Banking Efficiency and the Economic Transition Process

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Abstract

This paper investigates the role of the banking system in the economic transition process. This is considered in the context of an overlapping generation model with endogenous growth. There are two production technologies, one for the production of a final good and the other for the production of an investment good. The return to capital invested in the investment good technology is stochastic. Banks collect the saving of households and finance the production of the investment good while respecting some prudential rules .

We show that capital accumulation is constituted of several phases and that the economic transition process depends on the fragility of the financial system defined as the degree of the credit market perfection and bank inefficiency. Hence, efficient banks enable the economy to resist bad performance in the investment good sector. However, in the case of inefficient banks, the situation can degenerate in to a confidence crisis in the banking system delaying the economic transition process by several years. We show that this negative impact is more severe when the economy is less developed.

Key Words: Banking efficiency, confidence crisis, transition process.

JEL *Classification*: G14, G21, O00, O16

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1 Introduction

The importance of the financial sector for economic growth has been extensively analyzed in recent years. The literature which started with 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. Bernanke and Gertler (1989) stress the importance of credit market imperfections in the aggregate fluctuations of investment. Other papers like Bencivenga and Smith (1992), Greenwood and Jovanovic (1990) and Guillard and Rajhi (1993) develop endogenous growth models including a financial sector and show that efficient financial intermediaries facilitate the allocation of savings to productive investments by reducing information costs.

However, there are few theoretical attempts to analyze the interactions between the financial sector and the dynamic of capital accumulation which can explain the simultaneous banking crises and economic recession. This is an important issue for two reasons. First, one can expect that some aspects of the financial sector-growth relation vary with the stage of economic development. Second, the relation between banking crisis and economic recession includes mechanisms that differ from the financial sector performance-growth relation. Indeed, the occurrence and the magnitude of banking crisis and economic recession depend on the economy's stage of development, its capital accumulation level and its capacity to absorb the imperfections of the financial system.

In other terms, the effect of a banking crisis on economic activity depends on the economy's capacity to absorb it. In addition, the likelihood of an economic recession degenerating in to a banking crisis depends on the level of capital accumulation. Hence, a negative macroeconomic shock that affects an economy with low capital accumulation and an inefficient banking system may degenerate in to a banking crisis and a prolonged recession. However, an economy with a high level of capital accumulation can absorb the negative macroeconomic shock even if it has an inefficient banking system.

Several examples such as the Mexican crises of 1994 and 1995, the East Asian crisis of 1997, the Japanese recession, the Russian crisis of 1998 and recently the crisis of Argentina, consolidate this point of view. Although some mechanisms related to international capital markets played an important role in triggering the crises, it seems that more developed economies are more able to absorb the effect of a banking crisis.

In this paper we try to elucidate the relation between the degree of economic development and the occurrence of banking crises as well as the persistence of the recessions generated by these crises. For this purpose, we choose an endogenous growth framework which enables us to model the transition of a lower developed economy, with no banking system, towards a more developed one where banks play a crucial role. This framework enables us to determine the role of the banks in the economic transition process (considered from an economic point of view, i.e. capital accumulation and growth, and not the institutional one).

The model that we present is an overlapping generation model in which private agents need banks to finance their investment project. To finance the projects the banks should respect two prudential rules or constraints. The first is related to the solvency of the projects and the second concerns the projects' profitability or equivalently the bank's efficiency. A similar solvency constraint is used in Matsuyama (2001) where there is no banking system and macroeconomic shocks. One of our results concerns the dependence of the level of capital accumulation on credit market perfection (in addition to the banks efficiency) which contradicts the result of Matsuyama (2001). This is due to the introduction in our model of a banking system and the use of a constant returns to scale technology.

In our paper the economy's financial fragility and poor macroeconomic conditions may generate a confidence crisis in the banking system and cause a recession. The impact of financial fragility on economic activity has been treated by various authors attempting to explain the U.S Great Depression. Bernanke and Gertler (1990) define financial fragility as a situation in which the borrowers have low wealth relative to the size of their project and private information about the project's return. This situation leads to increased agency costs and to poor performance in the investment sector. Cooper and Corbae (2000) define financial fragility in relation to depositors' confidence in the intermediation process. In our paper, financial fragility has two components. The first is the inefficiency of the banks in screening projects and determining its effective risk. The second is the credit market imperfection. The first component contributes directly to the occurrence of the banking crisis, whereas the second is indirectly involved.

In this model, depositors' confidence in the banking system is essential as in Cooper and Corbae (2000). In the latter, the depositors' loss of confidence in the banking system results from an exogenous change in expectations about the deposit's net return. In our model, the confidence crisis is the consequence of the banks' inability to honor their financial engagements.

The paper shows that financial fragility can lead to economic recession with persistent effects if poor macroeconomic conditions occur when the economy is at a determined stage of development (a zone of vulnerability to banking crisis). This concurs with the result of Bernanke and Gertler (1990). The dynamic aspect of our model allows us to conclude that a more perfect credit market tends to place the economy outside the vulnerability region.

In section two we consider an efficient banking system and show that the dynamic of capital accumulation is constituted of several phases, and that the economic transition process is dependent on credit market perfection. Because banks are efficient, the economy resist bad performance in the investment goods sector .

In the third section, we consider an inefficient banking system. The bad performance in the investment goods sector may affect the bank's ability to honor the deposit contract, causing depositors' loss of confidence in the banking system. In this case, the economic transition process is inhibited. We show that the lower the level of capital accumulation the more severe the effect of the confidence crisis in the banking system.

2 The Model

We construct an overlapping generation model. Each generation consists of a continuum of agents 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 goods can be used for consumption and production of the investment good. The investment goods is used as an input in the final good production technology. Moreover, there is a bank managed by a central banker which gathers household savings and lends to entrepreneurs in the investment goods sector.

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 receive the principal and interest at $t+1$, or he can use it to undertake an investment project, in which case he may need to borrow money from the bank.

Therefore, in general there are in each period depositors and entrepreneurs among the older generation. This is not the case when potential depositors have no confidence in the bank and prefer to hold their wages at home until the end of their life. In this case there is no saving and the entrepreneurs have no access to bank loans.

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

2.2 Production Technology

2.2.1 The Final Good Production Technology

The final goods 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

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

Therefore we obtain

$$Y_t = K_t$$

and the output per capita is

$$y_t = \frac{K_t}{L_t} = k_t$$

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 using the following technology; $\bar{w} \geq 1$ indivisible units of a final good invested at t yieldss R_{t+1} units of investment good at $t+1$.

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

Let S_t be a variable that takes 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 is produced, the entrepreneurs will sell it to the final good technology and receive αR_{t+1} final goods (because one unit of the investment good gives α units of the final good). Therefore, the return of this technology is $\frac{\alpha R_{t+1}}{\bar{w}}$, assumed to be strictly superior to unity if the good state of the nature occurs i.e. $\frac{\alpha(R+\sigma)}{\bar{w}} > 1$ and strictly inferior to unity otherwise i.e. $\frac{\alpha(R-\sigma)}{\bar{w}} < 1$. Note that $\forall\ t > 0$

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

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 in the first period of its life in the final good production sector, so that total labor supply is

$$L_t = 1$$

At date t he earns a wage w_t and has to decide how to use it until date $t+1$ when he consumes all his wealth before dying. The agent's decision consists of maximizing his wealth W_{t+1}. Depositing wages in the bank at a gross interest rate of r_{t+1} increases 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 become entrepreneurs. The remainder proportion, $1 - p_t$, is credit-rationed and deposit his wages at the bank.

In the case of no confidence in the banking system potential depositors keep their wages out of the bank. We will give details of this mechanism in following sections.

2.4 Economic Development Phases

In this paper, we study the interaction between the financial system and economic development in an economy which is initially endowed with a low stock of capital. To facilitate the analysis we propose dividing the economic development process into different phases according to the following reasoning.

Initially, the economy's 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 his 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 his first project but does not have sufficient capital to finance the second project. He will therefore require bank loans. In this phase, the bank considers the first project as a guarantee against the entrepreneur's default and changes the prudential rules that were 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 in the case of Efficient Banks

3.1 The Efficient Bank

The bank gathers household saving and lends it to the entrepreneurs of the investment good sector. It has to fix the suitable interest rate on loans, which is also the gross deposit return rate, in order to satisfy two prudential rules: the profitability and the solvency of projects. In addition, it has to hold some reserves to face the possible default of entrepreneurs in the case of poor economic performance in the investment good sector.

3.1.1 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 agent to undertake investment good projects. This means that it will be more profitable to them to undertake a project than to deposit their money at the bank. Using equations (2) and (3) the interest rate has to be fixed such that

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

which gives the following **profitability constraint**

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

In addition, the bank has to ensure that (on average) the entrepreneur will not 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**

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

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.

To collect agents' saving the gross interest rate has to satisfy the following condition:

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

otherwise they will keep their savings out of the bank until the end of their life.

Proposition 1

for $k_t \leq k_a$ condition (5) dominates (4)
for $k_a < k_t \leq k_\alpha$ condition (4) dominates (5)
where $k_a = \bar{w}\dfrac{1-\lambda}{1-\alpha}$

Proof. See appendix I. ■

For $k_t < k_m$, satisfying the solvency constraint means setting an interest rate $r_{t+1} < 1$. But at this interest rate potential depositors will prefer to hold their capital until the end of their life. Hence, in the region of the lower stage of development[1], $]0, k_m[$, domestic saving is held out of the banking system depriving the economy of important resources for its capital accumulation dynamic.This corresponds of an informal economy.

At the 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. In equilibrium, the interest rate is fixed such that the solvency constraint is satisfied. In this case, some profitable projects are credit rationed.

At *the 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 so that (4) dominates (5). In equilibrium, the interest rate is fixed such that the production of investment goods is profitable. Finally, the interest rate is determined by the following

$$\boxed{r_{t+1} = \begin{cases} \dfrac{\lambda\alpha E(R)}{\bar{w} - (1-\alpha)k_t} & \text{if } k_m \leq k_t \leq k_a \\ \dfrac{\alpha E(R)}{\bar{w}} & \text{if } k_a < k_t \leq k_\alpha \end{cases}} \tag{7}$$

Where k_m is obtained by setting

$$\frac{\lambda\alpha E(R)}{\bar{w} - (1-\alpha)k_t} = 1$$

and the following holds

$$k_m = \frac{\bar{w} - \lambda\alpha E(R)}{1-\alpha}$$

To verify condition (6) the parameters have to be chosen such that

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

Figure (2) illustrates equation (7)

3.1.2 Bank Reserves Per Project

Bank reserves per project are equal to the amount of possible default per project. Therefore, before determining its expression we should determine in which cases the entrepreneurs default on their loans at the end of period $t+1$.

Proposition 2

> *for* $k_t \leq k_b$ *there is a systematic default of the entrepreneurs if and only if* $S_{t+1} = L$
>
> *for* $k_b < k_t \leq k_\alpha$ *there is no default whatever the state* S_{t+1}
>
> *where* $k_b = k_a + \frac{\bar{w} 2\pi\lambda\sigma}{(1-\alpha)E(R)}$

Proof. See appendix II. ■

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

[1] The banking structure of the Soviet time was a simple system of payment with no orientation towards the market (Bonin and Wachtel (1999)). The development of commercial banks to finance private investment projects accompanied the transition.

The amount of the default per project is therefore equal to the difference between the interest payment and the amount that the bank can seize

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

Using (7) we obtain

$$\boxed{d_t = \begin{cases} 2\pi\alpha\lambda\sigma & \text{if } k_m \leq k_t \leq k_a \\ \alpha E(R) \{\bar{w} - [1-\alpha] k_t\} - \alpha\lambda(R-\sigma) & \text{if } k_a < k_t \leq k_b \\ 0 & \text{if } k_b < k_t \leq k_\alpha \end{cases}} \tag{8}$$

In the region $[0, k_m]$ the bank plays no role, so that the bank reserves and the interest rate are set to zero. The economic transition from region $[k_m, k_a]$ to $[k_a, k_b]$ is accompanied by the reduction of the amount of the possible default per project. In region $[k_m, k_a]$, the solvency constraint dominates the profitability constraint so bank reserves are at their maximum and the interest rate is lower than that of regions $[k_a, k_b]$, $[k_b, k_\alpha]$. In region $[k_b, k_\alpha]$, there is no default and bank reserves are zero. In this region, the number of realized projects and the growth rate are maximal. Figure (3) illustrates equation (8).

3.2 The Proportion of Entrepreneurs

- For $k_t \in [k_m, k_\alpha]$. Because of the possibility of default the bank has to cut reserves to pay its depositors the total amount of $r_{t+1}\ (1 - p_t)\, w_t$ at the end of period $t + 1$. Since p_t is the proportion of entrepreneurs, B_t, total bank reserves at the beginning of period $t+1$, are given by

$$B_t = p_t d_t \tag{9}$$

If the entrepreneurs pay back their loans at the end of period t, which corresponds to $S_t = H$, then 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 this as a fraction β_t of the salary mass w_t and we have

$$B_t = \beta_t w_t + 1_{\{S_t = H\}} B_{t-1} \tag{10}$$

We have also the following equation

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

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

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

and

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

Note that $\bar{w}\dfrac{k_t}{k_\alpha}$ respectively $\bar{w}\dfrac{k_t}{k_\alpha}+p_{t-1}d_{t-1}$ are the total amount of capital available at the beginning of period $t+1$ when the low state L respectively the high state H occurs.

- <u>For $k_t \in \,]k_0, k_m]$</u>. The economy is informal and we propose the following simple mechanism. A fraction τ of old individuals collect their wages and sign 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 future generations from signing share contracts, causing a slowdown of 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 $S_t = H$.

3.3 Capital Accumulation Dynamics

3.3.1 Theoretical Expression

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

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

using equations (14) and (15) we obtain

$$\boxed{E_t\left(k_{t+1} \setminus k_t < k_m\right) = \tau \frac{k_t}{k_\alpha} E\left(R\right)}$$

$$\boxed{E_t\left(k_{t+1} \setminus S_t = L,\ k_m \leq k_t < k_\alpha\right) = \frac{\bar{w}}{\bar{w} + d_t} \frac{k_t}{k_\alpha} E\left(R\right)}$$

$$\boxed{E_t\left(k_{t+1} \setminus S_t = H,\ k_m \leq k_t < k_\alpha\right) = \frac{1}{\bar{w} + d_t}\left(\bar{w}\frac{k_t}{k_\alpha} + p_{t-1}d_{t-1}\right) E\left(R\right)}$$

where (d_t) is given by (8).

3.3.2 Comments

1. When the good state $S_t = H$ occurs, period t reserves will serve in period $t+1$ which decreases the amount of reserves that the bank cuts from period $t+1's$ deposit, increasing, at the same time, the proportion of financed projects at period $t+1$. This explains why the level of capital accumulation for $S_t = H$ is superior to that for $S_t = L$.
2. The level of capital accumulation in period $t+1$ depends not only on the different regions of the transition phase ($[0, k_m]$, $[k_m, k_a]$, $[k_a, k_b]$, and $[k_b, k_\alpha]$) but also on the state S_t realized at period t for the first two regions. It is clear that the initial level of development k_0 and the history $(S_1, S_2, ..., S_t)$ of the variable S affect $E_t\left(k_{t+1}\right)$ since they determine the region the capital stock.
3. Note that the width of the regions $[k_m, k_a]$, $[k_a, k_b]$ and $[k_b, k_\alpha]$ depends on the degree of credit market perfection, as represented by λ. We will return to this effect in section (3.3.3).

To ensure that an economy can move from the initial region $[k_m, k_a]$ (where the solvability constraint dominates the profitability constraint) to region $[k_a, k_b]$ (where project finance is conditioned by its profitability) we have to impose conditions on our parameters. Suppose that $k_t \in [k_m, k_a]$ and $S_t = L$ then

$$k_{t+1} = \begin{cases} \dfrac{(1-\alpha)(R+\sigma)}{\bar{w} + 2\pi\alpha\lambda\sigma} k_t & \text{with probability} \quad \pi \\ \dfrac{(1-\alpha)(R-\sigma)}{\bar{w} + 2\pi\alpha\lambda\sigma} k_t & \text{with probability} \quad 1-\pi \end{cases}$$

Therefore, the condition is

$$\frac{(1-\alpha)(R+\sigma)}{\bar{w} + 2\pi\alpha\lambda\sigma} > 1 \tag{16}$$

In the other case, there will be recession even if the good return state comes about. It is easy to show that the transition from region $[k_a, k_b]$ to $[k_b, k_\alpha]$ is possible when condition (16) is satisfied.

3.3.3 The Effect of Credit Market Imperfection

Credit market perfection affects the different regions of the economy's development. Indeed, we have

$$\frac{\partial k_m}{\partial \lambda} < 0$$

which means that the more perfect the cedit market is the earlier banks will emerge

$$\frac{\partial(k_a - k_m)}{\partial\lambda} < 0$$

meaning that the region where the solvabilty constraint dominates the profitability one is narrowed when credit market perfection increases. Meanwhile, the region $[k_b, k_a]$ where the profitability constraint dominates the solvency constraint is enlarged. Indeed, we have

$$\frac{\partial(k_b - k_a)}{\partial\lambda} > 0$$

In addition, we have

$$\frac{\partial(k_\alpha - k_b)}{\partial\lambda} > 0$$

Therefore, the more perfect is the credit market the faster the economy finishes the transition phase and passes to the second phase of development. In fact, in region $[k_m, k_b]$, an amelioration of credit market perfection reduces the necessary amount of bank reserves, which increases the proportion of realized projects.

Figures (5) and (6) illustrate the above remarks. They shows the different regions, bank reserves per project and the interest rate for the values of λ of 0.4 and 0.9.

Figure (7) shows how an improvement in credit market perfection affects the different regions of development and the level of capital accumulation. Note that the region of high development is not affected by credit market perfection. Hence, the latter affects the path only through the intermediary stages of development.

3.3.4 Numerical Simulation

a) ***Parameterization*** The parameters $\bar{w}$, k_0, R, α,σ, π, and λ should satisfy the following conditions presented above

$$\begin{cases} \dfrac{\alpha(R+\sigma)}{\bar{w}} > 1 \\ \dfrac{\alpha(R-\sigma)}{\bar{w}} < 1 \\ \dfrac{\alpha(R+(2\pi-1)\sigma)}{\bar{w}} > 1 \\ \dfrac{(1-\alpha)(R+\sigma)}{\bar{w}+2\pi\lambda\alpha\sigma} > 1 \\ 0 < k_0 < \dfrac{\bar{w}}{1-\alpha} \end{cases} \tag{17}$$

The following values satisfy these conditions but are not unique

α	$\bar{w}$	π	σ	R	λ	τ	k_0
0.37	1	$[0.9, 1]$	1	2	$[0, 1]$	$[0, 1]$	$]0, 1.58]$

b) ***The Capital Accumulation Path***

The function $E_t(k_{t+1} \backslash S_t = L) = f(k_t)$ is illustrated in figure (7) which shows that in region $[k_b, k_\alpha]$ the economy achieves the maximum growth rate. Remember that in this region bank reserves are set to zero because entrepreneurs don't default on loans. This leads to an increasing proportion of financed projects as shown in figure (4). The dynamic of capital accumulation depends on the history of (S) and can therefore alternate between the different levels that appear in figure (7). To show this we consider in the following paragraph two scenarios.

An Example of two Scenarios

Assume that the initial capital level of the economy is $k_0 \in [k_m, k_a]$ and consider the economy's dynamics under the following two scenarios S_1 and S_2 where $S_i = (S_i(t))_{t\in[1,T]}$ and

$$S_1(t) = H \qquad \text{for} \quad t \in [1,T]$$

$$S_2(t) = \begin{cases} L & \text{for} \quad t \in \{5,6\} \\ H & \text{for} \quad t \in [1,T] \setminus \{5,6\} \end{cases}$$

As figure (8) shows, for the two scenarios, during the first five periods the capital level is increasing, passing from region $[k_m, k_a]$ to region $[k_b, k_\alpha]$. For the scenario (S_1), the capital level continues increasing and reaches the second phase of economic development i.e. the region $[k_\alpha, 2k_\alpha[$ at the end of the fifth period. Whereas, for the second scenario (S_2), the realization of low returns during the fifth and sixth periods delays the economy reaching the second phase of development..

4 The Economic Transition Process in Case of Inefficient Banks

4.1 The Inefficient Bank

An inefficient bank is unable to determine the risk of the investment good production projects because of information asymmetry between the entrepreneurs and the bank. The bank believes that $\bar{w}$ indivisible units of a final good invested at t yields $\hat{R}_{t+1}$ units of investment good at $t+1$, where

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

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

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

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

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

4.1.1 The Interest rate

The new interest rate fixed in equilibrium is given by replacing R_{t+1} with $\hat{R}_{t+1}$ in equation (7)

$$\hat{r}_{t+1} = \begin{cases} \dfrac{\lambda\alpha\widehat{E(R)}}{\bar{w} - (1-\alpha)k_t} & \text{if } k_t \leq k_a \\ \dfrac{\alpha\widehat{E(R)}}{\bar{w}} & \text{if } k_a < k_t \leq k_\alpha \end{cases} \tag{18}$$

4.1.2 Bank Reserves Per Project

From equation (18) 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

$$\hat{k}_b = k_a + \frac{\bar{w}2\pi\lambda\ \hat{\sigma}}{(1-\alpha)(R+\hat{\sigma}\ (2\pi-1))} < k_b \tag{19}$$

In this case, the anticipated amount of default on each loan $\hat{d}_t$ is obtained by replacing σ by $\hat{\sigma}$, k_b by $\hat{k}_b$ and k_m by $\hat{k}_m$ in equation (8). It is easy to show that

$$\boxed{\hat{d}_t < d_t \quad \forall\ t}$$

This result is obtained because the bank underestimates the risk of the investment good technology. As figure (9) shows, the amount of reserves per project that it actually holds, $\hat{d}_t$, is less than required level, d_t for any stage of the economy's development. Note also, that information asymmetry tightens the zone of possible default since

$$\begin{cases} \hat{k}_m > k_m \\ \hat{k}_b < k_b \end{cases}$$

Hence, information asymmetry is beneficial to the entrepreneurs when the capital level k_t, is in the region $\left[\hat{k}_b, k_b\right]$. As figure (10) shows, the proportion of financed project increases. However, when the capital level is in the region $\left[k_m, \hat{k}_m\right]$, the information asymmetry penalizes entrepreneurs since the bank refuses to finance their projects, fearing insufficient returns $(\widehat{E(R)} < E(R))$

4.2 The Proportion of Entrepreneurs

The proportion $\hat{p}_t$ of financed projects, at the beginning of period $t+1$, is obtained by similar reasoning to that of the previous section, and is obtained by replacing $\hat{d}_t$ by d_t and $\hat{d}_{t-1}$ by d_{t-1} in equation (14). Figure (10) illustrates the proportion of financed projets in the case of efficient and inefficient banks.

4.3 Banking Confidence Crises

4.3.1 The Origin

From equation (9) bank reserves are

$$\boxed{\hat{B}_t = \hat{p}_t\ \hat{d}_t}$$

The necessary bank reserves are obtained by multiplying the proportion of financed projects $\hat{p}_t$ by the real possible default per project d_t

$$\tilde{B}_t = \hat{p}_t\ d_t > \hat{B}_t$$

This means that in the case of entrepreneur default the bank is unwilling to repay their depositors the interest it promised them. It can repay the maximum level of

$$\hat{B}_t + \hat{p}_t\ \lambda\alpha(R-\sigma) < \tilde{B}_t + \hat{p}_t\ \lambda\alpha(R-\sigma) = r_{t+1}(1-\hat{p}_t)w_t \tag{20}$$

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

$$\hat{r}_{t+1} = \frac{\hat{B}_t + \hat{p}_t \ \lambda\alpha(R-\sigma)}{(1-\hat{p}_t)w_t} \tag{21}$$

From (20) we have $\hat{r}_{t+1} < r_{t+1}$. But we assume that the confidence crisis occurs only if $\hat{r}_{t+1} < 1$ i.e. when the bank pays the depositors of generation $(t-1)$ a quantity of final goods inferior to their initial deposit. In this case, the potential depositors of generation (t) have no confidence in the bank management and decide to hold the wages they earn at $t+1$ outside 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. $\hat{\sigma} = \sigma$.

Proposition 3 *Under conditions (17)*

1. *if* $S_t = L$ *and* $S_{t+1} = L$ *the confidence crises occur at date* $t+1$ *if and only if* $k_t < k_c$ *where* $k_c = k_\alpha - \dfrac{\bar{w}\lambda\alpha(R-\sigma)}{1-\alpha} > k_a$

2. *if* $S_t = H$ *and* $S_{t+1} = L$, *under certain conditions there exist* k_u, k_v, k_p, k_q, k_r *and* k_s *such that the confidence crises occurs in regions* $\left[\hat{k}_m, k_a\right] \cap]k_u, k_v[$, $\left[k_a, \min(\hat{k}_b, k_c)\right] \cap]k_p, k_q[$ *and* $\left[\hat{k}_b, \max(\hat{k}_b, k_c)\right] \cap]k_r, k_s[$.

3. *The confidence crises do not occur for* $k_t \geq k_c$ *for* $S_t = H, L$

Proof. See appendix III. ■

4.3.2 The Economic Consequences

As a consequence of the confidence crisis, the bank does not 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 implying that some entrepreneurs give their capital to others. At the end of the period the project return is divided proportionally to the amount of capital invested. Let p^c_{t+1} denote the new proportion of entrepreneurs. The following equation determines p^c_{t+1} :

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

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

$$p^c_{t+1} = \frac{w_{t+1}}{w_0} p_{t+1} \tag{22}$$

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

$$p^c_{t+1} = \frac{(1-\alpha)^2}{\bar{w} + d_{t+1}} \frac{k^2_{t+1}}{\bar{w}}$$

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

$$E_{t+1}(k^c_{t+2}) = p^c_{t+1} E(R) < \ \ p_{t+1} E(R) = E_{t+1}(k_{t+2}) \tag{23}$$

We conclude that an inefficient banking system (one that underestimates the risk of the investment good technology) can generate a crisis of confidence among depositors which in turn leads to a decline in economic activity.

4.4 The level of Development and Confidence Crises

The effect on the transition process (the long term effect) is more severe when the crisis occurs at the beginning of transition. Indeed, this can be shown by analyzing the ratio of the average of the capital accumulation level after the crises to that without crisis . From (22) and (23)we have

$$\frac{E_{t+1}(k^c_{t+2})}{E_{t+1}(k_{t+2})} = \frac{p^c_{t+1}}{p_{t+1}} = \frac{(1-\alpha)k_{t+1}}{\bar{w}} \qquad \text{where } \ k_{t+1} \ = p_t(R-\sigma)$$

Therefore, the more developed a country is the less affected it is in the case of a confidence crisis. When its level of capital accumulation becomes superior to k_c it is completely immunized against a confidence crisis, which can not occur (see proposition(4))

This is shown, for $\lambda = 0.75$, in figure (13) where the state of low return ($S = L$) occurs respectively at dates $t = 3, 4$, 5 and 6.

4.5 Credit Market Perfection and Crisis Amplitude

Let us assume that the transition process begins with an initial level of capital equal to k_0. Assume also that during the T first periods the return of the investment good technology is high ($S_1 = S_2 = ... = S_T = H$) and that the first low return occurs at period $T+1$ ($S_{T+1} = L$). From our previous analysis, we know that the more perfect is the credit market, the higher is the level of the capital at the end of period T (because the proportion of financed projects is higher at each period). Therefore, when the low return occurs, **the economy with the more perfect credit market will be the strongest, and the damage from a confidence crisis, if it occurs, will be the lowest. When credit market perfection is sufficiently high there will be no confidence crisis** in the banking system because the level of capital accumulation is higher than the threshold k_c.

We note that **the region of vulnerability to confidence crises shrinks at the level of the credit market perfection increases**. In fact, as proposition (4) suggests, these regions are $\left[\hat{k}_m, k_a\right] \cap]k_u, k_v[$, $\left[k_a, \min(\hat{k}_b, k_c)\right] \cap]k_p, k_q[$ and $\left[\hat{k}_b, \max(\hat{k}_b, k_c)\right] \cap]k_r, k_s[$. In appendix IV, we show that

$$\frac{\partial k_i}{\partial \lambda} > 0 \ \ and \ \ \frac{\partial k_j}{\partial \lambda} < 0 \quad for(i,j) = (u,v), (p,q) \ \ and \ \ (r,s)$$

Figure (14) illustrates the above comments for $T = 4$ and $\lambda \in \{0.75, 0.80, 0.85\}$.

5 Conclusion

This paper emphasises that the perfection of the financial system, defined as the efficiency of banks and the perfection of the credit market, plays an important role in the economic transition process.

We propose a model where the interest rate is the control variable of the bank. The interest rate is set in order to ensure that, on the one hand, the financed projects are profitable and solvent and, on the other hand, that depositors are remunerated by strictly positive deposit rate.

We showed that the economic role of the bank begins after the reaching of a certain economic development level. At the beginning of the transition process, profitable projects are not necessarily solvent because the entrepreneurs' capital contribution is low compared to the amount of loans. The bank protects itself against a likely default of payment, in case of poor performance by projects, by the constitution of reserves.

As the transition process progresses, the amount of the likely default of payment decreases. When the economy reaches a determined level of capital accumulation entrepreneurs do not default on loans. Consequently, banks' reserves decrease and the proportion of financed projects increases. When capital accumulation becomes sufficiently high, the entrepreneurs self-finance their projects.

We showed that the rare, are the poor performances on the investment good sector, the faster is the transition process. When banks are efficient, poor performance of financed projects provokes a short-term recession. The consequences of poor performance are more serious when banks are inefficient. Indeed, in this case banks underestimate the risk of projects that they finance and the reserves that they constitute are insufficient to face possible default of payment. In certain cases, banks will be incapable of honoring the contracts signed with their depositors, which provokes a crisis of confidence in the banking system and a flight of saving. This aggravates the recession and has long-term effects on the transition process.

The negative effects of a confidence crisis are more important when it takes place at the beginning of the transition process. We showed that the more perfect the credit market is, the lesser the aftermath will be on the transition process. This is true even if banks are inefficient. Besides, we showed that the region of vulnerability to confidence crises shrinks as the level of the credit market perfection increases. For a sufficiently high degree of credit market perfection, confidence crises do not occur.

An extension of this work is to study the role of the banking system in the transition process of a small open economy.

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Appendix

Appendix I

• Let $k_t \leq k_a$, assume that (3) is satisfied and let us show that (2) is satisfied.

Since (3) is satisfied we have

$$\frac{r_{t+1}\left(\bar{w}-w_t\right)}{\lambda} \leq \alpha E(R) \tag{24}$$

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 (24) we obtain

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

which is condition (2).

• Let $k_t > k_a$, assume that (2) is satisfied and let us show that (3) is satisfied.

Using (2) we obtain

$$r_{t+1}\left(\bar{w}-w_t\right) \leq \frac{\alpha E(R)}{\bar{w}}\left(\bar{w}-w_t\right) \tag{25}$$

but $k_t > k_a$ gives $\dfrac{\bar{w}-w_t}{\bar{w}} < \lambda$ so that we obtain using (25)

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

which is condition (3).

Appendix II

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

$$r_{t+1}\left(\bar{w}-w_t\right)-\lambda\alpha R_{t+1} = \begin{cases} \lambda\alpha\left[E(R)-R_{t+1}\right] & \text{if } k_m \leq k_t \leq k_a \\ \alpha\left[E(R)(\dfrac{\bar{w}-w_t}{\bar{w}})-\lambda R_{t+1}\right] & \text{if } k_t > k_a \end{cases} \tag{26}$$

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

We have $R_{t+1} = R - \sigma < E(R)$
- For $k_t \in [\ k_m, k_a]$.

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

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

$$\begin{aligned}
(1-\alpha)k_t &\le \bar{w}(1-\lambda) + \frac{\bar{w}2\pi\lambda\sigma}{(1-\alpha)E(R)} \\
w_t &\le \bar{w}(1-\lambda) + \frac{\bar{w}2\pi\lambda\sigma}{E(R)} \\
\bar{w} - w_t &\ge \lambda\bar{w} - \frac{\bar{w}2\pi\lambda\sigma}{E(R)} \\
\frac{\bar{w} - w_t}{\bar{w}} &\ge \lambda\left(\frac{R-\sigma}{E(R)}\right)
\end{aligned} \tag{27}$$

on the other hand,

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

using (27) we obtain

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

- For $k_t > k_b$

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

and

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

Therefore, for $S_{t+1} = L$, the interest payments are superior to the default cost in the region $[k_m, k_b]$ 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, $r_{t+1}\left(\bar{w} - w_t\right) - \lambda\alpha R_{t+1} < 0$ for $k_t \in [\ k_m, k_a]$.
for $k_t > k_a = \bar{w}\dfrac{1-\lambda}{1-\alpha}$

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

but we also have

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

Therefore,

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

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

Appendix III

To simplify the calculatrous we present the proof for $\bar{w}=1$.
The confidence crisis occurs if and only if (21) is satisfied. But

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

$\Longleftrightarrow$

$$\hat{p}_t\ \left[\hat{d}_t+\ \lambda\alpha(R-\sigma)\right]<(1-\hat{p}_t)w_t \tag{28}$$

- *For $S_t=L$*

We have

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

so that (28) 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 $k_c=k_a+\dfrac{\lambda}{1-\alpha}(1-\alpha(R-\sigma))>k_a$. Also, we have $k_c<\hat{k}_b$ if and only if $\hat{\sigma}>\dfrac{R(1-\alpha(R-\sigma))}{1-(2\pi-1)\alpha(R-\sigma)}$. 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 also have

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

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

- – For $S_t = H$, we have

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

Equation (28) is equivalent to

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

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

$$(w_t)^2 + (\hat{p}_{t-1}\hat{d}_{t-1} + \lambda\alpha(R-\sigma) - 1)w_t + \hat{p}_{t-1}\hat{d}_{t-1}(\hat{d}_t + \lambda\alpha(R-\sigma)) < 0 \tag{29}$$

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

We have $\hat{d}_t = 2\pi\lambda\alpha\hat{\sigma}$, so that (29) becomes

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

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

$$\begin{aligned} \Delta_P &= \left(\hat{p}_{t-1}\hat{d}_{t-1}\right)^2 - 2(\lambda\alpha(R-\sigma) - 1 + 2\pi\lambda\alpha\hat{\sigma})(\hat{p}_{t-1}\hat{d}_{t-1}) + (\lambda\alpha(R-\sigma)-1)^2 \geq 0 \\ \text{and } \hat{p}_{t-1}\hat{d}_{t-1} &\leq 1 - \lambda\alpha(R-\sigma) \end{aligned} \tag{30}$$

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 $\hat{p}_{t-1}\hat{d}_{t-1}$ (satisfying conditions (30)) 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 (29) becomes

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

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

$$\Delta_Q = \left(\hat{p}_{t-1}\hat{d}_{t-1}\right)^2 - 2(\lambda\alpha(R-\sigma) - 1 + 2\pi\lambda\alpha\hat{\sigma})(\hat{p}_{t-1}\hat{d}_{t-1}) + (\lambda\alpha(R-\sigma) - 1)^2 \geq 0 \tag{31}$$

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 $\hat{p}_{t-1}\hat{d}_{t-1}$(satisfying conditions (31)) 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 (29) becomes

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

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

$$\begin{aligned} \Delta_R &= \left(\hat{p}_{t-1}\hat{d}_{t-1}\right)^2 - 2(\lambda\alpha(R-\sigma) + 1)(\hat{p}_{t-1}\hat{d}_{t-1}) + (\lambda\alpha(R-\sigma) - 1)^2 \geq 0 \\ \text{and } \hat{p}_{t-1}\hat{d}_{t-1} &\leq 1 - \lambda\alpha(R-\sigma) \end{aligned} \tag{32}$$

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 $\hat{p}_{t-1}\hat{d}_{t-1}$(satisfying conditions (32)) the confidence crisis occurs in $\left[\hat{k}_b, \max(\hat{k}_b, k_c)\right] \cap [k_r, k_s]$

Appendix IV

Let us show that

$$\frac{\partial k_i}{\partial \lambda} > 0 \ \text{ and } \ \frac{\partial k_j}{\partial \lambda} < 0 \qquad \text{for } (i,j) = (u,v), (p,q) \text{ and } (r,s)$$

From Appendix III, we have

$$\left\{ \begin{array}{c} (1-\alpha)(k_u + k_v) = 1 - \hat{p}_{t-1}\hat{d}_{t-1} - \ \lambda\alpha(R-\sigma) \\ (1-\alpha)^2 k_u k_v = \hat{p}_{t-1}\hat{d}_{t-1}(2\pi\lambda\alpha\hat{\sigma} + \lambda\alpha(R-\sigma)) \\ (1-\alpha)(k_p + k_q) = 1 - \lambda\alpha(R-\sigma) - \hat{p}_{t-1}\hat{d}_{t-1}(1 - E(R) \\ (1-\alpha)^2 k_p k_q = \hat{p}_{t-1}\hat{d}_{t-1}(E(R)) \\ (1-\alpha)(k_r + k_s) = 1 - \hat{p}_{t-1}\hat{d}_{t-1} - \ \lambda\alpha(R-\sigma) \\ (1-\alpha)^2 k_r k_s = \hat{p}_{t-1}\hat{d}_{t-1}(\lambda\alpha(R-\sigma)) \end{array} \right.$$

Therefore,

$$\left\{ \begin{array}{c} \frac{\partial(k_i+k_j)}{\partial \lambda} = -\lambda(R-\sigma) \\ \frac{\partial(k_i k_j)}{\partial \lambda} \geq 0 \end{array} \right. \qquad \text{for } (i,j) = (u,v), (p,q) \text{ and } (r,s)$$

Hence,

$$\left\{ \begin{array}{c} \frac{\partial k_i}{\partial \lambda} = -\frac{\partial k_j}{\partial \lambda} - \lambda(R-\sigma) \\ \frac{\partial(k_i k_j)}{\partial \lambda} = k_j \frac{\partial k_i}{\partial \lambda} + k_i \frac{\partial k_j}{\partial \lambda} \geq 0 \end{array} \right.$$

which gives

$$\left\{ \begin{array}{c} \frac{\partial k_j}{\partial \lambda}(k_j - k_i) - k_i\lambda(R-\sigma) \geq 0 \\ \frac{\partial k_j}{\partial \lambda}(k_i - k_j) - k_j\lambda(R-\sigma) \geq 0 \end{array} \right.$$

Noting that $k_j \geq k_i \ \ \forall \ (i,j)$ we obtain

$$\left\{ \begin{array}{c} \frac{\partial k_i}{\partial \lambda} \geq \frac{k_i\lambda(R-\sigma)}{k_j - k_i} \geq 0 \\ \frac{\partial k_j}{\partial \lambda} \leq -\frac{k_j\lambda(R-\sigma)}{k_j - k_i} \leq 0 \end{array} \right. \quad \blacksquare$$

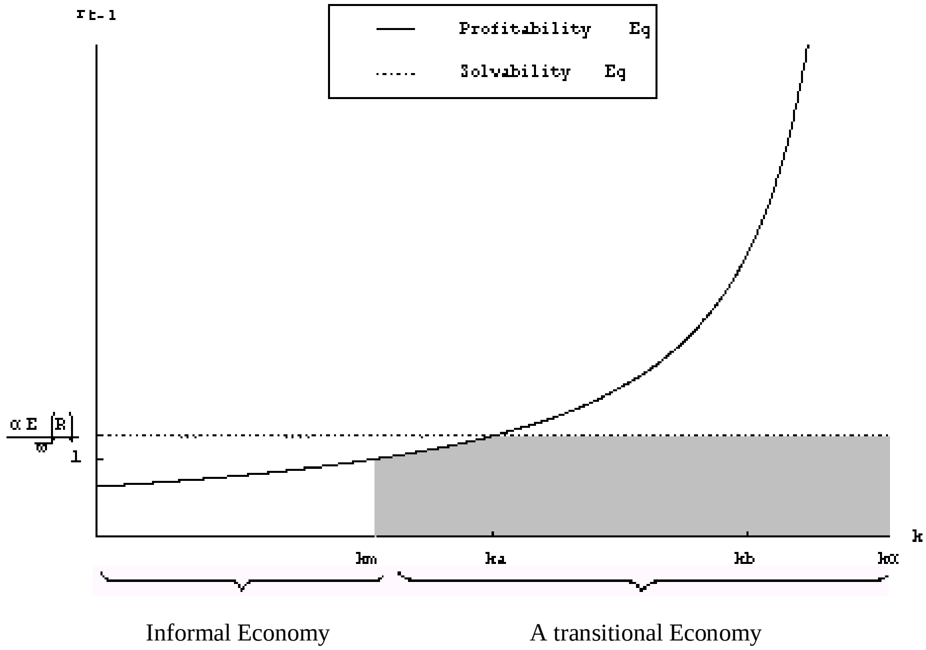

Figure 1: The Profitability and Solvability Equations

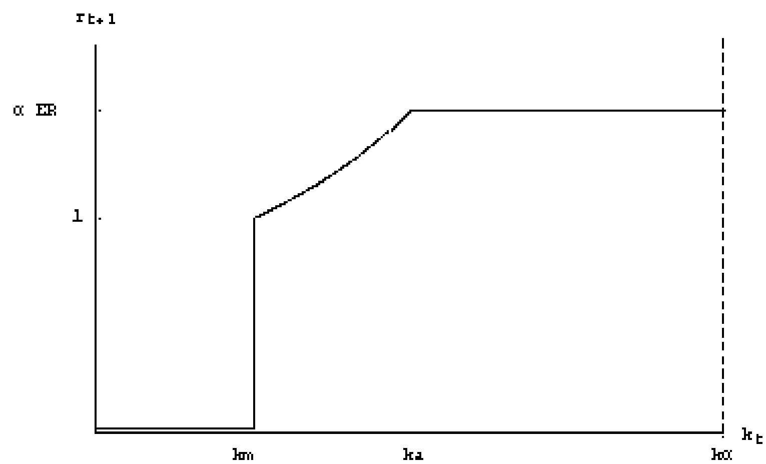

Figure 2: The Interest rate and the Economic Transition Process

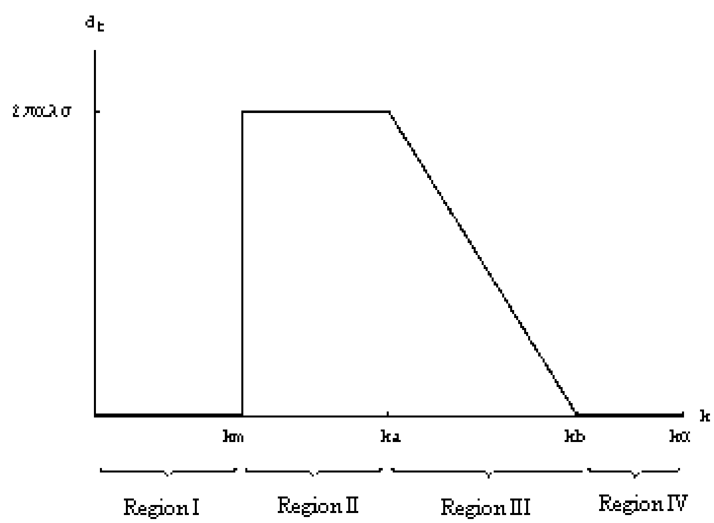

Figure 3: The Possible Default Per Project and the Economic Transition Process

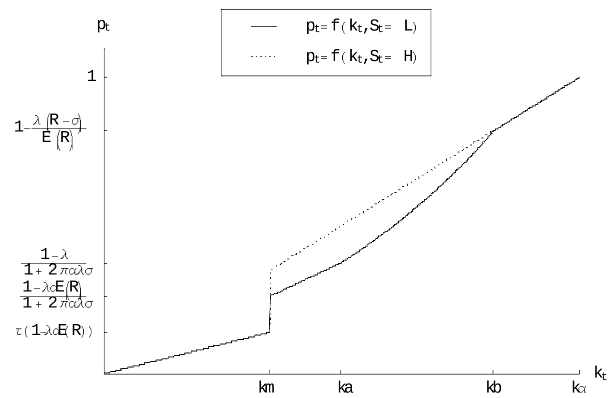

Figure 4: The proportion of projects in the Economic Transition Phase

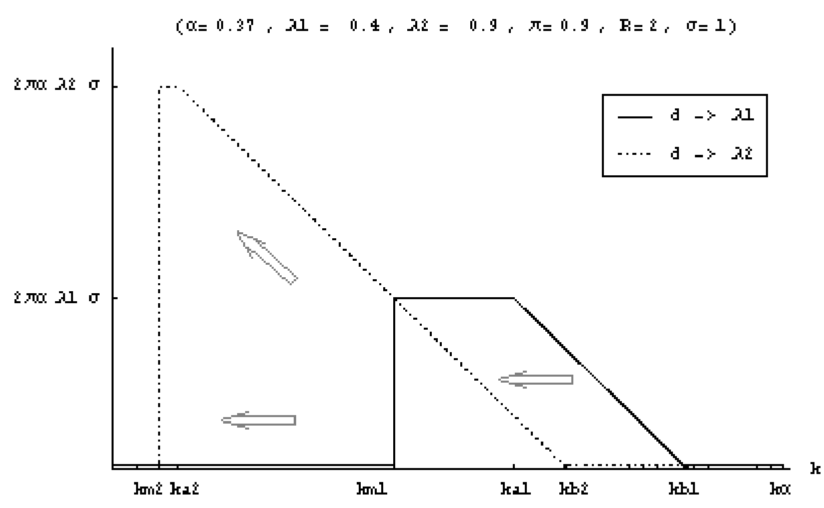

Figure 5: The Effect of an improvement in Credit Market Perfection on the Bank's Reserves

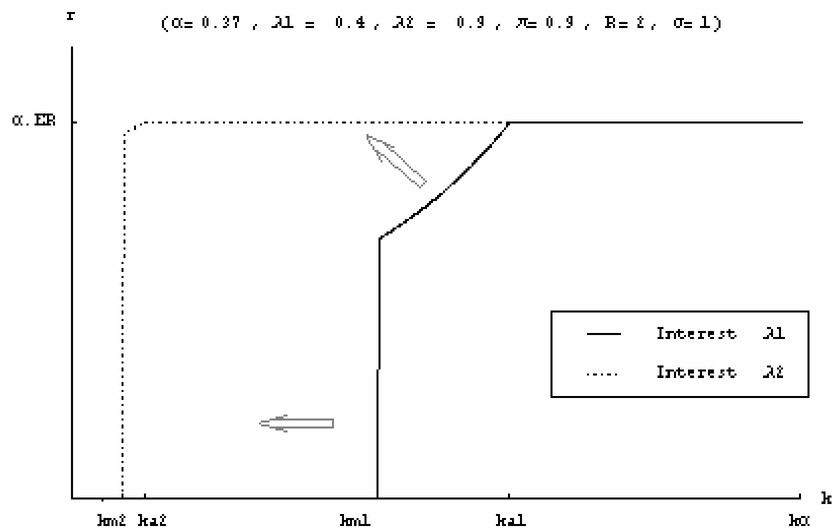

Figure 6: The Effect of an Improvement in Credit Market Perfection on the Interest Rate

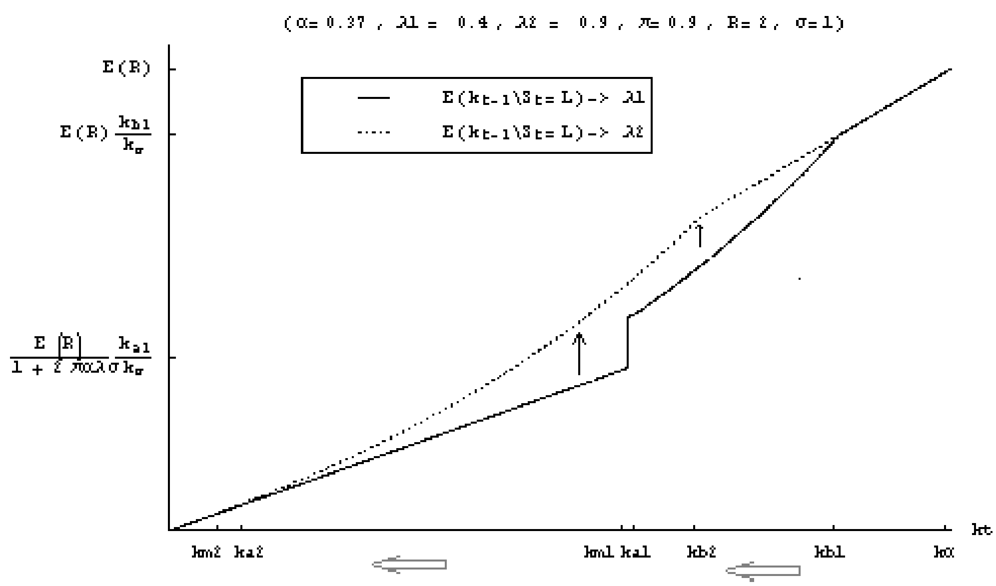

Figure 7: The Effect of an Improvement in Credit Market Perfection on Capital Accumulation

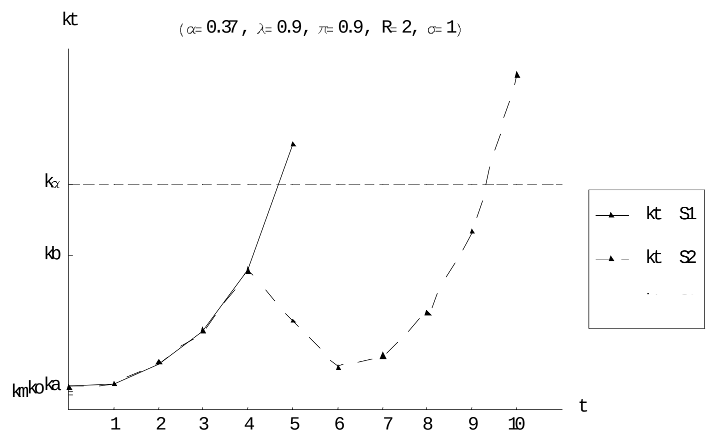

Figure 8: The Capital Accumulation Path Under Two Senarios

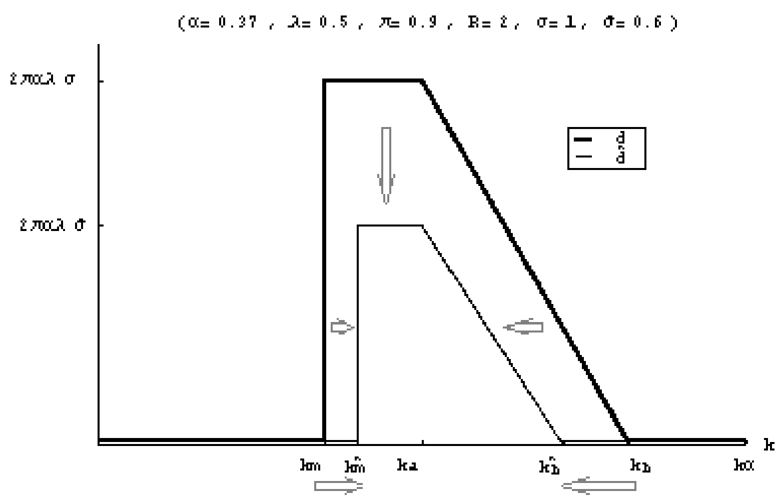

Figure 9: Reserves Per Project

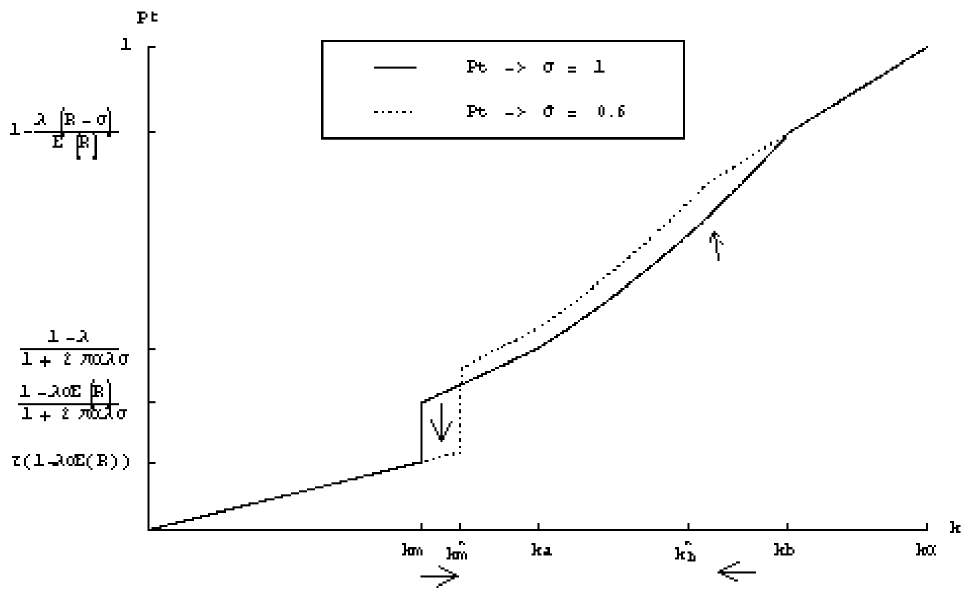

Figure 10: The proportion of projects at different levels of the capital level

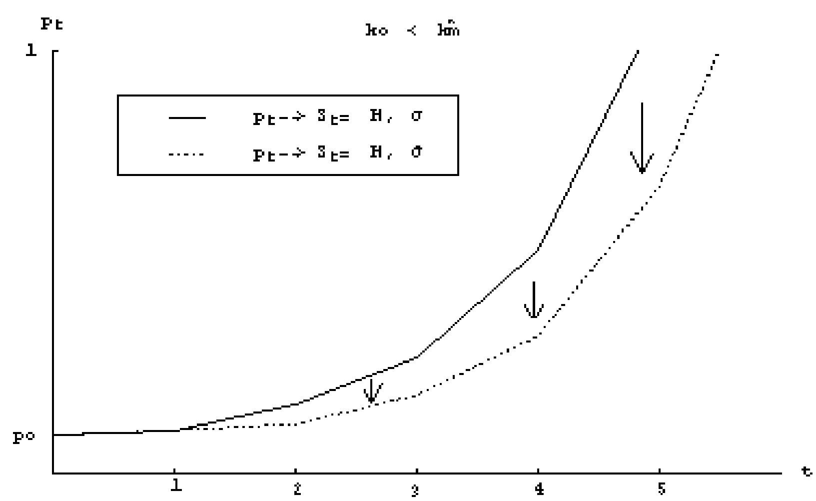

Figure 11: The Dynamics of the of the project proportion when ko < kmc and St = H for every t

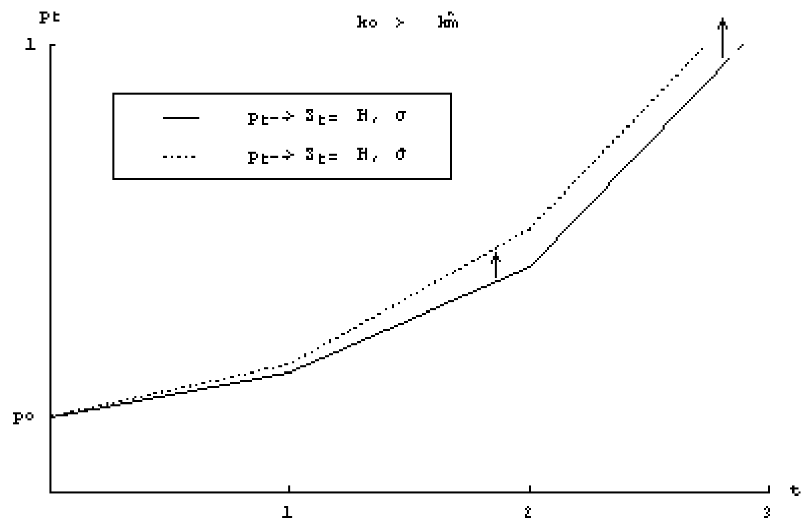

Figure 12: The Dynamics of the of the project proportion when ko > kmc and St = H for every t

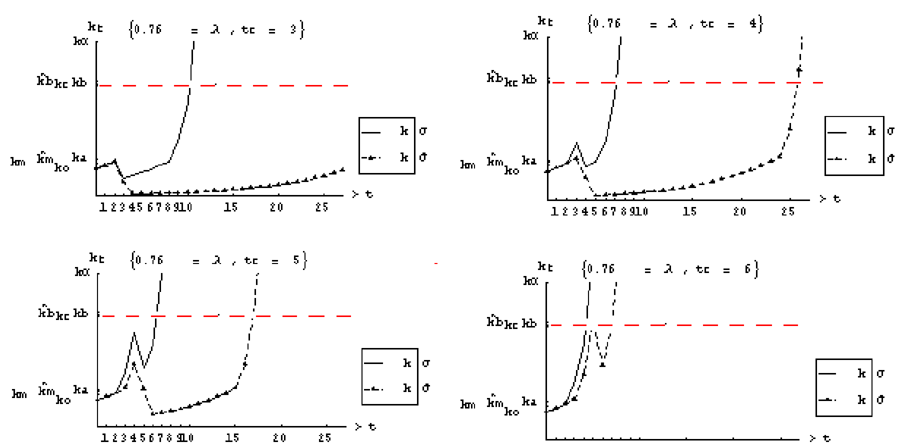

Figure 13:

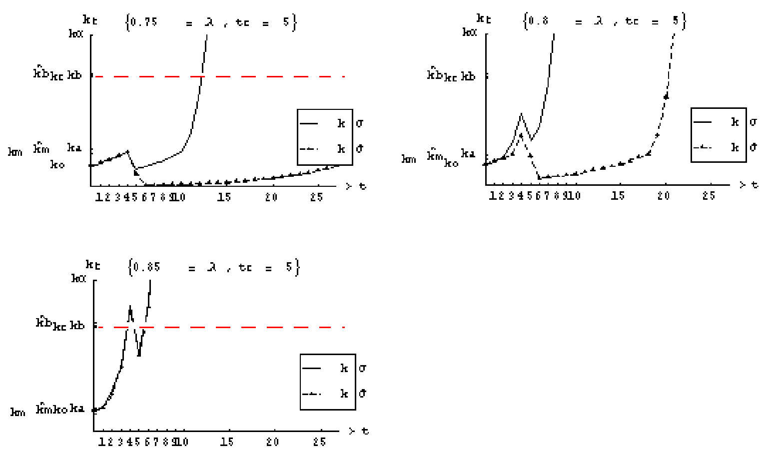

Figure 14: