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Tax Evasion, Financial Dualism, and Economic Growth

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ABSTRACT

This paper examines the optimal policy of tax enforcement in an endogenous growth model with the presence of financial dualism. Individuals can accumulate capital by depositing savings into the formal and informal financial sectors, and capital incomes derived via informal (formal) financial institutions are evadable (non-evadable). By following the argument of new structuralists, we find that it may be optimal for countries with a less developed formal financial sector to choose a policy of tax enforcement that results in more severe tax evasion and a larger informal financial sector. Conversely, countries with a more developed formal financial sector should impose a policy of tax enforcement that leads to more tax compliance and a small size of the informal financial sector. This result is consistent with recent empirical studies. Moreover, our calibration shows that countries with a less developed financial sector and more severe tax evasion can perform equally well in terms of economic growth with those countries whose financial sector is more developed and tax evasion is less severe. This may provide a theoretical explanation for the growth experience of Asian tigers in the 1980s and 1990s.

1. INTRODUCTION

Tax evasion is pervasive all over the world, and its presence has important implications for the effects of government tax policy. As tax-related policies have been recognized as important determinants of an economy's long-run growth, it is not surprising that a few studies have started recently to incorporate tax evasion into models of endogenous growth and re-examine the effects of government tax and enforcement policies on economic growth.[1] With some minor variations, recent studies have generally reached the following conclusions: government tax enforcement is effective to induce compliance, government policies of tax enforcement lead to ambiguous effects on economic growth, and the rate of economic growth with tax evasion is lower than that without it.

It is worth noting that tax evasion is more severe in poor countries than in rich ones. Gordon and Li (2009, p. 857), for example, have noted that poor countries, on average, collect only two-thirds or less of the amount of tax revenue (as a fraction of GDP) of rich countries, though the tax rates are not very different between poor and rich countries.[2] Since incomes from the informal sector are not easy to tax, the fact that developing countries possess a larger share of the informal sector than developed ones seems to be the cause of this empirical fact (Gordon and Li, 2009).[3] To the extent that tax evasion is detrimental to economic growth and poor countries need to improve their growth performance, there seems to be a puzzle as to why developing countries do not adopt a policy of tax enforcement to induce tax compliance.[4] One natural response

[1] Examples include Caballe and Panades (1997), Lin and Yang (2001), Chen (2003), and Levaggi and Menoncin (2012).

[2] See also Edwards and Tabellini (1991, p. S20).

[3] Cobham (2005), for example, estimates that developing countries lose US$285 billion per year due to tax evasion in the domestic shadow economy. Note that, according to Schneider and Enste (2002), the informal economy in OECD is about 15% of GDP, while the median size of the informal economy in developing countries is 37% of GDP, ranging from 13% in Hong Kong and Singapore to 71% in Thailand and 76% in Nigeria.

[4] Early studies (Kolm, 1973; Baldry, 1984) have asserted that the strictest policy of tax enforcement (i.e., a full-compliance policy that results in zero evasion) may not be optimal from the standpoint of social welfare because resources are needed for enforcing the tax laws. Given this, the optimal policy may be obtained by increasing the probability of detection until the marginal increase of revenue is equal to the marginal resource cost of so doing. Slemrod and Yitzhaki (1987), however, show that this optimal rule is not correct, as the revenues generated by the policy do not represent a net gain to the economy, but rather a mere transfer from noncompliant taxpayers to the government. Given this, the optimal rule should be the one that equates the marginal resource cost to the marginal social benefit of reduced evasion. The measurement of social benefit, however, is not unanimous. Slemrod (2006), for

to this puzzle may be that developing countries are constrained by weak capacities of tax administration.[5] Gordon and Li (2009, p. 856), for example, conjecture that "poor countries lack the best enforcement methods, e.g. based on modern information technology." Nevertheless, to the best our knowledge, a theory of why poor countries lack better enforcement technology is still not available. As an alternative, it may be an optimal policy for developing countries to adopt a looser policy of tax enforcement that leads to more tax evasion. The purpose of this paper is to explore this possibility.

Our starting points are based on the following empirical facts in the literature. First, the financial sector plays an important role in facilitating capital investment and economic growth.[6] Second, the financial sector in developing countries is characterized by dualism, in which both formal, organized and informal, unorganized financial institutions coexist, and informal financial institutions play an influential role in channeling resources for developing countries.[7] In particular, evidence that the informal financial sector is important for capital investment has been found in some developing countries. Kan (2000), for example, finds evidence showing that informal financial institutions played an important role in facilitating capital investment in Taiwan for the period 1977–1992. Cole and Park (1983) and Tressel (2003) reach a similar conclusion for Korea and other developing countries.[8] Moreover, it is found that the formal financial sector, on average, is more developed in developed countries than in developing ones. Finally, informal financial institutions in developing countries are thought to be more efficient at providing needed financial intermediation than the formal ones. Indeed, as noted by Daniel and Kim (1992, p. 570), new structuralists (van Wijnbergen,

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example, asserts that invasion of privacy may be required by greater enforcement, which is nonpecuniary. Similarly, the social benefit in Slemrod and Yitzhaki (1987) is related to the reduced risk-bearing that is associated with reduced tax evasion. It is worth noting that little attempt has been made to investigate the difference of this optimal rule for developing and developed countries, which is our main purpose.

[5] Given this, extant studies focus on the optimal tax structure of developing countries; i.e., how should developing countries tax? See Gordon and Li (2009).

[6] For comprehensive reviews on this, please see Pagano (1993) and Levine (1997).

[7] For studies of financial dualism in developing countries, please see Germidis (1990), Ghate (1992), Besley et al. (1993), and Tressel (2003). Early studies have concluded that informal financial institutions are important for resource allocation in developing countries. Wai (1980), for example, summarized the following conclusions related to the informal financial sector in developing countries: (i) the informal financial sector was much more important than formal ones in Africa, Asia, and the Middle East; (ii) the informal financial sector was larger than formal ones in about half of the sample of 16 countries in the 1950s; while in the 1970s, there were still 3 countries out of the sample of 17 that had a larger informal financial sector. See also Chandavarkar (1985).

[8] Table 1 in Tressel (2003, p. 227) has reported the share of informal financial sector for some countries. See also Besley (1995) and Montiel et al. (1993).

1983; Taylor, 1983) have asserted that informal financial institutions (or curb markets) are more efficient than banking systems because they are not subject to reserve requirements and other government regulations.[9] Moreover, some economists (McKinnon, 1973; Shaw, 1973; Fry, 1982, 1988) have emphasized that governments in developing countries tend to repress formal financial institutions (by imposing interest rate ceilings) to channel cheap credit to the public sector or certain priority activities. Interest rate ceilings, which keep the interest rate below the market equilibrium level, may attract inefficient borrowers (with lower-yield investment projects) and hence lead to inefficient capital investment, however. On the other hand, informal institutions, whose operations are not controlled by the government, can match the demand and supply of funds at the market equilibrium rate and hence yield a more efficient outcome of capital investment than formal ones.

Based on these facts, this paper constructs a simple endogenous growth model with two-period-lived overlapping generations in which financial dualism exists in the economy and agents can deposit their savings into either formal financial institutions (such as banks) or informal ones (such as rotating savings and credit associations, ROSCAs) to generate capital incomes. To capture the view that informal institutions may be more efficient than formal ones in converting deposits into capital, we assume that banks incur transaction costs in converting deposits into capital.[10] As in Bose and Cothren (1996) and Blackburn et al. (2012), the unit cost of banking transactions is negatively related to the level of financial development, which is treated as an exogenously given variable.[11] Note that individuals' involvement in the informal financial sector may incur participation costs and, as in Chen (2003), tax evasion also incurs costs to taxpayers.[12] The government imposes a flat tax rate on output production to finance an exogenously given, useless expenditure. Following Gordon and Li (2009),

[9] As can be seen below, while informal institutions are more efficient than banks, banking operations are safer than ROSCAs.

[10] As is pointed out by Blackburn et al. (2012), the costs associated with formal financial sectors include "transaction costs associated with the management of asset portfolios and the provision of liquidity services, and agency costs associated with the processing of information, the enforcement of contracts and the screening and monitoring of borrowers (e.g., Diamond, 1984; Fama, 1980; Gurley and Shaw, 1960)."

[11] Many studies that examine macroeconomic consequences of financial development usually treat the level of financial development as an exogenously given variable. See Bose and Cothren (1996), Ho and Wang (2005), and Blackburn et al. (2012). In particular, financial development in these studies is proxied by a decrease in the unit cost of loan transactions in the formal financial sector.

[12] Under the argument of new structuralists, if there are no costs associated with activities in the informal financial sector and tax evasion, the formal financial sector will disappear.

it is assumed that the government can access banks' records of depositors and use them to enforce tax law, implying that capital incomes derived from banks are not evadable. By contrast, the government has no control over informal financial institutions, so that capital incomes from ROSCAs are evadable. Obviously, the agent must decide the fraction of savings channeled to formal and informal financial institutions by weighting costs and benefits of both sectors. As can be seen, the possibility of evading capital incomes through depositsin ROSCAs plays an important role in this decision.[13]

Knowing that the agent may conceal capital incomes in ROSCAs, government may audit taxpayers with a positive probability to discern whether the taxpayer conceals capital incomes or not. If taxpayers are audited and tax evasion is discovered, they must pay taxes on the hidden income as well as a fixed penalty rate on the amount of taxes evaded. As in Chen (2003), government is able to induce tax compliance by changing the probability of detection and/or the fixed penalty rate. However, the penalty rate is usually stated in a country's law and hence cannot be directly controlled by the planner, as is pointed out by Schroyen (1997). Thus, we follow a strand of literature (Andreoni et al., 1998; Slemrod and Yitzhaki, 2002) by assuming that the penalty rate is exogenously given and the probability of detection is optimally chosen by the government (in terms of maximizing social welfare).[14] The purpose of this paper is to examine whether it is optimal for developing countries to adopt a policy of tax enforcement that leads to severe tax evasion.

We find that an increase in the probability of detection leads to two opposite effects on capital investment and economic growth. First, it leads to more tax compliance, which is accomplished by inducing agents to allocate more savings into the formal sector. Since the formal financial sector is less efficient than the informal one in terms of facilitating capital investment (due to the presence of transaction costs in the formal sector), this is detrimental to economic growth and hence can be viewed

[13] Waston (1985) first constructed a model with labor markets in which tax evasion will always be detected by the government in one market (non-evadable market), but it may not be detected in another one (evadable market). Jung et al. (1994) further pointed out that tax evasion in the underground/informal sector is easier than in the overground/formal sector. Fugazza and Jacques (2004) also presented a model in which individuals go underground in order to escape government taxation. Following these studies, we assume that individuals allocate savings into the informal sector for the purpose of evading tax obligation. Note that our paper can be viewed as following the spirit of this literature, but extending it into capital market.

[14] Note that both the probability of detection and the penalty rate are exogenously given in Chen (2003) and Caballe and Panades (1997). The government in these studies determines the optimal tax rate and optimal share of public spendings, both of which are abstracted in this paper. See below for further discussion.

as the marginal cost of an increase in the probability of tax detection on economic growth. Second, more tax compliance implies that the government can receive more tax revenues. To finance a constant fraction of government spendings, the tax rate must decrease under a balanced government budget. A decrease in the tax rate implies that agents have more savings and thereby more capital investment, which further leads to higher economic growth. Obviously, this is beneficial to economic growth and hence can be viewed as the marginal benefit of an increase in the probability of tax detection on economic growth. The optimal probability of tax detection (i.e., optimal policy of tax enforcement) is obtained by balancing the marginal cost and the marginal benefit.

We next examine the effects of financial development, measured by a decrease in the unit cost of banking transactions, on the optimal probability of tax detection, the equilibrium tax rate, and tax evasion. We find that financial development directly induces the agents to allocate more savings into banks and hence directly raises tax compliance. In addition to this direct effect, financial development causes an indirect effect on tax compliance by affecting the marginal cost and the marginal benefit of an increase in the probability of tax detection on economic growth. It turns out that financial development may increase or decrease the optimal probability of tax detection which may indirectly lead to more tax compliance or more tax evasion. Recall that an increase in the probability of tax detection leads to tax compliance. Thus, if financial development indirectly leads to an increase in the optimal probability of tax detection and hence more tax compliance, then both the direct and indirect effects of financial development result in tax compliance. In this case, financial development is associated with tax compliance. However, financial development may indirectly lead to a decrease in the optimal probability of tax detection and hence more tax evasion. In this latter case, the direct effect of financial development leads to more tax compliance, but the indirect effect results in more tax evasion (less tax compliance). Nevertheless, if the direct effect dominates the indirect one, then financial development is still associated with tax compliance. In sum, our model reaches a conclusion that, as financial development occurs, it is optimal for the government to adopt a policy of tax enforcement that leads to tax compliance. Given this, developing countries whose financial sector is less developed should adopt a policy of tax enforcement that leads to less tax compliance (more tax evasion) and a larger the informal sector.[15] This conclusion is

[15] Since tax evasion is associated with activities in the informal sector, our model implies that financial development is associated with a smaller the informal sector. This conclusion is consistent with Blackburn et al. (2012) and Capasso and Jappelli (2013). However, both studies contain no growth issues and treat the tax rate exogenously. We derive this result from an endogenous growth model and thus can shed

consistent with some recent empirical studies.[16]

We also calibrate our model by employing parameters obtained from recent studies. Results show that countries with a less developed financial sector and hence more severe tax evasion can have growth performance similar to those countries whose financial sector is more developed and hence whose tax evasion is less severe. This result provides an alternative explanation to Chen (2003), who first incorporates tax evasion into Barro (1990) and examines the effects of tax evasion on the optimal tax rate, the optimal share of government public spending, and economic growth. He finds that if the output elasticity of public spending is not too large (which seems consistent with some empirical studies), tax evasion has no significant effect on economic growth.[17] As pointed out by Chen (2003), this is consistent with the growth experience of the Asian tigers in the 1980s and 1990s, as these countries performed equally well in terms of economic growth; however, tax evasion was more severe in Taiwan and Korea, but much less severe in Singapore and Hong Kong. By highlighting financial dualism, our calibration shows that countries with a more-developed financial sector and hence less severe tax evasion (such as Singapore and Hong Kong) can have growth performance similar to those countries whose financial sector is less developed and hence whose tax evasion is more severe (such as Taiwan and Korea).[18]

The rest of this paper is organized as follows. Following this section, Section 2 presents the basic setting of the model and examines the optimal decisions of the representative agent. The optimal policy of tax enforcement is examined in Section 3 and results of the calibration are presented in Section 4. We also discuss some aspects of our modeling strategy in Section 5. Section 6 concludes.

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light on the growth experience of the Asian tigers, as stated below.

[16] La Porta and Shleifer (2008), for example, investigate the relationship between underground activity and financial development by using six measures of underground activity for samples of between 57 and 145 countries. They find a robust negative correlation between underground activity and the availability of private credit (which is an indicator of financial development).

[17] Specifically, the calibration of Chen (2003) shows that tax evasion has a negligible effect on economic growth if the degree of externality of public spending is less than 0.2.

[18] The formal financial sectors in Taiwan and Korea were highly regulated in the 1980s, while Singapore and Hong Kong had liberalized their financial sectors and have become the financial centers of Asia since the 1980s. Moreover, informal financial institutions, such as rotation savings and credit associations (ROSCAs), have been found to facilitate industrial development in Taiwan and Korea. Cole and Park (1983), for example, point out that the informal credit market plays an important role in Korea's economic development, and Tressel (2003) indicates that curb markets in Taiwan provided 48 percent of loans to private business in 1986. Montiel et al. (1993) also report that the share of informal credit in rural Korea is equal to 51% in 1982. Kan (2000) presents evidence showing that informal financial institutions play an important role in capital accumulation in Taiwan. See also Fry (1995) and Shea (1983).

2. MODEL

Consider a model economy inhabited by two-period-lived overlapping generations (OLG) of agents. Time is discrete and indexed by $t = 0, 1, 2 \cdots$. There is no population growth, and we normalize the population of each generation to one. At the beginning of each period t, young agents provide their labor endowment to earn the competitively determined, after-tax wage rate $(1 - \tau_t)w_t$, where τ_t is the tax rate on output imposed by the government.[19] Let s_t and S_t be the savings rate and total savings of the young agent. Then, young agents will save

$$S_t = s_t(1 - \tau_t)w_t, \tag{1}$$

for their old-age consumption. As highlighted by Schumpeter (1939), financial sectors play an important role in the process of accumulating productive capital. Following this view, we assume that there are financial institutions in the economy that accept deposits from young agents at period t, convert deposits to capital at the beginning of period $t + 1$, and rent out capital to firms to generate capital incomes.[20] Moreover, as financial dualism is a widespread phenomenon in the developing countries, we assume that there are two types of financial institutions in the economy: formal financial institutions, such as commercial banks, and informal ones, such as rotating savings and credit associations (ROSCAs).

The operations of formal financial institutions in developing countries are quite different from those of informal ones.[21] Specifically, banks in developing countries are heavily regulated by the government, and government regulations incur banking

[19] We focus on tax evasion of capital incomes in this paper, as we highlight how the presence of financial dualism affects individuals' decision on tax evasion of capital incomes and, through this channel, economic growth. Tax evasion of labor incomes may contain important implications for economic growth. Nevertheless, those implications are not related to financial dualism. Due to this reason, we focus only on tax evasion of capital incomes.

[20] We could assume that there is another type of agents (capital borrowers) who are endowed with capital projects and need funding from financial institutions to produce capital. Since loan contracts between financial institutions and capital borrowers are not the focus of this paper, we abstract from capital borrowers by assuming that financial institutions directly convert output into capital.

[21] See Germidis et al. (1991) for a comprehensive comparison. A website (http://www.gdrc.org/icm/formal-informal.html) has offered a summary from Germidis et al. (1991) on the differences between formal and informal financial institutions.

operational costs. For example, banks are forced to join deposit insurance programs to prevent bank runs.[22] Other government regulations include restrictions on bank entry and regulatory restrictions on bank activities that keep banks from other lines of risky business.[23] Restrictions on bank entry and bank activities impede banking competition, which creates an environment with deleterious implications for efficiency. Empirically, Demirguc-Kunt et al. (2004), using data from over 1,400 banks across 72 countries, find evidence that tighter regulations on bank entry and bank activities increase the cost of financial intermediation (which is proxied by the net interest rate margin).[24] Moreover, formal financial institutions provide financial services to a large set of individuals. Collecting and processing information of a large set of people entail significant transaction costs to the bank.[25] By contrast, informal financial institutions are not subject to government regulations, so they are free from transaction costs associated with government regulations. Moreover, they are formed by a small group of friends, relative, or co-workers and they usually provide services only to this small group of people. Obviously, transaction costs associated with the provision of financial services to a small group of related people are much smaller.[26] To capture this perspective, it is assumed that each bank incurs δ units of resources per unit of deposits to channel savings into capital. By contrast, free government regulations and providing services to a small group of related people lead to a sufficiently small amount of transaction costs (which we normalize to zero in this paper) to ROSCAs.[27] As can be seen below, the presence of this transaction/intermediation cost in banking operations leads to a spread (or interest rate margin) between the rate of returns for deposits and

[22] Besides deposit insurance programs, banks are required to hold a fraction of deposits in the form of cash as reserve requirement.

[23] For example, banks are not allowed to engage in business in stock markets and real estate. See Demirguc-Kunt et al. (2004).

[24] The net interest rate margin is defined by interest income minus interest expense divided by interest-bearing assets.

[25] Indeed, banks need to manage asset portfolios to provide sound liquidity services to their depositors. Lending to a large set of borrowers also requires banks to process information, enforce contracts, and screen and monitor borrowers. These banking activities are associated with transaction costs. Moreover, because information about a large set of borrowers is not easy to obtain, banks usually rely on collateral to make their loan decisions. As noted by Scholes et al. (1976), when collateral is required to secure a loan, its value must be ascertained. The determination of the value of collateral requires specialized expertise and hence is costly to banks.

[26] As indicated by Ayyagari et al. (2010b, p. 3049), "informal financial institutions usually rely on relationships and reputations to make loan decisions and can be very efficient in monitoring and enforcing repayments (due to the peer monitoring view in Stigltiz (1990) and Arnott and Stiglitz (1991))."

[27] Given this, ROSCAs are more cost-efficient than banks in channeling savings into capital.

the rate of returns from capital loans. As in Blackburn et al. (2012), a decrease in δ reduces this spread and can be viewed as financial development (in the formal sector).

While government regulations as well as other bank restrictions are costly to banks, they can reduce risk associated with banking activities. Indeed, using data on 69 countries over the period 1980–1997, Beck et al. (2006) provide evidence that a concentrated banking system is less vulnerable to banking crisis, and banking regulations are also associated with bank stability.[28] Moreover, lending to a large set of borrowers enables the bank to diversify risk associated with loans and to offer its depositors a fixed rate of returns on deposits. By contrast, the operation of informal financial institutions is riskier. To this end, it is assumed that banks can convert a unit of deposits into a unit of capital with certainty, while ROSCAs can convert a unit of deposits into a unit of capital with probability λ, $\lambda < 1$.[29]

In addition to the cost efficiency and riskiness, the other key characteristic of depositing savings in banks is that the government can access banks' records of each depositor, and can use them to enforce tax law, as in Gordon and Li (2009). This implies that capital incomes derived from deposits in banks are not evadable from tax obligations. On the other hand, capital incomes derived form ROSCAs may be evaded, as ROSCAs are free from government control and regulation.[30] Given this, each agent will decide the fraction of savings deposited in banks and ROSCAs by considering the costs and benefits of tax evasion.[31] Knowing that the agent may conceal his savings and hence capital incomes in ROSCAs to evade tax obligations, the government may audit the agent at period $t+1$ to discern whether the agent conceals his incomes. Let p_{t+1} be the probability of tax detection (set by the government). If an agent is audited detected and tax evasion is discovered, he must pay the tax payment for evaded capital incomes plus the amount of fines at a fixed penalty rate $\pi - 1 > 0$ of evaded capital incomes. We assume that financial institutions, either in the formal or informal sector, can convert one unit of time t output (savings) into one unit of time $t+1$ capital. Figure 1 depicts the timing of events for periods t and $t+1$.

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[28] Restrictions on bank activities, however, prevent banks from diversifying outside their transitional business, which may make them more vulnerable to external shocks (that is, shocks outside the banking industry).

[29] We thank a referee for raising this point.

[30] This is also consistent with Ayyagari et al. (2010a) who, using a sample of 25,000 firms from 57 countries, showed that informal financing is associated with greater tax evasion than formal financing.

[31] People may engage in activities in the informal sector for various reasons. This paper focuses on the case where people engage in the informal sector for the purpose of evading taxes.

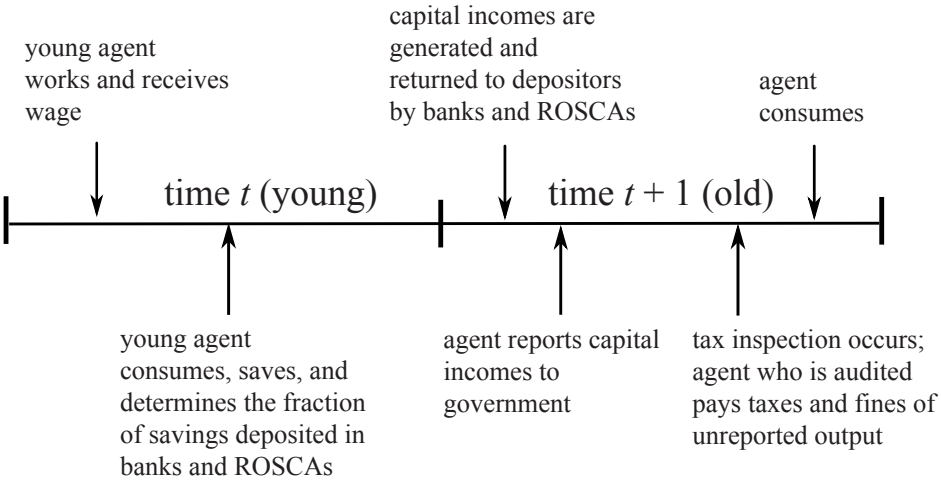

Figure 1 Timing of Events at Periods t and $t+1$

After capital is converted at the beginning of period $t+1$, financial institutions, either in the formal or informal sector, will rent out the capital to firms in exchange for capital incomes. Firms at period $t+1$ can rent capital from financial institutions and can hire young agents as labor to produce output y_{t+1} according to the following technology:

$$y_{t+1} = Ak_{t+1}^{\alpha}(\overline{k}_{t+1}L_{t+1})^{1-\alpha}, \quad \alpha \in (0,1), \quad A > 0, \tag{2}$$

where k_t and L_t are the capital and labor employed, respectively, and $\overline{k}_t$ is the average capital stock per firm, which represents the stock of knowledge in the economy. For simplicity, capital is not depreciated. We normalize the number of firms to one; hence, y_{t+1} is also the total output of the economy. Capital and labor markets are competitive; hence, the wage rate and rental rate of capital at period $t+1$ are given as

$$w_{t+1} = \frac{\partial y_{t+1}}{\partial L_{t+1}} = (1-\alpha)Ak_{t+1}^{\alpha}L_{t+1}^{-\alpha}\overline{k}_{t+1}^{1-\alpha} = (1-\alpha)Ak_{t+1} = (1-\alpha)y_{t+1} \tag{3}$$

and

$$\rho_{t+1} = \frac{\partial y_{t+1}}{\partial k_{t+1}} = \alpha A\overline{k}_{t+1}^{1-\alpha}k_{t+1}^{\alpha-1}L_{t+1}^{1-\alpha} = \alpha A\overline{k}_{t+1}^{1-\alpha}K_{t+1}^{\alpha-1}L_{t+1}^{1-\alpha} = \alpha A = \rho. \tag{4}$$

Note that $L_{t+1} = L = 1$ has been substituted.

Denote β_t and $1 - \beta_t$, $\beta_t \in (0, 1)$ as the fraction of the young agent's savings deposited in banks and ROSCAs at period t, respectively. In other words, the agent deposits $\beta_t S_t$ into banks, which can generate $\beta_t S_t(1-\delta)$ of capital and hence $\beta_t S_t(1-\delta)\rho_{t+1}$ units of capital incomes from banks at period $t+1$. A decrease in δ implies that banks can generate more units of capital incomes per unit of deposits. Since financial development (in the formal sector) can facilitate capital investment, a decrease in δ can be viewed as an indicator of financial development.

As stated, capital incomes derived from ROSCAs are evadable and, as in Chen (2003), tax evasion involves transaction costs to the agent. It should be noted that informal financial institutions are formed by a small group of related people, such as friends, co-workers, relatives, or neighbors, and the formation as well as operation of informal financial institutions need their members to participate. Participation of ROSCAs, of course, also incurs transaction costs to the agent. Moreover, we focus on the case where the agent engages in the informal financial sector for the purpose of evading capital incomes taxation. For simplicity, we follow Chen (2003) by consolidating the transaction and participation costs related to tax evasion and activities of ROSCAs into a single function. Specifically, the transaction costs to an agent who deposits $(1-\beta_t)S_t$ units of time t output in ROSCAs, which can generate an expected amount of $(1-\beta_t)\lambda S_t\rho_{t+1}$ of evadable capital incomes at period $t+1$, are equal to $h_0(1-\beta_t)^2\lambda S_t\rho_{t+1}$ units of time $t+1$ output.[32] It should be noted that this assumption implies that the rate of returns of deposits in ROSCAs displays diminishing returns to the fraction of savings deposited in ROSCAs (i.e., $1-\beta_t$), a result consistent with Blackburn et al. (2012).[33] To see this, denote κ^I_{t+1} as the amount of capital incomes from ROSCAs net of transaction costs at period $t+1$. Then, we can see that

$$\kappa^I_{t+1} = [(1-\beta_t) - h_0(1-\beta_t)^2]\lambda S_t\rho_{t+1}. \tag{5}$$

It is easy to verify that $\partial^2\kappa^I_{t+1}/\partial(1-\beta_t)^2 < 0$.

The government can increase tax compliance by changing the probability of tax

[32] In Chen (2003), the agent produces y_t and only reports βy_t to the tax authority. Chen (2003) then assumes that the transaction costs of tax evasion are equal to $h_0(1-\beta)^2 y_t$.

[33] In Blackburn et al. (2012), agents can invest their initial asset endowment into the formal financial institutions or into the informal sector. While the rate of return from the formal financial institutions displays constant returns, the rate of returns from the informal sector exhibits diminishing returns.

auditing and/or the fixed penalty rate in this framework. To simplify our analysis, we follow existing literature (e.g., Schroyen, 1997; Caballe and Panades, 1997; Chen, 2003) by assuming that the penalty rate π is either a maximum or a predetermined value. By this assumption, the government enforcement policy corresponds to the probability of detection, which is endogenously determined by the government in this paper. It is worth noting that recent studies (e.g., Andreoni et al., 1998; Slemrod and Yitzhaki, 2002; and the references therein) have examined issues related to the optimal audit probability in the presence of tax evasion.

Denote c_t^y and c_{t+1}^o as the young- and old-age consumption of the agent. Then, we have

$$c_t^y = (1 - s_t)(1 - \tau_t)w_t. \tag{6}$$

To derive the old-age consumption, recall that a young agent deposits $\beta_t S_t$ and $(1 - \beta_t)S_t$ units of time t output in banks and ROSCAs, respectively. Moreover, the government audits the agent at period $t + 1$ with probability p_{t+1}. The expected old-age consumption of the agent can be calculated by using the tree diagram in Figure 2. Specifically, if the agent is not audited, then he can consume the after-tax capital incomes from banks (which are equal to $\beta_t S_t(1 - \delta)(1 - \tau_{t+1})\rho_{t+1}$) plus all capital incomes from ROSCAs (equal to $(1 - \beta_t)\lambda S_t \rho_{t+1}$) net of transaction costs (equal to $h_0(1 - \beta_t)^2 \lambda S_t \rho_{t+1}$). If the agent is audited and tax evasion is discovered, he can consume the after-tax capital incomes from banks (which again are equal to $\beta_t S_t(1 - \delta)(1-\tau_{t+1})\rho_{t+1}$) plus capital incomes from ROSCAs (equal to $(1-\beta_t)\lambda S_t \rho_{t+1}$) net of tax payment of evaded capital incomes (equal to $(1 - \beta_t)\lambda S_t \tau_{t+1}\rho_{t+1}$), fines (equal to $(\pi-1)(1-\beta_t)\lambda S_t \tau_{t+1}\rho_{t+1}$), and transaction costs (equal to $h_0(1-\beta_t)^2 \lambda S_t \rho_{t+1}$). Since the old agent is audited with the probability p_{t+1}, the expected old-age consumption at period $t + 1$ is derived as

$$\begin{aligned}
\mathrm{E}^t c_{t+1}^o = {} & (1 - p_{t+1})[\beta_t S_t(1 - \delta)(1 - \tau_{t+1})\rho_{t+1} + (1 - \beta_t)\lambda S_t \rho_{t+1} \\
& - h_0(1 - \beta_t)^2 \lambda S_t \rho_{t+1}] + p_{t+1}[\beta_t(1 - \delta)S_t(1 - \tau_{t+1})\rho_{t+1} \\
& + (1 - \beta_t)\lambda S_t(1 - \tau_{t+1})\rho_{t+1} - (\pi - 1)(1 - \beta_t)\lambda S_t \tau_{t+1}\rho_{t+1} \\
& - h_0(1 - \beta_t)^2 \lambda S_t \rho_{t+1}] \\
= {} & [\beta_t(1-\delta)(1-\tau_{t+1}) + (1-\beta_t)(1-p_{t+1}\pi\tau_{t+1})\lambda - h_0(1-\beta_t)^2\lambda]S_t\rho_{t+1}, \qquad (7)
\end{aligned}$$

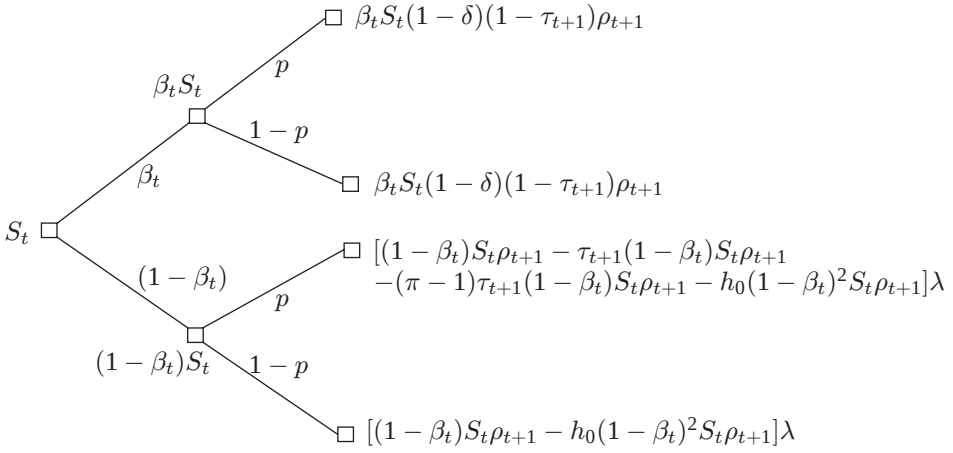

Figure 2 Tree Diagram of Old-Age Consumption

where E^t refers to the expected value at t.

The agent's lifetime utility function is given as

$$U(c_t^y, \mathrm{E}^t c_{t+1}^o) = \ln c_t^y + \eta \ln \mathrm{E}^t c_{t+1}^o, \tag{8}$$

where η is the discount factor. The young agent at period t can choose an s_t and β_t to maximize eq. (8) subject to eqs. (6) and (7), taking δ, λ, τ_t, τ_{t+1}, p_{t+1}, w_t, and ρ_{t+1} as given.[34] The first order conditions lead to[35]

$$s_t^* = s = \frac{\eta}{1+\eta} \tag{9}$$

and

[34] Theoretically speaking, the young agent may choose a β_t to maximize her/his expected life-time utility which is given as $\ln c_t^y + \eta[p_{t+1} \ln c_{a,t+1}^o + (1-p_{t+1}) \ln c_{n,t+1}^o]$, where $c_{a,t+1}^o$ and $c_{n,t+1}^o$ are the amount old-age consumption when she/he is audited and not audited, respectively. However, since the utility function is a concave function of consumption, the utility level under the maximized, expected old-age consumption (given in eq. (7)) is higher than the one that is obtained by maximizing the expected utility. Consequently, we follow Chen (2003) by assuming that the agent chooses a β_t to maximize his/her expected amount of old-age consumption.

[35] The saving rate is independent of the interest rate (the rate of returns from savings) between t and $t+1$ which is derived because the utility is logarithmic. Since the empirical evidence on the relationship between the saving rate and interest rate is inconclusive, we think that building a model that is abstracted from such a relationship is reasonable. See also Caballe and Panades (1997).

$$\beta_t^* = 1 - \frac{\tau_{t+1}(1-\delta-p\pi\lambda)+(\lambda+\delta-1)}{2\lambda h_0}. \tag{10}$$

Note that tax evasion exists when β_t^* lies between 0 and 1. For this purpose, we impose the following conditions:

Conditions TE (Tax Evasion):

$$(i)\ 1-\delta<\lambda \text{ and } (\lambda+\delta-1)-\tau_{t+1}(p\pi\lambda+\delta-1)>0 \tag{11a}$$

and

$$(ii)\ \tau_{t+1}<\overline{\tau}\equiv\frac{2\lambda h_0-(\lambda+\delta-1)}{(1-\delta-p\pi\lambda)}. \tag{11b}$$

A unit of deposits in banks can be converted to $1-\delta$ units of capital, while a unit of deposits in ROSCAs is expected to yield λ units of capital. The condition of $1-\delta<\lambda$ implies that deposits in ROSCAs are expected to yield a higher amount of capital than those in banks. The condition of $(\lambda+\delta-1)-\tau_{t+1}(p\pi\lambda+\delta-1)>0$ implies that a unit of deposits in ROSCAs can yield a higher amount of after-tax capital than the one in banks. This condition guarantees the existence of ROSCAs. Finally, the condition of $\tau_{t+1}<\overline{\tau}$ corresponds to $(1-p_{t+1}\pi\tau_{t+1})\lambda-2\lambda h_0<(1-\delta)(1-\tau_{t+1})$. Note that $(1-p_{t+1}\pi\tau_{t+1})\lambda-2\lambda h_0$ is the expected, net rate of returns from allocating all savings into ROSCAs, while $(1-\delta)(1-\tau_{t+1})$ is the counterpart from allocating all savings in banks. This condition implies that it is not profitable for agents to allocate all savings in ROSCAs. In sum, Conditions TE ensure that while ROSCAs are more efficient than banks in converting savings into capital, it is not optimal for the agent to allocate all savings into ROSCAs due to the presence of transaction costs associated with ROSCAs. Define p^c as $\frac{1-\delta}{\pi\lambda}$. From Conditions TE, we have the following results:

Proposition 1 All else equal, β_t^* is increasing in p, π, and h_0 but decreasing in δ under Conditions TE. Moreover, an increase in τ_{t+1} raises (reduces) β_t^* if $p^c\equiv\frac{1-\delta}{\pi\lambda}<$ (resp. $>$)p.

Increases in the probability of detection of tax evasion p_{t+1}, the fixed penalty

rate π, and the cost parameter of transaction costs of tax evasion (h_0) will increase the marginal benefit of putting more savings into the formal financial sector and hence induce the agent to increase β_t^*. By contrast, an increase in tax rate and the transaction costs of savings through the formal financial sector induces the agent to deposit more savings into the informal financial institutions. For a given τ_{t+1} the government can receive $\tau_{t+1}(1-\delta)$ (resp. $p\pi\lambda\tau_{t+1}$) units of taxes from banks (resp. ROSCAs) per unit of deposits. If $1-\delta > p\pi\lambda$, then an increase in τ_{t+1} enables the government to collect more revenue from deposits in banks. In response to this, the agent will decrease the fraction of savings deposited in banks.

3. TAX EVASION, GOVERNMENT DETECTION, AND ECONOMIC GROWTH

The government in the economy needs to finance an exogenously given, useless expenditure at the end of each period. We assume that the government expenditure at period $t+1$ (denoted as G_{t+1}) is a constant fraction of total output at the same period; that is, $G_{t+1} = \theta y_{t+1}, \theta \in (0,1)$. Moreover, it is costly for the government to audit taxpayers. Following Chen (2003), the total cost of government auditing for a given p_{t+1} at period $t+1$ is equal to $f_0 p_{t+1} y_{t+1}$, where f_0 is a cost parameter of tax detection. Note that the amount of capital converted by banks is equal to $\beta_t^*(1-\delta)S_t$ while the amount of capital converted by ROSCAs is equal to $(1-\beta_t^*)\lambda S_t$. Since capital incomes from ROSCAs are evadable, the government budget constraint can be written as[36]

$$\beta_t^*(1-\delta)S_t\tau_{t+1}\rho_{t+1} + p\pi\tau_{t+1}(1-\beta_t^*)\lambda S_t\rho_{t+1} + \tau_{t+1}w_{t+1} = f_0 p y_{t+1} + \theta y_{t+1}. \quad (12)$$

The total capital stock at period $t+1$ is a summation of capital converted by banks and ROSCAs. Thus,

$$k_{t+1} = [\beta_t^*(1-\delta) + (1-\beta_t^*)\lambda]s_t^*(1-\tau_t)w_t. \quad (13)$$

Given the values of k_t and τ_t the next-period values of k_{t+1} and τ_{t+1} for an exogenously given value of θ are jointly determined by eqs. (12) and (13). Because eqs. (12) and

[36] Eq. (12) implies that the aggregate economy is under equilibrium.

(13) are highly nonlinear, we focus on the balanced growth equilibrium in the rest of our analysis. The balanced growth equilibrium is defined as below:

Definition A balanced-growth equilibrium of the economy is a set of non-negative sequences $\{k_t, y_t, w_t, \rho_t, c_t^y, c_t^o, s_t^*, \beta_t^*\}$ for $t \geq 0$ satisfy eqs. (1)–(10). Moreover, along the balanced-growth equilibrium, k_t, y_t, w_t, c_t^y and c_t^o grow at a constant rate g, while ρ_t, s_t^*, β_t^*, p_t and the tax rate τ_t remain constant overtime.

Since τ_t and p_t are constant in the balanced growth equilibrium, β_t^* is also constant. We now drop time subscripts for the variables that are constant in the balanced growth equilibrium. Updating eq. (3) one period backward and substituting it into eq. (13), we derive the growth rate of the capital stock as

$$\frac{k_{t+1}}{k_t} = g = [\beta^*(1-\delta) + (1-\beta^*)\lambda]s^*(1-\tau)(1-\alpha)A. \tag{14}$$

With the help of eqs. (3) and (4), the government budget constraint in eq. (12) can be rewritten as

$$[(\theta + f_0 p) - \tau(1-\alpha)]y_{t+1} = \tau[\beta^*(1-\delta) + p\pi\lambda(1-\beta^*)]s^*(1-\tau)(1-\alpha)y_t\alpha A. \tag{15}$$

Dividing both sides of eq. (15) by y_{t+1} and knowing that $g = y_{t+1}/y_t$ we can rewrite eq. (15) as

$$\left[\frac{(\theta + f_0 p)}{\tau} - (1-\alpha)\right] = \alpha\frac{[\beta^*(1-\delta-p\pi\lambda)+p\pi\lambda]}{\beta^*(1-\delta-\lambda)+\lambda} = \alpha\frac{[\beta^*(1-\delta-p\pi\lambda)+p\pi\lambda]}{\lambda\left[1-\beta^*\left(\frac{\lambda+\delta-1}{\lambda}\right)\right]}. \tag{16}$$

Substituting β^* into the above equation, we finally have

$$\underbrace{\left[\frac{(\theta + f_0 p)}{\tau} - (1-\alpha)\right]}_{\text{LHS}} = \underbrace{\alpha\frac{2\lambda h_0(1-\delta) - (1-\delta-p\pi\lambda)^2\tau - (\lambda+\delta-1)(1-\delta-p\pi\lambda)}{2\lambda h_0(1-\delta) + [(\lambda+\delta-1) + \tau(1-\delta-p\pi\lambda)]\left(\frac{\lambda+\delta-1}{\lambda}\right)}}_{\text{RHS}}. \tag{17}$$

The equilibrium tax rate is then determined by eq. (17). The LHS of eq. (17) is the ratio of the share of total government expenditure (including its non-productive spending and auditing costs) net of tax revenues from labor incomes over the tax rate, while the RHS is the share of tax revenue of capital incomes plus expected revenues from an audited agent who concealed his capital incomes in ROSCAs. We now characterize eq. (17) as follows:[37]

Lemma 1 (i) $\frac{\partial \text{LHS}}{\partial \tau} < 0$ and $\frac{\partial^2 \text{LHS}}{\partial \tau^2} > 0$; (ii) $\frac{\partial \text{RHS}}{\partial \tau} < (>)\ 0$ if $p^c > (<)\ p$ and $\frac{\partial^2 \text{RHS}}{\partial \tau^2} > 0$ for $\tau < \overline{\tau}$.

While LHS is decreasing in τ, RHS may be an increasing or decreasing function of τ, depending on whether $p^c > p$ and $p^c < p$. Regardless of whether $p^c > p$ or $p^c < p$, it is obvious that if $\tau = 0$ then LHS $= \infty >$ RHS. We next impose the following condition:

Condition TR (Tax Rate):

$$1 > \frac{(\theta + f_0 p)(1 - \delta - p\pi\lambda)}{2\lambda h_0 - (\lambda + \delta - 1)}. \tag{18}$$

Condition TR implies that LHS $<$ RHS when $\tau = \overline{\tau}$ no matter whether $p^c > p$ or $p^c < p$.[38] Hence, Condition TR ensures that LHS and RHS must intersect each other at a unique τ^*, $\tau^* \in (0, \overline{\tau})$ for $p^c > p$ and $p^c < p$. Consequently, we have the following result:

Proposition 2 Under Conditions TR, there exists an unique equilibrium tax rate τ^*, $\tau^* \in (0, \overline{\tau})$, regardless of whether $p^c < p$ or $p^c > p$.

It is interesting to examine the effect of an increase in p on the equilibrium tax rate. To see this, we first obtain the following result:

Lemma 2 For any given τ, $\tau \in (0, \overline{\tau})$, $\frac{\partial \text{LHS}}{\partial p} > 0$ and $\frac{\partial \text{RHS}}{\partial p} > 0$, regardless of whether $p^c > p$ or $p^c < p$.

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[37] The proof of Lemma 1 is available from the author.

[38] In general, there are two equilibrium levels of tax rate. Under Condition TR, however, β^* in the other equilibrium tax rate will be negative, which should not be considered.

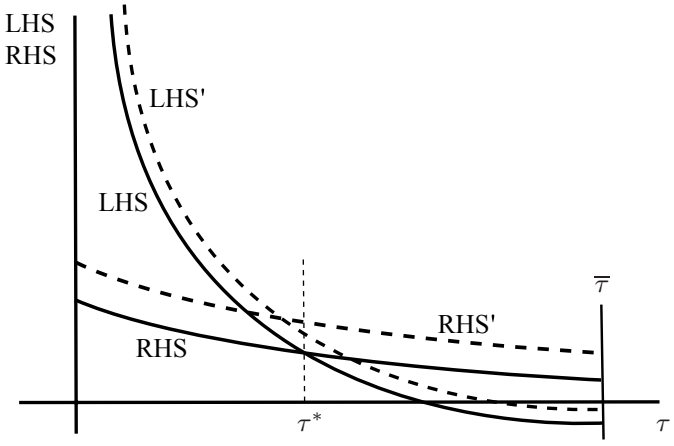

Figure 3 Determination of Equilibrium Tax Rate: $p^c > p$

Lemma 2 implies that an increase in p shifts the loci of LHS and RHS up. Recall that LHS is the share of total government expenditure over government tax revenue of capital incomes. An increase in p leads to an increase in government expenditure of tax detection, all else equal, and hence raises LHS. On the other hand, RHS is the share of tax revenue from capital incomes and expected revenue from the audited agents. An increase in p obviously raises the expected revenue from the audited agent for any given τ and hence shifts the locus of RHS up. Since an increase in p shifts both the loci of LHS and RHS up, its effect on the equilibrium tax rate is ambiguous. However, if f_0 is sufficiently small, then an increase in p only shifts up the locus of LHS slightly, as shown by the dotted lines in Figures 3 and 4. In reality, Chen (2003) reports a very small value of $f_0 = 0.0082$ for Taiwan. Hence, f_0 is assumed to be sufficiently small, and hence we have the following result:

Proposition 3 Assuming that f_0 is relatively small, an increase in p reduces the equilibrium tax rate τ^*, regardless of whether $p^c > p$ or $p^c < p$.

The government chooses an optimal probability of detection p to maximize the social welfare function, which is a summation of the agents' utility of all generations. Denote μ^t, $\mu \in (0, 1)$, as the Pareto weight placed on the utility of generation t. The social welfare function (denoted as W) can be derived as (ignoring constant terms)

$$\begin{aligned} W &= \sum_{t=0}^{\infty} \mu^t U(c_t^y, c_{t+1}^o) \\ &= \frac{1}{1-\mu}\left[(1+\eta)\ln(1-\tau^*) + \eta \ln M + \frac{(1+\eta)\mu}{(1-\mu)} \ln g\right], \end{aligned} \tag{19}$$

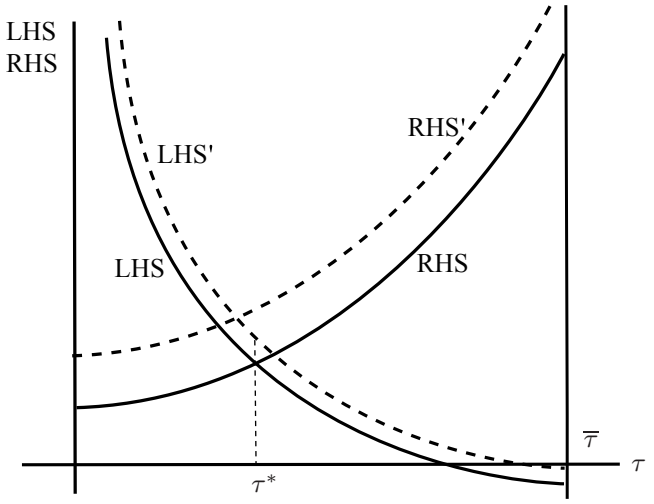

Figure 4 Determination of Equilibrium Tax Rate: $p^c < p$

where g is given in eq. (14) and $M \equiv \beta^*(1-\delta)(1-\tau^*) + (1-\beta^*)(1-p\pi\tau^*)\lambda - h_0(1-\beta^*)^2\lambda$. At first glance, the effect of an increase in p on the social welfare is very complicated. However, one sees that if μ is large enough, then the marginal impact of p on W through its effects on g will dominate its marginal impacts obtained through $(1-\tau)$ and M in eq. (19). Under this condition, the optimal p is mainly determined by the one maximizing economic growth.

Differentiating eq. (14) with respect to p and taking the equilibrium tax rate determined by eq. (14) into account lead to

$$\frac{\partial g}{\partial p} = \Big\{ \underbrace{-[\beta^*(1-\delta)+(1-\beta^*)\lambda]\frac{d\tau^*}{dp}}_{\text{MB}} \underbrace{-(1-\tau^*)(\lambda+\delta-1)\frac{d\beta^*}{dp}}_{\text{MC}} \Big\} s^*(1-\alpha)A. \quad (20)$$

Thus, the optimal probability of tax detection (denoted as p^*), if it exists, is derived by the following equation:

$$\underbrace{[\beta^*(1-\delta)+(1-\beta^*)\lambda]\left(-\frac{d\tau^*}{dp}\right)}_{\text{MB}} \underbrace{-(1-\tau^*)(\lambda+\delta-1)\frac{d\beta^*}{dp}}_{\text{MC}} = 0. \quad (21)$$

From eq. (10) we have

$$\frac{d\beta^*}{dp} = -\frac{(1-\delta-p\pi\lambda)}{2\lambda h_0}\frac{d\tau^*}{dp} + \frac{\tau^*\pi}{2h_0}. \tag{22}$$

Obviously, if $p < p^c$ (so that $1-\delta-p\pi\lambda > 0$), then $\frac{d\beta^*}{dp}$ must be positive. On the other hand, if $p > p^c$ then the sign of $\frac{d\beta^*}{dp}$ is ambiguous. However, if $\frac{d\beta^*}{dp} < 0$ for the case of $p > p^c$, then eq. (20) implies that the optimal probability of tax detection is equal to one, which is not reasonable in reality. Hence, we assume that $\frac{\tau^*\pi}{2h_0} > -\frac{(1-\delta-p\pi\lambda)}{2\lambda h_0}\frac{d\tau^*}{dp}$ for the case of $p > p^c$. Given this, we have the following result:

Proposition 4 Government tax detection is able to induce tax compliance, regardless of whether $p < p^c$ or $p > p^c$.

Given Propositions 3 and 4, the first term in the big braces of the RHS of eq. (20) can be viewed as the marginal benefit (MB) of an increase in p on economic growth. Similarly, the second term is the marginal cost (MC). If there is any change in the exogenously given parameters so that MB and MC change, then eq. (21) can be satisfied either by an increase in p or a decrease in p. We next explore the effects of financial development (measured by a decrease in δ) on the optimal probability of tax detection p^*.

Although we have found an equation that determines p^*, the closed-form solution of this optimal probability cannot be obtained, as the equilibrium tax rate is highly non-linear. Nevertheless, this model is able to yield an implication that it is optimal for developing countries (with a higher level of δ) to adopt a policy of tax enforcement that results in severe tax evasion. To see this, consider now that financial development occurs as the intermediation cost δ decreases. As we stated, financial development (measured by a decrease in δ) may lead to an increase or a decrease in the optimal probability of tax detection p^*. We now consider each possibility in turn.

Case 1 Financial Development Leading to an Increase in p^*

This case arises when financial development intensifies MB and/or attenuates MC, leading to an increase in the optimal probability of tax detection p^*. Accord-

ing to Propositions 3 and 4, an increase in p^* leads to a decrease in τ^* and an increase in β^*. Note also that a decrease in δ also directly affects the optimal tax compliance β^*. To see this, we rewrite eq. (10) as

$$\beta_t^* = \frac{2\lambda h_0 - \tau^*(1 - p\pi\lambda) - \delta(1 - \tau^*) + (1 - \lambda)}{2\lambda h_0}. \tag{10a}$$

Since $(1 - \tau^*) > 0$, a decrease in δ also directly increases the optimal tax compliance β^*. This together with the fact that a decrease in δ leads to an increase in both p^* and β^* indicates that financial development is associated with an increase in p^* as well as β^* but a decrease in the tax rate τ^*. Conversely, developing countries which possess a higher δ and hence a less-developed financial sector should adopt a policy of tax enforcement that leads to more severe tax evasion and a larger size of the informal sector.

Case 2 Financial Development Leading to a Decrease in p^*

If financial development attenuates MB and/or intensifies MC, then financial development leads to a decrease in p^*. Intuitively, this case arises when a marginal decrease in the unit cost of banking transactions induces individuals to increase their deposits in banks to a large extent. Obviously, this increases the government tax revenues to a great extent. To keep the budget balanced, the government reduces its revenues from penalties by reducing the probability of tax detection. According to Propositions 3 and 4, a decrease in p^* leads to an increase in τ^* and hence a decrease in β^*. Though a decrease in p^* leads to a decrease in β^*, the overall effect of a decrease in δ on β^* is not negative. This is because, as shown in eq. (10a) above, a decrease in δ also directly increases β^*. If this direct effect from δ outweighs the one from a decrease in p^* on β^*, then the optimal tax compliance β^* can be increased as a result of a decrease in δ.[39] In this case, we can derive a conclusion that a decrease in δ is associated with an increase in β^*, implying that developing countries with a higher δ should adopt a policy of tax enforcement that leads to severe tax evasion and hence a larger size of the informal sector (i.e., a lower β^*). By assuming that the direct effect from δ outweighs

[39] If this direct effect from δ is outweighed, then a decrease in δ will lead to a decrease in β^*. This implies that developing countries should adopt a policy of tax enforcement that leads to more tax compliance and a smaller size of the informal sector. This case, however, is not consistent with recent empirical studies.

the one from p^* on β^* in Case 2, we reach the following conclusion from Cases 1 and 2:[40]

Proposition 5 If μ is large enough, countries with a less-developed financial sector should adopt a policy of tax enforcement that leads to more severe tax evasion and a larger size of the informal sector.

4. CALIBRATION

Since the equilibrium tax rate τ^* is too complicated to derive, we are not able to obtain an analytical solution for the optimal β^*. To obtain a more concrete image of our results, we calibrate the model by adopting values of parameters from recent studies.

Consider the following values for the model parameters. First, the income share of capital α is set equal to 0.92, as in Turnovsky (2000). Moreover, the cost parameter of tax detection f_0 is equal to 0.0082, the fixed penalty rate π is equal to 1.5, and the cost parameter of tax evasion h_0 is equal to 0.2.[41] All of these are taken directly from Chen (2003). Since the government size in developing countries is between 20% and 30% of GDP, the share of government expenditure θ is set equal to 0.25. If we view each period in the two-period-lived OLG model as 30 years, then the discount factor η is set equal to 0.4, implying that the discount factor for each year is about 97%. We also set $\mu = 0.8$ in the benchmark case, implying that, except the initial generation, the utility of each generation is discounted at 80% in the welfare function. The value of 120 for A is chosen to yield reasonable figures of economic growth.[42] Note that the value of λ is not available from the literature. In order to satisfy the condition of $\lambda + \delta - 1 > 0$ for any possible value of δ, we set $\lambda = 0.95$.

Due to the nature of tax evasion, data related to tax evasion are difficult to obtain, because they usually escape normal statistical registration and documentation. Recently, Beck et al. (2014) employ a large data set from World Bank-IFC to measure

[40] We calibrate our model with a relatively high value of μ (i.e., $\mu = 0.8$) in the next section. We also calibrate the case of a lower value of μ ($\mu = 0.5$). We find that our conclusions still hold for $\mu = 0.8$ or $\mu = 0.5$. Results are available upon request.

[41] The cost parameter of tax evasion h_0 in the benchmark case of Chen (2003) is equal to 0.15. Since we consolidate costs of tax evasion and participation in the informal sector, we assume that h_0 is equal to 0.2 in the benchmark case. Note that Chen (2003) also changes h_0 from 0.15 to 0.39.

[42] Note that β^* and p^* are independent of A.

the degree of tax evasion. The data set is a set of firm-level surveys containing more than 64,000 firm observations across 102 countries over the period 2002 to 2010. From this data set, they construct a tax evasion ratio, which is equal to one minus the share of sales reported for tax purpose. We calibrate our model to yield values of $1-\beta^*$ that are consistent with the tax evasion ratios reported by Beck et al. (2014). According to Table 1 of Beck et al. (2014), the tax evasion ratio ranges from 68% in Gambia to less than 4% in Ireland, indicating that the values of $1-\beta^*$ should lie between 0.04 and 0.68. Since the purpose of our study is to examine the relationship between tax evasion and financial development, we should consider values of δ that can yield values of $1-\beta^*$ in a range of 0.04 and 0.68. Given the above parameter values, we find that $1-\beta^*$ is equal to 0.684 if $\delta = 0.47$. Moreover, if $\delta = 0.078$, then $1-\beta^*$ is equal to 0.04. Consequently, we should consider δ in a range of 0.078 and 0.47.

Before we examine the relationship between financial development and tax evasion, we first examine the relationship between the probability of p and τ^*, β^*, g^*, and W^*, respectively, for a given δ. This can confirm the existence of the optimal probability of tax detection. For this purpose, we choose $\delta = 0.3$, which is in the range of 0.078 and 0.47. Results are presented in Figure 5. As shown in part (A) of Figure 5, an increase in p reduces the equilibrium tax rate τ^* (Proposition 3) for given other parameters. On the other hand, an increase in p increases β^* (Proposition 4) as shown in part (B) of Figure 5. From parts (C) and (D) of Figure 5, the optimal probability of tax detection that maximizes social welfare is equal to 0.735, and the corresponding economic growth rate is equal to 1.676.

We now turn our attention to examining the effects of financial development, measured by a decrease in δ from 0.47 to 0.078 on β^*, τ^*, p^*, g^*, and W^*, where g^* and W^* are economic growth and social welfare when p is optimally chosen. We report the results in Table 1.

Some interesting results are obtained from Table 1. First, financial development in the formal financial sector, represented by a decrease in δ from 0.47 to 0.078 is associated with a decrease in p^*, an increase in τ^*, and hence a decrease in $1-\beta^*$, implying that financial development is associated with a policy of tax enforcement that leads to more tax evasion. This corresponds to Case 2, which we discussed above. Hence, countries with a more developed financial sector should adopt a policy of tax detection that leads to less-severe tax evasion, more tax compliance (a higher β^*), and a smaller size of informal financial sector. This conclusion provides a theoretical explanation for why developing countries with a less-developed financial sector have

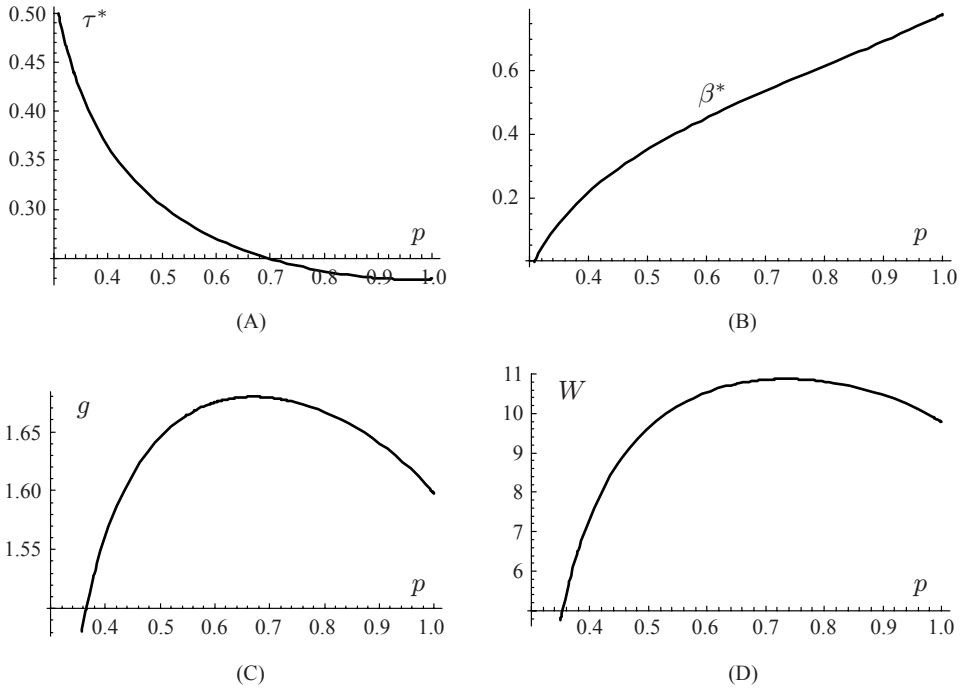

Figure 5 Effects of Increase in p on τ^*, β^*, g, and W

a larger size of informal sector and more severe tax evasion.

Second, a decrease in δ from 0.47 first leads to a decrease in economic growth, until δ reaches 0.275, from where a further decrease in δ leads to an increase in economic growth.[43] This implies that there exists a threshold effect of financial development on economic growth or a nonlinear relationship between financial development and economic growth. This threshold effect has been discovered by many recent studies. Bose and Cothren (1996), for example, present a model with asymmetric information in which lenders may induce self-selection either by rationing and/or screening a fraction of borrowers. While there is no cost associated with rationing borrowers, screening is costly. In this setting, there are two opposite effects of a decrease in the screening cost, which can be viewed as financial development, on capital investment and economic growth. First, it induces the lender to screen more borrowers and hence

[43] As an alternative view from Table 1, the impact of financial development in the formal financial sector, measured by a decrease in δ, may be ambiguous or insignificant on economic growth when $\delta > 0.15$, because a decrease in δ may lead to a decrease or an increase in economic growth. Nevertheless, when $\delta < 0.15$ a further decrease in δ significantly enhances economic growth. This implication is consistent with empirical studies presented below.

Table 1 Effects of a Decrease in δ on β^*, τ^*, p^*, g, and W: The Case of $\alpha = 0.92$

δ	$1-\beta^*$	τ^*	p^*	g^*	W^*
0.470	0.684	0.198	0.936	1.796	12.539
0.450	0.656	0.207	0.895	1.767	12.094
0.425	0.621	0.216	0.853	1.737	11.635
0.400	0.586	0.224	0.819	1.713	11.281
0.375	0.548	0.230	0.791	1.696	11.031
0.350	0.512	0.236	0.769	1.684	10.882
0.325	0.473	0.240	0.750	1.677	10.831
0.300	0.434	0.244	0.735	1.676	10.875
0.275	0.393	0.247	0.722	1.680	11.012
0.250	0.352	0.249	0.712	1.689	11.237
0.225	0.309	0.251	0.704	1.703	11.549
0.200	0.265	0.252	0.697	1.722	11.942
0.175	0.221	0.253	0.692	1.745	12.414
0.150	0.176	0.2542	0.687	1.774	12.960
0.125	0.130	0.2547	0.684	1.808	13.576
0.100	0.083	0.2551	0.681	1.847	14.258
0.078	0.042	0.2554	0.679	1.891	15.000

enables more borrowers to obtain credit. Second, screening more borrowers implies that a larger amount of resources are lost, which is detrimental to capital investment and economic growth. Bose and Cothren (1996) demonstrate that a decrease in δ may decrease economic growth initially.[44] Only when δ falls below a threshold level will a decrease in δ lead to an increase in economic growth. In Deidda and Fattouh (2002), financial intermediation enables individuals to diversify risk so that savings could be more productive. However, transactions in financial intermediation incur fixed costs. Thus, the presence of financial intermediation may first lower economic growth, until the income of the economy reaches a threshold level.[45] Empirical evidence that

[44] See also Hung and Cothren (2002) and Hung (2005). In these models, financial development may first benefit consumption borrowing, which crowds out capital investment and economic growth. The positive correlation between financial development and economic growth can be obtained only when financial development reaches a threshold level.

[45] It is generally believed that the level of financial development is positively correlated with income

confirms the existence of the threshold effects of financial development and economic growth can be found in De Gregorio and Guidotti (1995), Odedokum (1996), Deidda and Fattouh (2002), and Rioja and Valev (2004).[46]

While our model obtains a nonlinear relationship between financial development and economic growth, the mechanism underlying this relationship is totally different from recent studies. By integrating tax evasion with financial dualism, a decrease in δ also leads to two opposite effects on economic growth in our model. First, a decrease in δ induces the agents to allocate more savings into the formal financial sector. This is detrimental to capital investment and economic growth, because the efficiency of banks is less than that of ROSCAs. Second, financial development directly enhances the efficiency of capital investment (through banks), which leads to an increase in economic growth. Table 1 implies that the first (second) effect dominates the second (first) for higher (lower) values of δ.

Finally and more importantly, Table 1 indicates that countries with severe tax evasion can have growth performance similar to that of countries with less-severe tax evasion. For example, the growth rate when $\delta = 0.47$ (less-developed financial sector) and hence $1 - \beta^* = 0.684$ (severe tax evasion) is roughly equal to the one when $\delta = 0.125$ (more-developed financial sector) and $1 - \beta^* = 0.130$ (less-severe tax evasion). This result captures the growth performance of the Asian tigers in the 1980s and 1990s well, as countries with a less-developed financial sector and severe tax evasion (such as Taiwan and Korea) can have growth performance similar to that of countries with a more developed financial sector and less severe tax evasion (such as Hong Kong and Singapore).

5. DISCUSSION

Several aspects of our modeling strategy merit comments. First, we abstract from issues related to tax evasion of labor incomes in this model. Tax evasion of labor incomes can be introduced by assuming that young agents may underreport their labor incomes to the tax authority or allocate some labor into production in the informal

level. Given this, Deidda and Fattouh's (2002) model implies a nonlinear relationship between financial development and economic growth.

[46] While different techniques of estimation in these studies may lead to different conclusions, these studies generally conclude that there is a nonlinear relationship between financial development and economic growth.

sector. This consideration, however, will only complicate our analyses without adding new insights. Recall that the purpose of this paper is to illustrate a possibility that it may be optimal for developing countries to adopt a looser policy of tax enforcement. As we have shown, this possibility hinges on the two following facts: First, a young agent may deposit a fraction of savings in ROSCAs for the purpose of evading tax on capital incomes. Second, ROSCAs may be more efficient than banks in facilitating capital investment. The fraction of young agents' savings deposited in ROSCAs, however, is determined by the costs and benefits of doing so. The costs include the rate of returns from deposits on banks and the possibility of concealing capital incomes from being audited. On the other hand, the benefits are the possibility of evading taxes on capital incomes. Obviously, whether the young agent can evade taxes on labor incomes or not plays no role in influencing the costs and benefits of this decision.[47]

Second, our model has a feature that the choice of deposits in ROSCAs is equivalent to the choice of tax evasion. Again, we make this assumption to simplify our analysis. We may, as an alternative, separate this decision into two distinct decisions such that young agents determine the fraction of savings deposits in ROSCAs at period t and underreport capital incomes (derived from banks and ROSCAs) to the tax authority at period $t+1$. Following Gordon and Li (2009), the government can access banks' records of agents and use them to enforce tax payment. By contrast, the government does not have any control on ROSCAs, so taxes on capital incomes derived from ROSCAs are evadable. Given this, the old agent at period $t+1$ will report all capital incomes derived from banks but underreport those derived from ROSCAs. As a rational agent, the young agent, who decides the fractions of savings deposited in banks and ROSCAs at period t, will take this disparity of tax evasion on capital incomes in the next period into account. Specifically, suppose that the government announces that the probability of tax detection p will be increased in the next period (i.e., at period $t+1$), which will induce the (old) agent to report a greater fraction of capital incomes derived from ROSCAs to the tax authority. Knowing that he will be forced to report more capital incomes derived from ROSCAs at the next period, the agent will reduce the fraction of savings deposited in ROSCAs at period t, because deposits in ROSCAs

[47] The presence of tax evasion of labor incomes will change the amount of after-tax labor incomes and hence savings S_t. The fraction of savings deposited in ROSCAs, however, is not affected by the amount of S_t. Note that tax evasion is less severe in wages and salaries, as both are covered by withholding (Clotfelter, 1983). By contrast, the reporting rate of capital incomes is much smaller. This may give an alternative reasoning that considering tax evasion on capital incomes seems more important. We also thank an anonymous referee for bringing this point to our attention.

incur transaction costs. Consequently, an increase in p at period $t+1$ will result in a higher fraction of reported capital incomes at period $t+1$ and a lower fraction of savings deposited in ROSCAs at period t. In our current model, both are equivalent to a higher value of β^*. Consolidating these two different decisions into one, however, can simplify our analysis without losing generality.

Third, one may think that the integration of the choices of deposits in ROSCAs and tax evasion may not be consistent with reality. Indeed, the majority of tax evasion in developing countries is due to their industrial structure of small retail business and small manufacturing, rather than ROSCAs.[48] Nevertheless, we think that our model is consistent with the majority of tax evasion in developing countries, since agents who intend to engage in small business and manufacturing usually seek external funding from informal financial institutions. Tang (1995), for example, provides a comprehensive survey on the roles of informal financial institutions in developing countries with a focus on Taiwan. Specifically, credit markets in developing countries are segmented, as large-scale firms seek external financing from banks while small-scale ones borrow from informal financial institutions. More recently, Beck et al. (2008), using a firm-level survey database covering 48 countries, confirm that small firms use significantly more informal finance than large firms, especially in countries with underdeveloped financial markets. Moreover, they find that small firms, even with access to informal and other financing, still face severe financial constraints.[49] Given that the majority of tax evasion in developing countries is by small-scale firms which obtain loans from ROSCAs, our setting in which capital incomes derived from deposits in ROSCAs are tax evadable should be consistent with reality.

Our model also abstracts from the possibility that government spending may facilitate private production as in Chen (2003), who adds tax evasion into Barro (1990) and examines the effects of tax evasion on the optimal tax rate, the optimal share of government public spending, and economic growth. By optimizing individual's behavior of tax evasion, Chen (2003) finds that tax evasion has a negligible effect on economic growth if the degree of externality of public spendings is less than 0.2, which seems to be consistent with some empirical studies.[50] Note that a lower degree of the ex-

[48] We thank an anonymous referee for raising this point.

[49] This implies that the amount of loans offered in credit markets (through formal or informal institutions) is determined by the supply side, not the demand side of small firms. Thus, this paper focuses on deposits in informal financial institutions (the supply side of loans), not the demand side of loans from small firms.

[50] Various conclusions regarding the degree of externality of public spending are obtained by recent

ternality of public spending actually implies that government spending is relatively unimportant to output production and hence economic growth. From this, the effects of tax evasion on economic growth, through influencing government tax revenues and hence spending, are also unimportant. It should be noted that a small degree of the externality of public spending in Barro (1990) implies that private capital investment is the key impetus to output production and hence economic growth. In other words, if the degree of externality of government spending is small, we should focus on how tax evasion directly influences capital investment, instead of emphasizing how tax evasion affects government tax revenues and spendings. Consequently, we do not consider the possibility that government spending may facilitate private production.

Our analysis focuses on the optimal probability of tax detection. As stated, Chen (2003) examines the optimal tax rate with the presence of tax evasion. In the literature of tax evasion, however, both the tax rate and the optimal probability of tax detection have been the central issues of investigation. Without considering the productive role of government spending, it should be noted that the tax rate and the optimal probability of tax detection are actually interrelated under the balanced government budget. Indeed, as we have seen from eq. (17), an increase in the optimal probability of tax detection leads to a decrease in the tax rate for a given constant share of government useless spending. In fact, our conclusions will not change if we derive an optimal tax rate first and allow eq. (17) to determine the optimal probability of tax detection. Since our purpose is to illustrate the possibility that it may be optimal for developing countries to adopt a looser or stricter policy of tax enforcement, we choose to obtain the optimal probability of tax detection, instead of the optimal tax rate.

It may be worth comparing our model with Chen (2003). The focus of Chen (2003) is the optimal tax rate and optimal government spending. The probability of tax detection is exogenously given in his analysis. The optimal tax rate is derived in Chen (2003), as an increase in the tax rate raises two different effects. First, it raises government spending, which facilitates private production. Second, it results in additional distortions, which is detrimental to private production. By abstracting from the productive role of government spending in our model, the first effect of Chen (2003) disappears. Nevertheless, the endogenous choice of the probability of tax detection (and hence the optimal tax rate) brings in a new set of two opposite effects to the econ-

empirical works, ranging from no significant effect to a strongly positive effect of public capital on output. See Bom and Ligthart (2008) for a discussion. In this paper, we follow Chen (2003) by assuming a small degree of the externality (productivity) of public spending in the Asian tigers.

omy. This may lead to a question as which mechanism of obtaining the optimal tax rate between Chen (2003) and ours is more reasonable. It should be noted that there is no clear-cut answer to this question. Indeed, we wish to illustrate the possibility that it may be optimal for developing countries to adopt a looser policy of tax enforcement. Hence, we focus on the optimal probability of tax detection. If one intends to investigate how tax evasion influences government tax revenues and spendings, the mechanism of Chen (2003) should be emphasized.

6. CONCLUSION

This paper integrates tax evasion and financial dualism in a simple endogenous growth model. We show that, in addition to the tax rate and tax enforcement policies, the relative efficiency in converting savings into capital between the formal and informal financial sectors also plays a role in determining the behaviors of tax evasion.

Under this setting, we find that it may be an optimal policy for a government with a less-developed formal financial sector to choose a policy that allow a larger extent of tax evasion. Since concealed capital incomes are accumulated through informal financial sector, an increase in the level of tax evasion implies that more savings are channeled into the more efficient informal financial sector. This facilities capital investment and economic growth. By contrast, a government with a more developed formal sector should provide a stricter environment to mitigate tax evasion. More importantly, these two types of countries may have very similar economic growth performance. These results may provide an explanation for the growth experience of the Asian tigers in the 1980s and 1990s.

Our model yields a testable implication for future studies related to the Asian tigers. Specifically, an increase in the probability of tax detection is associated with a decrease in the tax rate. Moreover, this implication is based on an assumption that the government takes the share of its expenditure as given, and then adjusts the tax rate and the detection probability to balance the budget. We, however, are not able to find a reliable set of data consisting of tax rates, the detection probability, and government behavior of the Asian tigers in the 1980s and 1990s. Future studies may try to collect the data and test these issues.

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逃漏稅, 金融雙元性與經濟成長

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摘　要

本文建立一個包含有金融雙元體系的內生成長模型,以探究政府的最適逃漏稅稽查政策。模型中,人們可透過正式的金融體系或非正式金融體系累積資本,並且由非正式金融體系所獲得的資本所得可以逃漏稅但由正式金融體系所獲得的資本所得無法逃漏稅。延續結構學派的看法,我們發現適度的允許資本逃漏稅對開發中國家而言是一個最適的政策。相反的,已開發國家政府應致力減少逃漏稅。此外,逃漏稅愈嚴重,地下金融體系規模就愈大。因此,本文發現開發中國家,相對於已開發國家,有較嚴重的逃漏稅及較大規模的地下金融體系。最後,本研究的模擬分析也發現,具有較嚴重逃漏稅及較大規模的地下金融體系國家,其經濟成長表現可以和逃漏稅較不嚴重國家及地下金融體系較小的國家相類似。這個結果與1980 年代和1990 年代亞洲四小龍的經濟成長經驗相符合。