A MICRO MODEL OF CAPITAL MARKET DYNAMICS WITH EXAMPLES FROM EAST ASIA

Submitted by : Sanjay Kumar

Department of Economics
Dyal Singh College (M), Lodi Road
Delhi University, New Delhi.
New Delhi - 110003
Tel +91 9818801654 / +91 01151767040
Email: gmskvk@yahoo.com

A MICRO- MODEL OF CAPITAL MARKET DYNAMICS WITH EXAMPLES FROM EAST ASIA

Sanjay Kumar
Department of Economics, Dyal Singh College, Lodi Road
Delhi University, New Delhi.
Email- gmskvk@yahoo.com

ABSTRACT

This paper developes a partial equilibrium model of dynamics of financial markets in the case of complete financial liberalization.. It tries to establish that complete financial liberalization, as it is done , is not destabilizing in the long run. But if perverse kind of demand supply responses are present and are able to sustain themselves for a long period of time financial crisis is inevitable in any economy.

The paper does a survey of the existing literature on the subject, to start with. Findings are corroborated with the data from the East Asian economies during the crisis phase.

Keywords : partial equilibrium, financial liberalization, financial stability, interest rate East Asia.

JEL Classification: F30, F32, F33, F43, G15.

Full Address of the Author

Residential Address

Sanjay Kumar,
C-6/6123, Ground Floor, Vasant Kunj, New Delhi.
New Delhi –110070.
Phone - +91-9818801654, +91-011-41767040.

Institutional Affiliation and Address

Sanjay Kumar,
Department of Economics,
Dyal Singh College (M), Delhi University.
Lodi Road. New Delhi. 110003.

Contents Page No.

1.INTRODUCTION

In 1997 a major financial crisis swept across most of the South East Asian economies. These countries, thanks to their spectacular economic performance since mid- 1980s , were described as newly emerging economic tigers (Rakshit, Mihir, 2002). The crisis erupted in Thailand and spread to Indonesia, South Korea, Malaysia, Philippines, Hong Kong ,Mainland China and Taiwan (Cook and Devereux,2001).

The external capital inflows during the period early 1990s to mid- 1990s came to an abrupt halt followed by massive outflows. It left both the foreign and local investors starved of financial resources (Njo, 1997)

This raised serious doubts about the stability of the capital markets in the case of complete financial liberalization . The crisis was unanimously unpredicted (Bustelo, 1998). Debt ratings by international credit rating agencies, spreads on foreign lending and stock indices (except in latter case minor correction in Thailand and South Korea in early 1996) did not change significantly before turmoils. Furthermore, both the International Monetary Fund and Asian Development Bank (ADB) failed to anticipate any kind of financial problem.

2.CURRENCY CRISIS – SOME EXPLANATIONS

Financial crises characterized by banking crisis and currency crisis (i.e.the balance of payment disequilibrium) have long been studied (Masahiro, 2001). There are various explanations.

McKinnon and Pill (1991, 1997) point to the overborrowing syndrome of developing countries in the presence of moral hazard and adverse selection.Their argument is : when the domestic banking system is having the moral hazard problem, financial liberalisation will induce huge overborrowing and bad debt. In other words, financial liberalization magnifies a domestic problem and crises happen. They look upon financial evolution in three stages. Stage one – financially repressed economy, stage two - domestically liberalized economy, stage three - financially liberalized economy. In the financially repressed economy,the banking sector is undeveloped. Banks are not able to operate because profits are low and reserve ratios are high..Deposit rates are too low or negative, lending rates are very high.As a result, no one really uses banks. Financial institutions work as government's fiscal agents. The second stage is that of a domestically liberalized economy. Government no longer levies high taxes on the banking sector, so the spread between lending and borrowing rates narrows. In addition, *banks are well regulated* so they do not lend recklessly. People begin to use banks for deposits and investment. Under this situation, normally both small and large projects are undertaken. Large projects are financed by bank lending. Small projects may be financed informally. The domestic interest rate is determined at the point where returns to both projects are equalized. In the case of uncertainty, return to the large projects is *stochastic*, so the project may yield a good result or a bad result. If the banks are *risk-neutral* (they only care about the average results in the long run), their lending behavior and the interest rate will be determined by the average outcome. If so, there is no general overlending even though the large projects sometimes succeed and other times fail. In the

case of moral hazard and adverse selection bad debt problem may get magnified but is still manageable. In the McKinnon-Pill model, moral hazard is the key problem. The government (explicitly or implicitly) guarantees borrowings, if the projects succeed, banks get high returns; and if they fail, the government will bail them out (instead of jailing the manager and confiscating all his assets). Banks only think of the good outcome and lend excessively to high-risk, high-return projects--namely, they overlend. The domestic interest rate will be higher because of this. The economy will exhibit over-investment in the first period compared with the case without moral hazard. But this overspending is relatively small when the economy is not integrated with the global financial market (because there is only a limited amount of capital available domestically). Hence there is no financial crisis in this case too. The third stage is that of an internationally liberalized economy. The economy is opened up financially without solving the moral hazard problem. The interest rate is no longer determined domestically. It is assumed that world interest is lower than the domestic interest rate. In this case every one who has the opportunity will borrow from abroad and invest in large projects. Small projects will be dominated by large projects in terms of rate of return. Moreover, because of the moral hazard problem, banks' lending behavior is based on the best outcome, not average. If a good situation materializes, fine. But if the outcome is average or bad, people will have to compress consumption in the second period below expectation, or even default on the loans. In this way, external financial liberalization amplifies the banks' moral hazard problem and (will cause bank run) will result in financial crisis.

According to First Generation Models[1] crises arise as a result of loose macro-economic policies (for instance excessive public sector deficits which are monetised) which may become inconsistent with pegged exchange rate regime The earliest version of the First Generation Models was presented by Krugman (1979) deriving influences from the work of Salant and Henderson (1978). Krugman's modelling of a currency crisis is one of the most influential ideas in open economy macroeconomics (Sen,Partha). He showed that long run expansionary fiscal policy increases central bank holding of government bonds,causing increase in the supply of money and decrease in the domestic interest rate. This induces investors to convert domestic bonds to foreign bonds (Rakshit, Mihir, 2002) creating huge demand of Dollar and resulting in depletion of foreign exchange reserves. Currency speculators, at this juncture, further aggravate the demand of Dollar in expectation of a collapse of currency peg and sharp depreciation of local currency. Government keeps on selling Dollars continuously in the local market and eventually exhausts its reserve of foreign exchange. This is the point where the policy of currency peg is to be abandoned as government does not have enough forex reserves to protect the local currency from falling.Currency speculators are in full play and there is tremendous depreciation of the currency. A continuation of the earlier expansionary economic policies at this juncture raises inflation rate, currency depreciates continuously and currency crisis results.Thus a persistent monetisation of fiscal deficit is a recipe for currency crisis under complete financial liberlisation and rational expectations. The greatness of

[1] See Agenor and Flood (1994) for review of literature on First Generation Models and Jeanne (1995) for the same on Second Generation Models.

Krugman kind of analysis is in explaining how a budgetary disequilibrium (monetisation of fiscal deficit) in a financially liberlised economy creates a situation where currency peg eventually collapses and speculative attacks on local currency intensify leading to a currency crisis. The existence of a disequilibrium in public budget, is a precondition for crisis.. Crises can not happen in such models, unless there is problem with macro-economic fundamentals of the economy. Problems at the level of fundamental create negative expectations which aggravate into currency crisis due to intense speculative activity. In a way First Generation Model is trivial (Masahiro, 2001) so far as the cause of the crisis is concerned. If central bank continues to create money too fast there is no wonder that attack comes eventually, an important insight of the First Generation Model relates to the timing of the currency crisis (Rakshit, Mihir, 2002). Even before foreign reserves become zero due to increase in government securities private economic agents, possessed of perfect foresight, will buy up the entire foreign exchange and precipitate the crisis. The timing of the attack will depend on the difference between the expected exchange rate at zero forex reserves (called shadow rate) and the pegged exchange rate. The attack will happen the difference between two is the highest.

First Generation Models are not able to explain why crisis will happen in the countries with sound fiscal and monetary health hence they fail as explanatory tools for the East Asian crisis,(although they very will fit the Latin American currency crises of 1970). Most of the the East Asian economy when crisis struck were in sound fiscal health. For example until 1997, government accounts in Thailand, the Philippines, Malaysia and Korea showed a succession of surplus budgets. Indonesia , it is true, often ran a fiscal deficit, but deficit was in the range of 0.2 to 0.4 percent of gross domestic product. (Rakshit, Mihir, 2002) .

The Second Generation Models (Obstfeld, 1986) highlight the inherent instability of the private currency markets with emphasis on speculation. Attack may come even if economic fundamentals are good.

The model is based on some kind of *nonlinearity* in the policy reaction function. If the policy is linear (roughly speaking, the policy is the same before and after the attack), there is usually only one solution to the model. But if it is not linear (the policy changes before and after the attack), there is a possibility of *multiple equilibria*: an equilibrium with attack and an equilibrium without attack are both possible.

For example, this can occur when the government is pursuing two goals. It wants to have a fixed exchange rate on the other hand, but it also wants to keep unemployment down (or keep interest rates low, protect banks' balance sheets, contain external debt burden, etc) on the other. Tight money supports the fixed exchange rate but worsens unemployment. While the government is able to maintain exchange rate stability by tight macro policy(and at the same time maintaining employment), it may choose to do so. But when a big attack comes, maintaining the exchange rate becomes too costly (in term of domestic goal e.g. employment), and the government will switch to the other regime of floating the currency and achieving the domestic goal. In other words,

the policy of fixing the exchange rate under some domestic strain and the policy of giving up currency stability and achieving domestic goals are both possible. Which one will be realized depends on whether the market attacks or not. The first solution is chosen if the market does not attack, but the second is chosen if the attack comes. It is the market, not the government, which decides.

The above explanation is just one example. There are many other ways to model policy nonlinearity and have similar indeterminate results. Another point: the second generation models can show the possibility of multiple equilibria but cannot tell us which outcome (attack solution or non-attack solution) is more likely to emerge empirically. In other words, the theory takes the market psychology as externally given, instead of explaining it.

The following phenomena, which are mutually related, are associated with the second generation models: Self-fulfilling attack: if the market decides to attack, a currency crisis will occur. If the market chooses not to attack, a crisis will not happen. Any news or rumor (whether true or false) that affects the market sentiment may start a crisis. Whether the country's policy is good or bad is, in this sense, irrelevant. Herding: currency traders and international investors may behave like a herd of buffalos. If the leader goes in one direction, all others will follow without thinking. As a result, all of them may go over a cliff. Their behavior is not rational or based on solid facts. Investors invest in fashionable assets, but they do not really know very much about these assets. Information cascade: if one person (say, a market analyst) says that country A has a trouble, some people begin to believe it. Because some believe it, more and more people come to believe it, until everyone is pessimistic about this country--but in reality, the first analyst may be wrong, and there may be no problem with country A ! Once started, information spreads like avalanche and no one can stop it. The First and Second Generation models have very different policy implications. In the First Generation Models, the crisis is caused by problems in fundamentals. Bad policy invites attacks, so correct the policy. But the second generation model points to inherent instability in private sector behavior. If financial markets are inherently unstable and damaging, a free economy may not be such a good thing. The government should regulate markets rather than let them work freely.

3. AIM OF THE PAPER

The aim of this paper is to re- examine the question of stability. Are completely liberalized financial markets inherently unstable as suggested by the Second Generation Models? In other words is financial liberalization a recipe for crisis?

To answer this question this paper builds a micro-economic dynamic model of the capital market and explores the following hypothesis-

1. The internal capital markets in an economy in the case of complete financial liberalization tend to equilibrium in the long run i.e the capital markets in the

case of financial liberlisation are not inherently unstable as given by the Second Generation Models.

Through this model we also try to find an explanation for the 1997 East Asian crisis.

4. **THE MODEL**

We build a model of financial crisis through the dynamics of internal rate of interest. During the period of crisis high degree of positive correlation is seen between the exchange rate and the short term internal interest rate. For example in the case of Thailand the correlation coefficient between exchange rate and short term interest rate was 0.819 for the period June 1997 to Jan 1998. If we extend this period from from Jan1997 to December1999 this coefficient drops to 0.2246.

Thus we can take rising interest rate as a proxy for currency depreciation during the peiod of crisis.

Assumptions and specifications of the model

1. Capital market demand and supply curves are functions of rate of interest.
2. Complete financial liberalization in the sense of full mobility of capital, no lock – in periods, full capital account convertibility.
3. Full mobility of capital means that internal rate of interest will become a function of external rate of interest –

Thus complete financial liberlisation in this model means that[1] -

$r_i = j.r_e$ here j is a constant , j f 0, r_e is exogeneously determined. The internal rate of interest is determined by external rate of interest and not the other way round. The country under analysis is small consequently it is not able to influence external rate of interest.

Traditionally in all the mathematical models of macro economic dynamics in an intenternational set up the modelers start with the assumption of equality of internatinal rate of interest and local rate of interest. They do it for two reasons, first in all the currency models the idea to understand the currency dyanmics directly not through the mechanism of the rate of interest. Second, methodologywise all the models of comparative statics start with an equlibrium situation and then examine how and when

and why a given equilibrium is disturbed. This paper assumes that the prime mover of capital mobility is interest differential ,to start with, at least in the short run. This is also because we are trying to build a micro- model of the system and price (i..e interest rate in the case of capital) is a prime deteminant of the dynamics.

4. The exchange rates of the country vis-a- vis that of other countries is fixed.

   Thus ,

   $\frac{\Delta e}{e_t} = \frac{e_t - e_{t-1}}{e_t} = 0$ this means that the rate of depreciation of country's currency is zero with respect to the currency of the rest to the world. This assumptions seems valid if we look at the way the financial liberalisation is done in most the countries. Take for example the East Asian countries. In all these countries local borrowers were allowed to convert their long term NPA into short term debt by borrowing from the rest of the world. Their govermnets had promised them that the local currency will not be allowed to be depreciated . Some kind of exchange rate stability is a necessary (not sufficient) condition for interest rate differentials to attract global capital. Some countries adopt fixed exchange rates to facilitate intra-regional commodity- factor mobility. For example during the day of 31 December 1998, the European finance ministers met in Brussels to adopt irrevocable conversion rates for eleven national currencies. By taking the fixed exchange rate egime to start with we can better understand the adjustment mechanism in the case of floating rate regimes.

future. 5.Total internal demand for capital is a sum total of demand from internal sources as well as external sources. Total internal supply of capital is the sum total of the supply from the internal sources and external sources. Otherwise we can directly make the internal rate of interest as a function of excess demand of capital internally. Demand and supply of capital play a very important part in this model and all the dynamics of the capital market is captured in demand and supply dynamics. Changes in demand and supply do capture the present rate of interest as well as the expected rate of interest . Expectations are not treated separately. This is keeping in line with

---

[1] Dornbush and Fisher (1994) give the following specification in the case of liberalised capital markets - $r_i = r_e + \frac{\Delta e}{e}$, this may be true, however, in long run and not in the initial periods of liberalisation.

the way a traditional micro- economic modelling is done and also to maintain simplicity.

Economists have always known that the world is a dynamic one, yet a scan of the books and articles before 1970s would make one wonder if they really believed it. With a few exceptions dynamic modeling were absent before this time period. This began to change in 1970s. The 1970s became a watershed in both economic analysis and economic policy. It was a turbulent time. Economic relationships broke down. Models were to be made be more dynamic if they had to be realistic (Shone,2005) These were the days of dynamic modeling. Dynamics enter into Economics in two ways. The first which has its counterpart in natural sciences is from the fact that the present depends upon the past where we consider one period lag. The second way dynamics enters into Economic has no counterpart in natural sciences, arise from the fact that economic agents in present have expectations about the future.

Demand for internal capital

$Q_{id} = a - br_i,\ a, b \neq 0$

Demand for external capital

$Q_{ed} = c - dr_e,\ c, d \neq 0$

Supply of internal capital

$Q_{is} = e + f r_i$

Supply of external capital

$Q_{es} = g + hr_e$

Total demand for capital in the internal sector(T_{Qid})

$$T_{Qid} = Q_{id} + Q_{ed} = a - br_i + c - dr_e$$

$$= a + c - br_i - dr_e$$

Total supply of capital in the internal sector(T_{Qis})

$$T_{Qis} = Q_{is} + Q_{es}$$

$$= e + g + fr_i + hr_e$$

Excess demand of capital in the internal economy

$$E_d = T_{Qid} - T_{Qis}$$

$$= a + c - br_i - dr_e - (e + g + fr_i + hr_e)$$

$$= a + c - br_i - dr_e - e - g - fr_i - hr_e$$

$$= a + c - e - g - r_i (b + f) - r_e (d + h)$$

$$= a + c - e - g - r_i (b + f) - \frac{r_i}{j}(d + h)$$

$$= a + c - e - g - r_i \left(b + f + \frac{d}{h} + \frac{h}{j}\right)$$

$$= \pm \gamma - r_i \theta$$

4.1 **INTEREST RATE DYNAMICS IN A FINANCIALLY LIBERA.LISED ECONOMY**

Having developed an expression for excess demand of financial capital in a fully liberalised economy our task is now to see how internal rate of interest will behave overtime. Remember that internal rate of interest is a function of excess demand of financial capital.

Thus we write the following expression for the time- path of internal rate of interest –

$\frac{dr_i}{dt} = k(E_d)$, here k f 0 and k is an adjustment coefficient

$$\text{Thus, } \frac{dr_i}{dt} = k(\pm\gamma - r_i\theta)$$

$$\frac{dr_i}{dt} = \pm k\gamma - r_i k\theta$$

$$\frac{dr_i}{dt} = \pm k\gamma - \alpha r_i \text{ , here, } \alpha = k\theta$$

$$\frac{dr_i}{dt} + \alpha r_i = \pm k\gamma$$

This equation is very interesting in the sense that here the rate of change in internal rate of interest is the function of internal rate of interest itself. This is a kind of exponential function (i.e. its solution will always give exponential results). Exponential functions are characterized by the fact that their rate of growth is proportional to their own value. If the constant of proportionality is positive such functions exhibit exponential growth if the constant of proportionalilty is negative such functions exhibit exponential decay.

Mathematicallly the above equation is a linear non- homogeneous differential equation, the general solution is a superposition of the particular solution $\left[\mathrm{r}_{\mathrm{i}p}(t)\right]$ and the complementary solution $\left[\mathrm{r}_{\mathrm{i}c}(t)\right]$. Thus,

$$\mathrm{r}_{\mathrm{i}}(t) = \mathrm{r}_{\mathrm{i}p}(t) + \mathrm{r}_{\mathrm{i}c}(t)$$

4.2 **GETTING THE COMPLEMENTARY SOLUTION**

Put, $\frac{dr_i}{dt} + \alpha r_i = 0$

$$\frac{dr_i}{r_i dt} + \alpha = 0$$

$$\frac{dr_i}{r_i} + \alpha dt = 0$$

$$\frac{dr_i}{r_i} = -\alpha dt$$

$$\int \frac{dr_i}{r_i} = -\alpha \int dt + \beta \text{ , here } \beta = \text{ Constant}$$

$$\ln |r_i| = -\alpha t + \beta \text{ , Here, } r_i \neq 0$$

Taking anti- log

$$e^{\ln|r_i|} = e^{-\alpha t + \beta}$$

$$e^{\ln\|r_i\|_i} = e^{\beta} e^{-\alpha t}$$

$$|r_i| = \varpi e^{-\alpha t}, \ \varpi = e^{\beta}$$

$$r_{ic}(t) = \varpi e^{-\alpha t}$$

4.3 **GETTING THE PARTICULAR SOLUTION**

The particular solution is a solution for any particular value of the time dependent variable. Put, r_i = Constant , and put this value in the general non- homogeneous linear equation –

$$\frac{dr_i}{dt} + \alpha r_i = \pm k\gamma$$

$$0 + \alpha r_i = \pm k\gamma$$

$$r_i = \pm \frac{k\gamma}{\alpha}$$

$$0 + \alpha r_i = \pm k\gamma$$

$$r_i = \pm \frac{k\gamma}{\alpha}$$

$$r_{ip} = \pm \frac{k\gamma}{\alpha}$$

4.4. **THE GENERAL SOLUTION**

Thus the general solution for the time- path of internal rate of interest can be written as below –

$$r_i(t) = \omega e^{-\alpha t} \pm \frac{k\gamma}{\alpha}$$

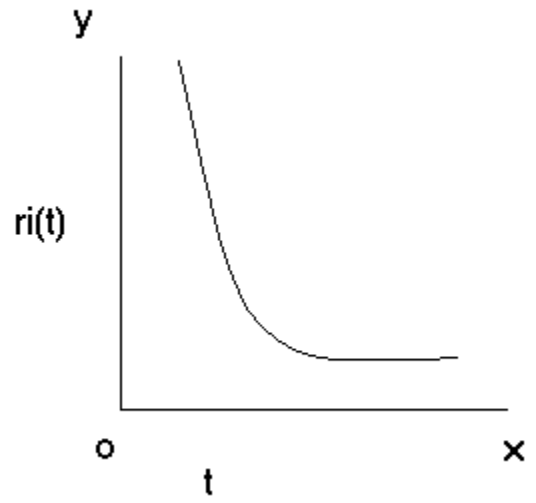
5. **ANALYSING THE RESULTS**

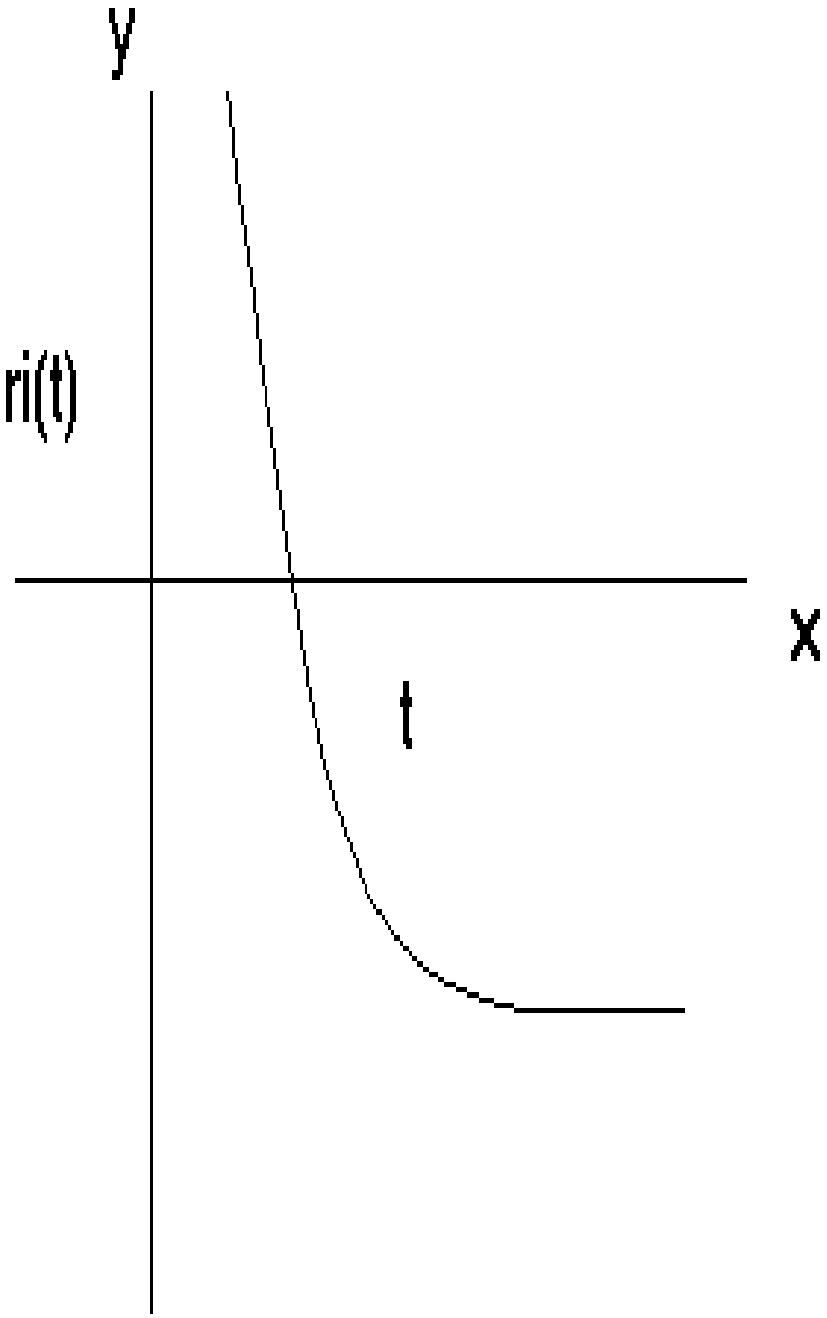
5.1 **THE FIRST SCENARIO (THE NORMAL CASE)**

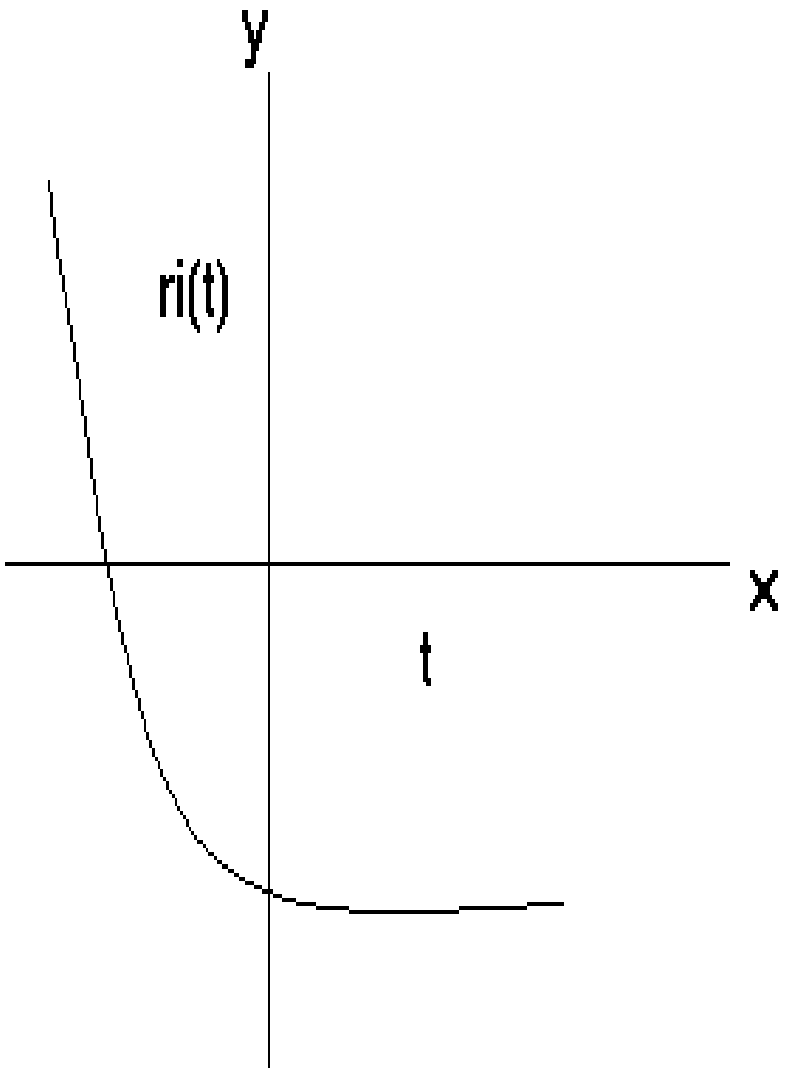
Normally the value of α is positive because in our formulation

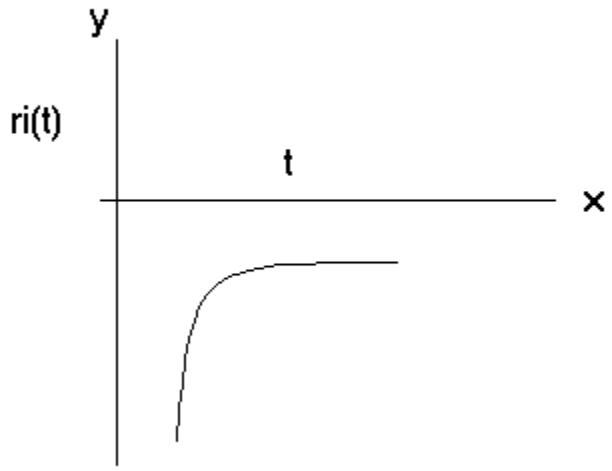
$\alpha = k\theta$ and $\theta = b + f + \frac{d}{j} + \frac{h}{j}$ f 0 because all of these are positive constants

k f 0, thus α f 0. In this case as $t \to \infty$, r_i (t) $\to \pm \frac{k\gamma}{\alpha}$ which is a constant. This constant is, in fact, equal to the equilibrium value of the internal rate of interest. Thus one can argue that in the long run, in normal case, the internal rate of interest will fall and converge towards an equilibrium value which is a constant . Thus we see that even in the case of financial liberalisation capital markets tend to stability in the long run. Following time- paths will emerge-




y
ri(t)
x
t

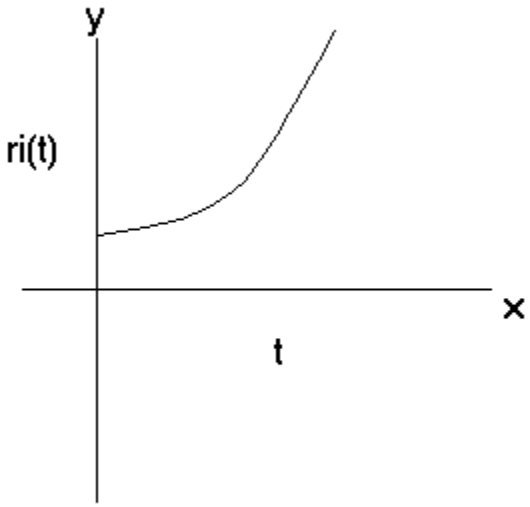

y
ri(t)
x
t

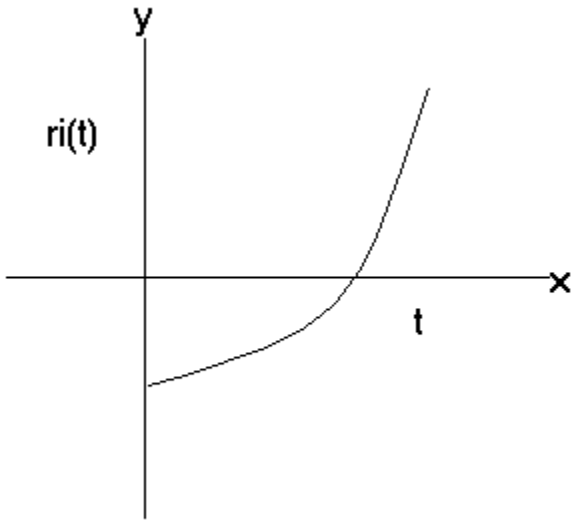


The first case is realistic (as nominal interest rate becoming negative has no meaning) which shows that as time passes the internal rate of interest falls and converges towards a constant value(which is the equilibrium value).

5.2 **THE SECOND SCENARIO (THE NON-NORMAL EAST ASIAN CASES)**

Normally the value of α in this formulation will be positive as shown in earlier discusstion. But remember that $\alpha = k\theta$, and $\theta = b + f + \frac{d}{j} + \frac{h}{j}$. If any of these constants becomes negative then α has the potential of becoming - ve.In this case a perverse type of demand supply response is generated and the internal rate of interest overshoots indicating financial instabiltity. In our equation ($r_i(t) = \omega e^{-\alpha t} \pm \frac{k\gamma}{\alpha}$) then the value of the second part will become immaterial, becasue the value of the first part of the equation will overwhelm the first part. Graphically the following type of situations will emerge -





The first graph is more realistic in the sense that nominal rate of interest can never be negative in any time period. In both these cases what is most important for us is the fact that interest rate shoots up exponentially over time if perverse demand supply responses are present and sustain themselves for a sufficiently long period of time.

6. **EMPIRICAL SUPPORT**

The empirical support for the possibility of such kind a scenario comes from what happened in the East Asian economies after July – 1997. In almost all these countries (Thailand, South Korea, Malaysia, Philippines, Hong- Kong, Taiwan) the internal financial sector became highly unstable. Internal rate of interest shot up enormously yet the supply of capital came down in the form of huge capital flight. Short term interest rate in all the countries, except Japan, increased after June 1997 reflecting the

authorities attempt to arrest currency depreciation. Between 25 June and and 3 December the interest rate went up by 325 points basis points in Thailand, 1787 point in Indonesia, 141 points in Malaysia, 324 points in Philippines, 312 points in South Korea , and 323 points in Hong Kong. Over night the interest rate often jumped by 50 to 300 percent. (Rakshit, Mihir, 2002)

7.CONCLUSION

> Thus the hypothesis which we made earlier in this paper 'The internal capital markets in an economy in the case of complete financial liberalization tend to equilibrium in the long run i.e the capital markets in the case of financial liberlisation are not inherently unstable as given by the Second Generation Models', stands validated.

In normal cases financial liberalization does not lead to any instability in the capital market. But if perverse demand and supply responses are present in the financial sector and if these sustain themselves for a long period of time then financial instability is inevitable leading to interest rate overshooting.