n - \frac{ng}{h_1}$	$f'(h_2) = n - \frac{ng}{h_1}$

Most governments of developing economies do not rely heavily on reserve requirements, in order to avoid further growth of the informal sector. Promoting the size of the informal economy is not in the interest of the government; this could be one of the reasons that developing economies use the inflationary policy. We might say that the IMF prescription for holding maximum reserve requirements is not really helpful to the economies that rely on seigniorage as their main source of revenue. This could be one of the sources of the resistance and tension between the global institutional demand and what country-level policymakers need.

5. Conclusions

In economies with developed financial intermediation, where the size of the informal sector is small to be negligible, the agents prefer the informal economy if the policy relies on a maximum reserve requirement. The government that minimizes the reserve requirements is not only optimizing the inflationary policy but also inducing the agent to favour the formal economy. In searching for Pareto improvement, using the open-market operations remains a reasonable mechanism designed to offset the transfers of wealth between generations when the government is paying a return on reserves. Open-market operations will reward deposit in the formal economy and mitigate the need to use the informal economy unless the rate of return is equalized between the two sectors. This issue is left for future research.

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Appendix

$$U(c_{1t}) + V(c_{2t})$$

subject to

$$c_{1_t} + h_{1_t} + h_{2_t} \leq y \tag{1}$$

$$c_{2t} \leq \rho h_{1t} \ + f(h_{2_t}) \tag{2}$$

The stock of fiat money available in this economy is

$$M \ = N_t \gamma h_{1t} p_t \tag{3}$$

2.3 Competitive Equilibrium

The agent's problem can be transformed as follows. Let h_{1t}, h_{2t} denote the total savings of a young agent at time t in the formal and informal sectors, so that the young agent chooses $h_{it}, E[0, y]$ to maximize:

$$U(y - h_{1t} - h_{2t}) + V(\rho h_{1t} + f(h_{2t})) \tag{4}$$

The first-order condition:

$$\max_{h_1, h_2} U(y - h_{1t} - h_{2t}) + V(\rho h_{1t} + f(h_{2t})) \tag{5}$$

$$\frac{U'(y - h_{1t} - h_{2t})}{V'(\rho h_{1t} + f(h_{2t})} = \rho \tag{6}$$

$$\frac{U'(y - h_{1t} - h_{2t})}{V'(\rho h_{1t} + f(h_{2t})} = f'(h_{2t}) \tag{7}$$

2.4 Characterization of Stationary Equilibrium

The market clearing condition is the real rate of return on fiat money from (3):

$$\frac{p_t}{p_{t+1}} = \left(\frac{m_t}{N_t h_{t1}}\right) \Big/ \left(\frac{m_{t+1}}{N_t h_{1t}}\right) = \frac{n}{z} \tag{8}$$

$$\rho = \gamma \frac{n}{z} + (1 - \gamma) x \tag{9}$$

Also from equations (6) and (7) we define the rate of return in the informal sector:

$$f'(h_{2t}) = \gamma \left(\frac{n}{z}\right) + (1-\gamma)x \tag{10}$$

Finally, the government's budget constraints require that

$$g = \left(1-\frac{1}{z}\right)\gamma h_{1t} \tag{11}$$

3. Maximizing the Welfare of Future Generations

$$\max_{\gamma,\phi} U\left(y - h_1(\rho) - h_2(\rho)\right) + V\left(\rho h_1(\rho) + f(h_2 \right. \tag{12}$$

$$\left.(\rho))\right) + \lambda\left((1-\phi)\gamma\ h_1(\rho) - g\right)$$

$$\frac{\partial \ell}{\partial \gamma} = -U'\frac{\partial h_1}{\partial \rho}\cdot\frac{\partial \rho}{\partial \gamma} - U'\frac{\partial h_2}{\partial \rho}\cdot\frac{\partial \rho}{\partial \gamma} + \rho\frac{\partial h_1}{\partial \rho}\cdot\frac{\partial \rho}{\partial \gamma}V' + V'h_1\frac{\partial \rho}{\partial \gamma}$$

$$f'(h_2)\frac{\partial h_2}{\partial \rho}\frac{\partial \rho}{\partial \gamma}V' + \lambda\left((1-\phi)h_1 + (1-\phi)\gamma\frac{\partial h_1}{\partial \rho}\frac{\partial \rho}{\partial \gamma}\right) \le 0 \tag{13}$$

Using the envelope theorem we cancel out the following terms:

$$-U'\frac{\partial h_1}{\partial \rho}\cdot\frac{\partial \rho}{\partial \gamma} + \rho\frac{\partial h_1}{\partial \rho}\cdot\frac{\partial \rho}{\partial \gamma}V' = 0 \tag{14}$$

$$-U'\frac{\partial h_2}{\partial \rho}\cdot\frac{\partial \rho}{\partial \gamma} + f'(h_2)\frac{\partial h_2}{\partial \rho}\cdot\frac{\partial \rho}{\partial \gamma}V' = 0 \tag{15}$$

From equation (9) we get $\frac{\partial \rho}{\partial \gamma} < 0$

$$\frac{\partial \rho}{\partial \gamma} = \left(\frac{n}{z} - x\right) = (\phi n - x) < 0 \tag{16}$$

$$\frac{\partial L}{\partial \gamma} = -(x - n\phi)h_1 V' + \lambda\left((1-\phi)h_1 - (1-\phi)\gamma\ (x - n\phi)\frac{\partial h_1}{\partial \rho}\ \right) \leq 0 \quad (17)$$

$$\lambda \frac{\partial L}{\partial \gamma} = 0 \ \text{ If } \lambda \geq 0$$

$$\lambda = \frac{(x - n\phi)V'}{(1-\phi)\left(h_1 - \gamma\ (x - n\phi)\frac{\partial h_1}{\partial \rho}\right)} > 0 \quad (18)$$

Since the government finances its expenditures through money creation, equation (19) shows the steady-state utility of the agent under this policy regime.

$$\frac{\partial \ell}{\partial \phi} = -U'\frac{\partial h_1}{\partial \rho}.\frac{\partial \rho}{\partial \phi} - U'\frac{\partial h_2}{\partial \rho}.\frac{\partial \rho}{\partial \phi} + \rho\frac{\partial h_1}{\partial \rho}.\frac{\partial \rho}{\partial \phi}V' + V'h_1\frac{\partial \rho}{\partial \phi}$$

$$+\ f'(h_2)\frac{\partial h_2}{\partial \rho}\frac{\partial \rho}{\partial \phi}V' + \lambda\left(-\phi h_1\ + (1-\phi)\gamma\frac{\partial h_1}{\partial \rho}\frac{\partial \rho}{\partial \phi}\right) \quad (19)$$

Using the envelope theorem the following terms in (20) and (21) will cancel out.

$$-U'\frac{\partial h_1}{\partial \rho}.\frac{\partial \rho}{\partial \phi} + \rho\frac{\partial h_1}{\partial \rho}.\frac{\partial \rho}{\partial \phi}V' = 0 \quad (20)$$

$$-U'\frac{\partial h_2}{\partial \rho}.\frac{\partial \rho}{\partial \phi} + f'(h_2)\frac{\partial h_2}{\partial \rho}.\frac{\partial \rho}{\partial \phi}V' = 0 \quad (21)$$

Since we define $\frac{1}{z} = \phi$, for simplicity we need to define $\frac{\partial \rho}{\partial \phi}$ to determine the sign of equation (19). After cancelling out the terms in equations (20) and (21) we get equation (26):

$$\frac{\partial \rho}{\partial \phi} = (n\gamma) \quad (22)$$

$$\frac{\partial \ell}{\partial \phi} = n\gamma h_1 V' - \lambda\left(\gamma h_1 - (1-\phi)\gamma^2 n\frac{\partial h_1}{\partial \rho}\right) \quad (23)$$

Using λ from equation (21) in equation (26) we obtain equation (24):

$$\frac{\partial \ell}{\partial \phi} = \frac{h_1^2 \gamma (n - x)}{(1-\phi)\left(h_1 - (x - n\phi)\gamma \frac{\partial h_1}{\partial \rho} \right)} < 0 \qquad (24)$$

Using the rate of return in the informal economy in equation (11) we obtain equation (25):

$$\frac{f'(h_{2t}) - x}{n\phi - x} = \gamma \qquad (25)$$

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