Financial Regulation and Financial Development: tradeoff or synergy?

Stavros B. Thomadakis
Konstantinos I. Loizos

Department of Economics
University of Athens

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Abstract

This paper argues that financial regulation can be designed as policy that would accommodate rather than antagonize financial development, since regulation can be linked to building institutional protections for savers and investors. Using a governance framework, the argument in a nutshell is the following: Regulation can lower transaction costs related to contract rights, bargaining costs, information costs and enforcement costs. By doing so it can supplement pecuniary with non-pecuniary returns to savers and provide safeguards that will gradually increase confidence, which corresponds to a cumulative process of 'institution-building'. Furthermore this can be achieved in a manner that endogenises fiscal sustainability, as benefits bestowed by government to the investing public can be financed by a tax on financial returns over the long term.

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Corresponding Author: Konstantinos I. Loizos, email: komilos@hol.gr

1. Introduction

The tension between financial stability and financial liberalization is obvious, even to the layman, after the great financial crisis of 2008. Financial regulation has historically sought to achieve stability. Liberalization has long been proposed as policy that fosters financial development. Since the 1970s, the use of administered interest rates as a regulatory instrument has been branded as 'financial repression' of market agents by government. In this paper we reconsider the nexus of government regulation and financial market development through the lens of a governance structure which could, under conditions to be specified, preserve stability and foster development at the same time. Early critics of 'financial repression' have bequeathed us with a portrayal of a negative tradeoff between regulation and development. This portrayal is missing an important ingredient: institutional development as an ongoing process. We argue that when this missing element is factored into the analysis, the antagonism between regulation and development may in fact become a synergy.

In a world where fundamental uncertainty, unanticipated shocks and endogenous crises of confidence are prevalent, as the history of financial markets teaches, it is necessary to think of institutional arrangements not as an exogenous infrastructure but as a process that co-evolves and interacts with the path of financial development and financial crisis. This is consistent with the essence of 'confidence' as proposed by Keynes (1936) and elaborated by Minsky who, in a characteristic phrase wrote that "public tolerance of uncertainty is limited…the creation of new economic institutions that constrain the impact of uncertainty is necessary"[1].

In our proposed reconsideration of the nexus of public intervention and financial development as a governance structure, we utilize the insights of Williamson's contractual analysis to expand the notion of financial return from a simple pecuniary benefit offered by private agents to non-pecuniary safeguards offered by government. We understand non-pecuniary safeguards, as they stabilize and cumulate, to represent none other than institutional development, which is taken up by many authors and in many different contexts nowadays, as the indispensable companion of financial development.

The basic understanding of safeguards is based on Williamson's concept of 'asset specificity'. Asset specificity in the case of financial assets devolves, by and large, not on the technical characteristics of the assets but on institutional arrangements that protect asset-holders from contractual hazards by promoting verifiability of returns and confidence. Bodies of rules for disclosure, investor

[1]Minsky (1996), p. 359. More generally, 'confidence' is the factor that conditions or 'weighs' probabilistic estimates as first introduced in Keynes (1921) and further elaborated in Keynes (1936) especially Chapter 12. Minsky in another highly relevant comment argues how the use of the lender-of-last-resort facility may create expectations that need to be controlled by additional institutional reform (Minsky (1986), pp. 57-9). For a modern example of the interplay of 'confidence' and the institutional environment see the extensive literature on bank runs and deposit insurance (Diamond and Dybvig (1983), (1986)).

protection, creditor protection, deposit guarantees and interventions of 'last resort' are examples of safeguards embedded in institutional arrangements. All these however have a time element as they require the buildup of confidence based on experience and on progressively acquired competencies in effective enforcement.

Our chosen approach in this paper is to show an example of how 'repression' in the form of interest rate restrictions can be made consistent with economic development by maintaining the aggregate level of savings at the theoretically 'unrepressed' level; this is achieved through the offer of a counterbalancing quantity of non-pecuniary benefits to financial savers through government intervention. We use a simple multi-period model with representative agents including banks, saver-households, and the government in a loanable-funds framework with finite horizon. We show that intervention consistent with development can be feasibly modeled, and that it depends on variables such as the risk-adjusted rates of time preference of private agents and the government. We draw implications on the need for consistency of government policy and the effect of such policy on the reduction of risk-premia over time, as confidence increases.

The remainder of the paper is organized in four sections. In section 2 we undertake a review of literature on the significance of institutional development for financial markets. In section 3 we develop motivation for a model which embodies the nexus of government intervention and private agent optimization as a governance structure providing time-variant safeguards and institutional enhancement. In section 4 we develop and analyze such a simple model. In section 5 we discuss implications and conclusions.

2. Brief Literature Review

Financial repression policies through regulation of interest rates were heavily criticized in the McKinnon-Shaw theoretical tradition. They were deemed to be responsible for reduced supply of capital to finance investment ((McKinnon (1973), Shaw (1973)) and lower efficiency of funded investment projects (Fry (1995)). On the contrary, financial market liberalization was viewed as optimal policy that would restore prices at their market levels and enable "financial deepening" (Shaw (1973)). These were cast as prerequisites for financial development that would boost both the volume and efficiency of investment.

Financial development includes increased financial intermediation and innovation. Levine (1997) identifies the functionality of the financial system with its ability to decrease aggregate risk by enhancing liquidity and diversifying idiosyncratic risk, to allocate capital efficiently to investment uses by lowering the costs of acquiring information and coping with principal-agent problems among firms' stakeholders; to pool and channel savings from surplus to deficit units and facilitate exchange by devising contracts that lower transaction costs. The underlying unifying principle of this definition of financial development is according to one major proponent of liberalization (Fry (1995)) the minimization of transaction and information costs. Hence, financial development appears closely related to institutional development, even in the thinking of repression critics. Issues such as accounting systems for information disclosure, contract enforcement and definition and enforcement of property rights are institutional developments which are seen to reduce the risks that lenders assume (World Bank (1989)).

In this context, Arestis (1999) stresses the importance of the legal infrastructure of LDCs concerning contract enforcement, bankruptcy procedures and banking regulation and supervision. Arestis and Glickman (2002) assert that financial liberalization in countries with weak regulatory framework precipitated and made financial crises more severe. What these approaches stress is the inefficiency of financial liberalization policies in economies institutionally unprotected to abrupt international short-term capital flows. Arestis and Stein (2005) propose a theoretical framework for institutional transformation that would take into account the existing institutional matrix of each country concerning norms, rules, incentives and existing capacities of financial organizations to assume the burden of transformation towards a more liberalized regime. It is noted that in the latter contribution institutional development is viewed as a process that embodies experience and expands over time.

In a different strand of thinking which brings out the importance of the institutional environment in bolstering the development of capital markets, the so-called 'law and finance' literature (LaPorta et.al. (1998), (1999)) centers on different law systems and argues that common law jurisdictions enable protections and incentives that open the horizon to arms-length markets for finance and financial development, as compared to civil law jurisdictions. In this approach the institutional makeup of societies, as expressed in legal systems, is seen as an 'endowment' which liberates markets from a multitude of encumbrances from the government and entrenched interests.

From a viewpoint of stability and the achievement of normal functioning markets, Modigliani and Perotti (1997) indicate that financial liberalization, not accompanied by appropriate institutional development concerning legal protections of investors *and their enforcement*, might lead to instability and crisis. The absence of such protections results in a shift of institutionally underdeveloped economies to systems characterized by long-term relations and relationship finance instead of arms-length transparent markets

In another important strand of literature (Rajan and Zingales (2003a, 2003b, 1998)) financial repression regimes are characterized as a governance structure constructed on a relationship-based system among incumbent large firms, banking oligopolies and the government. An important ingredient of this system is the restriction of capital flows that insulates the financial system from external competition and market discipline. Investor protection takes on non-price forms such as specific monopoly power of the bank over the firms it finances using connections with managers and politicians, as a means of contract enforcement. In a sense, hierarchical control is substituted for market control and makes the efficiency of the legal system and contract enforcement less important. Furthermore, dissemination of information is discouraged rather than encouraged, since disclosure may endanger the system of relationship finance. All these make financial repression a vehicle serving incumbent interests and an impediment for financial development.

This short review of different strands of thinking indicates a common major issue: Although it is desirable to lower the cost of capital and boost investment and financial stability through regulatory policies, the price to be paid is high as these policies might impede financial development. On the other hand, financial liberalization policies without an adequate institutional infrastructure might prove self-defeating. Hence, the question arises: Is there a way to think of financial regulation as a policy that would accommodate rather than prevent financial development? Our paper attempts to answer this question by studying financial regulation policies from the perspective of governance structures, admitting at the same time that institutions are not given a priori but co-evolve with the operation of the financial system. Following the pioneering work of Williamson (1985) the question relates to the conditions under which a choice between markets and hierarchies should be made on the basis of related transaction costs. In that approach, financial development can be identified with policies that lead to decreased transaction costs and lower risk premiums over time.

3. Governance structures: Liberalization, regulation and financial contracts

When the critics of 'financial repression' proposed liberalization as optimal policy, their vision embodied the existence of a counterfactual: a market that would freely achieve equilibrium with full-information prices. In a classic statement Fry (1995) writes: "Financial restriction encourages financial institutions and financial instruments from which government can expropriate significant seigniorage, and discourages others. …Private bond and equity markets are suppressed through transaction taxes, stamp duties, special tax rates on income from capital and an unconducive legal framework, because seigniorage cannot be extracted as easily from private bonds and equities"[2].

Fry's assertions embody at least three assumptions. First, that seigniorage taxes are used for unrelated purposes or wasted; second that, if tax burdens on markets were absent, they would attain a healthy, full-information equilibrium. Third, that the 'unconducive legal framework' could be replaced by one conducive to financial development instantaneously and without costs. In other words, these assumptions can be questioned by considering that market failures do not arise simply from government policy but from deeper issues of information, opportunism and lack of confidence. The preeminence of banks and intermediated finance in less developed countries could be simply a way in which market agents seek to bypass problems of informational imperfections and agency conflicts, even in the absence of public interventions. We will come back to this point below.

In his seminal contributions to our understanding of the governance of contracts, Williamson (1985), (1996) considers the case in which arms-length markets offer optimal allocations, and where adaptation to change can take place exclusively through the price mechanism. Full – information prices do not succumb –

[2] Fry (1995) p. 14

in principle - to opportunistic perturbations and markets clear with no (or minimal) transaction costs. To this idealized condition, Williamson juxtaposes situations in which opportunistic behavior is possible in the sense of creating contractual hazards; as, for example, in bilateral contracts that extend over many periods, and where one party can take advantage of her position to reduce the value due to another. Williamson's basic view is that in these cases prices will diverge from their full-information level, and that governance mechanisms will emerge, offering non-price safeguards that mitigate the effects of opportunistic behavior. He develops these mechanisms as his famous 'hierarchies'.

A central analytical category, important to our understanding of 'repression', is the Williamsonian analysis of asset specificity. The transaction costs associated with acquisition of an asset are not retrievable in the market. They are undertaken in order to provide confidence about the value of the asset in the face of opportunism by the issuer (the supplier of the promises embedded in the asset) after the transaction is completed. The safeguards required may be provided by the issuer himself through pledges, covenants and rights provided to the buyer. These come under the general rubric of contract design. (Tirole (2006), Gale and Helwig (1985)).

However, in the context of an undeveloped financial market, privately supplied safeguards may not suffice as they may not be credible, since they are themselves tainted by future opportunistic behaviors. It then falls to the state and state powers of enforcement to supply credible safeguards. Hence, in undeveloped financial markets, asset specificity poses not a technical but an institutional problem: the permanent provision of public safeguards which allow a general reduction of transaction cost for financial assets, mitigating, in other words, their asset specificity.

History and theory suggest a long list of safeguards embedded in institutional arrangements and rules: mandatory public disclosure, accounting and auditing standards, legal bankruptcy, anti-fraud regulations, minority protections in joint-stock companies, insider trading prohibitions. All these require the organization of public enforcement mechanisms. In turn this implies a commitment of resources for the organization of agencies of enforcement and a continued flow of resources for maintaining the activities and building up the reputation of those agencies. Monitoring mechanisms, mechanisms of resolution of disputes, authorities with powers of 'last resort' interventions, judicial authorities and regulatory agencies are practical public instruments comprising the institutional infrastructure of confidence in financial transactions. A great variety of such public instruments has developed over time in response to historical conditions and is to be found both in developed and in emerging economies. This great variety cannot be simply explained by the need of government to extract seigniorage.

The public provision of safeguards is therefore not a frictionless process. It incurs tangible public costs that must be financed. It also requires, as we said, the buildup of a regulatory reputation by the public mechanisms of enforcement. In short, it requires money, time and policy consistency. Practices characterized as 'repression' may then be alternatively interpreted as means for obtaining and using resources devoted to the public provision of institutional infra-structures that underpin general confidence in the financial system.

To look at issues of time-paths, consistency, and the values of critical parameters in the context of an economy with a circuit of savings and investment that uses intermediation, we need a tractable multi-period model. To achieve tractability we focus on banks as agents of financial intermediation. We note that a simplified banking market with deposits and loans is found in most models of 'repression', capturing the essence of the financing relationship. Furthermore, in most empirical measures of 'financial deepening' banking assets make up the primary quantity.

Looking at each side of a bank's functions in turn, depositors provide funds and obtain promises of returns motivated by the level of interest but also by confidence that the bank will honor nominal commitments. Confidence is not a vague subjective feeling, but devolves on describable safeguards, such as deposit guarantees and mechanisms that shield the bank from opportunism by its borrower-clients. Although bank loans are not marketable in this context, they are nevertheless bearers of asset specificity and incur transaction costs. Banks themselves can act as agents with some capabilities in selecting ex ante good projects to lend to, in monitoring ex-post borrower performance and in enforcing final repayment, as compared to individual savers and investors. Thus, they may be themselves an institutional response to asset specificity. Yet, the public provision and enforcement of general rules of transparency, audit and bankruptcy may offer superior results as it will achieve at least two goals. On one hand, it will increase confidence in banks by improving the quality of their loan portfolios; and on the other hand it will free up resources that banks devote in the selection and monitoring of their clients in an institution-less environment; under competition this will even produce pecuniary benefit by suppressing banks' intermediation margins. Thus, even with the simplest portrayal of a capital market as a market for deposits and loans, publicly provided safeguards can produce both non-pecuniary and pecuniary benefits.

A central feature of any model of institutional development is the government. It is both a bearer of public power and the primary promoter of public interest. The political economy of government action represents a complex field of modern analysis (Stiglitz (1989)), (Tanzi (2011)). From our perspective, it is not an acceptable premise to posit the government either as an avid myopic extractor of rents or as an infinitely generous supplier of free benefits. In any simple model of tradeoffs offered by public action two elements are needed, in a realistic and more balanced view. First, the supply of public tradeoffs must be fiscally sustainable so that its net costs are non-positive. Second, the public powers must view tradeoffs as an exercise that entails a buildup over time and benefits to be reaped in future. This means that the government is not myopic, i.e. does not have infinitely high time-preference, as a regime might have if we assumed extreme populism. These modest precepts are portrayed in the simple model which we present.

4. A Formal Model of Taxes and Safeguards to Deposit Returns

We assume an economy that lives for Z periods and is comprised of households/savers and owners of firms, banks and the government each one expressed by a representative agent. All variables are presented in real terms. Households own firms but do not know how to manage them. For this reason they employ managers who choose and implement investment projects with the stated aim to maximize firms' profits. However, households do not have the knowledge and the capability to monitor managers and hence, they cannot prevent a possibly opportunistic manager from selecting highly risky projects. If these projects succeed the manager's reputation is raised while a possible failure might be ascribed by the manager to adverse economic conditions. In effect, opportunism emerges because households' bounded rationality and limited calculability prevents them from distinguishing a good from a bad project. This is a function performed by banks as coalitions of depositors where households place their savings. Banks have to devote resources to this function, but the quality of their monitoring is also imperfect and depends on the level and quality of institutional arrangements such as disclosure policies, accounting standards, law enforcement.

Finally, the government oversees the whole system and intervenes to alter incentives. The model focuses on the interaction of household – supplier of funds– and of the government with banks playing a passive intermediating role between savers and firms, pricing their funds at marginal cost. The problem is that a government policy that lowers deposit rates $\bar{d}_t$ administratively in order to lower the loan rates $\bar{l}_t$– maintaining a constant intermediation margin for banks – and boost investment might lead to a gap between investment demand and supply of loan capital, as decreased savings reduce the flow of deposits to banks. The question is what the government can do to alleviate this gap and sustain the increased level of investment deemed necessary for economic development.

Williamson's (1985) contracting schema indicates that lowering market price in the face of high asset specificity is possible if the new hierarchical governance structure is able to provide safeguards. To the degree that institutional risk is an economy-wide risk that also affects individual projects' risk, the government could intervene in the financial market by providing a more efficient legal system, the establishment of bankruptcy laws, increase the efficiency of law enforcement, provide guidelines concerning disclosure and dissemination of information. In addition, it could implement programs sponsored by itself for the training of business managers and bank employees on more transparent accounting techniques, more efficient monitoring and supervision of investment projects and inculcation of values of business ethics. Finally, it could safeguard the short-term path to institutional development through its lender of last resort and deposit insurance functions which avert the danger of sudden and unexpected ruptures in the financial mechanism. All these imply that the state (including the monetary authority) is able to build an institutional structure to provide the investor with additional safeguards for its protection against borrower or managerial opportunism. Hence, the government aims at substituting the functions that a developed financial market would undertake given an initial state of institutional underdevelopment through its own institutional interventions.

If $\theta_t > 1$ is a variable indicating government investment in institutions termed as "safeguards", how can this affect the behavior of households/savers and sustain savings?

Saving, in the typical model of household behavior is a by-product of the preference between current and future consumption given their relative prices. If the price of current consumption is the financial variable $(1 + \tilde{d}_t)$ then the price of future consumption is $(1 + \rho_t)$ and it is determined by the subjective risk-adjusted preference factor ρ_t (assumed common to all households) which is an argument of the intertemporal additive expected utility function of a household. A low $\rho_t$increases the value which attaches to future consumption as it increases the discount factor $\frac{1}{1+\rho_t}$ and hence, increases savings ceteris paribus. Safeguards can alter the risk-adjusted preference for future consumption by providing institutional guarantees –which depend on the reliability of each sovereign state – for the protection of households' savings. The price that the state must pay to provide these guarantees depends on the factor of subjective risk-adjusted preferenceρ_t. Then θ_t applied to the discount factor raises the present value of the utility obtained from future consumption and hence, it raises savings. Furthermore, if agents adjust their expectations according to recent experience, government's expenditure on safeguards in period t might also affect the paths of the deposit rate and of the risk-adjusted preference factor, i.e. the paths of opportunity costs for current and future consumption respectively. If the ultimate aim of policy is to secure financing for development, then *investment* in safeguards θ_t as described above might end up to a *stock* of institutions $\Theta_T$at the policy horizon T, affecting both the behavior of households and the intermediation margin of banks, yielding lower loan rates for given deposit rates. This fulfills the ultimate goal for development with the embedded feature of institutional development.

Yet, the safeguard variable affects the decision of households between current and future consumption given the effect of a variable $\alpha_t < 1$ on the deposit rate that makes up the administered deposit rate $\alpha_t \tilde{d}_t < \tilde{d}_t$. But what is α_t in this case? If the deposit rate collected by households after government intervention is $\alpha_t \tilde{d}_t$, though banks pay $\tilde{d}_t$, then we can consider the difference $\tilde{d}_t - \alpha_t \tilde{d}_t = (1 - \alpha_t)\tilde{d}_t$ as an explicit tax levied on deposit interest income with the tax rate being $(1 - \alpha_t)$. This tax is meant to finance the interventionist policy of the government through the safeguard variable θ_t. But why should the government opt for this kind of tax rather than another one? Note that a tax on personal income would not do the job since it would tax both current consumption and savings in the present, irrespective of time preference. This would undermine the ultimate goal of government for economic development. On the other hand, a tax on firms' profits would just decrease the incentive for investment that the policy is meant to boost. Finally, a direct tax on banks' loan rate would entail an indirect tax on the deposit rate – to the degree that the marginal cost of banks is left unaltered – and would lead to net transfer of resources from lenders to borrowers (firms) as a direct subsidy to them without any resources left to finance government safeguards to depositors. Only a tax on deposit interest income enables a direct trade-off between pecuniary loss and non-pecuniary gain by safeguards offered to depositors and financed by them without affecting aggregate expenditure, investment demand or the viability of the banking sector.

A model based on these ideas is described in the following sections.

4.1 The Problem of the Representative Bank

In a world without money but with default risk on behalf of firms, a typical bank acting in a competitive environment would maximize its expected profit given the difference between the proceeds from extended loans $\sum_{j=1}^{k} \bar{l}_{tj}\mathcal{L}_{tj}$ and costs of deposits $\sum_{h=1}^{m} \bar{d}_{th}D_{th}$ and operation $C_t(\mathcal{L}_{jt}, \Theta_T)$. The latter depends positively on the volume of loans extended $\mathcal{L}_{jt}$ (assuming that in a loanable funds framework the operating cost of deposits is included therein) and negatively on the institutional conditions in the financial markets Θ_T (concerning information asymmetries and contract supervision and enforcement) that determine the cost of monitoring and enforcing loan contracts. Operating cost on loans increases as loans increase because of the effort needed to identify the risk of an additional project proposed for finance.

Following Klein (1971), Santomero(1984)[3], the maximization problem of a competitive bank b becomes

$$max_{\mathcal{L}}\Pi_t = \bar{l}_t\mathcal{L}_t - \bar{d}_tD_t - C_t(\mathcal{L}_t, \Theta_T) \quad (1)$$

s.t.

$$\mathcal{L}_t = \sum_{j=1}^{k} \mathcal{L}_{tj} = \sum_{h=1}^{m} D_{th} = D_t$$

Define $\bar{l}_t = \sum_{j=1}^{k} x_j\bar{l}_{tj}$ as the weighted average loan rate charged on a portfolio of loans with x_j the weight of asset type j in this portfolio. Similarly define $\bar{d}_t$ as the all-purpose deposit rate. Then we can also define the financial intermediation margin according to which the competitive bank charges a margin equal to the marginal operating cost on loans:

$$\bar{l}_t - \bar{d}_t = C_t'(\mathcal{L}_t, \Theta_T) \quad (2)$$

The existence of asymmetric information indicates the need for each bank to utilize its own resources in order to discern the creditworthiness of the borrower given his/her past history of performance, management competence and the

[3]In fact, this is a simplified version of the Monti-Klein model of the banking firm in competitive conditions.

perceived prospects of the proposed projects in a noisy environment. This expenditure of scarce resources from banks is expressed on average in their operating cost and hence, households pay a price to them for this function. This is the spread of the financial intermediation that equals the marginal operating cost of banking activity. A falling marginal cost, due to an improved institutional environment (a rising θ_T) , should be accompanied by a falling spread, that is a lower loan rate for given deposit rate. In this sense, the marginal operating cost of banks, which is closely related to the cost of curbing the problem of asymmetric information, is the sole determinant of their pricing policy.

4.2 The Problem of the Representative Household/Saver

Households are interested in smoothing their consumption over the longer period. To do this they include as inputs to their maximization problem the expected profits of the firm at each period of time W_t^i, which they expect to receive as income, and the expected deposit rate offered by banks $\bar{d}_t$. Note that in a multiperiod model the household cannot know from period 1 the projects that the manager of the firm will pursue in period t so as to calculate the related expected profits that will flow to it as income. Consequently, its expectation of the future and the competence of the manager for the immediate following period condition its expectation for the ensuing periods. This makes its dependency on the contract signed with the manager – through the bank – stronger. The household cannot know the deposit rate that will be effective in future periods since this will be determined as the difference of the loan rate and the marginal cost of the bank. Hence, we treat the deposit rate in the multiperiod framework as the expected deposit rate. In this context, households' problem is solved on the basis of the discounting of intertemporal utility by their subjective risk-adjusted preference factor ρ_t.

Following our premises and Sargent (1987) the maximization problem of the household becomes:

$$\max_{C_t} E_0 \left[\sum_{t=0}^{Z-1} \left(\frac{\vartheta_{t-1}{}^{1/t}}{1+\rho_{t-1}} \right)^t u_i(C_t^i) \right]$$

s.t.

$$S_{t+1}^i = \left(S_t^i + W_t^i - C_t^i\right)\left(1 + \alpha_t \bar{d}_t\right)$$

$$S_0^i = given \tag{3}$$

$$E_0 \left(\frac{\vartheta_{Z-1}{}^{1/Z}}{1+\rho_{Z-1}} \right)^Z \left(S_Z^i\right) = 0$$

The limit condition excludes the case of perpetual borrowing so that there is neither outstanding debt at time $t = Z$ nor savings left over. This yields the Euler equation:

$$u'(C_t) = \frac{\theta_t}{1+\rho_t} E_t\left[u'(C_{t+1})(1+\alpha_t \tilde{d}_t)\right]$$
(4)

We will assume that α_t and θ_t are known to the agent when he makes his decision in period t in the sense that government policy for the said period is known at decision time.

The question that arises now is how the path of consumption, and hence saving, will be affected by government intervention.

Note the decompositions:

$$E\left[\frac{u_i'(C_{t+1})(1+\tilde{d}_t)}{u_i'(C_t)}\right] = E\left[\frac{u_i'(C_{t+1})}{u_i'(C_t)}\right] E\left[(1+\tilde{d}_t)\right] + cov\left[\frac{u_i'(C_{t+1})}{u_i'(C_t)}, \tilde{d}_t\right] \tag{5}$$

$$E\left[\frac{u_i'(C_{t+1})\theta_t(1+\alpha_t \tilde{d}_t)}{u_i'(C_t)}\right] = $$
$$= E\left[\frac{u_i'(C_{t+1})}{u_i'(C_t)}\right] E\left[\theta_t(1+\alpha_t \tilde{d}_t)\right] + \theta_t \alpha_t cov\left[\frac{u_i'(C_{t+1})}{u_i'(C_t)}, \tilde{d}_t\right] \tag{6}$$

Then keeping the ratios implied by the two Euler equations constant at the level before government intervention, namely

$$\frac{E_t\left[u'(C_{t+1})\theta_t(1+\alpha_t \tilde{d}_t)\right]}{u'(C_t)} = \frac{E_t\left[u'(C_{t+1})(1+\tilde{d}_t)\right]}{u'(C_t)} = 1+\rho_t \tag{7}$$

This is equivalent to setting $\theta_t(1+\alpha_t \bar{d}_t)=(1+\bar{d}_t)$ and $\theta_t = \frac{1}{\alpha_t}$ which jointly yield a value of $\alpha_t = 1$ indicating no government intervention. However, this analysis does not take into account the compound effect of θ_t and α_t on the ratio of the marginal utilities from consumption. It can be proved that if $\theta_t > 1$, $\alpha_t < 1$ then $\theta_t = \frac{1}{\alpha_t}$implies $\theta_t(1+\alpha_t \bar{d}_t) > (1+\bar{d}_t)$.

If this is the case then $E_t\left[\frac{u'(C_{t+1})}{u'(C_t)}\right]$ should decrease for (7) to hold; this implies a steeper path for consumption and hence, current savings above the levels attained before government intervention, given the uncertainty concerning the deposit rate. [4] This means that bridging the gap between investment demand and decreased savings at the lower deposit rate $\alpha_t \bar{d}_t$ it is possible through government intervention that entails $\theta_t > 1$, $\alpha_t < 1$and $\theta_t \leq \frac{1}{\alpha_t}$.

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[4] A similar result is obtained given the negative covariance between the expected deposit rate and the marginal utility from future consumption under the assumption that $\theta_t(1+\alpha_t \bar{d}_t) = (1+\bar{d}_t)$ and $\alpha_t < 1$ since, $\alpha_t < 1 \Rightarrow \alpha_t + \alpha_t \bar{d}_t < 1 + \alpha_t \bar{d}_t \Rightarrow \alpha_t(1+\bar{d}_t) < 1 + \alpha_t \bar{d}_t \Rightarrow \frac{1+\bar{d}_t}{1+\alpha_t \bar{d}_t} < \frac{1}{\alpha_t} \Rightarrow \theta_t < \frac{1}{\alpha_t}$

There is at least one plausible economic explanation to the rise of savings above the levels in the unregulated regime. As Llewellyn (1999) puts it, this could be for example a case of “Akerlof’s lemons” and “confidence”. Because of asymmetric information between borrowers and lenders, the latter cannot distinguish between good and bad projects. Although this might entail the charge of a higher risk premium, it also implies that marginal (risk averse) investors will exit the financial market thus lowering the level of savings available for investment. Financial regulation has the opposite effect: by rebuilding investors’ confidence on the soundness of given projects, it will attract marginal surplus units back to the market and raise savings above the unregulated levels. In our representative agent model, this is translated into a rise in the confidence of the household on the efficiency of the financial system – here intermediated by the bank – and hence a rise in its savings.

4.2 The Cost-minimization Problem of the Government

Let us now inquire under what conditions the government should take the decision to lower administratively the deposit rate. As has been described so far, the model embodies all three factors of Williamson’s (1985) schema, appropriately translated to the situation of financial markets. His core argument is also present, as additional safeguards given – by the state in our case – when asset specificity is high, permit a lower price – the interest rate in our case – for the debt claim. In this context, a financial framework of administratively set deposit rates $\alpha_t\bar{d}_t$ (through the related tax levied on them) but supplemented by the necessary safeguards is a representation of a financial regulation regime seeking to cope with the problems of non-verifiability of project returns because of low institutional development.

However, the shift to this governance structure (Williamson,1991a, 1991b)also entails the calculation of its costs. We will take as given the bureaucratic costs of hierarchies as part of general government outlays. Therefore, we will focus on the costs of degrading incentives along with the net pecuniary cost of government policy. In this context, we can distinguish two kinds of cost. The first is the cost of setting interest rates lower than the market rate by fiat. This cost is represented by the difference between the return on savings at the market rate and the return after the imposition of the administered rate, namely

$$\left(1+\bar{d}_t\right)-\left(1+\alpha_t\bar{d}_t\right)=(1-\alpha_t)\bar{d}_t \qquad (8)$$

This is what savers lose from the return on their savings. This cost is commonly characterized in the literature as a tax imposed by the government on savers. This cost becomes zero for $\alpha_t=1$(no government intervention) and increases for values of $\alpha_t<1$.

The other cost relates to what the government has to pay in order to provide safeguards to savers so as to mitigate the effect of distorted interest rates on savings. Since the variable of safeguards that acts upon the risk-adjusted preference parameter of households takes on values above 1, then we can represent this cost as the difference[5]

$$(\theta_t - 1)\rho_t \quad (9)$$

For the lowest value of $\theta_t = 1$ which indicates that no safeguards are provided, this cost is zero. This cost may represent expenditures of the "monetary authority" in order to implement its monitoring and enforcement functions by accumulating information, imposing disclosure etc. It may also include costs of establishing new institutions and improving the institutional infrastructure of the economy.

The net cost of government intervention is the difference between the cost of safeguards and the receipts from the tax on deposit interest income, namely:

$$NC = (\theta_t - 1)\rho_t - (1 - \alpha_t)\bar{d}_t \quad (10)$$

What is a cost to the government is a benefit to savers. The cost of safeguards is an indirect subsidy to savers while the receipts from tax on deposit interest income is exactly a tax to them. Hence, another way to see this relation is the difference, from the perspective of savers, of the subsidy provided to them as safeguards by the government minus the subsidy paid by them to firms, to satisfy their increased investment demand.

In governance terms, if $(1 - \alpha_t)\bar{d}_t$ is a fee paid by agents to the government for policies that lower transaction costs; the objective of the government is to minimize the net cost of implementing this task. However, the constraint in regulatory policy of providing finance to investment with lower-than-market rates, is that savings remain available to support this policy. Hence, the government is constrained to maintain savings at levels equal or greater to those prevailing before intervention.

Given the conditions for government intervention $\theta_t > 1$, $\alpha_t < 1$ and $\theta_t \leq \frac{1}{\alpha_t}$, we can define the time path of the deposit rate (its equation of motion) as:

$$\bar{d}_{t+1} = \bar{d}_t - (1 - \theta_t\alpha_t)\bar{d}_t \quad (11)$$

$$\bar{d}_{t+1} \leq \bar{d}_t \quad if \quad \theta_t \leq \frac{1}{\alpha_t} \quad (12)$$

This simply says that the level of the deposit rate for the next period depends on the level of the deposit rate in the current period and government expenditure

[5] One can envisage a linear relationship between the non-pecuniary θ_t that enters the households' maximization problem and the pecuniary say $\theta_t^{*} = \zeta + \eta\theta_t$ that enters the minimization problem of the government. Since such a modification would not change essentially neither the theoretical implications of the model nor their mathematical representations we drop it for simplicity.

on safeguards for the same period $(\theta_t - 1)$[6]. To put it more succinctly, it translates the non-pecuniary effect of safeguards on current deposit rate into a pecuniary deposit rate for the next period offered by the banks.

Assuming that agents learn from recent experience, government investment on safeguards θ_t that takes place at time $t$will affect the value for the risk-adjusted preference factor of households/savers for the next period. In this case its equation of motion is given by:

$$\rho_{t+1} = \frac{\rho_t}{\theta_t}$$

$$\rho_{t+1} \leq \rho_t \quad if \quad \theta_t \geq 1 \tag{13}$$

Equation (13) describes a process of period-by-period embodiment of safeguards expenditure θ_t in households/savers' attitudes and behavior. The latter takes the form of a gradual decline of ρ_t.

Now, the problem for the government is:

$$\min_{\alpha_t, \theta_t} V = \sum_{t=0}^{T-1} \beta^t \left[(\theta_t - 1)\rho_t - (1 - \alpha_t)\bar{d}_t \right]$$

s.t.

$$\bar{d}_{t+1} = \bar{d}_t + (\alpha_t \theta_t - 1)\bar{d}_t$$
$$\bar{d}_0 = given$$
$$\bar{d}_T = free$$
$$\rho_{t+1} = \rho_t + \rho_t \left(\frac{1}{\theta_t} - 1 \right)$$
$$\rho_0 = given$$
$$\rho_T = free$$
$$T = given$$

(14)

The problem entails two control variables, $\theta_t$and α_t, and two state variables, $\bar{d}_t$ and ρ_t. The government seeks to minimize the value function V which is the discounted sum of the net cost of intervention with $\beta = \frac{1}{1+\gamma} < 1$ being the relevant discount factor. In order to achieve that, it must choose a path for the control variables subject to the equations of motion for the state variables. The initial values of the interest rate and the risk-adjusted discount factor of savers are assumed given

[6]Note that $\theta_t(1 + \alpha_t \bar{d}_t) \geq (1 + \bar{d}_t) \Rightarrow (\theta_t - 1) \geq (1 - \theta_t \alpha_t)\bar{d}_t$where $(\theta_t - 1)$ represents government spending on safeguards' provision.

and the same holds for the time horizon T of this operation which is assumed shorter than the time horizon of the household Z.
Solving the model we obtain[7]:

$\bar{d}_t^* = \bar{d}_0 \quad \forall t$
(15)

$\rho_t^* = \left(\frac{1}{(1+\gamma)}\right)^t \rho_0$
(16)

$\alpha_t^* = \frac{1}{(1+\gamma)} \forall t$
(17)

$\theta_t^* = 1 + \gamma \forall t$
(18)

$\Theta_T^* = (\theta_t^*)^T = (1+\gamma)^T$
(19)

The paths for the control variables, $\alpha_t = \frac{1}{(1+\gamma)}$ and $\theta_t = 1 + \gamma$depend on the time preference factor of the government γ and imply that $\theta_t \alpha_t = 1 \Rightarrow \theta_t = \frac{1}{\alpha_t}$ which by (12) places us to the case where $\bar{d}_{t+1} = \bar{d}_t = \bar{d}_0$. On the other hand, the path of the risk-adjusted preference factor of households $\rho_t^* = \left(\frac{1}{(1+\gamma)}\right)^t \rho_0$ is decreasing and depends on γ and the initial ρ_0.Finally, the stock of institutional safeguards $\Theta_T^*$is derived as the cumulative safeguards until T and depends positively on both the time preference of the government γ and the horizon of its policy T. In this sense, another way to view equation (16) is by considering the factor ρ_T in period T as the initial ρ_0 decreased by the stock of institutional safeguards up to period T , Θ_T, i.e.

$$\rho_T = \frac{1}{(1+\gamma)^T} \rho_0 = \frac{1}{\Theta_T} \rho_0 \tag{20}$$

Furthermore, inserting the optimum values for the parameters into the objective function we obtain the optimum net cost $NC^* = \gamma \left(\left(\frac{1}{(1+\gamma)}\right)^t \rho_0 - \frac{\bar{d}_0}{1+\gamma}\right)$. A government would prefer this net cost to be non-positive otherwise it might have to supplement its tax receipts with borrowing or foreign aid in order to finance its

[7] See the Mathematical Appendix.

supply of safeguards. It can be proved that the optimum net cost is negative or zero if the risk-adjusted preference factor of savers is less than or equal to the after-tax deposit rate namely, $\rho_t^* < \alpha_t^* \bar{d}_0$.[8]Working out this expression gives an upper boundary for the value of the government's time preference factor$\gamma \leq \frac{d_0}{\rho_t} - 1$. This means that for given $\bar{d}_0$, the higher the 'private'ρ_0 is, the lower the 'public'γ should be set by government for the net cost of intervention to be non-positive. In this case, the optimum selection of α_t and $\theta_t$which in turn depend on γwill sustain a self-financed policy. The results on the conditions that determine government's choice for intervention are summarized in Table 1.

Table 1: The choice for government intervention

	No government intervention	Government intervention
α_t	$\alpha_t = 1$	$\alpha_t = \frac{1}{(1+\gamma)} < 1$
θ_t	$\theta_t = 1$	$\theta_t = 1 + \gamma > 1$
Θ_T	$\Theta_T = 0$	$\Theta_T = (1+\gamma)^T$
γ	$\gamma = 0$	$\gamma \leq \frac{d_0}{\rho_t} - 1$
d_t	$d_t = d_0$	$d_t = d_0$
ρ_t	$\rho_t = \rho_0$	$\rho_t = \left(\frac{1}{(1+\gamma)}\right)^t \rho_0$
NC^*	$NC^* = 0$	$NC^* = \gamma\left(\left(\frac{1}{(1+\gamma)}\right)^t \rho_0 - \frac{\bar{d}_0}{1+\gamma}\right)$

5. Discussion, model implications and extensions

The model we have analyzed embodies basic micro-foundations to macroeconomic paths in the spirit of Williamson's conception of governance as provision of safeguards. The portrayal of financial regulation as governance structure involves conceptualization of a basic tradeoff: lower returns to depositors are counterbalanced by public provision of institutional safeguards to financial saving; these, in turn, enable the inter-temporal sustainability of aggregate savings. In addition, the consistent provision of safeguards exercises not a transitory but a cumulative influence which can be conceived as 'institutional development'. This feature of the model corresponds to insights of a long line of contributions about the importance of institutions in the evolution of financial markets

Furthermore, it makes more sense of historical examples as compared to the simple narrative of 'financial repression' which essentially either ignores institutional development altogether or assumes that it is an automatic substratum of market equilibrium.

[8]See the Mathematical Appendix.

In the construction of the model we have opted for a self-imposed limitation in portraying banks as passive agents in the process of finance. The drawback of this assumption is that it ignores bank strategies to use their incumbent powers and maintain margins despite institutional development, i.e. not allow the passing of its benefits through lower rates to borrowers. This admitted limitation ignores another area of possible regulatory intervention, i.e. the regulation of non-competitive behavior of banks, which we consider an important but separate matter. However, this simplification enables a gain by leaving room for portraying the government as an active decision-maker, without compromising the tractability of the model.

The government as an agent of regulation is primarily engaged, besides taxing deposit rates, in the public provision of Williamsonian safeguards. Thus, the simplistic representation of public behavior that is pervasive in models of financial repression becomes enriched with the additional dimension of provision of public benefits, as the counterpart to the extraction of taxes. Thus, the government is now portrayed not as a maximizer of rent but as a cost minimizer which can, in addition seek to achieve fiscal balance in the long-run. This more sensible and balanced portrayal of government allows several novelties in perspective. First, it is possible to construct a process of institutional development spurred on by government safeguards and to derive explicit conditions for this process to be self-financed in an inter-temporal setting. Second, self-financed safeguards make unnecessary any analytical recourse to accumulating government debt which may create various other effects upon financial development, such as financial crowding out for example. Third, the model explicitly produces paths ('equations of motion') for critical variables which are smooth, thereby underlining the importance of consistency and continuity in government decision behavior. It is implied that a process of uneven, haphazard or random provision of safeguards will undermine the cumulative effect that in this model is portrayed as stable institutional development.

One of the major analytical choices whose effects are portrayed in the model is the impact of safeguards on saving behavior through their *gradual and cumulative influence* upon the risk-adjusted rate of time preference of households. In fact, we can discern a two-step process. The first step is the implementation of government's safeguards as these are expressed by a θ_t above unity operating on the saving decision of households. Then the second and more substantial step is the embodiment of these safeguards in the attitudes and behavior of agents. We have seen in the model that this might be a gradual process for households/savers as they learn from their period-by-period experience. However, as government's *investment* in safeguards θ_t piles up, in any given time period T, a *stock* representing institutional endowment Θ_T is formed affecting the behavior of both households-savers and banks. Then financial development entails a change in agents' preferences for future consumption – or for higher saving – namely $\rho_T < \rho_0$ along with a lower loan rate $\bar{l}_T < \bar{l}_0$ indicating lower marginal costs for banks $\bar{l}_T - \bar{d}_0 = C_T'(\mathcal{L}_T, \Theta_T)$ in an institutionally more developed market[9].

[9] Note that this kind of government interventionism is not a short-lived income transfer from lenders/savers to borrowers. On the contrary, it is long-term looking policy to the degree that lower lending rates are granted to firms because the marginal verification cost of banks is decreased as the latter are aided by the institutional infrastructure that the government builds.

This is again an impact inspired by Williamson's notion of safeguards which endow those who enter the world of financial transactions with a sense of security. In fact, households' perception of insecurity may be caused by a very noisy environment where low disclosure, lack of transparency, heavy asymmetries of information and lack of mechanisms controlling opportunistic managerial behaviors are reflected in saving decisions through high risk aversion and time preference. In fact all these conditions can be mitigated by public safeguards which however do not work instantaneously but through gradual learning in the actual environment. Furthermore, even fundamental uncertainty a la Knight (1921) may be mollified – to a degree - by the existence of standby institutional arrangements such as safeguard provisions of last resort, e.g. deposit insurance, lender of last resort facilities, bankruptcy resolution regimes and reserve funds for strategic bailouts. In our conception of financial development therefore, the linkage of institutional development with the structure of risk perceptions of saver-households is a valuable tool for understanding the functioning and the evolution of a financial market. The simple model we have analyzed underlines and illuminates this linkage.

One of the important analytical results of the model refers to the relative time preference factors of households and government respectively (ρ, γ). Whereas the factor for households is taken as a simple reflection of the perception of the environment at each point in time, the government time preference is inevitably a more 'managed' factor in the sense that government may have a more strategic view of long term goals. As our analysis has shown, the higher the initial value of ρ, the lower the value of the government factor γ must be for the equilibrium path to be optimal. This implies that the government must act as an agent with a longer horizon and probably also lesser risk-aversion. This is consistent with the view that in environments of low institutional development, the government may have a view that is more aggregate and more 'visionary' than that of price-taking households, or, in any case that the government's perspective cannot succumb to the temptation of myopic behavior to the same degree as households, when tackled with a noisy, uncertain and possibly threatening environment.

An important remark on the type of equilibrium that the model provides relates to the terminal condition of the finite horizon T, i.e. the 'developed market condition'. Even if the system has reached a level characterized by mature institutions that render continuous government intervention redundant after time T, there is still the issue of the system's fragility and the need to preserve its stability. As Dow (1996) indicates, financial development goes hand in hand with the need for regulation, although the latter might take more sophisticated or more contingent forms. To put it in the context of the previous model, a low value of ρ_t depends not only on the establishment of confidence in the system through past values of θ_t, but also on the established expectation that the state would provide the adequate safeguards were these needed in adverse times in the future.

This is evident in the case of exogenous shocks, or contagious panic where agents lose confidence on both the solvency of the banks and the success of the projects held by firms. If banks face difficulties in obtaining the full amount of the principal plus interest of loans then agents might consider less probable that firms will have positive profits in the future and saving will become more inelastic with respect to the deposit rate. In this case, they might prefer to increase current consumption rather than leave aside resources in the form of savings with uncertain – not just risky – future value translated to future consumption. The immediate effect would be a decrease of deposits held at banks. In this environment asset specificity rises again, as the marginal verification cost of banks rises, the deposit rate will also rise along with the loan rate, as banks attempt to maintain the flow of savings at previous levels. In the model described in this paper, a change in the preference for postponing consumption – that is a preference for a decrease in savings – can be represented by an upward shock to the risk-adjusted preference factor ρ_t. In such a situation, what investors demand the most are safeguards once again. Then, a government policy that intervenes in the market by providing a rising θ_t, though at the expense of a falling α_t, is indeed what agents require for a restoration of their confidence in the financial system.

In this sense, prudential regulation entails not only a lender of last resort but, more generally, a safeguard provider "of last resort". By this peculiar notion we mean the need for a continuous background presence of the state in the financial system as the ultimate guarantor and gatekeeper of its liquidity and stability. Deposit insurance and Lender of Last Resort facilities are essential but do not exhaust the list of safeguard provisions even in developed markets. Such provisions also entail the commitment of regulatory authorities to stand by and design provision of safeguards on an emergency or non-emergency basis. The point here is that asymmetric information is not simply static but Is in fact embedded in a fundamentally uncertain environment in the sense of Knight(1921)/Keynes (1921) which makes the role of confidence, as established by past and future expected θ_t, crucial for financial stability. If this is the case, then ρ_t will remain low only if θ_t is above unity by a small amount ε close to zero, so that $\theta_t - 1 = \varepsilon > 0$ acts as a the signal provided by government to market participants that it will act with a safeguarding plan if and when needed. By the same token α_t will never be exactly equal to unity but close to it, the difference being a small ε' that represents the price agents have to pay for having a regulatory authority acting as a monitor of the system. This is, as Llewellyn (1999) puts it, the "insurance premium" that agents pay. To put it differently, we may consider $\theta_t - 1 = \varepsilon$,financed by $\alpha_t = 1 - \varepsilon'$, as a "depreciation" expenditure necessary to keep up the stock of institutional safeguards Θ_T.Then, if d_t is the hypothetical benchmark rate of an ideal unregulated market, $\alpha_t d_t = (1 - \varepsilon')d_t$ is the prevailing interest rate in a world with developed and prudentially regulated financial markets surrounded by the unpredictabilities of fundamental uncertainty.

Mathematical Appendix

The problem of the government becomes:

$$\max_{\alpha_t, \theta_t} - V = \sum_{t=0}^{T-1} \beta^t \left[-(\theta_t - 1)\rho_t + (1 - \alpha_t)\bar{d}_t \right]$$

(A1)

s.t.

$$\bar{d}_{t+1} = \bar{d}_t + (\alpha_t\theta_t - 1)\bar{d}_t$$
$$\bar{d}_0 = given$$
$$\bar{d}_T = free$$
$$\rho_{t+1} = \rho_t + \rho_t\left(\frac{1}{\theta_t} - 1\right)$$
$$\rho_0 = given$$
$$\rho_T = free$$
$$T = given$$

The current value Hamiltonian is:

$$H_c = -(\theta_t - 1)\rho_t + (1 - \alpha_t)\bar{d}_t + \beta\lambda_{1t+1}(\alpha_t\theta_t - 1)\bar{d}_t + \beta\lambda_{2t+1}\left(\frac{1}{\theta_t} - 1\right)\rho_t \tag{A2}$$

The Lagrangian:

$$L = \sum_{t=0}^{T-1} \beta^t \left\{H_c + \beta\lambda_{1t+1}\left(\bar{d}_t - \bar{d}_{t+1}\right) + \beta\lambda_{2t+1}(\rho_t - \rho_{t+1})\right\} \tag{A3}$$

Then by the maximum principle conditions we obtain:

$$\frac{\partial L}{\partial\theta_t} = \frac{\partial H_c}{\partial\theta_t} = -\rho_t + \beta\lambda_{1t+1}\alpha_t\bar{d}_t - \beta\lambda_{2t+1}\frac{\rho_t}{(\theta_t)^2} = 0 \tag{A4}$$

$$\frac{\partial L}{\partial\alpha_t} = \frac{\partial H_c}{\partial\alpha_t} = -\bar{d}_t + \beta\lambda_{t+1}\theta_t\bar{d}_t = 0 \Rightarrow$$

$$\Rightarrow \theta_t = \frac{1}{\beta\lambda_{1t+1}} \tag{A5}$$

$$\frac{\partial L}{\partial\beta\lambda_{1t+1}} = 0 \Rightarrow \bar{d}_{t+1} - \bar{d}_t - (\alpha_t\theta_t - 1)\bar{d}_t = 0 \tag{A6}$$

$$\frac{\partial L}{\partial\beta\lambda_{2t+1}} = 0 \Rightarrow \rho_{t+1} - \rho_t - \rho_t\left(\frac{1}{\theta_t} - 1\right) = 0 \tag{A7}$$

$$\frac{\partial L}{\partial\bar{d}_t} = 0 \Rightarrow \beta\lambda_{1t+1} - \lambda_{1t} = -\frac{\partial H_c}{\partial\bar{d}_t} \Rightarrow$$

$$\Rightarrow \beta\lambda_{1t+1} - \lambda_{1t} + (1 - \alpha_t) + \beta\lambda_{1t+1}(\alpha_t\theta_t - 1) = 0 \tag{A8}$$

$$\frac{\partial L}{\partial\rho_t} = 0 \Rightarrow \beta\lambda_{2t+1} - \lambda_{2t} = -\frac{\partial H_c}{\partial\rho_t} \Rightarrow$$

$$\Rightarrow \beta\lambda_{2t+1} - \lambda_{2t} - (\theta_t - 1) + \beta\lambda_{2t+1}\left(\frac{1}{\theta_t} - 1\right) = 0$$

(A9)

Out of (A5) and (A8) we obtain:

$$(A5),(A8) \Rightarrow \beta\lambda_{1t+1} - \lambda_{1t} + (1-\alpha_t) + \beta\lambda_{1t+1}\left(\frac{1}{\beta\lambda_{1t+1}}\alpha_t - 1\right) = 0 \Rightarrow \lambda_{1t} = 1\ \forall t$$

(A10)

Then by (A5):

$$(A5) \Rightarrow \theta_t = \frac{1}{\beta} = 1 + \gamma$$

(A11)

Using this expression and substituting into (A7) we have:

$$(A7),(A11) \Rightarrow \rho_{t+1} - \rho_t - \rho_t(\beta - 1) = 0 \Rightarrow$$

$$\Rightarrow \rho_{t+1} = \beta\rho_t \Rightarrow \rho_{t+1} = \frac{1}{(1+\gamma)}\rho_t$$

(A12)

Using the definition of $\beta = \frac{1}{1+\gamma}$. Then, solving this difference equation we obtain the path for the subjective rate of households:

$$\rho_t = \left(\frac{1}{(1+\gamma)}\right)^t \rho_0$$

(A13)

Then we can also define the stock of thetas until time T as the compound effect on the initial ρ_0 :

$$\Theta_T = (1+\gamma)^T$$

(A14)

By (A9), (A11), and (A13) we have:

$$(A9),(A11),(A13) \Rightarrow \beta\lambda_{2t+1} - \lambda_{2t} - \left(\frac{1}{\beta} - 1\right) + \beta\lambda_{2t+1}(\beta - 1) = 0 \Rightarrow$$

$$\Rightarrow \beta^2\lambda_{2t+1} - \lambda_{2t} - \left(\frac{1}{\beta} - 1\right) = 0 \Rightarrow$$

$$\Rightarrow \lambda_{2t+1} = \frac{1}{\beta^2}\lambda_{2t} + \frac{1-\beta}{\beta^3}$$

(A15)

Solving this difference equation we obtain the path of the co-state variable λ_{2t} :

$$\lambda_{2t} = (\lambda_{2_0} - C)(1+\gamma)^{2t} + C$$

(A16)

Where

$$C = \frac{\frac{1-\beta}{\beta^3}}{1-\frac{1}{\beta^2}}$$

Furthermore, by (A4), (A10), (A15) and (A16) and substituting we can get:

$$(A4),(A10),(A15),(A16) \Rightarrow \alpha_t \bar{d}_t - \lambda_{2t+1}\beta^2\rho_t - \frac{\rho_t}{\beta} = 0 \Rightarrow$$

$$\Rightarrow \alpha_t \bar{d}_t = \left[(\lambda_{2_0} - C)(1+\gamma)^{2t} + C + 2\gamma + 1\right]\left(\frac{1}{(1+\gamma)}\right)^t \rho_0 \Rightarrow$$

$$\Rightarrow \alpha_t = \frac{A(t)}{\bar{d}_t}\rho_0$$

(A17)

Defining the expression $(t) = \left[(\lambda_{2_0} - C)(1+\gamma)^{2t} + C + 2\gamma + 1\right]\left(\frac{1}{(1+\gamma)}\right)^t$. Then by (A6), (A11) and (A17) we obtain:

$$(A6),(A11),(A17) \Rightarrow \bar{d}_{t+1} = \alpha_t \theta_t \bar{d}_t \Rightarrow$$

$$\Rightarrow \bar{d}_{t+1} = (1+\gamma)A(t)\rho_0$$

(A18)

However, the transversality conditions for this truncated vertical terminal line problem are:

$$\lambda_2(T) \geq 0, \rho_T \geq \rho_{min} \ and \ (\rho_T - \rho_{min})\lambda_2(T) = 0$$

(A19)

$$\lambda_1(T) \geq 0, \bar{d}_T \geq \bar{d}_{min} \ and \ (\bar{d}_T - \bar{d}_{min})\lambda_1(T) = 0$$

(A20)

Then (A19) holds for $\lambda_2(T) > 0$, $\rho_T = \rho_{min}$ and a falling ρ_t from a ρ_0 to a minimum ρ_{min} as (A13) indicates.

On the other hand, (A20) holds for $\lambda_1(T) > 0$, $\bar{d}_T = \bar{d}_{min}$ in either of two cases:

1) If $\bar{d}_T = \bar{d}_{min} = \bar{d}_0 = \bar{d}_t$ namely, the deposit rate remains at its initial level in every period t ($\bar{d}_{t+1} = \bar{d}_t$) then by (A18) $\alpha_t = \frac{1}{1+\gamma} \forall t$.
2) If $\bar{d}_T = \bar{d}_{min}$ and $\bar{d}_{t+1} < \bar{d}_t$ then by (A18) $\alpha_t < \frac{1}{1+\gamma}$ and $\bar{d}_t$ falls from an initial level $\bar{d}_0$ to $\bar{d}_T = \bar{d}_{min}$.

However, the last case, though mathematically possible, lacks sound economic justification. We should expect that depositors would demand a deposit rate at least maintained at its original level and certainly not falling given their additional tax burden. If there is an upper bound for the deposit rate set out by the maximization problem of banks then it is reasonable to expect a constant path $\bar{d}_0 = \bar{d}_t$.

Inserting the optimum values for the parameters into the objective function we obtain the optimum net cost:

$$NC^* = (\theta_t^* - 1)\rho_t^* - (1 - \alpha_t^*)\bar{d}_t^* =$$

$$= \gamma\left[\left(\frac{1}{(1+\gamma)}\right)^t \rho_0 - \frac{\bar{d}_0}{1+\gamma}\right]$$

(A21)

This expression is negative or zero if the term in the parentheses is negative or zero which entails:

$$NC^* \leq 0 \Rightarrow \rho_t^* \leq \alpha_t^* \bar{d}_0$$

(A22)

Which implies:

$$\gamma \leq \frac{d_0}{\rho_t} - 1$$

(A23)

Besides, forming the maximized Hamiltonian H_c^o, that is the Hamiltonian evaluated along the α_t^*, θ_t^* paths, we can prove that it is concave in the state variables $\bar{d}_t$, ρ_t $\forall t$ for given λ_{1t}, λ_{2t} which satisfies the Arrow sufficiency theorem (Chiang (1992)) for the conditions of the maximum principle to be sufficient for the global maximization of the objective functional. Indeed, forming H_c^o we obtain:

$$H_c^o = -\left(\frac{1}{\beta} - 1\right)\rho_t + (1-\beta)\bar{d}_t + \left(\frac{1}{\beta}\lambda_{2t} + \frac{1-\beta}{\beta^2}\right)(\beta - 1)\rho_t$$

(A24)

Since, H_c^o is linear in $\bar{d}_t$ and ρ_t for every t then it is also concave in $\bar{d}_t$ and ρ_t and hence, the Arrow sufficiency theorem is satisfied.

References

Arestis, P., 1999.Financial Liberalization: The Experience of Developing Countries. Eastern Economic Journal 25 (4), 441-457.

Arestis, P., Glickman, M., 2002.Financial Crisis in Southeast Asia: Dispelling Illusion the Minskyan Way. Cambridge Journal of Economics 26 (2), 237-260.

Arestis, P., Stein H., 2005.An Institutional Perspective to Finance and Development as an Alternative to Financial Liberalization, International Review of Applied Economics 19 (4), 381-398.

Chiang, A. C., 1992.Elements of Dynamic Optimization, McGraw-Hill.

Diamond, D. And P. Dybvig (1983) Bank Runs, Deposit Insurance and Liquidity, Journal of Political Economy, 91, pp. 401-419

Dow, S. C., 1996. Why the Banking System Should be Regulated. The Economic Journal 106 (436), 698-707.

Fry, M. J., 1995 Money, Interest and Banking in Economic Development, second Ed., Johns Hopkins University Press, Baltimore.

Gale, F.G. and M. Hellwig 1985, Incentive Compatible Debt Contracts, Review of Economic Studies, 52, pp. 647-663.

Keynes, J. M., 1921. A Treatise on Probability, London: MacMillan & Co

Keynes, J. M., 1936. The General Theory of Employment, Interest and Money, reprinted in *The Collected Writings of J. M. Keynes*, Vol. VII, 1973,MacMillan

Klein, M. A., 1971. A Theory of the Banking Firm, Journal of Money, Credit and Banking 3 (2), 205-218

Knight, F. H., 1921. Risk, Uncertainty and Profit, Boston & N.Y.: Houghton Mifflin Co.

LaPorta R.F, F. Lopez de Silanes, A. Schleifer, R. Vishny, 1998, Law and Finance, Journal of Political Economy, 106, pp. 1113-1155.

LaPortaR.F, F. Lopez de Silanes, A. Schleifer, R. Vishny, 1999, The quality of Government, Journal of Law, Economics and Organization, 15, pp. 222-283.

Levine, R., 1997. Financial Development and Economic Growth: Views and Agenda. Journal of Economic Literature 35 (2), 688-726.

Llewellyn, D., 1999. The Economic Rationale for Financial Regulation. FSA Occasional Paper Series, 1 (April), 1-58.

McKinnon, R. I., 1973. Money and Capital in Economic Development.Brookings Institution, Washington D.C.

Minsky, H., 1986. Stabilizing an Unstable Economy,Yale University Press, New Haven and London

Minsky H., 1996. Uncertainty and the Institutional Structure of Capitalist Economies, BARD COLLEGE, 6-1-96

Modigliani, F., Perotti E., 1997.Protection of Minority Interest and the Development of Security Markets. Managerial and Decision Economics 18(7/8), The Use of Finance and Economics in Securities Regulation and Corporation Law, 519-528.

Rajan, R. G., Zingales L., 1998. Which Capitalism? Lessons from the East Asian Crisis. Journal of Applied Corporate Finance 11(3), 40-48.

Rajan, R. G., Zingales L., 2003a. The Great Reversals: The Politics of Financial Development in the Twentieth Century. Journal of Financial Economics 69, 5-50.

Rajan, R. G., Zingales L., 2003b. Saving Capitalism from the Capitalists: Unleashing the Power of Financial Markets to Create Wealth and Spread Opportunity, Princeton University Press.

Santomero, A. M., 1984. Modeling the Banking Firm.A Survey. Journal of Money, Credit and Banking 16 (4), 576-602

Sargent, T. J., 1987. Dynamic Macroeconomic Theory, Harvard University Press, Cambridge Mass.

Shaw, E. S., 1973. Financial Deepening in Economic Development, Oxford University Press, New York.

Stiglitz, J. , 1989, The Economic Role of the State, Basil Blackwell, Oxford and Cambridge, Ma.

Tanzi, V. 2011, Government versus Markets, Cambridge University Press

Tirole, J. , 2006, The Theory of Corporate Finance, Princeton University Press

Williamson, O. E., 1985. The Economic Institutions of Capitalism, Free Press, New York.

Williamson, O. E., 1991a. Comparative Economic Organization: The Analysis of Discrete Structural Alternatives. Administrative Science Quarterly 36(2), 269-296

Williamson, O. E., 1991b. Economic Institutions: Spontaneous and Intentional Governance. Journal of Law, Economics and Organization 7, (Special Issue), 159-187.

Williamson, O. E., 1996. The Mechanisms of Governance, Oxford University Press.

World Bank, 1989. World Development Report 1989. Washington D.C..