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Abstract

In this essay we develop a stylized model to investigate the role of external financial liberalization in the development process of a small economy. Firstly, we show that there exists an economic development threshold under which the capital account liberalization can not occur. Secondly, we show that in the presence of banking inefficiency, the financial liberalization presents a major risk for the economic development process. Indeed, if the economy is situated in a vulnerability region every bad performance of the investment sector could degenerate in a banking crisis delaying the development process by several periods relatively to the situation of closed economy. Finally, it is also shown that reducing the credit market imperfection decreases the likelihood of a banking crisis.

Key Words: Banking efficiency, financial liberalization, confidence crisis, economic development.

JEL Classification: F34, G15, O00, O16

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1 Introduction

The importance of the financial sector in the process of economic growth has been extensively analyzed in recent years. The literature which started with Goldsmith (1969), McKinnon (1973), and Gurely and Shaw (1973) has shown that the existence of a stable financial structure plays an enormous role in encouraging economic growth. Indeed, it increases the risk sharing and facilitates the efficient allocation of saving among productive activities by reducing the informational costs.

Therefore, as Chan-Lau and Chen say "*it is not surprising that policies aiming to accelerate the pace of financial development and liberalization have gained acceptance in an increasing number of countries during the last few years*"[1]. In fact, many developing countries adopted measures to liberalize their capital accounts, hoping to fuel economic growth by attracting foreign investment. This contributes to the increase of net private capital flows to developing nations which passed from around US$36 billion per year during 1987-89 to US$230 billion per year during 1995-97 (World Bank 1998).

However, since the Asian crisis economists as well as policy makers are being concerned about the financial development and liberalization process in developing countries. In one hand, few economists as Arestis and Glickman (2002) argued that "*financial liberalization is never a good policy prescription, even in principle because it necessarily makes the financial system more fragile*"[2]. In the other hand, many economists as Chan-Lau and Chen (2001), while recognizing that the financial liberalization process may be risky for developing countries, emphasize its growth-promoting attributes and show that "*it is important that the financial liberalization be accompanied by financial development, in the form of improvement in the financial sector's efficiencies*"[3]. The link between the soundness of the domestic financial sector and the international financial stability is widespread among economists. Wachtel (1999) say that "*in addition to the traditional macro fundamentals- inflation, growth, fiscal deficit, external debt, current account, exchange rate- we have to monitor the new fundamentals: the quality of the financial sector, particularly domestic banks, asset prices, corporate governance, corporate sector exchange rate exposure and the quality of investment projects*"[4].

A good empirical study Bailliu (2000) shows that capital inflows foster higher economic growth only for economies where the banking sector has reached a certain level of development and suggests that "*the domestic financial sector plays a pivotal role in ensuring that international capital flows do indeed promote economic growth in developing countries*"[5].

This paper belongs to the theoretical attempts that investigate the effect of financial liberalization in the development process of a small economy endowed with an inefficient banking system. It distinguishes from the existing literature by its endogenous dynamic aspect that link different characteristics of the economy: the macroeconomic conditions, the economic stage of development, the progressively versus instantaneously financial liberalization, the inefficiency of the banking system, and the credit market perfection.

Firstly, we show that there exists an economic development threshold under which the financial liberalization can not occur. Secondly, we show that in the presence of banking inefficiency, the financial liberalization presents a major risk for the economic development process. Indeed, we show that there is a vulnerability zone (defined in terms of capital accumulation level) where every bad performance of the investment good sector may degenerate in a confidence crisis in the banking system which in turn delays the economic development process by several periods in comparison to that achieved without financial liberalization. We also show that in some cases, improving the credit market perfection decreases the likelihood of a confidence crisis in the banking system.

[1] Chan-Lau, Jorge A and Chen. 2001. Crash-Free Sequencing Strategies for Financial Development and Liberalization. IMF Staff Papers, Vol. 48, No. 1

[2] Arestis, Philip and Glickman. 2002. Financial Crisis in Southeast Asia: dispelling illusion the Minskyan way. Cambridge Journal of Economics, No. 26, p. 237-260.

[3] Same reference as footnote 1.

[4] Wachtel, Paul. 1999. Market oriented Banking, Economic Growth and International Financial Stability. Internet.

[5] Bailliu, Jeannine. 2000. Private Capital Flows, Financial Development, and Economic Growth in Developing Countries. Bank of Canada, WP. 2000-15, p.3

The remainder of this paper is organized as follows. In section 2 we present the structure components of the model: the production technology, the households (depositors and entrepreneurs), the inefficient bank and defines the economic development process. In section 3 we setup the dynamic structure of the model in the case of a closed financial system. In section 4 we generalize the model to the case of a progressive/ instantaneously liberalized financial system and examine the interaction between the economic development, the macroeconomic conditions, the banking inefficiency, the credit market perfection and the financial liberalization.

2 The Model

We construct an overlapping generation model. Each generation consists of a continuum of agent living for two periods. There are two production technologies in the economy; a technology for the production of a final good and another for the investment good. The final good can be used for consumption and production of the investment good. The investment good is used as an input in the final good production technology. Moreover, there is a bank managed by a central banker which gather the household's saving and lend to the entrepreneurs of the investment good sector. In the case of a liberalized financial sector, the bank liabilities include not only the household's saving but also foreign loans borrowed from foreign investors.

2.1 Sequence of Events

The timing of events can be summarized as follows. Date t marks the beginning of period $t+1$ and the end of period t. Each date a new generation of two-period living individuals is born.

An individual born on date $t-1$ works when he is young (i.e. during its first period of life) in the final good production sector and consumes at date $t+1$ before dying. At date t, he earns a wage then decides how to use it during period $t+1$. He can deposit it at the bank and receives the principal and interests at $t+1$, or he can use it to undertake an investment good production project, in which case he may need to borrow loans from the bank.

Therefore, in general there are each period depositors and entrepreneurs among the old generation persons. This is not the case when potential domestic depositors have no confidence in the bank and prefer to hold their wages in home until the end of their life.

In a closed financial system the household saving is the only source that the bank disposes to finance the entrepreneurs projects. After the financial liberalization, the bank have access to short-term foreign loans , in addition to the households saving,.

An entrepreneur that undertakes a project during period $t+1$ sell its investment good production to the final good production sector.

2.2 Production Technology

2.2.1 The Final Good Production Technology

The final good are produced with the investment good, K_t, and labor, L_t, using the Cobb-Douglas technology

$$Y_t = A_t.K_t^{\alpha}.L_t^{1-\alpha}$$

where A_t is a productivity term that introduces a positive externality, depending on the per capita capital level

$$A_t = \bar{K}_t^{1-\alpha} = \left(\frac{K_t}{L_t}\right)^{1-\alpha}$$

The output per capita is therefore

$$y_t = A_t.k_t^{\alpha}$$

The inputs price in terms of the final good are

$$\begin{aligned} \rho_t &= \alpha \\ w_t &= w(k_t) = (1-\alpha)k_t \end{aligned} \tag{1}$$

2.2.2 The Investment Good Production Technology

The investment good is produced with the final good according to the following technology; $\bar{w} \geq 1$ indivisible units of a final good invested at t gives R_{t+1} units of investment good at $t+1$.

$$R_{t+1} = \begin{cases} R+\sigma & \text{with probability} \quad \pi \\ R-\sigma & 1-\pi \end{cases}$$

Let S_t a variable that take the value (high) H if the return R_t is equal to $R+\sigma$ and (low) L in the other case. Once the quantity R_{t+1} of the investment good produced, the entrepreneurs will sell it to the final good technology and receive αR_{t+1} final good. Therefore, the return of this technology is $\dfrac{\alpha R_{t+1}}{\bar{w}}$ assumed to be strictly superior to the unity if the good state of the nature occurs i.e. $\dfrac{\alpha(R+\sigma)}{\bar{w}} > 1$ and strictly inferior to the unity otherwise i.e. $\dfrac{\alpha(R-\sigma)}{\bar{w}} < 1$. Note that $\forall\ t > 0$

$$E_t(R_{t+1}) = E(R) = R + (2\pi - 1)\sigma$$

2.3 Agents Behavior

Each agent of the $[0,1]$ continuum of individuals of generation $t-1$ born at date $t-1$ supplies inelastically one unit of labor at the first period of its life in the final good production sector so that the total labor supply is

$$L_t = 1$$

At date t he earns a wage w_t and have to decide how to use it until date $t+1$ when he consumes all its wealth before dying. The agent decision consist to maximizing his wealth W_{t+1}. Depositing its wage in the bank in return of a gross interest rate r_{t+1} increases its wealth to

$$W_{t+1}^d = r_{t+1} w_t \tag{2}$$

Whereas, undertaking a project yields the following expected wealth

$$E_t(W_{t+1}^p) = \underbrace{\alpha E(R)}_{\text{expected return in term of final good}} - \underbrace{r_{t+1}(\bar{w} - w_t)}_{\text{interest payment}} \tag{3}$$

Hence, if $E_t(W_{t+1}^p) \geq W_{t+1}^d$ each agent will prefer to undertake a project. However only a proportion p_t of individuals effectively becomes entrepreneurs. The remainder proportion, $1-p_t$, is credit rationed and deposit its wage at the bank.

In case of no confidence in the banking system potential depositors keep their wage out of the bank. We will give details of the mechanism that takes place in next sections.

2.4 The Inefficient Bank

The inefficient bank is unable to determine the risk of the investment good production projects because the latter is a private information of the entrepreneurs. The bank believes that $\bar{w}$ indivisible units of a final good invested at t gives $\widehat{R}_{t+1}$ units of investment good at $t+1$, where

$$\widehat{R}_{t+1} = \begin{cases} R+\hat{\sigma} & \text{with probability } \pi \\ R-\hat{\sigma} & \text{with probability } 1-\pi \end{cases}$$

and $\hat{\sigma} < \sigma$. Thus we have

$$Var(\widehat{R}_{t+1}) < Var(R_{t+1})$$

which means that the bank underestimates the risk of the investment good technology. Note that $\forall\ t$

$$E_t\left(\widehat{R}_{t+1}\right) = \widehat{E(R)} = R + (2\pi - 1)\hat{\sigma}$$

2.5 The Economic Development Phases

In this paper, we study the effect of financial liberalization on the economic development of an economy which is initially endowed with a low stock of capital. To facilitate the analysis we propose to divide the economic development process into different phases according to the following reasoning.

Initially, the economy stock of capital is k_0 such that $w(k_0) < \bar{w}$ which is equivalent to

$$k_0 < k_\alpha = \frac{\bar{w}}{1-\alpha}$$

The first development phase is therefore $[k_0, k_\alpha[$ where each entrepreneur has to borrow $\bar{w} - w_t$ to finance its project. When the stock of capital reaches the level k_α the second economic development phase $[k_\alpha, 2k_\alpha[$ begins. In this phase the entrepreneur's wage satisfies

$$\bar{w} \leq w_t < 2\bar{w}$$

Therefore the entrepreneur can self finance its first project but haven't sufficient capital to finance its second project. He will therefore ask for bank loans. In this phase, the bank considers the first project as a guarantee against the entrepreneur's default and change the prudential rules that was applied in the first phase of development.

In general, the n^{th} phase of development corresponds to the region $[(n-1)k_\alpha, nk_\alpha[$ where each entrepreneur can self-finance $n-1$ projects and ask for bank loans to finance the n^{th} project.

In this paper we focus on the first phase of development $[k_0, k_\alpha[$ which we call the **transition phase** because it marks, as we will see, the emergence of the bank's economic role and the passage from a low stock of capital k_0 to a relatively high one k_α.

3 The Economic Transition Process with a Closed Financial System

The bank gathers the households' saving and lends to the entrepreneurs of the investment good sector. When the financial system is closed, the bank (here managed by a central banker) has to fix the interest rate on loans, which is also the deposit gross return rate, in order to satisfy two prudential rules: the profitability and the solvability of projects.

Besides, because of the systemic risk in the investment good sector, the bank has to hold some reserves to face possible default of entrepreneurs.

3.1 The Interest Rate

At the beginning of period $t+1$, i.e. at date t, the bank fixes the interest rate r_{t+1} in order to encourage the old agents to undertake investment good projects. This means that it will be more profitable to them to undertake a project then to deposit at the bank. From equations (2) and (3) it appears that the interest rate have to be fixed such that

$$\widehat{E_t}(W_{t+1}^p) \geq W_{t+1}^d$$

which gives the following **profitability constraint**

$$\frac{\alpha \widehat{E(R)}}{\bar{w}} \geq r_{t+1} \tag{4}$$

In addition, the bank has to ensure that (in average) the entrepreneurs will not make default. Hence, it has to fix the interest rate such that the interest payments should be inferior to the default penalty represented by $\lambda \alpha E(R)$ (which is the bank seizure). This is formulated by the following **solvency constraint**

$$\underbrace{r_{t+1}\,(\bar{w}-w_t)}_{\text{Interest Payment}} \leq \underbrace{\lambda \alpha \widehat{E(R)}}_{\text{Default Penalty}} \tag{5}$$

The parameter $\lambda \in]0,1]$ is a structural parameter of the economy which measure the systemic risk related to the credit market imperfection. The maximum expected amount that the bank can seize in case of default is proportional to the expected project production.

When the credit market is perfect, the bank can seize all the project return in case of default on loans. It remains a natural condition which is necessary to collect the agents' saving otherwise they will retain their saving out of the bank until the end of their life:

$$r_{t+1} > 1 \tag{6}$$

for $k_t \leq k_a$ condition (5) dominates (4)
for $k_t > k_a$ condition (4) dominates (5)

where $k_a = \bar{w}\dfrac{1-\lambda}{1-\alpha}$

Proof. See appendix I. ■

At earlier stage of the economic development ($k_t \leq k_a$) (5) dominates (4) which means that if (5) is satisfied then (4) is satisfied. Whereas (4) may be satisfied and (5) is not. At the equilibrium, the interest rate is fixed such that the solvency constraint is satisfied. If the interest rate is fixed such that the production of the investment good is profitable, the entrepreneurs may have an incentive to default because the cost of default is less than the interest payment.

At advanced stage of the economic development when the economy accumulates a sufficient level of capital ($k_t > k_a$) the entrepreneur's share in the project financing increases sufficiently such that (4) dominates (5). Thus, all profitable projects become solvable. At the equilibrium, the interest rate is fixed such that the production of investment good is profitable. Finally, the interest rate is determined by the following

$$r_{t+1} = \begin{cases} \dfrac{\lambda \alpha \widehat{E(R)}}{\bar{w} - (1-\alpha)k_t} & \text{if } \widehat{k}_m \leq k_t \leq k_a \\ \dfrac{\alpha \widehat{E(R)}}{\bar{w}} & \text{if } k_t > k_a \end{cases} \tag{7}$$

Where $\widehat{k}_m$ is obtained by setting $\dfrac{\lambda\alpha\widehat{E(R)}}{\bar{w}-(1-\alpha)k_t}=1$ and verify

$$\boxed{\widehat{k}_m=\frac{\bar{w}-\lambda\alpha\widehat{E(R)}}{1-\alpha}}$$

For $k_t<\widehat{k}_m$, satisfying the solvency constraint means setting an interest rate $r_{t+1}<1$. But at this interest rate level the potential depositors will prefer to hold their capital until the end of their life. Hence, in the region of lower stage of development[6], $]0,\widehat{k}_m[$, the domestic saving is hold out of the banking system depriving the economy from important resources for its capital accumulation dynamic. To verify the condition (6) the parameters have to be chosen such that

$$\alpha(R+(2\pi-1)\hat{\sigma})>\bar{w}$$

3.2 The Bank Reserves Per Project

The Bank reserves per project are equal to the expected amount of possible default per project. Before determining its expression reserves let's determine in which cases the entrepreneurs default on their loans at the end of period $t+1$.

Proposition 1

for $k_t\leq k_b$ there is a systematic default of the entrepreneurs if and only if $S_{t+1}=L$.
However the bank don't anticipate the possible defaults in region $\left[\hat{k}_b,k_b\right]$
for $k_t>k_b$ there is no default whatever the state S_{t+1}
where $\hat{k}_b=k_a+\dfrac{\bar{w}2\pi\lambda\ \hat{\sigma}}{(1-\alpha)\widehat{E(R)}}$ and $k_b=k_a+\dfrac{\bar{w}2\pi\lambda\ \sigma}{(1-\alpha)E(R)}$

Proof. See appendix II. ■

If $k_t\leq k_b$ and $S_{t+1}=L$ happens at the end of period $t+1$, the entrepreneurs have an incentive to default on their loans. This occurs because the effective cost of default $\lambda\alpha(R-\sigma)$ (the cost believed by the bank is $\lambda\alpha(R-\hat{\sigma})$) is inferior to the interest payment $r_{t+1}\ (\bar{w}-w_t)$.

The actual possible default per project is equal to the difference between the interest payment and the amount of seizure

$$d_t\ =r_{t+1}\ (\bar{w}-w_t)-\lambda\alpha(R-\sigma)$$

However, the bank overestimates the amount of possible seizure leading to insufficient amount of reserves per projects denoted $\widehat{d}_t$ and given by

$$\widehat{d}_t\ =r_{t+1}\ (\bar{w}-w_t)-\lambda\alpha(R-\hat{\sigma})$$

using (7) we obtain

$$\boxed{\widehat{d}_t\ =\begin{cases}2\pi\alpha\lambda\ \hat{\sigma} & \text{if } \widehat{k}_m\leq\ k_t\leq k_a\\ \alpha\widehat{E(R)}\left\{\bar{w}-[1-\alpha]\,k_t\right\}-\alpha\lambda(R-\hat{\sigma}) & \text{if } k_a<\ k_t\leq\widehat{k}_b\\ 0 & \text{if } k_t>\ \widehat{k}_b\end{cases}} \tag{8}$$

[6] The banking structure of the Soviet time was a simple system of payment with no orientation towards the market (Bonin and Wachtel (1999)). It was only one system of payment shouldering the government's planning mechanisms. The transition is accompanied by the development of commercial banks to finance the private agents investment projects.

In region $\left[0, \widehat{k}_m\right]$ the bank don't play any role that's why the bank reserves as well as the interest rate are set to zero. The economic transition from region $\left[\widehat{k}_m, k_a\right]$ to $\left[k_a, \widehat{k}_b\right]$ is accompanied with a reduction in the amount of the possible default per project. In region $\left[\widehat{k}_m, k_a\right]$, the solvency constraint dominates the profitability one that's why the bank reserves are at their maximum and the interest rate is lower than that of regions $\left[k_a, \widehat{k}_b\right]$, $\left[\widehat{k}_b, k_\alpha\right]$. In region $\left[\widehat{k}_b, k_\alpha\right]$, the bank expects that there is no default and sets its reserves at zero. Figure (3) illustrates equation (8).

3.3 The Proportion of Projects

The quantity k_{t+1} of the investment good produced at the end of period $t+1$ is equal to the proportion of realized projects multiplied by the return R_{t+1} of one project. Since R_{t+1} is stochastic we have

$$E_t\left(k_{t+1}\right) = p_t E_t\left(R_{t+1}\right) = p_t E\left(R\right)$$

- For $k_t \in [\widehat{k}_m, k_\alpha]$. Because of the possibility of default the bank have to cut reserves to pay its depositors the total amount of $r_{t+1}\ \left(1-p_t\right) w_t$ at the end of period $t+1$. Since p_t is the proportion of entrepreneurs, $\widehat{B}_t$ the total bank reserves at the beginning of period $t+1$, satisfies

$$\widehat{B}_t = p_t \widehat{d}_t \tag{9}$$

If the entrepreneurs pay their loans at the end of period t, which corresponds to $S_t = H$, then the period t bank reserves B_{t-1} will serve for the constitution of period $t+1$ reserves . To determine the necessary amount of reserves that the bank will cut at each period from the total deposit we formulate it as a fraction β_t of the salary mass w_t and we have

$$\widehat{B}_t = \beta_t w_t + 1_{\{S_t = H\}} \widehat{B}_{t-1} \tag{10}$$

We have also the following equation

$$\underbrace{\left(1-p_t\right) w_t}_{\text{Total deposit}} = \underbrace{\beta_t w_t}_{\text{Reserves cutted at date t}} + \underbrace{p_t(\bar{w} - w_t)}_{\text{Total bank loans}} \tag{11}$$

The proportion of entrepreneurs is obtained from equation (11):

$$p_t = (1-\beta_t)\frac{w_t}{\bar{w}} = (1-\beta_t)\frac{k_t}{k_\alpha} \tag{12}$$

Combining (9), (10) and (12) we obtain

$$\beta_t = \begin{cases} \dfrac{\widehat{d}_t}{\bar{w} + \widehat{d}_t} & \text{if} \quad S_t = L \\ \dfrac{\widehat{d}_t}{\bar{w} + \widehat{d}_t} - \dfrac{k_\alpha}{k_t}\dfrac{p_{t-1}\widehat{d}_{t-1}}{\bar{w} + \widehat{d}_t} & \text{if} \quad S_t = H \end{cases} \tag{13}$$

and

$$\boxed{p_t = \begin{cases} \dfrac{\bar{w}}{\bar{w}+\widehat{d}_t}\dfrac{k_t}{k_\alpha} & \text{if} \quad S_t = L \\ \dfrac{1}{\bar{w}+\widehat{d}_t}\left(\bar{w}\dfrac{k_t}{k_\alpha} + p_{t-1}\widehat{d}_{t-1}\right) & \text{if} \quad S_t = H \end{cases}} \tag{14}$$

Note that when the good state $S_t = H$ occurs the period t reserves $p_{t-1}\widehat{d}_{t-1}$ will serve in period $t+1$ which decreases the amount of reserves that the bank cut from period $t+1$ deposit increasing, by the same time, the proportion of financed project at period $t+1$. This explains why the proportion of projects for $S_t = H$ is superior to that corresponding to $S_t = L$.

- For $k_t \in]k_0, \widehat{k}_m]$. The economy is informal and we propose the following simple mechanism. A fraction τ of old individuals collects their wages and signs share contracts to undertake investment good projects. At the end of the period the project return is divided proportionally to the amount of invested capital. The remainder fraction $1-\tau$ of agents decides to hold their wage until the end of their life. Let denote p_t^m the proportion of realized projects. The following equation determines p_t^m :

$$\int_0^{p_t^m} (\bar{w} - w_t)dn = \int_0^{\tau} w_t dn - \int_0^{p_t^m} w_t dn$$

which means that the amount of capital flow needed to achieve p_t^m projects is equal to the shareholders total capital. We obtain

$$\boxed{p_t^m = \tau\frac{w_t}{\bar{w}} = \tau\frac{k_t}{k_\alpha}} \tag{15}$$

Note that the entrepreneurs have no incentive to repay the shareholders'total piece in the cake. If some entrepreneurs default, this may dissuade the future generations from signing share contracts causing a slowdown of the investment and an economic recession. The following figure illustrates the proportion of financed projects at date $t+1$ for different capital levels k_t, when $S_t = L$ and $S_t = H$.

4 The Effect of the Financial Liberalization on the Economic Transition Process

4.1 The Necessary Conditions for a Financial Liberalization

When the financial system is liberalized, the bank disposes of foreign currency loans, in addition to the household's saving. Besides, the interest rate is no more fixed by the bank but is equal to the interest rate of the international financial markets r^*. But before the financial liberalization, the central banker who manages the inefficient bank has to verify if the economy is prepared for that. **First**, he has to ensure that the capital good production sector remains profitable after the financial liberalization which is the case if the following conditions is satisfied:

$$\frac{\alpha\widehat{E(R)}}{\bar{w}} \geq r^* \tag{16}$$

Second, he has to ensure that under the new fixed interest rate the entrepreneurs have not an incentive to default on loans. Therefore, the following conditions should be satisfied :

$$r^*(\bar{w} - w_t) \leq \lambda\alpha\widehat{E(R)} \tag{17}$$

Condition (17) enables us to determine the timing of a possible financial liberalization. In terms of capital accumulation k_t, we should have

$$r^*(\bar{w} - (1-\alpha)k_t) \leq \lambda\alpha\widehat{E(R)}$$

or

$$k_t \geq \widehat{k}^* = \frac{1}{1-\alpha}\left[\bar{w} - \frac{\lambda\alpha\widehat{E(R)}}{r^*}\right] \tag{18}$$

We can verify that $k_a \geq \widehat{k}^*$ which means that the financial liberalization can occur in the first phase of the economic development.

Hence, if the economy is not enough developed ($k_t < k^*$) the financial liberalization will lead to an economic disaster. Indeed, the capital good projects will not be financed because they are not solvent. Note, that the less perfect is the credit market perfection, the higher is the level of capital accumulation that an economy have to reach in order to succeed its financial liberalization. Similarly, the higher is the international interest rate, the more developed an economy have to be. The following figure shows the interest of two economies, one that keeps its financial system closed and the other liberalizes its financial system when it reaches the capital level accumulation of $\widehat{k}^*$.

4.2 The Bank Reserves Per Project

We can show as in section one that the bank anticipates the default of the entrepreneurs, at the end of period $t+1$, if $S_{t+1} = L$ and $k_t \leq \hat{k}_b^*$ where

$$\hat{k}_b^* = k_a + \lambda\left(\frac{\bar{w}r^* - \alpha(R-\hat{\sigma})}{(1-\alpha)r^*}\right) \tag{19}$$

In this section we consider a country that decides to liberalize its financial system when its capital stock reaches the level k^* . Before the financial liberalization the domestic bank use the interest rate r as a control variable (as we have seen in the previous section) to ensure the profitability and the solvency of financed projects. After the financial liberalization, the interest rate on loans as well as the deposit return are exogenously fixed and are equal to the interest rate of the international financial markets r^*.

- For $k_t \in \left[k_m, \widehat{k}^*\right]$, The financial system is closed and the bank reserves per project are $\widehat{d}_t^* = \widehat{d}_t = 2\pi\alpha\lambda\widehat{\sigma}$.
- For $k_t > \widehat{k}^*$, the financial system is liberalized and the interest payments that each entrepreneur has to pay are equal to $r^*(\bar{w} - w_t)$. Since, the maximum amount that the bank believes it can seize in case of default is $\lambda\alpha(R - \widehat{\sigma})$, the amount of default per project (which is also the amount of reserves per project) is equal to

$$\begin{aligned}\widehat{d}_t^* &= r^*(\bar{w} - w_t) - \lambda\alpha(R - \widehat{\sigma}) \\ &= r^*(\bar{w} - (1-\alpha)k_t) - \lambda\alpha(R - \widehat{\sigma})\end{aligned}$$

The following proposition determines in which cases the entrepreneurs' default occurs.

Proposition 2

for $k_t \leq k_b^*$ there is a systematic default of the entrepreneurs if and only if $S_{t+1} = L$

However the bank don't anticipate the possible defaults in region $\left[\widehat{k}_b^*, k_b^*\right]$

for $k_t > k_b^*$ there is no default whatever the state S_{t+1}

where $k_b^* = k_a + \lambda\left(\dfrac{\bar{w}r^* - \alpha(R-\sigma)}{(1-\alpha)r^*}\right)$ *and* $\widehat{k}_b^* = k_a + \lambda\left(\dfrac{\bar{w}r^* - \alpha(R-\widehat{\sigma})}{(1-\alpha)r^*}\right)$

Proof. See appendix I. ■

Note that for $r^* < \dfrac{\alpha\widehat{E(R)}}{\bar{w}}$ we have $\widehat{k}_b^* < \widehat{k}_b$. This seems to be normal, because a decrease of the interest rate from $\alpha E(R)$ to r^* influences the entrepreneurs' incentive to default. For $r^* = \dfrac{\alpha\widehat{E(R)}}{\bar{w}}$ we obtain $\widehat{k}_b^* = \widehat{k}_b$.

- Finally the amount of reserves per project has the following expression:

$$\widehat{d}_t^* = \begin{cases} 2\pi\alpha\lambda\widehat{\sigma} & \text{if } k_m \leq k_t \leq \widehat{k}^* \\ r^*\left\{\bar{w} - [1-\alpha]\, k_t\right\} - \alpha\lambda(R-\widehat{\sigma}) & \text{if } k^* < k_t \leq \widehat{k}_b^* \\ 0 & \text{if } k_t > \widehat{k}_b^* \end{cases} \tag{20}$$

4.3 The Proportion of Projects

Before the financial liberalization ($k < \widehat{k}^*$) the proportion p_t^*can be deduced from (14) and (15) and is given by

$$p_t^* = \begin{cases} \tau\dfrac{k_t}{k_\alpha} & \text{if} \quad k_t < \widehat{k}_m \\ \dfrac{\bar{w}}{\bar{w} + \widehat{d}_t^*}\dfrac{k_t}{k_\alpha} & \text{if } \widehat{k}_m \leq k_t < \widehat{k}^* \text{ and } S_t = L \\ \dfrac{1}{\bar{w} + \widehat{d}_t^*}\left(\bar{w}\dfrac{k_t}{k_\alpha} + p_{t-1}^*\widehat{d}_{t-1}^*\right) & \text{if } \widehat{k}_m \leq k_t < \widehat{k}^* \quad \text{and} \quad S_t = H \end{cases} \tag{21}$$

After the financial liberalization, capital will flow to this economy and the domestic bank disposes of more capital and finance more projects than in the case of closed financial system. Let $\text{L}_{m,t}$ denotes the maximum amount of loans in term of the final good that the foreign investors are willing to invest in the economy. It corresponds to the amount of funds needed to finance all the possible projects

$$\text{L}_{m,t} = 1.(\bar{w} - w_t) = l_t w_t$$

where $l_t = \dfrac{\bar{w}}{w_t} - 1$. In practice, even if the economy liberalizes its financial markets in one step (which is not generally the case), the amount of capital inflows increases progressively. Here we assume, that the capital inflows L_t reaches its maximum value $\text{L}_{m,t}$ after T periods according to the following dynamic

$$\text{L}_t = a_t \text{L}_{m,t} \tag{22}$$

where

$$a_t = e^{-\mu.1_{\{t\leq T\}}(T-t)^\rho} = \begin{cases} e^{-\mu(T-t)^\rho} & \text{si } t < T \\ 1 & \text{si } t \geq T \end{cases} \qquad \mu > 0 \quad \text{and } \rho \geq 1$$

If we continue denoting p_t^* the proportion of financed projects and $\beta_t^* w_t$ the reserves that the bank cut from period $t+1$ total deposit, we have

$$\underbrace{a_t l_t w_t}_{\text{foreign loans}} + \underbrace{(1-p_t^*)\, w_t}_{\text{domestic deposits}} = \underbrace{\beta_t^* w_t}_{\text{Reserves}} + \underbrace{p_t^*(\bar{w}-w_t)}_{\text{loans to entrepreneurs}} \tag{23}$$

The period $t+1$ necessary reserves B_t satisfies

$$\begin{aligned} \widehat{B}_t^* = p_t^* \widehat{d}_t^* &= \beta_t^* w_t + 1_{\{S_t=H\}} B_{t-1} \\ &= \beta_t^* w_t + 1_{\{S_t=H\}} p_{t-1}^* \widehat{d}_{t-1}^* \end{aligned} \tag{24}$$

Using (22) and (23) we obtain

$$\begin{aligned} p_t^* &= (1 + a_t l_t - \beta_t^*)\frac{w_t}{\bar{w}} \\ &= (1-\beta_t^*)\frac{w_t}{\bar{w}} + a_t(1-\frac{w_t}{\bar{w}}) \end{aligned} \tag{25}$$

replacing the above expression of p_t^* in (24) we obtain

$$\beta_t^* = \begin{cases} \dfrac{d_t^*}{\bar{w}+\widehat{d}_t^*}\left(\bar{w} - a_t\left(\dfrac{\bar{w}}{w_t}-1\right)\right) & \text{if} \quad S_t = L \\ \dfrac{d_t^*}{\bar{w}+\widehat{d}_t^*}\left(\bar{w} - a_t\left(\dfrac{\bar{w}}{w_t}-1\right)\right) - \dfrac{p_{t-1}^*\widehat{d}_{t-1}^*}{\bar{w}+\widehat{d}_t^*}\dfrac{1}{w_t} & \text{if} \quad S_t = H \end{cases}$$

and therefore we obtain

$$p_t^* = \begin{cases} \dfrac{1}{\bar{w}+\widehat{d}_t^*}(w_t(1-a_t) + a_t\bar{w}) & \text{if} \quad S_t = L \\ \dfrac{1}{\bar{w}+\widehat{d}_t^*}(w_t(1-a_t) + a_t\bar{w} + p_{t-1}^*\widehat{d}_{t-1}^*) & \text{if} \quad S_t = H \end{cases} \tag{26}$$

where $\widehat{d}_t^*$ and $\widehat{d}_{t-1}^*$ are given by (8). Figure (3) illustrates the pace of the proportion of projects in cases of a closed financial system, a progressively liberalized one and a one-step liberalized financial system.

4.4 The Confidence Crisis in the Domestic Bank

a) The Origin When the bad state of nature occurs at date $t+1$ i.e. $S_{t+1} = L$ and the economy have not yet reached the level $\hat{k}_b^*$ of capital accumulation, the entrepreneurs will default on their loans. The banks expected this event and hold reserves to honor its interest payments obligations. However, when the bank is inefficient, it underestimates the necessary amount of reserves. This is can lead to a confidence crisis. Indeed, from equation (24) the bank reserves are

$$\widehat{B}_t^* = p_t^*\ \widehat{d}_t^*$$

and satisfy

$$r^*\Big(\underbrace{l_t w_t}_{\text{foreign loans}} + \underbrace{(1-p_t^*)\,w_t}_{\text{domestic deposits}}\Big) - \underbrace{p_t^*\lambda\alpha(R-\hat{\sigma})}_{\text{expected production to seize}} = \underbrace{p_t^*\,\widehat{d}_t^*}_{\text{bank reserves}}$$
$$< \underbrace{p_t^*\,d_t^*}_{\text{bank necessary reserves}} = B_t^*$$

But the expected production to seize is inferior to the effective quantity of $p_t^*\lambda\alpha(R-\sigma)$. In other terms, in case of the entrepreneurs default, the bank reserves are insufficient to repay their domestic and foreign lenders the interests it was agreed on. It can repay the maximum level of

$$\widehat{B}_t^* + p_t^*\lambda\alpha(R-\sigma)$$

which is strictly inferior to the global interest payments given by

$$B_t^* + p_t^*\lambda\alpha(R-\sigma) = r^*\left[l_t w_t + (1-p_t^*)\,w_t\right]$$

We can define the ex-post rate of return $\widehat{r}_{t+1}^*$ as follows

$$\widehat{r}_{t+1}^* = \frac{\widehat{B}_t^* + p_t^*\lambda\alpha(R-\sigma)}{l_t w_t + (1-p_t^*)\,w_t} \tag{27}$$

and conclude that

$$\widehat{r}_{t+1}^* < r^* \tag{28}$$

The Domestic and Foreign Depositors' Reactions

Because $\widehat{r}_{t+1}^* < r^*$,the foreign investors, specially those providing short term loans as it is the case in our model, may be aggressive and decide to adjust their portfolios and direct their capital to more sure countries.

We assume that the confidence crisis of foreign depositors lasts one period and leads to a domestic depositors confidence crisis in the bank.

The domestic depositors confidence crisis consists in the following scenario. When the interest rate that the bank pays to the depositors of generation $(t-1)$ is inferior to r^*, the potential depositors of generation (t) have no confidence in the bank management and decide to hold the wages they earn at $t+1$ out of the banking system. We assume that this loss of confidence lasts for one generation after the default event. This means that generation $(t+2)$ depositors put their wages in the bank if there is no further crisis. This is guaranteed if we assume that the bank is restructured after the confidence crisis so that it knows exactly the risk of the investment technology i.e. $\hat{\sigma} = \sigma$.

Finally we can summarize what we have said in the following proposition

Proposition 3 ***When domestic banks are inefficient, there is a foreign and domestic depositors' confidence crisis if and only if*** $S_{t+1} = L$ ***and*** $\widehat{k}^* < k_t < \widehat{k}_b^*$

Proof. First, $\widehat{k}^* < k$ is a necessary condition for the financial liberalization. Second, a foreign depositors' confidence crisis occurs if and only if the entrepreneurs default on their loans and the amount of the bank reserves are inferior to necessary level. The entrepreneurs' default occurs if and only if $S_{t+1} = L$ and $k_t < \widehat{k}_b^*$. In addition, we have $\widehat{d}_t^* < d_t^*$ when $k_t < \widehat{k}_b^*$. The proof is achieved because we assumed that a foreign depositors' confidence crisis leads to a domestic depositors confidence crisis. ■

4.5 The Financial Liberalization and the Confidence Crisis

4.5.1 The Occurrence of the Confidence Crisis

In the case of a closed economy we assume that no confidence crisis occurs (in practice, often domestic politics may be sympathetic toward bailing out domestic creditors). After the financial liberalization, every bad performance of the investment good sector will degenerate in a confidence crisis in the banking sector if the economy capital level is situated in the region $\left[\widehat{k}^*, \widehat{k}_b^*\right]$ which we call the *vulnerability region*. But if the financial liberalization is operated in one step (which corresponds to $a_t = 1$), the capital accumulation pass instantaneously the threshold of $\widehat{k}_b^*$ and the economy is situated outside the vulnerability region. This is not the case for a progressively liberalized financial system.

Therefore, the confidence crisis becomes more likely to happen in the region $\left[\widehat{k}^*, \widehat{k}_b^*\right]$ for a progressively liberalized economy than for a closed one.

4.5.2 The Economic Consequence

- As a consequence of the confidence crisis, the bank don't play any economic role during period $t+1$. The proportion p_{t+1}^* of generation (t) potential entrepreneurs have no access to loans and are, therefore, unable to realize their projects. Hence, they decide to cooperate by putting their capital in common and signing share contracts involving that some entrepreneurs give their capital to others. At the end of the period the project return is divided proportionally to the amount of invested capital. Let denote p_{t+1}^{*c} the new proportion of entrepreneurs. The following equation determine p_{t+1}^{*c} :

$$\int_0^{p_{t+1}^{*c}} (\bar{w} - w_{t+1}) dn = \int_0^{p_{t+1}^*} w_{t+1} dn - \int_0^{p_{t+1}^{*c}} w_{t+1} dn$$

which means that the amount of loans needed by the proportion p_{t+1}^{*c} of entrepreneurs is equal to the shareholders total capital. We obtain

$$p_{t+1}^{*c} = \frac{w_{t+1}}{\bar{w}} p_{t+1}^* \tag{29}$$

It is clear that the number of realized project decreases largely in comparison to p_{t+1}^* ($w_{t+1} < \bar{w}$). Using equation (14) we obtain since $S_{t+1} = L$ and $k_{t+1} < k_\alpha$

$$p_{t+1}^{*c} = \frac{(1-\alpha)^2}{\bar{w} + \widehat{d}^*{}_{t+1}} \frac{k_{t+1}^2}{\bar{w}}$$

where d_{t+1} is given by equation (8). The average of the capital accumulation level for period $t+2$ satisfies

$$E_{t+1}(k_{t+2}^c) = p_{t+1}^{*c} E(R) < \ p_{t+1}^* E(R) = E_{t+1}(k_{t+2}) \tag{30}$$

Thus, the confidence crisis leads to a decline of the economic activity.

- A period after the crisis's occurrence, the foreign investors will give loans to the domestic banks if the crisis had not placed the capital level accumulation under the threshold of $\widehat{k}^*$(necessary condition for the investment solvability). In this case, the amount of foreign loans will increase progressively as it was the case when the economy liberalized its financial markets. In fact, one can expect that the foreign investors' confidence in the economy will return back progressively.

- Figures (4) and (5) illustrate possible evolution of the capital accumulation level when the bad state of the investment good sector occurs only one time at date $t = 6$.we see that the capital level increases from.k_0 and passes the threshold of $\widehat{k}^*$ at date $t = 4$ when the central banker may decide to liberalize its financial system in one step, progressively liberalize it or keeps it closed. Figure (4) shows that the one-step financial liberalization enables the economy to end its first development phase in one period i.e. at date $t = 5$. Hence, the economy escapes the vulnerability region $\left[\widehat{k}^*, \widehat{k}_b^*\right]$ and the occurrence of the bad state at $t = 6$ don't trigger a confidence crisis. Therefore, the banking inefficiency is concealed but may be unmasked in the second phase of development. However, when financial liberalization is progressive the capital level at date $t = 5$, although superior to that corresponding to a closed financial system stays in the region $\left[\widehat{k}^*, \widehat{k}_b^*\right]$. That's why the occurrence of the bad state at $t = 6$ triggers a confidence crisis in the banking system and affects the economic transition process. This corresponds to the scenario described in figure (5) where we see that it is optimal to the economy to keep its financial system closed.

The important lesson that we can extricate from the above remarks is the following: *when the banking system is not sound, the effect of the financial liberalization on the economic development process depends on many parameters as the degree of financial liberalization, the macroeconomic conditions and other characteristics of the economy as the credit market perfection. Finally, it seems necessary to ensure the efficiency of the domestic banking system before proceeding to the financial liberalization.*

4.5.3 The Confidence Crisis Prevention

We see that the parameter λ is a structural parameter of the economy that defines the credit market perfection level. Suppose that $\lambda < 1$ then there exists a manoeuver margin for preventing or let's say reducing the confidence crisis magnitude even with an inefficient banking system. Indeed, we see from equation (27) that by increasing λ we can increase the interest rate $\widehat{r}_{t+1}^*$ and therefore reducing the gap to r_{t+1}^*. Therefore, if at date $t + 1$, the entrepreneurs default on loans, the central banker have an incentive to increase the sizeable fraction of the entrepreneurs' production i.e. trying to increase the credit market perfection.

Proposition 4 *Assume that $\lambda < 1$ and the entrepreneurs default at date $t + 1$*

If $\lambda_{t+1} = \lambda + \dfrac{d_t^* - \widehat{d}_t^*}{\alpha(R - \sigma)} \leq 1$ then increasing the credit market perfection from λ to λ_{t+1} will prevent the occurence of the confidence crisis since it will equalize $\widehat{r}_{t+1}^*$ to r_{t+1}^*

Proof. *See appendix IV.* ■

5 Conclusion

The paper underlines the complex dynamic interactions between several economic aspect of a developing economy: the macroeconomic conditions, the economic stage of development, the progressively versus instantaneously financial liberalization, the inefficiency of the banking system, and the credit market perfection.

The stylized model offers a realistic modelling of the bank's role in a developing economy. It shows that if the financial system is not liberalized, inefficient banking can promote the economic development through its effects on capital accumulation. Unfortunately this is not the case when the financial system is liberalized.

We start the study of the financial liberalization by determining the necessary stage of development that the economy has to reach in order to proceed to the financial liberalization. Then, we show that because domestic banks are inefficient, the necessary condition is not sufficient and the financial liberalization can turn in a confidence crisis in the domestic banking system generating an economic recession which can be avoided if there is no financial liberalization. The achieving of this result pass through the determining of a vulnerability zone to bad macroeconomic conditions.

We also show that in some cases, improving the credit market perfection decreases the likelihood of a confidence crisis in the banking system.

A natural extension of this work is to incorporate a nominal sector to the model in order to study how the confidence crisis in the bank system can trigger a currency crisis.

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Appendix

Appendix I

- Let $k_t \leq k_a$, assume that (5) is satisfied and let us show that (4) is satisfied.

Since (5) is satisfied we have

$$\frac{r_{t+1}\,(\bar{w}-w_t)}{\lambda} \leq \alpha E(R) \tag{31}$$

but

$$\begin{aligned} k_t &\leq k_a = \bar{w}\frac{1-\lambda}{1-\alpha} \\ (1-\alpha)k_t &\leq \bar{w}-\bar{w}\lambda \\ w_t &\leq \bar{w}-\lambda\bar{w} \\ \frac{\bar{w}-w_t}{\lambda} &\geq \bar{w} \end{aligned}$$

Thus, with (31) we obtain

$$r_{t+1} \leq \frac{\alpha E(R)}{\bar{w}}$$

which is condition (4).

- Let $k_t > k_a$, assume that (4) is satisfied and let us show that (5) is satisfied.

Using (4) we obtain

$$r_{t+1}\,(\bar{w}-w_t) \leq \frac{\alpha E(R)}{\bar{w}}(\bar{w}-w_t) \tag{32}$$

but $k_t > k_a$ gives $\dfrac{\bar{w}-w_t}{\bar{w}} < \lambda$ so that we obtain using (32)

$$r_{t+1}\,(\bar{w}-w_t) \leq \lambda\alpha E(R)$$

which is condition (5).

Appendix II

At the end of period $T+1$, the entrepreneur defaults if the interest payments $r_{t+1}\,(1-w_t)$ are superior to the cost of default $\lambda\alpha R_{t+1}$. Using equation (7) we obtain

$$r_{t+1}\,(\bar{w}-w_t)-\lambda\alpha R_{t+1}=\begin{cases}\lambda\alpha\left[E(R)-R_{t+1}\right] & \text{if } k_m\leq k_t\leq k_a\\ \alpha\left[E(R)(\dfrac{\bar{w}-w_t}{\bar{w}})-\lambda R_{t+1}\right] & \text{if } k_t>k_a\end{cases}\tag{33}$$

- If $S_{t+1}=L$

We have $R_{t+1}=R-\sigma<E(R)$

- For $k_t\in\left[\widehat{k}_m,k_a\right]$.

$$r_{t+1}\,(\bar{w}-w_t)-\lambda\alpha R_{t+1}=\lambda\alpha\left[E(R)-(R-\sigma)\right]>0$$

- For $k_a<k_t\leq k_b$ $=k_a+\dfrac{\bar{w}2\pi\lambda\sigma}{(1-\alpha)E(R)}$, in one hand, we have

$$\begin{aligned}(1-\alpha)k_t&\leq\bar{w}(1-\lambda)+\frac{\bar{w}2\pi\lambda\sigma}{(1-\alpha)E(R)}\\ w_t&\leq\bar{w}(1-\lambda)+\frac{\bar{w}2\pi\lambda\sigma}{E(R)}\\ \bar{w}-w_t&\geq\lambda\bar{w}-\frac{\bar{w}2\pi\lambda\sigma}{E(R)}\\ \frac{\bar{w}-w_t}{\bar{w}}&\geq\lambda\left(\frac{R-\sigma}{E(R)}\right)\end{aligned}\tag{34}$$

in the other hand,

$$r_{t+1}\,(\bar{w}-w_t)-\lambda\alpha R_{t+1}=\alpha\left[\frac{E(R)}{\bar{w}}(\bar{w}-w_t)-\lambda(R-\sigma)\right]$$

using (34) we obtain

$$r_{t+1}\,(\bar{w}-w_t)-\lambda\alpha R_{t+1}\geq 0$$

- For $k_t>k_b$

$$\frac{\bar{w}-w_t}{\bar{w}}<\lambda\left(\frac{R-\sigma}{E(R)}\right)$$

and

$$\begin{aligned}r_{t+1}\,(\bar{w}-w_t)-\lambda\alpha R_{t+1}&=\alpha\left[\frac{E(R)}{\bar{w}}(\bar{w}-w_t)-\lambda(R-\sigma)\right]\\ &<0\end{aligned}$$

Therefore, for $S_{t+1}=L$, the interest payment are superior to the default cost in the region $\left[\widehat{k}_m,k_b\right]$ which means that the entrepreneurs have an incentive to default on the loans.

- If $S_{t+1}=H$

We have $R_{t+1} = R + \sigma > E(R)$. Thus, $r_{t+1}\ (\bar{w} - w_t) - \lambda\alpha R_{t+1} < 0$ for $k_t \in \left[\ \widehat{k}_m, k_a\right]$.
for $k_t > k_a = \bar{w}\dfrac{1-\lambda}{1-\alpha}$

$$\begin{aligned} r_{t+1}\ (\bar{w} - w_t) - \lambda\alpha R_{t+1} &= \alpha\left[\frac{E(R)}{\bar{w}}(\bar{w} - w_t) - \lambda(R+\sigma)\right] \\ &< \alpha(R+\sigma)\left[\frac{\bar{w} - w_t}{\bar{w}} - \lambda\right] \end{aligned}$$

but we have also

$$\begin{aligned} (1-\alpha)k_t &> \bar{w}(1-\lambda) \\ \bar{w} - w_t &< \bar{w}\lambda \end{aligned}$$

Therefore,

$$r_{t+1}\ (\bar{w} - w_t) - \lambda\alpha R_{t+1} < 0$$

In this case, whatever the level of capital accumulation, the interest payments are inferior to the default cost, so that the entrepreneurs don't default on loans.

- To determine in which case the entrepreneurs default on loans from the bank point of vue, we have to replace σ by $\widehat{\sigma}$ in the calculus made above and we obtain that the bank expects the entrepreneurs'default in region $\left[\widehat{k}_m, \widehat{k}_b\right]$ when $S_{t+1} = L$. Therefore, if the confidence crisis occurs in region $\left[\widehat{k}_b, k_b\right]$ the bank will be unable to honor its engagements towards its depositors.

Appendix III

To alleviate the calculus we make the proof for $\bar{w} = 1$.
The confidence crisis occurs if and only if (**??**) is satisfied. But

$$\hat{B}_t + p_t\ \lambda\alpha(R-\sigma) < (1-p_t)w_t$$

$\Longleftrightarrow$

$$p_t\ \left[\hat{d}_t + \ \lambda\alpha(R-\sigma)\right] < (1-p_t)w_t \tag{35}$$

- *For $S_t = L$*

We have

$$p_t = \frac{1}{1+\hat{d}_t}\frac{w_t}{1}$$

so that (35) is equivalent to

$$w_t = (1-\alpha)k_t < 1 - \lambda\alpha(R-\sigma)$$

or equivalently

$$k_t < k_c = \frac{1}{1-\alpha} - \frac{\lambda\alpha(R-\sigma)}{1-\alpha}$$

Hence, the confidence crisis occurs if and only $k_t < k_c$.

Note that $k_c = k_a + \frac{\lambda}{1-\alpha}(1-\alpha(R-\sigma)) > k_a$. Also, we have $k_c < \hat{k}_b$ if and only if $\hat{\sigma} > \frac{R(1-\alpha(R-\sigma))}{1-(2\pi-1)\alpha(R-\sigma)}$. These can easily be showed by replacing k_c, k_a and $\hat{k}_b$ by their respective expressions.

- *For $S_t = H$*
  - From the previous calculus (case $S_t = L$) we have

$$\left[\frac{\hat{d}_t + w_t + \lambda\alpha(R-\sigma)}{1+\hat{d}_t}\right] > 1 \text{ if } k_t > k_c$$

Hence, if $k_t > k_c$ we have also

$$\left(1 + \frac{\hat{p}_{t-1}\hat{d}_{t-1}}{w_t}\right) \left[\frac{\hat{d}_t + w_t + \lambda\alpha(R-\sigma)}{1+\hat{d}_t}\right] > 1$$

This means that for $S_t = H$ and $k_t > k_c$ there is no confidence crisis.

- For $S_t = H$, we have

$$p_t = \frac{1}{1+\hat{d}_t}(w_t + \hat{p}_{t-1}\hat{d}_{t-1})$$

Equation (35) is equivalent to

$$\left(1 + \frac{p_{t-1}\hat{d}_{t-1}}{w_t}\right) \left[\frac{\hat{d}_t + w_t + \lambda\alpha(R-\sigma)}{1+\hat{d}_t}\right] < 1$$

which can be transformed equivalently to the following second degree inequality:

$$(w_t)^2 + (p\hat{d}_{t-1} + \lambda\alpha(R-\sigma) - 1)w_t + p_{t-1}\hat{d}_{t-1}(\hat{d}_t + \lambda\alpha(R-\sigma)) < 0 \qquad (36)$$

- *In region $\left[\hat{k}_m, k_a\right]$*

We have $\hat{d}_t = 2\pi\lambda\alpha\hat{\sigma}$ so that (36) becomes

$$\begin{aligned} P(w_t) &< 0 \quad \text{where} \\ P(w_t) &= (w_t)^2 + (p_{t-1}\hat{d}_{t-1} + \lambda\alpha(R-\sigma) - 1)w_t + p_{t-1}\hat{d}_{t-1}(2\pi\lambda\alpha\hat{\sigma} + \lambda\alpha(R-\sigma)) \end{aligned}$$

But $P(w_t) = 0$ has two positive solutions w_u, w_v if and only if

$$\begin{aligned} \Delta_P &= \left(p_{t-1}\hat{d}_{t-1}\right)^2 - 2(\lambda\alpha(R-\sigma) - 1 + 2\pi\lambda\alpha\hat{\sigma})(p_{t-1}\hat{d}_{t-1}) + (\lambda\alpha(R-\sigma) - 1)^2 \geq 0 \\ \text{and } p_{t-1}\hat{d}_{t-1} &\leq 1 - \lambda\alpha(R-\sigma) \end{aligned} \qquad (37)$$

in which case, we have $P(w_t) < 0$ for $w_t \in]w_u, w_v[$ or equivalently $k_t \in]k_u, k_v[$ where $k_u = \dfrac{w_u}{1-\alpha}$ and $k_v = \dfrac{w_v}{1-\alpha}$

Therefore, for certain values of $p_{t-1}\hat{d}_{t-1}$ (satisfying conditions (37))
the confidence crisis occurs in $\left[\hat{k}_m, k_a\right] \cap [k_u, k_v]$

- – *In region* $\left[k_a, \min(\hat{k}_b, k_c)\right]$

We have $\hat{d}_t = E(R)(1-w_t) - \lambda\alpha(R-\sigma)$ so that (36) becomes

$$\begin{aligned} Q(w_t) &< 0 \quad \text{where} \\ Q(w_t) &= (w_t)^2 + \left[p_{t-1}\hat{d}_{t-1}(\underbrace{1-E(R)}_{<0}) + \underbrace{\lambda\alpha(R-\sigma)-1}_{<0} \right] w_t + p_{t-1}\hat{d}_{t-1}(E(R)) \end{aligned}$$

But $Q(w_t) = 0$ has two positive solutions w_p, w_q if and only if

$$\Delta_Q = \left(p_{t-1}\hat{d}_{t-1}\right)^2 - 2(\lambda\alpha(R-\sigma) - 1 + 2\pi\lambda\alpha\tilde{\sigma})(p_{t-1}\hat{d}_{t-1}) + (\lambda\alpha(R-\sigma)-1)^2 \geq 0 \qquad (38)$$

in which case, we have $Q(w_t) < 0$ for $w_t \in]w_p, w_q[$ or equivalently $k_t \in]k_p, k_q[$ where $k_p = \dfrac{w_p}{1-\alpha}$ and $k_q = \dfrac{w_q}{1-\alpha}$

Therefore, for certain values of $p_{t-1}\hat{d}_{t-1}$ (satisfying conditions (38))
the confidence crisis occurs in $\left[k_a, \min(\hat{k}_b, k_c)\right] \cap [k_p, k_q]$

- – *In region* $\left[\hat{k}_b, \max(\hat{k}_b, k_c)\right]$

We have $\hat{d}_t = 0$ so that (36) becomes

$$\begin{aligned} R(w_t) &< 0 \quad \text{where} \\ R(w_t) &= (w_t)^2 + (p_{t-1}\hat{d}_{t-1} + \lambda\alpha(R-\sigma) - 1)w_t + p_{t-1}\hat{d}_{t-1}(\lambda\alpha(R-\sigma)) \end{aligned}$$

But $R(w_t) = 0$ has two positive solutions w_r and w_s if and only if

$$\begin{aligned} \Delta_R &= \left(p_{t-1}\hat{d}_{t-1}\right)^2 - 2(\lambda\alpha(R-\sigma)+1)(p_{t-1}\hat{d}_{t-1}) + (\lambda\alpha(R-\sigma)-1)^2 \geq 0 \\ \text{and } p_{t-1}\hat{d}_{t-1} &\leq 1 - \lambda\alpha(R-\sigma) \end{aligned} \qquad (39)$$

in which case, we have $R(w_t) < 0$ for $w_t \in]w_r, w_s[$ or equivalently $k_t \in]k_r, k_s[$ where $k_r = \dfrac{w_r}{1-\alpha}$ and $k_q = \dfrac{w_s}{1-\alpha}$

Therefore, for certain values of $p_{t-1}\hat{d}_{t-1}$ (satisfying conditions (39))
the confidence crisis occurs in $\left[\hat{k}_b, \max(\hat{k}_b, k_c)\right] \cap [k_r, k_s]$

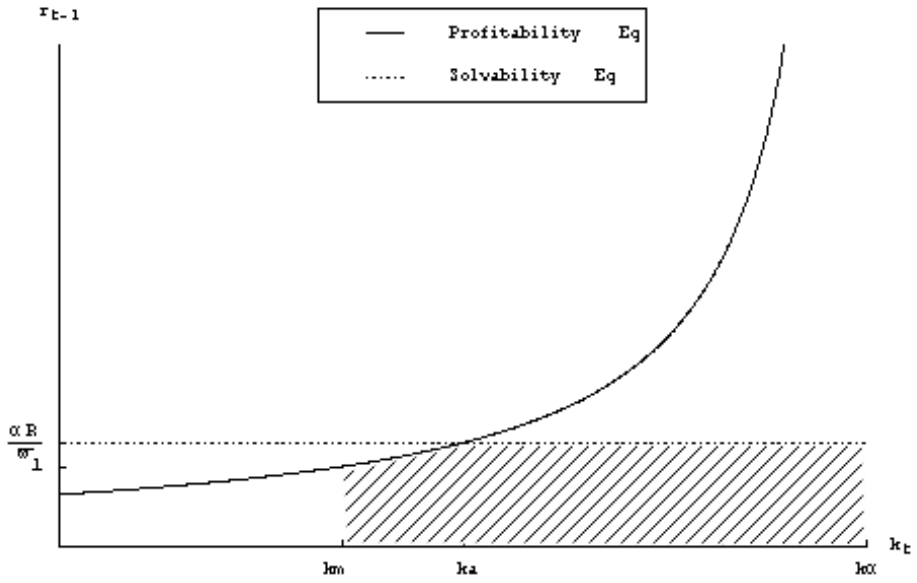

Figure 1:

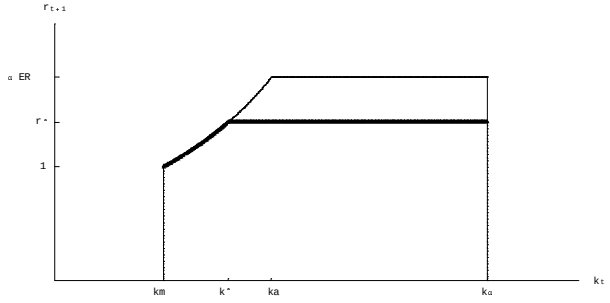

Figure 2:

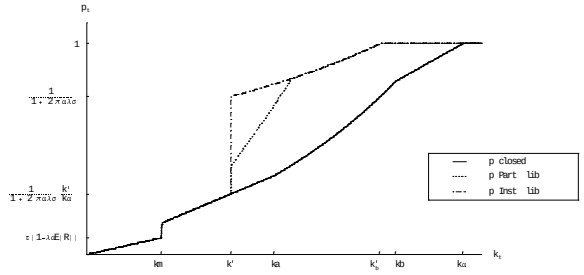

Figure 3:

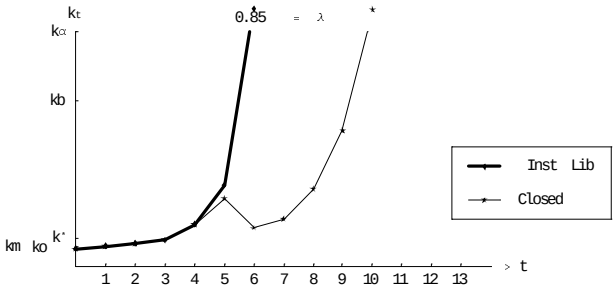

Figure 4:

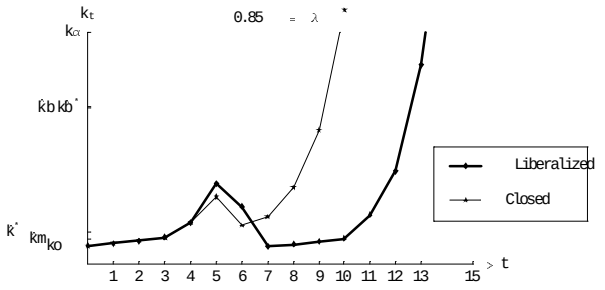

Figure 5: