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MARKET FLUCTUATIONS AND ECONOMIC GROWTH

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Abstract: *The economics growth depend on long term credit policy and this policy could be very costly. Further to higher costs of lending capital result could be lower capital accumulation, slower economic growth and stronger needs for welfare. That is why some new economic approach with stronger impact of government institutions. These institutions would be dedicated to preserve stronger economic growth and lower need for social welfare.*

Keywords: *credit market, economic growth, endogenous growth, strategy, economic development*

INTRODUCTION

An increasing amount of interest and a growing body of work has been emerging in the literature applying principal-agent contract theories to analyze macroeconomic issues, such as business cycles, capital accumulation, and economic growth. For example, Williamson studies the effect of equilibrium credit rationing in a financial market with a costly state verification problem. In a model with agency costs varying inversely with borrowers' net worth, Bernanke and Gertler argue that credit market imperfection can amplify and propagate the external shocks to create significant economic fluctuations. Bose and Cothren examine the adverse effects of ex ante asymmetric information on growth in a model that allows for both rationing and screening contracts. More recently, Ho and Wang investigate the effects of adverse selection in the credit market on public capital provision, taxation policy, and economic growth.

However, it is well recognized that the self-selection equilibrium used in many of these applications does not satisfy the time consistency property, as long as there are costs associated with the revelation principle in sustaining such an equilibrium. This problem of time (in) consistency can be simply stated as follows. In a typical principal-agent environment with the presence of asymmetric information, if agents end up self-selecting themselves according to their true types in equilibrium, the principal has the incentive to forgo the costly enforcement activities, such as screening or auditing as the case may be, that are specified and required in equilibrium contracts so as to induce the self-selection of agents in the first place1. Moreover, there is another drawback associated with the self-selection equilibrium: it implies that all agents in those principal-agent setups will not lie about their types, and none will be detected of doing such, in equilibrium. This predication certainly appears to be at odds with the casual observation that fraudulent reporting and claims made by individuals and companies are, in fact, quite pervasive in real life. Indeed, anecdotal and empirical evidence of corporate and individual fraud have been well documented2.

The present paper studies the credit market equilibrium without the aforementioned time inconsistency problem and explores its implications for economic growth and welfare in an endogenous growth framework. Specifically, we consider a credit market in which investment returns are privately observed by borrowers and where state verification by lenders is costly. We will assume that lenders cannot commit to an auditing strategy when making their loan offers to borrowers and the interaction between lenders and borrowers is modelled as a two-stage problem. In the first stage, lenders choose and offer the optimal contracts comprising the loan rates and the loan size. In the second stage, lenders and borrowers play a simultaneous Nash game to decide on their auditing and cheating strategies, respectively. Under this setup, the auditing strategy is not announced in the first stage as a part of the contractual terms because of the lack of auditing commitment, and, instead, the equilibrium auditing and cheating strategies are simultaneously determined as the mutual best responses to each other in the second-stage Nash game. The equilibrium auditing strategy determined through this process is, therefore, no longer subject to the aforementioned time inconsistency problem. Furthermore, it will become clear that the Nash equilibrium in the second-stage game is characterized by mixed-strategies for both lenders and borrowers, implying that both auditing and cheating will occur with positive probabilities in equilibrium. Consequently, the credit market equilibrium in this setup exhibits a certain degree of cheat-

1 Perhaps less obvious, a similar argument also applies in cases with rationing contracts that do not require costly contract enforcement (see Bencivenga and Smith 1993; Bose and Cothren 1996, 1997). In equilibrium, once the lenders announced the loan contract terms, including the probability of obtaining funds, borrowers will self-select in accordance with their own types. Rationing is then no longer optimal for the lenders: they can simply deny loans to the undesirable borrowers and allocate all funds to the borrowers of the preferred type.

2 For example, some recent corporate accounting scandals, such as the Enron case, have been well documented. In addition, in the context of tax evasion, Andreoni, Erard, and Feinstein (1998) estimated that the nominal tax gap, defined as the difference between the income taxes households owed and what they actually reported and paid voluntarily, had almost a fivefold increase from \$22.7 billion to \$95.3 billion in the United States for the tax years from 1973 to 1992.

ing on the part of agents – an implication that squares well with documented evidence of cheating behaviour in real life.

More precisely, we consider a widely studied contractual environment with costly state verification. In this environment, borrowers (agents) seek loans from lenders (the principal) to finance their investment projects, the random returns (high or low) of which are observed by agents themselves and can be verified by the principal only through costly auditing. As is typical in this kind of principal-agent situation, the self-selection equilibrium contracts assume a form whereby the borrowers who report low returns are audited with a positive probability, whereas those who report high returns are never audited. However, as described earlier in the time inconsistency problem, this type of equilibrium can easily unravel because of the incentives of lenders to forgo the costly auditing once borrowers are induced to report their true investment returns. For such a self-selection equilibrium to be viable, one needs to assume (either explicitly or implicitly) that the lenders can commit to the pre-announced auditing policy. However, such an assumption on lenders' commitment is indeed questionable on several grounds. First, this assumption is against lenders' self-interest. Second, in most of the existing literature, the interaction between borrowers and lenders lasts for only one period and hence precludes the possibility of using any reputation mechanism to resolve the time inconsistency problem3. Moreover, the lack of proper institutional mechanisms to enforce and bind lenders' auditing decisions will ultimately render such commitment (by lenders) untenable. Thus, for much of our analysis, we will take the position that it is, in fact, impossible for lenders to commit to any pre-announced auditing strategy, and such inability to commit by lenders is known to borrowers as well.

We then embed the aforementioned credit market friction into a framework similar to those in Bernanke and Gertler and Bhattacharya. The economy comprises overlapping generations of heterogeneous agents who live for two periods. In each period, young lenders (or workers) earn their wage income, which, in turn, constitutes the source of loan supply in the credit market, by supplying their endowed labour to the labour market. On the other hand, young borrowers (or entrepreneurs), who are endowed with capital-producing projects, approach lenders for loans in the credit market amid the previously described informational frictions. To understand the consequences of the inability-to-commit assumption, we first discuss the benchmark model with the conventional assumption that commitment to pre-announced auditing is always upheld by lenders. Unsurprisingly, the usual self-selection equilibrium in the credit market prevails in this benchmark model. Next, we examine our main model under the assumption that lenders cannot commit to a pre-announced auditing policy. In this case, the auditing strategy by lenders is simultaneously determined with the cheating strategy by borrowers as the equilibrium of Nash game. By contrasting the benchmark model with the main model, we can then show how the lenders' ability to commit, or the lack of it, will affect the nature of the credit market equilibrium and subsequently the macroeconomy.

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3 Bose and Cothren (1996) rely on a brand name that each lender purchases from a lender of the previous generation as a commitment device to solve the time inconsistency problem – only if a lender honours the brand name by implementing the terms of the separating contracts can he sell his own brand name in the future. However, determining how such a mechanism can be matched with real-world practices is difficult.

Our analysis yields the following main findings. First, although the equilibrium contracts in both cases with and without commitment to auditing offer the same loan rate to borrowers who report low returns, the case without commitment to auditing has a higher equilibrium loan rate for borrowers who report high returns. The reason behind this result is that when lenders cannot commit, the equilibrium contract entails some cheating activities (underreporting) by borrowers with high investment returns, which, in turn, will lower lender's expected payoff in the high-return state. As a result, lenders have to charge a higher loan rate for borrowers who truthfully report high returns to compensate for the loss of revenue arising from the cheating borrowers in this state. Second, the inability to commit will result in a higher auditing probability in equilibrium compared with the benchmark model. This result arises from the fact that the higher loan rate for borrowers with high returns under the no-commitment regime will also increase the incentives for these borrowers to cheat, so the auditing probability must then increase to keep the borrowers indifferent between cheating and complying. Auditing is wasteful because it expends resources, so the more frequent auditing arising from the inability to commit will result in less capital accumulation and lower economic growth. In addition, owing to the higher loan rate that borrowers with high investment returns need to pay in our main model, the inability to commit is associated with a lower level of social welfare as well.

The approach to the credit market equilibrium in the present paper follows closely the strand of literature on contracting under the lack of commitment. An early example of this line of research can be found in Graetz, Reinganum, and Wilde, who study a game between taxpayers and a tax collector (IRS) where in the auditing strategy of IRS cannot be committed ex ante, and an individual taxpayer's cheating strategy and IRS's auditing strategy are characterized by the Nash equilibrium. In a general principal-agent model, Khalil shows that, in the absence of auditing commitment by the principal, auditing will take place only if cheating occurs in equilibrium so that the principal can expect to collect penalties to cover the auditing costs. In a banking framework, Khalil and Parigi show that loan size can be used as a commitment mechanism to mitigate the problem stemming from the lack of commitment to auditing by banks. Bester and Strausz modify and extend the revelation principle in more general environments, wherein the principal cannot commit to the outcome induced by a mechanism. In the generalized equilibrium, the agent's optimal strategy entails truthful reporting only with a positive probability. By adding the auditor as an independent player to a principal-agent model, Khalil and Lawarree add another level of complexity in studying the dual problem of commitment (by principal) and collusion (between auditor and agent) in auditing, and consequently they derive an equilibrium that entails positive probabilities of shirking, collusion, and detection. More recently, Leoni applies a similar approach to examine the strategic game between banks and their regulators when regulators lack the commitment to audit and sanction, showing that the optimal contract typically involves a positive probability of fraudulent reporting by banks.

The present paper lends itself well to the expanding line of inquiry that examines the role of institutional factors in economic growth and development. The received wisdom that emerges from this literature argues that institutional factors offer a potential explanation for the divergent growth experiences across different countries, particularly in weak institutions that result in slower economic growth. For example, La Porta, Lopez-de-Silanes, and Shleifer, Levine, and Hall and Jones all find that strong institutions in the legal enforcement of private property rights, support of private contractual arrangements, and protection of the legal rights of investors, foster financial development, which, in turn, promote capital accumulation and economic growth. Beck and Levine provide a more detailed survey on this law-finance-growth nexus, suggesting a strong link among legal institutions, financial development, and growth. In a recent paper using data on a cross-section of 17 countries covering the period from 1880 to 1997, Bordo and Rousseau find that deep institutional fundamentals, such as legal origin and a number of political factors, can explain a good part of the cross-sectional variation in financial development and growth. Castro, Clementi, and MacDonald show both theoretically and empirically that the positive effect of investor protection on growth is stronger for countries with lower restrictions on capital flows. Acemoglu, Johnson, and Robinson study the interaction between political power/institution and economic institution (in the sense of private property right protection) and argue that economic institutions encourage economic growth when political institutions allocate power

to groups with interests in broad-based property rights enforcement. In all of these studies, institutional strength is customarily measured in terms of protecting creditors' rights and reining in borrowers' fraudulent behaviour. In contrast, we focus instead on the importance of constraining lender's behaviour and making their pre-announced auditing policies binding and credible. Given that even in economies that are commonly associated with strong legal/political institutions, the (ex post) decisions on whether or not to conduct auditing on borrowers are largely left to the discretion of lenders, our analysis suggests that introducing some commitment mechanisms to bind such free choices of the lenders can be economically and socially valuable[4]. Viewed in this light, the present paper offers a new micro-economic channel in a macroeconomic setting through which institutional failings (i.e., the lack of commitment mechanisms) can generate greater credit market distortions, lower economic growth, and lower social welfare.

The remainder of the current paper is organized as follows. Section 2 lays out the basic environment. We then study in section 3 the benchmark model, where commitment to auditing by lenders is assumed. The analysis of the main model with no auditing commitment follows in section 4. Section 5 compares the economic growth rates and the social welfare of the two models in the preceding sections. We conclude and discuss some possible extensions in section 6.

4 One possible commitment mechanism of this sort is perhaps to delegate auditing to a third-party, independent auditor. The auditor automatically conducts the necessary auditing, on behalf of the lender (for a fee of course), according to the probability specified in the offered contract initially. In this way, the pre-announced auditing strategies by the lenders are more likely to be binding, because the independent auditors have incentives (the fees to be collected) to follow through with the pre-announced auditing even if the lenders themselves do not. Of course, this mechanism of delegated auditing is only as effective as the system that monitors the independent auditors themselves, as the recent corporate scandals involving some of the accounting powerhouses like Arthur Anderson have shown.

1. THE ASSUMPTIONS

The basic framework of our model is similar to those of Bernanke and Gertler and Bhattacharya. In the economy, there is an infinite sequence of two-period lived overlapping generations. All generations are identical in size and composition, each generation comprising an equal number of lenders (or workers) and borrowers (or entrepreneurs). The population of young lenders/borrowers is normalized to a continuum with a measure of one (thus, the population of each generation has a measure of two). Lenders are initially workers who are endowed with one unit of labour when young, which is supplied inelastically on the labour market at the competitive wage rate. They then play the role of lenders, as their wages provide the only source of loanable funds in the economy. On the other hand, each borrower is an entrepreneur who is endowed with a project that produces capital goods that needs to be financed externally. The output of a borrower's project can take one of two possible values of $\kappa 1$ and $\kappa 2$, where $0 \leq \kappa 1 < \kappa 2$. The event $\kappa 1$ (bad state) occurs with the probability $\pi 1$ and $\kappa 2$ (good state) with $\pi 2$, where $\pi 1 + \pi 2 = 1$. Therefore, for $i \in \{1, 2\}$, an investment project can, with probability πi, convert one unit of consumption good at time t into κi units of capital good at time $t + 1$. All capital goods are supplied competitively at the market rental rate. For simplicity, both borrowers and lenders are also assumed to be risk neutral and consume only when they are old.

The credit market operates as in Bencivenga and Smith. In each period, after earning the market wage, a young lender can lend his wage income to a borrower in exchange for consumption goods in the next period. A lender makes an offer of a loan contract and, if the contract is not dominated by others, a borrower will approach him to sign the contract. In equilibrium, each lender will be approached by one borrower only, and the competition among lenders in the credit market will drive a lender's expected economic profit to zero[5]. As an alternative to supplying his loanable funds in the credit market, a lender has access to a default, risk-free technology that converts one unit of his wage at time t into q units of consumption good at time $t + 1$.

To introduce asymmetric information in the credit market, we assume that a lender can observe the output level, $\kappa 1$ or $\kappa 2$, of an individual borrower only after costly auditing. Specifically, δ amount of capital goods, per unit of the loan, will be lost in the auditing process. The project returns of a borrower will be appropriated by the lender if the borrower is caught lying under auditing. Each borrower becomes a firm owner in his old age, producing the consumption good by hiring capital and labour at the market rates.

Each firm at time t produces the final good, which can be used for either consumption or investment, according to the Cobb-Douglas production function:

$$Y_t = A\,\overline{k}_t^{\,\alpha} k_t^{\gamma} l_l^{1-\gamma}$$

5 There is a long tradition in modelling the credit market equilibrium in ways whereby lenders offer the best contract to optimize borrowers' expected payoffs/utility. Examples include Townsend (1979), Bernanke and Gertler (1989), Bencivenga and Smith (1993), Bose and Cothren (1996), Ho and Wang (2007), and Sevick (2011), among many others. Such an approach is equivalent to assuming that the financial intermediary sector is competitive with free entry, which is consistent with having a continuum of lenders in our model.

where yt is the output per firm, A is a technology parameter, $\bar{k}t$ is the average capital stock per firm, kt is the capital input of the firm, and lt is the labour input of the firm. To sustain perpetual long-run growth, it is assumed that $\alpha = 1 - \gamma$ with $0 < \gamma < 1$, as in the endogenous growth literature (see, e.g., Romer 1986). All firms hire the same amount of labour and the number of borrowers and lenders is equal, so the number of labour force per firm, lt, must be equal to one in each time period. The symmetry of firms also implies that $\bar{k}t = kt$ for all t. Hence, the rental rate, ρt, and the wage rate, wt, in period t are equal to the marginal products of capital and labour, respectively:

$$\rho t = \gamma A$$
$$wt = A(1 - \gamma)kt.$$

Without loss of generality, physical capital is assumed to depreciate fully after one period of use. Finally, we maintain the following technical conditions throughout the present paper:

$$\gamma A\kappa 1 < q < \gamma A(\pi 1\kappa 1 + \pi 2\kappa 2 - \delta).$$

The first inequality implies that the return from the risky investment in the bad state is less than that from the risk-free, default technology. The second inequality is adopted to guarantee the expected (net) return of the risky investment to be superior to the return of the risk-free technology.

2. METHODOLOGICAL APPROACH

As the basis for comparison, we first study a model in which the commitment to pre-announced auditing by lenders is taken to be binding. As argued above, such a presumption is necessary to avoid the time-consistency problem in a large number of previous studies with principal-agent setups. In this case, the loan contract at time t offered by a lender to a borrower can be specified as $C_t=[\varphi 1_t,\varphi^2_t,R^1_t,R^2_t,x_t]$, where$\varphi^1_t$ andφ^2_t are the auditing probabilities when low and high output levels are reported, respectively; R^1_t and R^2_t are the gross loan rates (in real terms) when low and high output levels are reported, respectively; and x_t is the loan size[6].

Following the tradition in the literature, we will consider the equilibrium contracts that give rise to the self-selection of borrowers. The expected payoff to a borrower of generation t in such an equilibrium is then given by

$$\pi_1\left(k_1\rho_{t+1} - R_t^1\right)x_t + \pi_2\left(k_2\rho_{t+1} - R_t^2\right)x_t$$

6 As in Khalil (1997) and Wang and Williamson (1998), we do not further differentiate between the loan rate in the state with auditing and that in the state without auditing to simplify the analysis.

Furthermore, to induce borrowers to truthfully report their output levels, the following incentive compatibility constraints must be satisfied:

$$(k_1 \rho_{t+1} - R_t^1)x_t \geq \left(1-\phi_t^2\right)\left(k_1\rho_{t+1} - R_t^2\right)x_t$$

$$(k_2 \rho_{t+1} - R_t^2)x_t \geq \left(1-\phi_t^1\right)\left(k_2\rho_{t+1} - R_t^1\right)x_t$$

Because of the competition in loan making in the credit market, lenders will earn zero expected economic profit in equilibrium. This zero profit condition can be expressed as:

$$\pi_1\left[\phi_t^1\left(R_t^1 - \delta\rho_{t+1}\right) + \left(1-\phi_t^1\right)R_t^1\right]x_t + \pi_2\left[\phi_t^2\left(R_t^2 - \delta\rho_{t+1}\right) + \left(1-\phi_t^2\right)R_t^2\right]x_t = qx_{t1}$$

The left-hand side of this equation describes the expected income from making loans and the right-hand side the forgone income of the loan. In addition, the equilibrium loan size must also satisfy the following feasibility constraint:

$$x_t \leq w_t$$

The equilibrium in the credit market can then be defined as follows.

DEFINITION 1. *An equilibrium in the credit market with commitment to audit is represented by a sequence of contracts* {*Ct*},*where* *Ct* = [ϕ_1^1, ϕ_t^2, R_t^1, R_t^2, x_t], *that maximizes previous values, taking the price sequences of* {ρ*t*} *and* {*wt*}*as given.*

We proceed with deriving the equilibrium contracts by assuming a standard property in this type of model with adverse selection: in equilibrium, only the incentive compatibility constraint for reporting high output, is binding, but not that for reporting low output[7]. As a result, the binding incentive compatibility constraint of yields

$$\phi_1^1 = \frac{R_t^2 - R_t^1}{k_2\rho_{t+1} - R_t^1}$$

7 Indeed, (6) can be easily verified to hold with strict inequality and (7) to hold with equality once the complete equilibrium contracts are derived. Intuitively, this property arises primarily because, in equilibrium, the loan rate for reporting the low output level is lower than that for reporting the high output level (i.e., $R_{1t} < R_{2t}$). Hence, borrowers with high project returns have incentives to masquerade as having low project returns, but not vice versa.

Making use of the zero-profit condition, one can show that the expected payoff to a borrower is strictly decreasing in the auditing probabilities of ϕ_t^1 and ϕ_t^2. Thus, since the incentive compatibility constraint is not binding, implying that a borrower with the low output will not have incentive to report the high output, auditing any borrowers who report a high level of output will not be optimal for lenders in equilibrium, that is, ϕ_t^2 = 0. Moreover, it follows that ϕ_t^1 is strictly decreasing with . Hence, lenders will set as high as possible, that is R_t^1 = γAk$_1$, to maximize the borrower's expected payoff. The equilibrium loan rate for borrowers reporting the high output level can then be solved from zero condition:

$$R_t^2 = \frac{q}{\pi_2} - \frac{\gamma A \pi_1}{\pi_2}\left(k_1 - \delta\pi_1\right)$$

When we substitute in association with R_t^1 =γAk$_1$,the auditing probability for borrowers reporting the low output level is given by:

$$\phi_t^1 \equiv \phi = \frac{q - \gamma A k_1}{\gamma A\left[\pi_2\left(k_2 - k_1\right) - \delta\pi_1\right]}$$

where 0< ϕ <1 follows from the technical assumptions.

Combining, we can derive the equilibrium loan rate for borrowers reporting the high output level as:

$$R_t^2 = \frac{\left(k_2 - k_1\right)\left(q - \gamma A\pi_1\right) - \delta\gamma A\pi_1 k_1}{\pi_2\left(k_2 - k_1\right) - \delta\pi_1}$$

It is worth noting that, from (13), > (=) holds under technical condition. Finally, it can be easily verified that in equilibrium are non-negative for *i* = 1,2. Consequently, condition where is must hold with equality in equilibrium, which determines the loan size for borrowers.

We now summarize the above results in the following proposition.

PROPOSITION 1. *In each period t, the equilibrium loan contract with auditing commitment is given by:* $C_t = \left[\phi_t^1, \phi_t^2 R_t^1, R_t^2 x_t\right]$, where $\phi_t^1 = \dfrac{q-\gamma A k_1}{\gamma A\left[\pi_2\left(k_2-k_1\right)-\delta\pi_1\right]}$ = 0,

$$R_t^1 = \gamma A k_1,\ R_t^2 = \frac{\left(k_2-k_1\right)\left(q-\gamma A\pi_1\right)-\delta\gamma A\pi_1 k_1}{\pi_2\left(k_2-k_1\right)-\delta\pi_1},\ x_t \le w_t.$$

Notably, the next period's capital is produced by the investment projects of current borrowers. For the reason that borrowers who report high output level are never audited, whereas those with low output level are (with probability φ), recalling the investment technology of the borrowers and full depreciation of capital, the economy-wide capital stock at time *t* + 1 is given by

$$K_{t+1} = (\pi_1 k_1 + \pi_2 k_2 - \delta\pi_1\phi)\ w_t$$

Recalling that *wt* = *A*(1 – γ)*kt* and making use of the fact that *Kt* = *kt* (since the size of firms is normalized to one), we see that the growth rate of capital stock, and hence that of aggregate production, over period *t* is given by

$$g_t \equiv \frac{K_{t+1}}{K_t} = A\left(1-\gamma\right)\left(\pi_1 k_1 + \pi_2 k_2 - \delta\pi_1\phi\right)$$

For simplicity, we measure the economy-wide social welfare in period *t* by the sum of the expected payoffs to generation-*t* – 1 borrowers and lenders[8]:

$$W_t = \pi_1\left(\gamma A k_1 - R_t^1\right)w_t + \pi_2(\gamma A k_2 - R_t^2)\ w_t + q w_t$$

Only old individuals consume in our model, so this welfare function also measures the aggregate consumption of all individuals in period *t*. We can further verify, as we do in the appendix, that in equilibrium, this aggregate consumption is indeed equal to the amount of goods available for consumption and, together with the market clearing for investment, the final goods market clears in every period.

Auditing with commitment enables lenders to use pre-announced auditing probabilities to achieve self selection from borrowers. However, this assumption is indeed problematic, as the derived credit market equilibrium is not sub-game perfect for lenders: Once the borrowers are induced to reveal their output levels truthfully, auditing is no longer optimal

8 Clearly, the welfare function we adopt here is rather special in that it considers only one generation at one point of time and weighs borrowers and lenders of each generation equally. However, as we point out in footnote 12, our welfare analysis also applies to cases with quite general welfare specifications.

for lenders. In what follows, we will characterize the optimal contracts under which this assumption no longer holds and subsequently study the effects of this condition on economic growth and social welfare.

3. THE STRATEGIC IDEA OF THE MODEL

In this section, we consider the more realistic scenario wherein the commitment by lenders to any pre-announced auditing strategies is taken as impossible for reasons we articulated previously. This inability to commit implies that including any auditing probabilities in lenders' contract offers would not be meaningful because such items would simply be disregarded as non-credible and hence nonbinding.

Under this no-commitment regime, the loan contract offered by a lender to a borrower at time *t* is characterized as $C_t = \left[R_t^1,\ R_t^2, x_t \right]$, where R_t^1, R_t^2 and x_t are similarly defined as in the previous section. Following Khalil (1997) and Khalil and Parigi (1998), the auditing probabilities of lenders are determined along with the cheating probabilities of borrowers in a simultaneous Nash game after the contract *Ct* is offered. Thus, the credit market equilibrium in the current model will be captured by a two-stage problem that can be solved backwards. In the second stage, the lenders' auditing strategies and borrowers' cheating strategies are simultaneously determined for the given contract terms. The equilibrium contract terms are then determined in the first stage by maximizing the borrowers' expected payoff subject to a proper set of constraints.

We consider the second-stage problem first. For *i* = 1,2, let ϕ_t^i *t* be the lender's auditing probability when the borrower reports the state-*i* output and v_t^i be the probability that a borrower with the state-*i* output reports the state-*j* output instead, where $i \neq j$. For a given contract offer of *Ct*, the Nash equilibrium auditing and cheating strategies of ϕ_t^i and v_t^i (*i* = 1,2) can be derived as follows.

As will be shown later, $R_t^1 < R_t^2$ holds in the equilibrium contract[9], indicating that truth-telling is the dominant strategy for borrowers who experience the adverse shock and end up with the low output level (*i*=1); hence, v_t^1 = 0. For the reason that borrowers with the low output level never cheat (v_t^1 = 0), as a part of the Nash equilibrium response, lenders would never need to audit borrowers who report the high output level; hence, ϕ_t^2 = 0. Thus, only borrowers with the high output level have incentives to cheat, whereas lenders need to audit only those who report the low output level. Specifically, this mixed-strategy Nash

9 We will explicitly verify in the appendix that this is indeed the case.

equilibrium of cheating (v_t^2,) and auditing (ϕ_t^1) for the second-stage problem between borrowers and lenders is determined from the following conditions[10]:

$$(1-\phi_t^1)\left(k_2\rho_{t+1}-R_t^1\right)x_t = \left(k_2\rho_{t+1}-R_t^2\right)x_t$$

$$\frac{\pi_2 v_t^2}{\pi_1+\pi_2 v_t^2}\left(k_2\rho_{t+1}-\delta\rho_{t+1}\right)x_t + \frac{\pi_1}{\pi_1+\pi_2 v_t^2}\left(R_t^1-\delta\rho_{t+1}\right)x_t = R_t^1 x_t$$

The above left-hand side of equation is the expected payoff of a borrower with the high project return who chooses to underreport (cheats), whereas the right hand side is the expected payoff if the same borrower reports truthfully. This equation suggests that, given lenders' auditing strategy, borrowers with high project returns are indifferent between cheating and complying in equilibrium. Analogously, the below left-hand side of equation represents a lender's expected payoff when he audits (someone who reports the low output level), whereas the right-hand side measures his payoff when he simply takes the borrower's words and does not audit. Thus, given the borrowers' cheating strategy, lenders are indifferent in equilibrium between auditing and not auditing borrowers who report low project returns.

Solving ϕ_t^1 and v_t^2 in terms of the contractual terms in C_t, obtain

$$\phi_t^1 = \frac{R_t^2 - R_t^1}{k_{2\rho_{t+1}} + R_t^1}$$

$$v_t^2 = \frac{\delta\pi_1\rho_{t+1}}{\pi_2\left(k_{2\rho_{t+1}} - \delta\rho_{t+1} - R_t^1\right)}$$

Together with $\phi_t^2 = v_t^1 = 0$ 9) complete the characterization of the equilibrium for the second-stage Nash game.

10 It is easy to see that no pure-strategy equilibrium of ϕ_t^1 and v_t^2 exists. For instance, if lenders never audit those who report low output (ϕ_t^1 0), borrowers with high output level would always cheat (v_t^2 = 1), but then ϕ_t^1 = 0 would not be optimal. Similarly, if lenders always audit those who report low output (ϕ_t^1 = 1), borrowers with high output level would never cheat (v_t^2 = 0), but then ϕ_t^1 = 1 would not be optimal.

The above characterization of ϕ_t^i and v_t^i (i = 1, 2) from the second-stage problemcan then be used to determine the first-stage equilibrium contract $C_t = \left[R_t^1, R_t^2, x_t\right]$. Since ϕ_t^2 = v_t^i = 0, the expected payoff to a borrower of generation *t* can be written as follows:

$$\pi_1\left(k_{1\rho_{t+1}} - R_t^1\right)x_t + \pi_2[v_t^2\left((1-\phi_t^1\right)(k_{2\rho_{t+1}} - R_t^1) + (1-v_t^2)(k_{2\rho_{t+1}} - R_t^2)]\ x_t$$

As is customary in the literature, lenders will offer in equilibrium the most favourable contractual terms to borrowers to the greatest extent possible.

In equilibrium, owing to competitive loan making and the fact that $\varphi_t^2 = v_t^1 = 0$, the zero (economic) profit condition for lenders again holds and can be written as

$$\left(\pi_1 + \pi_2 v_t^2\right)\{[\frac{\pi_2 v_t^2}{\pi_1 + \pi_2 v_t^2}\left(k_2\rho_{t+1} - \delta\rho_{t+1}\right) + \frac{\pi_1}{\pi_1 + \pi_2 v_t^2}\left(R_t^1 - \delta\rho_{t+1}\right) +$$

$$(1-\phi_t^1)R_t^1\}\ x_t + \pi_2(1-v_t^2)\ R_t^2 x_t = qx_t$$

The first term of the left-hand side of equation represents the expected payoff that a lender can collect from a borrower who reports the low output level, which occurs with probability $\pi_1 + \pi_2 v_t^2$. If th elender audits such a borrower, he will find that with probability $\pi_2 v_t^2 / \pi_1 + \pi_2 v_t^2$ this borrower is indeed unerreporting his project return (i.e., the borrower had actually encountered a fabourable otuput shock), in which case the borrower's entire investment otuput will bea pporopriated, a dnt lender's net profit is equal to $k_2\rho_{t+1} - \delta\rho_{t+1}$ times the loan size. With probability $\pi_1 / (\pi_1 + \pi_2 v_t^2)$, however, the borrower is reporting truthfully, in which case the lender's net profit is eaual to $R_t^1 - \delta\rho_{t+1}$ times the loan size. Onthe other hand, if thelender does not audit the low-output-reporting borrower, he will simply collect R_t^1 per unit of loan, irrespective of whether the borrower is cheating. The second term of the left-hand side is the lender's expected payoff collected from a borrower who reports the high output level, which occurs with probability π_2 (1- v_t^2) (recall that there will be no auditing in this case). The right-hand side of this equation is simpoly the opportunity cost of the loan.

In addition, the equilibrium contracts must also satisfy the following feasibility condition:

$$x_t \le w_t$$

Analogously, we can then formally define the equilibrium in the credit market as follows.

DEFINITION 2 – An equilibrium in the credit market without commitment to audit is represented by a sequence of contracts {Ct}, where Ct = [R_t^1, R_t^2, x_t] and a sequence of auditing and cheating strategies $\{\phi_t^i, v_t^i\}$ (i = 1, 2), where $\phi_t^2 = v_t^1 = 0$, that maximize subject and taking the price sequences of {ρ_t} and {w_t} as given.

To derive the complete credit market equilibrium, we first note that with substitution, the borrowers' expected payoff function can be rewritten as

$$\pi_1(k_1\rho_{t+1} - R_t^1)x_t + \pi_2(k_2\rho_{t+1} - R_t^2)\, x_t$$

Similarly, by substituting into the lenders' zero profit condition, we obtain

$$\left(\pi_1 + \pi_2 v_t^2\right) R_t^1 x_t + \pi_2 (1 - v_t^2) R_t^2\, x_t = q\, x_t$$

By combining se show in the appendix that borrower's expected payoff is strictly increasing with R_t^1 to be as high as possible, that is $R_t^1 \equiv R^1 = k_1\rho_{t+1} = \gamma A k_1$, will again be optimal. Substituting this result into yields the following equilibrium cheatin probability:

$$v_t^2 \equiv v = \frac{\delta\pi_1}{\pi_2\left(k_1 - k_2 - \delta\right)}$$

Whenthencansolveaftermakinuseand $R_t^1 = \gamma A k_1$ that $R_t^2 \frac{(k_2 - k_1)\left(q - \gamma A k1\right) - \delta q}{\pi_2(k_2 - k_1) - \delta}$

Substituting previous equation and $R_t^1 = \gamma A k_1$ gives us the following equilibrium auditing probability:

$$\phi_t^1 \equiv \phi = \frac{\left(q - \tilde{a}Ak1\right)(k_2 - k_1 - \ddot{a}q)}{\tilde{a}A(k_2 - k_1)\left[\pi_2 (k_2 - k_1) - \delta\right]}$$

Again, $k_i\rho_{t+1} - R_t^i$ (i = 1, 2) can be easily verified as non-negative, so the resource constraing must hold with equality. Furthermore, both 0 < v < 1 and 0 < ϕ < 1 are guaranteed by the tehcnical assumptions. Now resultes could somerized by results from abovu in proporsition 2.

Proposition 2 – In each period t, the credit market equilibrium without auditing commitment is characterized in two parts. First, the equilibrium loan contract is given by Ct = [

$R_t^1,\ R_t^2, x_t$] with $R_t^1 = \gamma A k_1,\ R_t^2$ and $x_t\ = wt.$ Second, the cheating and auditinig probabilities are given by $=v_t^1 = 0$, 0< v_t^2 < 1 and 0 < ϕ < 1.

In the credit market equilibrium outlined in proposition 2, cheating on the part of borrowers (those who have high investment returns) does occur, as does auditing by lenders. This condition results in a non-separating equilibrium where borrowers are no longer sorted by their true investment outcomes. In particular, among the borrowers reporting a low output level, some are those whose projects had truly received the unfavourable shock, but some are those who underreport. Auditing offers the only means of distinguishing the types of borrowers in this case. In what follows, we will focus primarily on the macroeconomic consequences of such a cred market equilibrium.

Recalling that the cost of auditing essentially represents the deadweight loss in capital accumulations, and with full capital depreciation, we find that the economy-wide aggregate capital stock in period *t*+1 in this model is equal to

$$k_{t+1} = [\pi_1 k_1 + \pi_2 k_2 - \delta(\pi_1 + \pi_2 v)\phi]\, w_t$$

Again, since $K_t\ = k_t$ and w_t = A (1 - γ) k_t , the growth rate of capital stock and hence that of aggregate output, over period *t* is equal to

$$g_t = \frac{K_{t+1}}{K_t} = A\ (1 -\ \gamma)\ [\pi_1 k_1 + \pi_2 k_2 - \delta(\pi_1 + \pi_2 v)\phi]$$

From the law of large numbers, no aggregate uncertainty, no aggregate uncertainty exists in the total payoffs to the population of borrowers, as well as in that of lenders. Since their sizes are normalized to one, the total payoffs to borrowers and lenders are given respectively in the previous calculations. By aggregating the payoffs across borrowers and lender of generation *t – 1*, the economy wide social welfare *n* period t is then represented by

$$W_t = \pi_1 (\gamma A k_1 - R_t^1)\ w_t + \pi_2 (\gamma A k_2 - R_t^2)\ w_t + q_t$$

Similar to its counterpart in the bnechmark model with auditing commitment, the welfare funciton also measures the aggregate consupmtpio in period *t*. We again show in the appendix that, in the preceding equilibrium, markets for consuption and final goods clear in every period.

4. CONSEQUENCES

In the current section, would be discussed the economic implications, particularly on growth and welfare, of the inability to commit by lenders to auditing contracts in the credit market. Technically, this can be easily accomplished by comparing the two models analyzed in the previous two sections because they differ only in the assumption on regarding the lenders' ability to commit to audition. Throughout In the current section, we discuss the economic implications, particularly on growth and welfare, of the inability to commit by lenders to auditing contracts in the credit market. Technically, this goal can be easily accomplished by comparing the two models analyzed in the previous two sections because they differ only in the assumption regarding the lenders' ability to commit to auditing. Throughout this and the remaining sections of the paper, all endogenous variables in the main model without auditing commitment will be capped with the symbol 'tilde' to facilitate the comparison between these two models. Such a comparison yields the following results with regard to the terms of the equilibrium contract, the economic growth rate, and the level of social welfare.

Comparing the benchmark model and the main model with and without auditing commitment, respectively, the following inequalities hold: $\tilde{R}_t^2 > R_t^2$, $\tilde{\phi}_t^1 > \phi_t^1$, $\tilde{g}_t > g_t$, and $\tilde{w}_t < w_t$ for all t and any given initial level of capital stock. The proof is following:

$$\tilde{R}_t^2 - R_t^2 = \frac{(\kappa 2-\kappa 1)(q-\gamma A\pi 1\kappa 1)-\delta q}{\pi 2(\kappa 2-\kappa 1)-\delta} - \frac{(\kappa 2-\kappa 1)(q-\gamma A\pi 1\kappa 1)-\delta\gamma A\pi 1\kappa 1}{\pi 2(\kappa 2-\kappa 1)-\pi 1\delta} =$$

$$\frac{\delta 2\pi 1(q-\gamma A\kappa 1)}{\left[\pi 2(\kappa 2-\kappa 1)-\delta\right]\left[\pi 2(\kappa 2-\kappa 1)-\pi 1\delta\right]} > 0$$

Simillary was obtained:

$$\tilde{\phi}_t^1 - \phi_t^1 = \frac{(q-\gamma A\kappa 1)(\kappa 2-\kappa 1-\delta)}{\gamma A(\kappa 2-\kappa 1)\left[\pi 2(\kappa 2-\kappa 1)-\delta\right]} \; \frac{q-\gamma A\kappa 1}{\gamma A\left[\pi 2(\kappa 2-\kappa 1)-\pi 1\delta\right]} =$$

$$\frac{(q-\gamma A\kappa 1)\pi 1\delta 2}{\gamma A(\kappa 2-\kappa 1)\left[\pi 2(\kappa 2-\kappa 1)-\delta\right]\left[\pi 2(\kappa 2-\kappa 1)-\pi 1\delta\right]} > 0$$

Since $\tilde{\phi} > \phi$ and $0 < \nu < 1$, $\tilde{g}_t > g_t$ follows immediately from comparing previous equations. Finally, for any given initial level of capital stock, we have $\tilde{w}_0 < w_0$ at t= 0. Since $w_t = w_0$ grow at the same rates as the capital stock in the two different models, respectively, it then follows from $\tilde{g}_t > g_t$ *gt* that $\tilde{w}_t < w_t$ for all t = 0. Thus, along with $\tilde{R}_t^1 = R_t^1$ and $\tilde{R}_t^2 > R_t^2$, it follows from comparing that $\tilde{w}_t < w_t$ holds for all t ≥ 0.

Some observations are in order. First, $\tilde{R}_t^2 > R_t^2$ implies that the inability to commit by lenders results in a higher equilibrium loan rate for borrowers who report a high output level. The intuition for this result can be understood as follows. To minimize the incentives from cheating by high-return borrowers, the loan rate for reporting the low output is set as high as possible, and hence the same $\tilde{R}_t^1 = R_t^1$), in both cases with and without auditing commitment by lenders.

However, under no-commitment, the equilibrium exhibits a positive probability of cheating behaviour by borrowers with high returns: in equilibrium, a fraction of the high-return borrowers will underreport in order to avoid paying a higher interest rate $\tilde{R}_t^1 < \widetilde{R}_t^2$. As can be seen lenders can expect only to recover their loans at the lower loan rate of $\tilde{R}_t^1$ from this group of borrowers[11]. To compensate for the loss of revenue recovered from the fraction of cheaters, lenders must raise the loan rate that applies to borrowers who truthfully report the high output level, $\tilde{R}_t^2$, to maintain their zero-profit condition. In this regard, the presence of cheaters under the no-commitment regime confers a negative externality on non-cheaters.

Next, the inability to commit also results in more frequent auditing by lenders in the equilibrium $\tilde{\phi}_t^1 > \phi_t^1$. This result is analogous to that of proposition 3 in Khalil. Intuitively, a higher loan rate of $\tilde{R}_t^2$ under no-commitment, relative to its counterpart in the case with auditing commitment, increases the potential benefit from cheating. To counterbalance such a heightened incentive to cheat, a greater probability of auditing is needed to maintain the equilibrium condition.

The macro implications of the inability to commit are straightforward. The result here for growth suggests that the growth rate in the model without auditing commitment will be lower than that in the benchmark model. This result comes about because the lack of audit-

11 In fact, not all borrowers who cheat end up paying the same amount to lenders: those who were caught (by auditing) will have their entire investment output appropriated, and those who got away (not being audited) will pay only the lower loan rate of R1t . However, in equilibrium, a lender's expected payoff from auditing a borrower who reports low output is the same as the payoff from not auditing, which is equal to R1t per unit of loan. Thus, lenders are expected ex ante to recover from cheaters, just as from other borrowers who truthfully report low output, at the loan rate of R1t regardless if auditing takes place.

ing commitment gives rise to cheating, thereby resulting in more frequent auditing in the credit market, and auditing activities are costly in the sense of generating deadweight loss in real resources. Consequently, under no-commitment, the process of capital accumulation is less efficient, and

economic growth is slower.

Finally, the social welfare in any period consists of the aggregate payoffs/consumption of three groups of individuals: the borrowers with low project returns, the borrowers with high project returns, and the lenders. For the group of low-return borrowers, recalling that $\tilde{R}_t^1 = \gamma A k_1$ holds in both cases with and without auditing commitment, their net payoff will be squeezed to zero in both models. As for the group of high-return borrowers, although some of them will cheat under no-commitment, the expected payoffs from cheating in equilibrium will, in fact, be just the same as those from complying. Therefore, the aggregate payoff to the high-return borrowers as a group can be calculated by assuming borrowers always comply, and such a payoff is lower under no-commitment than under commitment for the following two reasons. Under no-commitment, compliance means paying a higher interest rate $\tilde{R}_t^2 > R_t^2$, and each project has a smaller size $\tilde{w}_t < w_t$, except for $t = 0$. Furthermore, a lender's payoff in both models will be simply equal to the (opportunity) cost of funds, which is equal to q times loan size, because of perfect competition in lending. For the reason that the size of loanable funds grows at a slower rate under no-commitment, the aggregate payoff to lenders is also lower except for $t = 0$ without auditing commitment. Hence, starting from any given level of capital, the absence of auditing commitment will result in a lower economy-wide welfare for every generation in every period[12].12

In sum, starting from equal initial conditions, the economy in which lenders are unable to pre-commit any auditing strategies would grow more slowly and enjoy lower social welfare than that in which such commitment is effective. Interpreting the ability of lenders to make auditing commitment as reflecting the strength of financial and legal institutions in an economy, the above results are consistent with the line of research that suggests weak institutions as a cause for the divergence in growth and living standards among different countries.

5. CONCLUSION

It has been widely argued that weak institutions can prevent poor countries from catching up with the rich. Presumably, institutional strength for contract enforcement can be measured in terms of its ability not only to rein in borrowers' fraudulent behaviour, as has been much scrutinized in the existing literature, but also to discipline lenders' contractual

12 Our welfare analysis has compared only the welfare of one generation at one point of time with equal weights on borrowers and lenders. Since, as we have shown, the payoff under no-commitment is either weakly or strictly dominated by its counterpart under commitment for every generation and every group of individuals, the welfare implication derived here is, in fact, robust with respect to alternative, more general specifications of the welfare function that consider different weights on different generations, as well as on different groups of individuals in each generation.

commitment. In this regard, our analysis proposes a new micro-economic channel – the inability to commit to auditing in a credit market with costly state verification – through which the widely held view is confirmed. Alternatively, our analysis in the present paper can be interpreted as suggestive of how the failings in institutional arrangements to bind lenders' auditing responsibilities could be detrimental to economic growth and social welfare. For example, to the extent that lenders' disclosure of their auditing activities can help relevant parties (regulatory bodies, independent auditors, and borrowers) to monitor and enforce contractual obligations, the policy implication from our analysis is consistent with the view that advocates for institutional arrangements that implement mandatory-disclosure rules when voluntary disclosure is deficient what was explained by Bolton and Dewatripont.

To demonstrate how this channel works, we developed and compared two endogenous growth models. In the first model, by committing to a costly auditing strategy, lenders are able to induce self-selection, truth-telling behaviour from borrowers. As opposed to this common approach in this line of research, we assume that lenders cannot commit to their auditing strategy, as did Khalil from 1997, in the second model. The lack of commitment to auditing implies that the interaction between lenders and borrowers becomes a two-stage problem. In the second stage of the problem, we derived a mixed-strategy equilibrium in which both lenders audit and borrowers cheat with positive probabilities. In the first stage, lenders determine the optimal loan contract terms that are consistent with the mixed strategy equilibrium in the second stage. We found that, in the regime without commitment, the strategic interaction between borrowers and lenders raises the loan rate and auditing probability in equilibrium loan contracts, thereby generating greater dead-weight loss in the credit market. Consequently, economic growth rate and social welfare are lower when auditing commitment is absent.

In typical studies of asymmetric information, the announced contractual enforcement (e.g., auditing and monitoring) by lenders is implicitly assumed to be taken at its face value, and the separating (self-selection) contracts are then designed accordingly. Such an assumption can be quite problematic for at least two reasons. First, the resulting equilibrium suffers from a time-(in)consistency problem: lenders have incentives to not conduct the costly enforcement activity that is required to elicit truthful reporting from borrowers. Once these time-inconsistent incentives are recognized by borrowers, the separating, self-selection equilibrium can easily unravel. Second, we do not observe, in practice, obvious institutional

mechanisms that can serve as commitment devices to make lenders' auditing policy binding and hence renege the time-(in)consistency problem. As has been shown in our analysis, this inability to commit by lenders, acting as an additional source of informational friction, has non-trivial consequences. It is also worth noting that a lack of commitment to audit by lenders will result in a non-separating equilibrium, where cheating behaviour by the (some) borrowers is a necessary condition for the equilibrium. This equilibrium cheating behaviour by borrowers eventually justifies more stringent contractual terms and results in greater credit market distortions.

In the present paper, the role of commitment to audit has been studied within a rather simple model structure. Several potential extensions are possible. One possibility would be to introduce transitional dynamics into a neoclassical version of the model, which would allow us to study the joint determination of auditing and cheating probabilities along a dynamic equilibrium path. Such a result would generate new insights as to how both the extent of fraud and the strength of contract enforcement evolve and interact at different stages of development. Another possible extension would be to develop potential remedies for the inability to commit to audit. In Khalil and Parigi research from 1998, lenders choose to give a higher loan size under a no-commitment case as a commitment device, hoping to convince borrowers that they have a sufficiently large stake in auditing, given that the expected returns from auditing depend positively on the loan size. In the current setup, the loan size cannot play such a role because it is trivially pinned down by the constant wage of the lenders. It would be interesting to examine, when the loan size is endogenized, whether the same results in the current model will continue to hold. Finally, the population mix of borrowers and lenders in the current model is exogenously given to simplify the analysis. Similar to considering different openness scenarios, as in Sevick in his research from 2011, allowing the mixture of borrowers and lenders to vary over time would introduce additional shifts in the relative supply of loanable funds and this line of inquiry could bring further insights.

REFERENCES

Acemoglu, D., S. Johnson, and J. Robinson (2005) 'Institutions as the fundamental cause of long-run growth.' in *Handbook of EconomicGrowth*, 1, ed. P.Aghion andS. Durlauf. Amsterdam: North-Holland Andreoni, J., B. Erard, and J. Feinstein (1998) 'Tax compliance.' *Journal of Economic Literature* 36, 818–60

Beck, T., and R. Levine (2004) 'Legal institutions and financial development.' NBER Working Paper No. 10417

Bencivenga, V.R., and B.D. Smith (1993) 'Some consequences of credit rationing in an endogenous growth model.' *Journal of Economic Dynamics and Control* 17, 97–122

Bernanke, B., andM. Gertler (1989) 'Agency costs, net worth, and business fluctuations.' *American Economic Review* 79, 14–31

Bester, H., and R. Strausz (2001) 'Contracting with imperfect commitment and the revelation principle: the single agent case.' *Econometrica* 69, 1077–98

Bhattacharya, J. (1998) 'Credit market imperfections, income distribution, and capital accumulation.' *Economic Theory* 11, 171–200

Bolton, P., and M. Dewatripont (2004) *Contract Theory*. Cambridge, MA: MIT Press Bordo, M., and P.L. Rousseau (2006) 'Legal-political factors and the historical evolution of the finance-growth link.' NBER Working Paper No. 12035

Bose, N., and R. Cothren (1996) 'Equilibrium loan contracts and endogenous growth in the presence of asymmetric information.' *Journal of Monetary Economics* 38, 363–76 –– (1997) 'Asymmetric information and loan contracts in a neoclassical growth model.' *Journal of Money, Credit and Banking* 29, 423–39

Castro, R., G.C. Clementi, and G. MacDonald (2004) 'Investor protection, optimal incentives, and economic growth.' *Quarterly Journal of Economics* 119, 1131–75

Graetz, M.J., J.F. Reinganum, and L.L. Wilde (1986) 'The tax compliance game: toward an interactive theory of law enforcement.' *Journal of Law, Economics and Organization*, 2, 1–32

Hall, R.E., and C.I. Jones (1999) 'Why do some countries produce so much more output than others?'*Quarterly Journal of Economics* 114, 83–116

Ho, W.H., and Y. Wang (2005) 'Public capital, asymmetric information, and economic growth.' *Canadian Journal of Economics* 38, 57–80 –– (2007) 'Factor income taxation and growth under asymmetric information.' *Journal of Public Economics* 91, 775–89

Khalil, F. (1997) 'Auditing without commitment.' *Rand Journal of Economics* 28, 629–40 Khalil, F., and J. Lawarree (2006) 'Incentives for corruptible auditors in the absence of commitment.' *Journal of Industrial Economics* 54, 269–91

Khalil, F., and B.M. Parigi (1998) 'Loan size as a commitment device.' *International Economic Review* 39, 135–50

La Porta, R., F. Lopez-de-Silanes, and A. Shleifer (1998) 'Law and finance.' *Journal of Political Economy* 106, 1113–55

Leoni, P.L. (2010) 'Regulatory practices and the impossibility to extract truthful risk information.' *International Journal of Business* 15

Levine,R. (1999) 'Law, finance and economic growth.' *Journal of Financial Intermediation* 8, 8–35

Romer, P. (1986) 'Increasing returns and long run growth.' *Journal of Political Economy* 94, 1002–37

Sevcik, P. (2011) 'Financial contracts and the political economy of investor protection.' Manuscript, UQAM

Townsend, R. (1979) 'Optimal contracts and competitive markets with costly state verification.' *Journal of Economic Theory* 21, 265–93

Wang, C., and S.D. Williamson (1998) 'Debt contracts and financial intermediation with costly screening.' *Canadian Journal of Economics* 31, 573–95

Williamson, S.D. (1986) 'Costly monitoring, financial intermediation, and equilibrium credit rationing.' *Journal of Monetary Economics* 18, 159–79 –– (1987) 'Costly monitoring, loan contracts, and equilibrium credit rationing.' *Quarterly Journal of Economics* 102, 135–45