Economic Growth, Over-investment, and Financial Crisis

Sweta C. Saxena[*]
University of Pittsburgh

and

Kar-yiu Wong[**]
University of Washington

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[*] GSPIA, University of Pittsburgh, Pittsburgh, PA 15260, U. S. A.
[**] Department of Economics, Box 353330, University of Washington, Seattle, WA 98117, U. S. A.

1. Introduction

The 1997 Asian financial crisis shook the world, which did not seem to be prepared for such kind of troubles in that region at that time. The crisis was unprecedented, for several reasons. First, it happened quite quickly. The baht was devalued and allowed to float in July 1997. Despite the growing signs that there were troubles in many sectors of the Thai economy, the devaluation of the currency still surprised many people because for a long time before the crisis it was believed that the government could survive the speculative attacks. Second, the waves of devaluation spread to neighboring countries with high speeds, and suddenly so many countries were having financial crises of different degrees. Third, all the economies hit by financial crises had been growing very impressively starting from the sixties and seventies; furthermore, before the crises, there was evidence that the economies were having solid fundamentals.

Several years had passed since the devaluation of the baht; yet economists are still trying to understand more fully the nature, causes, and effects of the crisis. One of the things economists learned of the crisis is that previous economic theories of financial crisis may not be suitable tools to explain what happened in Asia in the late 1990s.[1]

The Asian financial crisis involves many financial phenomena of these Asian countries such as depletion of foreign reserves held by central banks, mounting foreign debts, outflow of capital (especially portfolio capital), problems of local financial systems, and devaluation of local currencies.[2] The major part of the literature so far focused mainly on these financial phenomena.

However, it is noted that all these countries had been growing very impressively for a long time before the crisis. The growth of these economies can be attributed to factors such as the accumulation of physical and human capital, technological progress through domestic research and development and international technology spillovers, construction of infrastructures like highways, and development of financial networks. Moreover, the governments of most of these countries had not shown any fiscal and monetary irresponsibilities like what one could find in, say, some Latin American countries in previous decades.

As a result, there has been growing interest in determining possible links between the growth of these Asian economies and the occurrence of a financial crisis. In particular, economists and government planners wanted to find out what may have happened in the

[1] For a survey of previous theories of financial crisis, see, for example, Saxena and Wong (2001).

[2] Different countries were hit to different degrees, and were adopting different policies to try to avoid a crisis. More notable were the following policies: China and Hong Kong maintained their pegged exchange rates and did not allow their currencies devalued; After the crisis, Malaysia decided to control capital flow (especially outflow) while South Korea encouraged foreign capital inflow (especially foreign direct investment); Thailand, Indonesia, and South Korea were three countries that received IMF aid packages after the crisis.

real sectors of these economies that shared part of the responsibility for the financial crisis later.

The objective of the present paper is to find out, both theoretically and empirically, some possible links between economic growth and a financial crisis. It is argued that under certain conditions economic growth of an economy can lead to misallocation of resources and over-borrowing of foreign debts, thus increasing the vulnerability of the economy. However, such vulnerability is not directly observable, and if the government is not alert enough and did not do something early enough, vulnerability can reach a level so that if the environment for the economy turns bad the economy can be in trouble. We can then say that in this stage bubbles are formed. What makes thing worse is that when the markets (or investors) are aware of the vulnerability of the economy before the government does, they will move their money abroad to safer places. The outflow of investment capital can cause enormous loss of foreign reserves of the central bank, prompting a financial crisis.

We also argue that an important link between economic growth and financial crisis is investment in certain important sectors of the economy. Investment is an important factor of growth, especially for many of these Asian economies, but investment that is supported by foreign debts can increase the vulnerability of the economy: If the investment turns sour, the economy could find itself unable to repay the foreign debts, or if vulnerability of the economy is noted by the markets and investors, capital flight can cause disruption and disturbances in the financial sector.

The second half of this paper is to investigate possible existence of over-investment and bubbles in the following Asian economies: Thailand, South Korea, and Malaysia. These economies were chosen in the present study because (a) reliable data are available, (b) Thailand and South Korea were two of the three economies that received aid packages from the IMF, and (c) Malaysia was the only Asian country at that time that imposed capital control. Of course, the methodology can be applied to other economies.

Section 2 introduces a simple theory of economic growth, over-investment, and financial crisis. Section 3 briefly explains the empirical parts of the present paper. Sections 4 to 6 describe three different approaches to estimate the possible existence of over-investment in these countries. Section 7 concludes.

2. A Simple Theoretical Model

Consider a sector in a small, open economy. The following assumptions about the sector and the economy are made:

(a) The sector is of considerable size of the economy. For example, the value of the output of the sector is a significant fraction of the GDP of the economy.

(b) The production of the output takes some time. This means that there is a considerable gap between the time an output level is chosen and the time the production is completed. Furthermore, the production decision is irreversible. So if an output level is chosen, production will be carried out until it is completed.

(c) At the time a production decision is made, the demand condition when the production is completed is unknown.

(d) The economy has access to foreign loan markets.

Let us explain these assumptions. The size of the sector does matter because if it is an insignificant one in the economy, no matter what happens in that sector will not have any important impact on the economy and will not cause something that can be called a crisis for the economy. Assumptions (b) and (c) together imply that there are risks associated with production since firms have to estimate what the conditions of the market will be in the near future. The last assumption is also important because without access to foreign loans, the economy will not be able to borrow from aboard, and thus there will not be a time when the economy is not able to repay foreign debts.[3]

Now let us consider a representative firm, called firm *i*, of the sector. At any time *t*, the risk-neutral firm has to choose the amount of input l_t, to produce an output q_{t+1} according to the production function:

(1) $\quad q_{t+1} = f(l_t)$.

For simplicity, we assume that the time horizon is not too long so that within the period concerned, the firm considers only one variable input while all other inputs are fixed. Denote the cost of production by $C_t = C(l_t)$, while let the revenue associated with the output be $R_{t+1} = R(q_{t+1}, \overline{q}_{t+1})$, where $\overline{q}_{t+1}$ is the vector of outputs of all other firms in the sector. The cost has to be paid at *t* while the revenue is received at *t*+1. Note that the costs of all fixed inputs have been included in the given cost function, and that the firm treats $\overline{q}_{t+1}$ as exogenously given. The revenue at time *t*+1 is unknown at time *t*, but depends on the market demand at time *t*+1. Therefore the problem of the firm is to choose l_t at time *t* to maximize the future value of the expected profit:

(2) $\quad \pi^e_{t+1} = E[R(f(l_t))] - (1+r_t)C(l_t)$,

where r_t is the interest rate at time *t* and $E[.]$ is the expectation operator. To be more explicit, we can consider a two-state model, with good state and bad state in the next period. Let the true probability of good state be ρ. Then equation (2) reduces to

[3] There are many types of financial crisis, and the one that we focus on in the present paper is the one that is due to the economy's inability to repay the debts it borrowed before.

(3) $\pi^e_{t+1} = \rho R^g(f(l_t)) + (1-\rho)R^b(f(l_t)) - (1+r_t)C(l_t)$,

where $R^i(f(l_t))$ is the revenue when state *i* is realized, *i* = *g* (for good state) or *b* (for bad state), $R^g_{t+1}(.) > R^b_{t+1}$. Assume that the firm knows the true probabilities of good and bad states. The expected profit function is assumed to be strictly concave in input l_t. Denote the solution by l^*_t, which is unique.

Since the firm pays for the cost at *t* but receives the revenue at *t*+1, it has to finance its production. Suppose that the firm borrows the amount C_t from a financial institution such as a bank at *t*. The bank, on the other hand, will borrow from abroad in an international loan market at a lower interest rate.

The model so far does not necessarily imply a financial crisis. The input l_t chosen by the firm should produce a non-negative expected profit.[4] The actual profit in state *i* is equal to

(4) $\pi^i_{t+1} = R^i_{t+1}(f(l_t)) - (1+r_t)C(l_t)$,

i = *g*, *b*. Thus we have

(5) $\pi^e_{t+1} = \rho\pi^g_{t+1} + (1-\rho)\pi^b_{t+1}$,

which means that the expected profit is a weighted average of the good-state and bad-state profits. We assume that competition drives the expected profit down to close to zero, and thus that the bad-state profit is negative.

Having a negative profit when the bad state occurs may not necessarily be a problem for the firm. In most cases, it will be able to, up to a limit, borrow from local banks to cover the loss and to finance a new production. The firm will earn a positive profit when the good state occurs and will earn a negative profit when the bad state occurs. As long as the firm knows the true probabilities of good and bad states, over time, the sum of discounted profits will be non-negative, appropriately discounted.

If, however, the firm chooses an input $l^0_t > l^*_t$, we say that the firm has over-invested.[5] We will later explain some of the conditions for over-investment, but for the time being let us analyze the consequence. Assuming that at least for small over-investment, the following condition holds:

(5) $\pi^g_{t+1}(l^0_t) = R^g_{t+1}(f(l^0_t)) - C(l^0_t) > R^g_{t+1}(f(l^*_t)) - C(l^*_t) = \pi^g_{t+1}(l^*_t)$.

[4] There is no harm to assume that the expected profit is non-negative, even in the short run.

[5] In other words, the firm has spent more on the input(s) than what is needed for (expected) profit maximization.

Condition (5) is a reasonable assumption: It means that should the firm know a priori that the good state will occur, it wants to invest more. That l_t^0 is not a solution to the (expected) profit maximization problem means

(6) $\pi_t^e(l_t^0) < \pi_t^e(l_t^*)$.

Combining (5) and (6) together, we have

(7) $\pi_t^b(l_t^0) < \pi_t^b(l_t^*)$.

Equations (5) to (7) mean that that if the firm knows a priori that the good (bad) state will occur, it will want to produce more (less). They also mean that if the firm over-invests and over-produces, then it will get a bigger profit if the good state occurs, and it will get a bigger loss if the bad state occurs. Of course, given the profit maximization problem, the firm will choose l_t^*, not l_t^0.

We now examine two cases in which the firm will voluntarily choose to over-invest.[6] In the first case, over-investment was induced by economic growth, and in the second case, it is induced by policies.

(a) Growth-induced Over-investment

In this case, growth is taken as given exogenously. These Asian economies experienced a long period of nearly uninterrupted and rapid growth for two to three decades. Economic growth will cause an increase in the demand for goods. If the sector considered above produces a non-traded good such as housing, the favorable effect of the growth on the demand for the produce is even more significant. With rising demand due to economic growth, firms in the housing market find that they have no problem in selling their outputs at good prices. Using the terminology we have above, we say that after the production is completed, the firm experiences a good state, and so it gets a positive profit.

If good states occur consecutively for a number of periods, as what these Asian economies experienced in the seventies and eighties, the firms could get more optimistic about the future and thus will be willing to produce more.

Tow reasons can be offered to explain why firms could get over-optimistic. One is that they do not know exactly the probability of the good state. When they experienced good states for a long time, they would revise their expectation and would believe that the good state should be more likely to occur than what they initially thought. Thus they will revise their perception, and thus will choose to produce more.

[6] These two cases are given in Wong (2001) and Wong (2000), respectively.

Second, suppose that initially there are some firms that are more optimistic and choose to produce more. These firms thus get good returns. When other firms realize what optimism can bring, they will tend to revise their expectation and become more aggressive in production, meaning that they will produce more. The behavior of these firms is called herding.[7] Herding can cause significant existence of over-investment.[8]

Because of these two reasons, the longer the growth, and the more significant the growth, the more optimistic the firms will become.

(b) Policy-induced Over-investment

Some countries use certain policies such as subsidies to promote the trade or production performance of firms in certain industries. Theory shows that under certain conditions, these policies can promote national welfare and improve the profits of firms in the industries. As these firms invest more in physical accumulation and research and development, the economy can grow faster. In this sense, these policies bring positive impacts to the economy. However, over-investment and over-production of these firms can increase the possibility of a financial crisis.

With over-investment and over-production, whether it is growth induced or policy induced, firms tend to borrow more to finance the production. As a result, banks will borrow more from abroad. In the nineties, cheap money was available in Asia and the U. S. Thus it is not surprising to find that countries like Thailand, South Korea, and Indonesia experienced mounting external debts.

When firms over-produce, they will get a bigger loss when the bad state occurs. They may not be able to get more loans from the banks to cover the losses and to finance more production. The banks would be worrying about more losses and thus refuse to lend more money. The firms thus have to declare bankruptcy. When they are not able to repay their loans from the banks, the banks may not have enough of resources to repay the foreign terms. In this way, troubles experienced by individuals firms can be translated into troubles of the market and troubles of the economy.

We can say that an economy is vulnerable in foreign borrowing when the economy may have difficulty in repaying foreign debts when a bad state occurs. Thus we see that in the above cases, economic growth can increase the vulnerability of the economy. If the vulnerability increases to a point so that the economy is not able repay the external debts, we say that bubbles are formed.[9]

[7] Lee (2002), using Korean firm data, found evidence that suggests the existence of herding in Korea before the crisis.

[8] One may ask while herding seems to be asymmetric that it tends to induce less optimistic firms to be more optimistic, but not the other way around. One reason for this asymmetry is that if a firm makes a loss, its manager will have less trouble if all other firms are making similar losses, but if a firm makes a profit and is the only firm to make such a profit, the manager may not get good rewards. Thus conservative managers tend to be more aggressive if other firms are also aggressive.

[9] There are several concepts of bubbles in the literature. See Wong (2000) for a discussion.

3. Empirical Studies of Over-investment

The rest of this paper examines possible existence of over-investment in the following countries: Thailand, South Korea, and Malaysia. We choose Thailand and South Korea because they were two of the three countries that received aids from the IMF after the crisis,[10] and because Malaysia was the only country that imposed capital control as a way to curb capital flight.

Figure 1 shows the shares of gross investment as a percentage of GDP from 1960 to 2001. These curves for the countries show similar trend: rapid rise from the sixties, and then sharp drops after the crisis.[11]

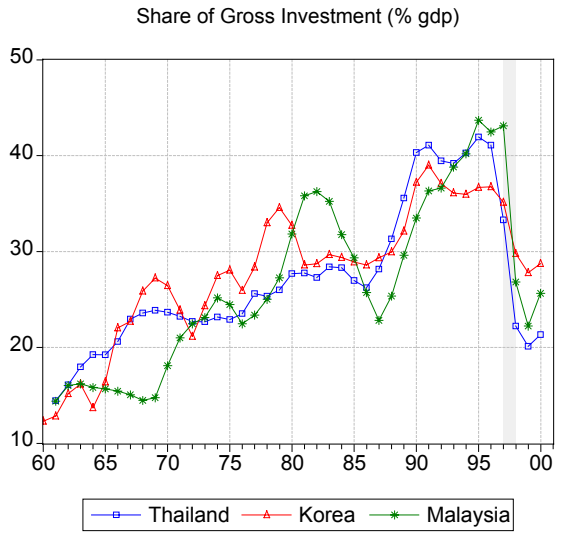


Figure 1

The theory introduced in the previous section focuses on the features of some of the sectors in the economy: over-investment in some sectors, especially non-traded sectors such as housing, are more likely caused by rapid and prolonged economic growth, while over-investment in some sectors, especially export-oriented sectors, are more likely to be due to export-promotion policies. In the empirical study below, we use the aggregate private investment mainly due to the availability of data. Ideally, we should examine the investment in some of sectors that have signs of herding and bubbles, and some sectors that are subject to export-promotion policies. Studying the aggregate investment series undoubtedly will include some sectors where no over-investment occurs. Unfortunately, our study is limited by availability of data.

The approach we use in the present paper to identify is to examine the series of observed aggregate investment of these three countries, and to decompose the series into a

[10] Indonesia is the other country in Asia that received IMF aids, but this country was also hit hard by political and social turmoil.
[11] The Malaysia curve shows more fluctuation, and that of Thailand rose more steadily.

permanent component and a temporary component. We postulate that the permanent component series is due to fundamentals and that the temporary series is due to short-term factors such as herding, over-optimism, and so on. The size and sign of the temporary component will give us an idea of the existence and degrees of over-investmnet.

In the following three sections, we introduce three approaches to investigate the existence of over-investment in these three countries before and after the crisis: unobserved component model, the regime-switching model, and the cointegration approach. All three empirical approaches can be useful for providing measures of the permanent or "equilibrium" level of investment. Positive deviations from equilibrium may then give evidence of speculative activity or over-optimism.

4. Univariate Unobserved Component Model

This approach decomposes observed aggregate investment into permanent and temporary component. The advantage of this approach is the ease of decomposition using minimal information. This advantage, however, becomes a con because the model doesn't have deep roots in economic theory.

Suppose that we are given a series y_t. We want to decompose it into two independent components: a stochastic trend component, y_{1t}, and a cyclical component, y_{2t}.

(8) $y_t = y_{1t} + y_{2t}$,

where

(9) $y_{1t} = \delta + y_{1,t-1} + e_{1t}$

(10) $y_{2t} = \phi_1 y_{2,t-1} + \phi_2 y_{2,t-2} + e_{2t}$

$e_{it} \sim \ i.i.d.N(0, \sigma_i^2), \ \ i = 1, 2, \ \ E[e_{1t} e_{2t}] = 0$, for all *t* and *s*.

so that the roots of $(1 - \phi_1 L - \phi_2 L^2) = 0$ lie outside the unit circle. Taking both y_{1t} and y_{2t} as unobserved state variables, this model could be written in the state-space form as follows:

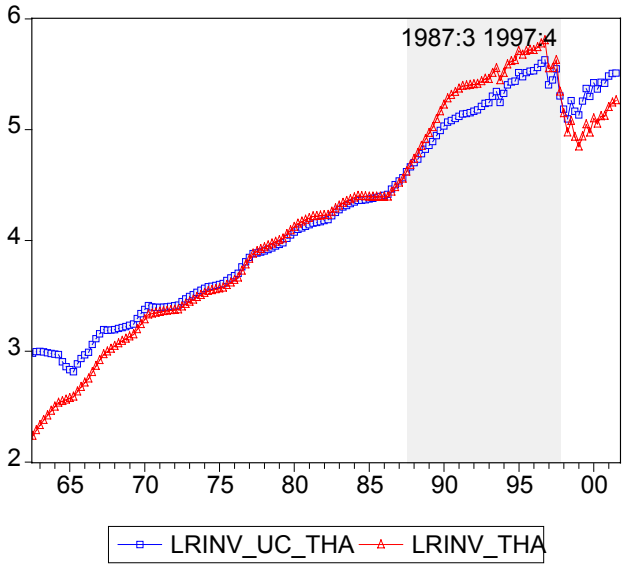
(11) $$y_t = [1 \ \ 1 \ \ 0] \begin{bmatrix} y_{1t} \\ y_{2t} \\ y_{2,t-1} \end{bmatrix},$$

and

(12) $$\begin{bmatrix} y_{1t} \\ y_{2t} \\ y_{2,t-1} \end{bmatrix} = \begin{bmatrix} \delta \\ 0 \\ 0 \end{bmatrix} + \begin{bmatrix} 1 & 0 & 0 \\ 0 & \phi_1 & \phi_2 \\ 0 & 1 & 1 \end{bmatrix} \begin{bmatrix} y_{1,t-1} \\ y_{2,t-1} \\ y_{2,t-2} \end{bmatrix} + \begin{bmatrix} e_{1t} \\ e_{2,t} \\ 0 \end{bmatrix}.$$

The model is then estimated using the Kalman filter. The results are given below.

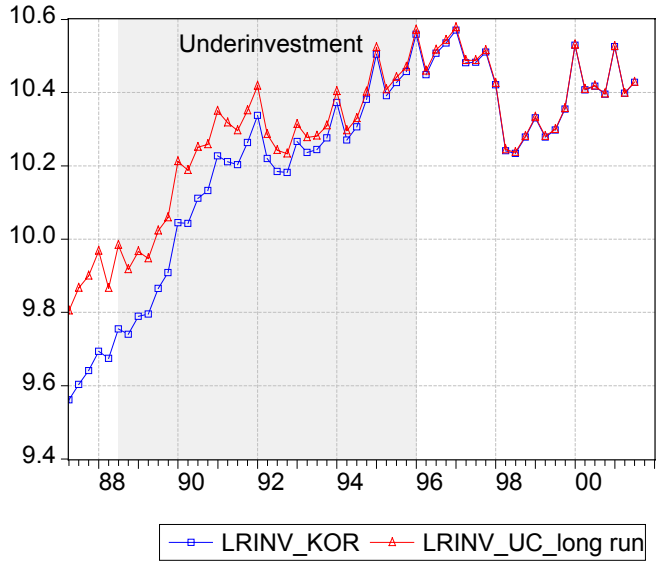
Thailand



Measuring the long run level of investment as the permanent component from this decomposed series, we still see that there is evidence of over-investment in Thailand from period 1989:1 through 1997:4. This period coincides with the period of massive capital inflows—which is later supported by cointegration approach (III).

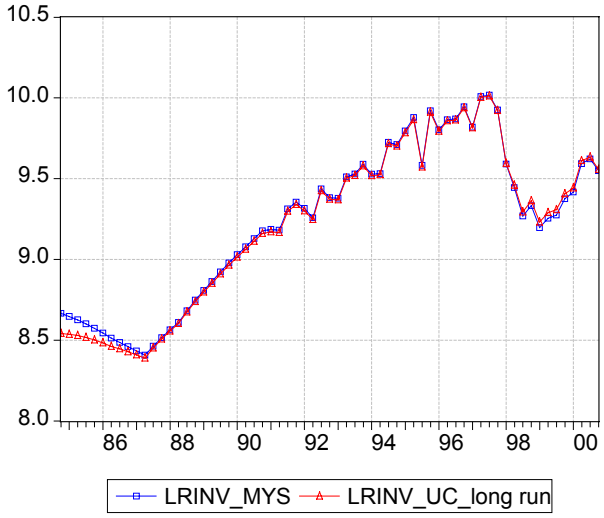
Korea

Using unobserved component model to estimate the long run investment level, Korean actual investment in fact shows underinvestment through 1996, after which the gap closes.



Malaysia

The unobserved component model shows no evidence of overinvestment in Malaysia in the 1990s.



5. Regime Switching Approach

This approach uses a multivariate filter to investigate the behavior of aggregate private investment as it relates to output, consumption and the business cycle. The model specifies regime-switching models in both the common permanent component (Hamilton, 1989) and common temporary component (Friedman, 1993). This regime-switching model is estimated in order to distinguish between pessimistic and optimistic behavior. When the common stochastic trend or the temporary component rises, it signifies an optimistic environment for the investors and they respond by increasing investment. By the same token, a decrease in either component denotes a pessimistic environment and hence a decrease in investment. This regime-switching model is useful for extracting the probabilities of being in an optimistic or pessimistic state. A similar approach has been used in Cerra and Saxena (2001). We estimate the comovement in real GDP, real investment and real consumption and introduce asymmetry in both temporary and permanent common factors, ala Kim and Piger (2000) and Kim and Murray (1998).

Each series is decomposed into a deterministic component, a permanent component and a transitory component. The permanent component has a constant that is state-dependent. To introduce asymmetry in the temporary component, we allow the temporary component to undergo regime switching in response to a second state variable.

We present the specification of the dynamic two-factor model now. The logs of each series can be decomposed into a deterministic component, DT_i, a permanent component, P_{it}, and a transitory component, T_{it}.

(13) $\overline{Y}_{it} = DT_i + P_{it} + T_{it}$

(14) $P_{it} = \gamma_i n_t + \varsigma_{it}$

(15) $T_{it} = \lambda_i x_t + \omega_{it}$,

where $\overline{Y}$ = [output, investment, consumption], n is the common permanent component, x is the common temporary component, and ζ and ω are the independent idiosyncratic permanent and temporary components, respectively. The model can be written in differenced deviations from means as follows:

(16) $\Delta y_{it} = \gamma_i \Delta n_t + \lambda_i \Delta x_t + z_{it}$,

where $z_{it} = \Delta\varsigma_{it} + \Delta\omega_{it}$ is a stationary composite of the idiosyncratic components and γ_i and λ_i are the factor loadings on the common permanent and common transitory components, respectively.

The growth rate of the common permanent component is stationary and is approximated by a second order autoregressive process. Note that a stationary growth rate implies that the level is nonstationary, in accordance with the definition of a stochastic trend. In addition, there is a constant, β, that depends on the permanent state, S_{1t}:

(17) $\Delta n_t = \beta_{S1t} + \phi_1 \Delta n_{t-1} + \phi_2 \Delta n_{t-2} + v_t$, $v_t \sim i.i.d.\, N(0,1)$.

The state-dependent constant introduces asymmetry along the lines of Hamilton (1989).

(18) $\beta_{S1t} = \beta_0 + \beta_1 S_{1t}$; $S_{1t} = \{0,1\}$.

During an expansion phase ($S_{1t} = 0$) the stochastic trend grows with the drift rate β_0. If β_1 is negative, the trend shifts to a lower growth state when $S_{1t} = 0$, and shifts to a recession phase if $\beta_0 + \beta_1 < 0$.

The common temporary component is stationary in its levels and is approximated by a second order autoregressive process. To incorporate Friedman's type of asymmetry, we allow the temporary component undergoes regime switching in response to a second state variable, S_{2t}.

(19) $x_t = \tau S_{2t} + \phi_{11} x_{t-1} + \phi_{12} x_{t-2} + u_t$, $u_t \sim i.i.d.,\ N(0,1)$.

In state $S_{2t} = 0$, the intercept is zero. If $\tau < 0$, then the economic series is "plucked" down when $S_{2t} = 1$. When the state returns to normal, $S_{2t} = 0$, the economy reverts back to trend.

Finally, each series has its own stationary idiosyncratic component, again approximated by an AR(2).

(20) $z_{it} = \psi_{i1} z_{it-1} + \psi_{i2} z_{it-2} + e_{it}, \quad e_{it} \sim i.i.d., \; N(0,1)$

(21) $E\left(v_r, u_{,s}\, e_{it}\right) = 0 \;, \forall \; i,r,s,t \;.$

Both state variables are assumed to be independent first-order Markov switching processes with transition probabilities given by:

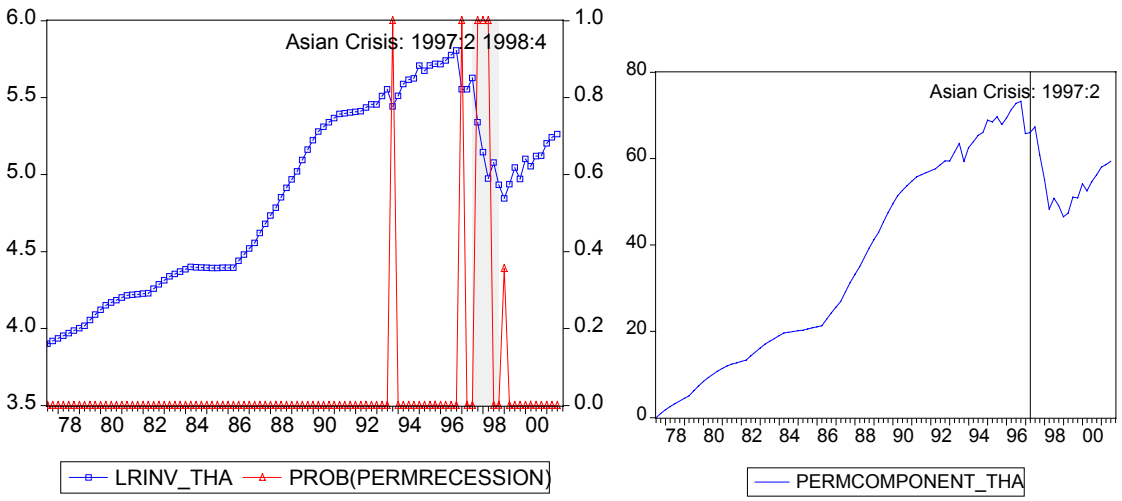
(22) $\Pr\left[S_{1t} = 0 \mid S_{1t-1} = 0\right] = q_1 \;, \; \Pr\left[S_{1t} = 1 \mid S_{1t-1} = 1\right] = p_1 \;,$

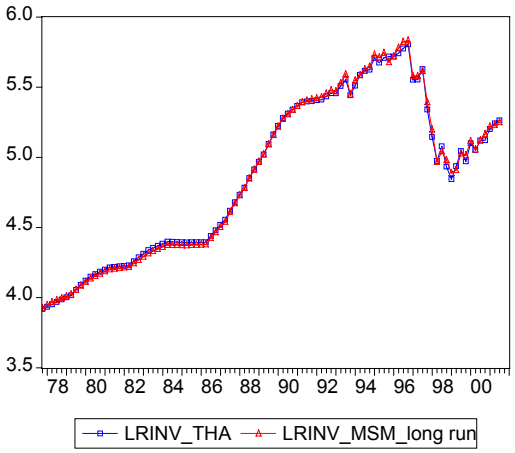
and

(16) $\Pr\left[S_{2t} = 0 \mid S_{2t-1} = 0\right] = q_2 \;, \; \Pr\left[S_{2t} = 1 \mid S_{2t-1} = 1\right] = p_2 \;.$

The results for the three countries are given below:

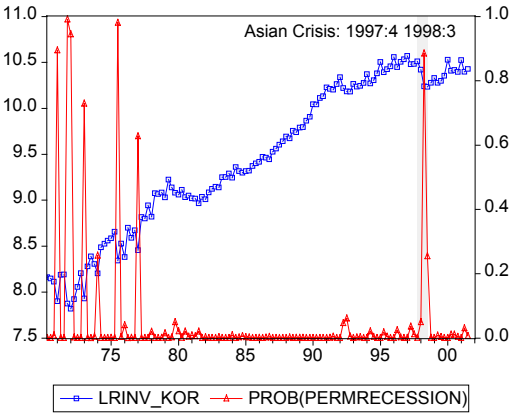
Thailand

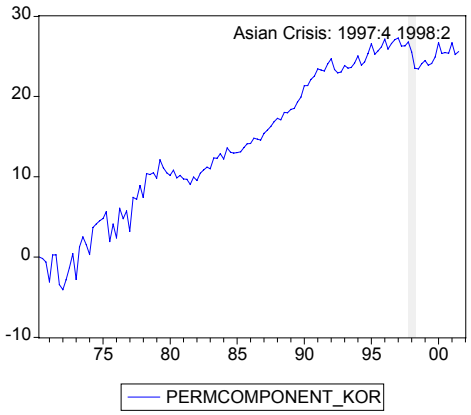


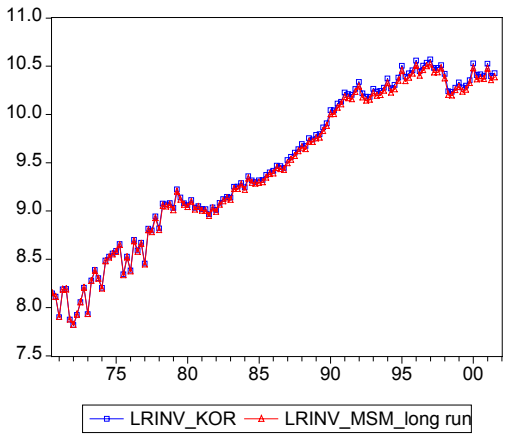


The probability that the recession is permanent is very high in the aftermath of the Asian crisis. The decreases in investment signify that the level of investment has been permanently lowered. The common permanent component also shows a big drop after the Asian crisis in 1997:2. Since the probability of a permanent expansion is so high during the entire period, it might indicate an optimistic era where people increase investment. However, the long-run component of investment and actual investment tend to move very closely together, indicating absence of any over-investment.

Korea

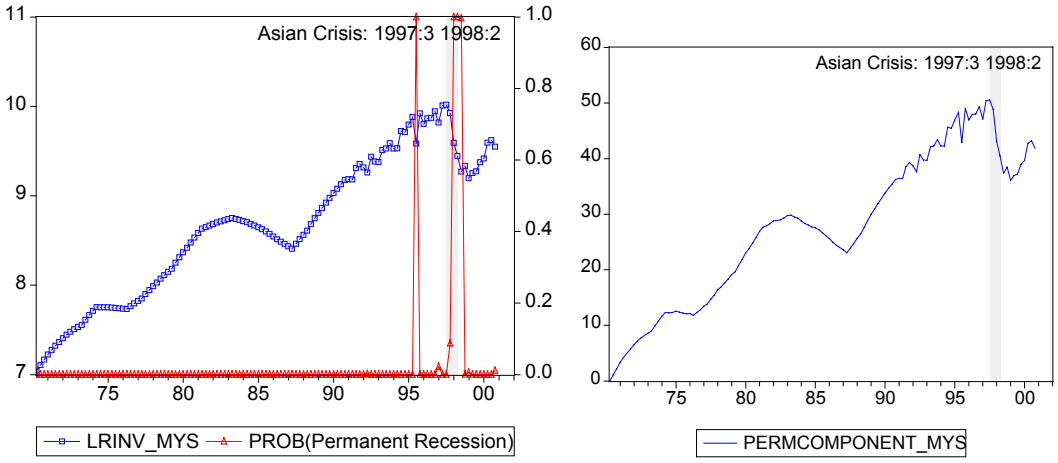


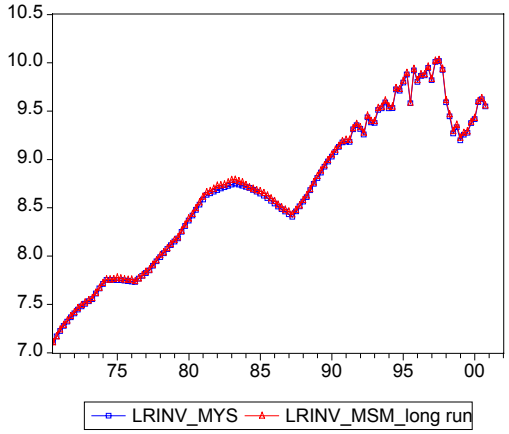




The probability that the recession is permanent is very high after the Asian crisis in Korea as well. Here, we use 1997:4 as the date for Korean crisis because that is the time Korea approached the IMF for loan. The common permanent component also shows a drop after the crisis in 1997. Again, the probability of a permanent expansion is high from 1975 till the crisis in 1997, suggesting an optimistic period. But here again, we don't find any evidence of over-investment.

Malaysia





Malaysia also shows a permanent recession after the Asian crisis. The drop in investment is permanent after the crisis in 1997. The common permanent component also shows a drop. Malaysia also experiences an extended period of expansion and optimism, like Thailand and Korea. According to this approach, Malaysia doesn't show over-investment.

6. Cointegration Approach

In this section, we investigate the existence of over-investment using the cointegration approach. The use of error correction model has the advantage of linking investment to its fundamentals. In addition, the error correction term denotes the movement of the actual investment in response to the deviation from an equilibrium level. If the error term has a positive sign, then it could be interpreted as a sign of a bubble—i.e., when the

actual investment is above the equilibrium level, it has the tendency of moving further away from the equilibrium instead of returning to the equilibrium level. A negative sign on the error term may also signify the correction of under-investment. In this respect, the regime-switching model has the advantage relative to this approach in that it can explore asymmetric behavior. Even if the error correction term is negative, indicating the tendency of investment to move toward its equilibrium, it may refer to the behavior over the entire sample period. There may still be periods of speculative drift within the sample that is eventually reversed.

Economic theory (see, for example, Greene, 2002) tells us that real investment depends on the following factors: real capital flows, real domestic credit, inflation, growth rate, real interest rate, public expenditure, ratio of debt service payments to exports of goods and services, real exchange rate.

We would expect the following signs:

- Increase in real capital flows increases investment as it increases available financing (+)
- Increase in domestic credit also increases available financing (+)
- Inflation should result in lower investment as higher inflation increases uncertainty of returns from investment (-)
- Faster growth should correspond with higher investment, either because higher growth makes investment more attractive (under adaptive expectation) or because investment is seen as promoting growth (reverse causality) (+)
- Higher real interest rates should lower investment, because they indicate higher cost of capital (-)
- Higher public expenditure could either increase investment (if public expenditures are complementary to private investment) or decrease investment (if public expenditures are unproductive and not supportive of private sector activity) (?)
- Higher debt service burdens funds available for investment spending (-)
- Appreciation of real exchange rate might reduce net capital inflows because appreciation reduces the country's competitiveness (-).

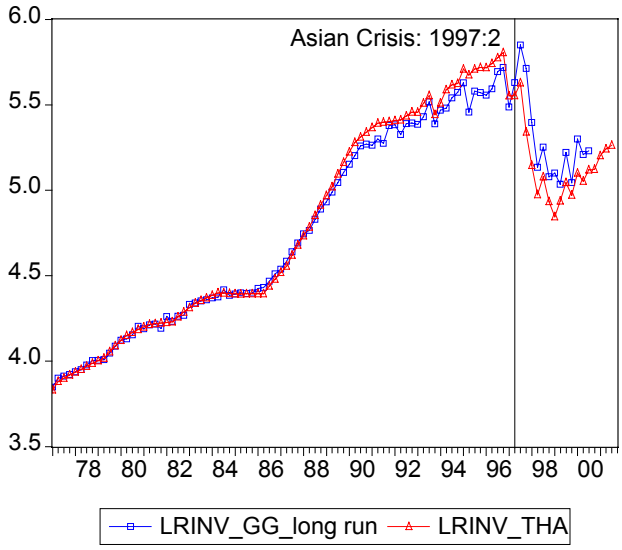
We use all these variables to look for a long run cointegrating relationship. When all the above variables were tried together, some of them were insignificant. Hence, insignificant variables were removed one by one, which led to the following long run relationships.

Thailand

Table 1 reveals the estimates from the error correction model. All signs are as expected, except the sign on real interest rate. An increase in real interest rate should decrease investment because the cost of capital increases. But this sign is consistent with the moral hazard story, where high interest rates invite risky investments. A positive coefficient on public expenditures means that government spending was complementary to private investment.

The sign on the cointegrating equation (which is the error term—difference between the actual and the long run investment) in the private investment equation is "positive". This clearly shows that there could have been some herding effect. The error should dissipate over time, but this positive sign indicates that there could have been a bubble in investment.

We use this cointegrating equation and the error correction term to estimate the long run level of real investment using Granger-Gonzalo method. The results are depicted in the following graph:



Note: We do see signs of overinvestment starting in mid-1980s through 1997:1.

Korea

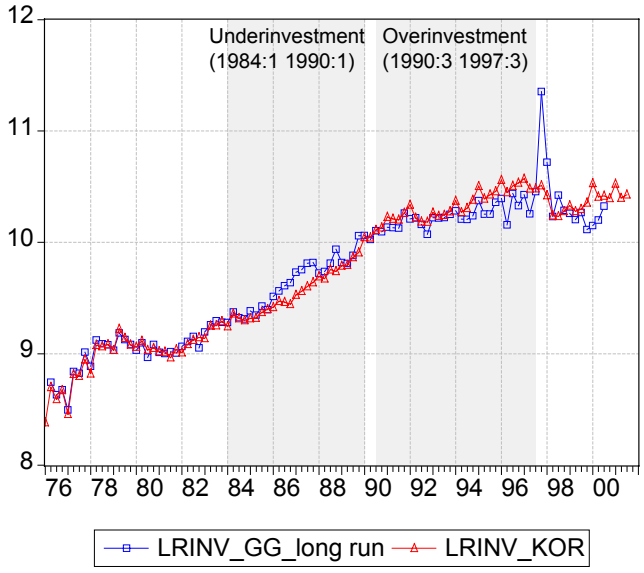
The results from estimation are reported in Table 1. The signs indicate the following explanation:

- An increase in net capital inflows might indicate the vulnerability to a shift in sentiment, hence leads to a decrease in investment.
- An increase in domestic credit eases liquidity constraints in the economy, hence leads to an increase in investment.
- Higher growth stimulates higher investment.
- An increase in inflation does not seem to discourage investment—probably because of positive effect of higher growth in the economy.
- An increase in government investment decreases private investment, suggesting that government expenditures could be unproductive and not supportive of private activity.
- Higher debt service discourages investment.

- An appreciation of real exchange rate encourages investment—it could suggest that appreciation is caused by higher productivity, which doesn't make the Korean economy uncompetitive.

The sign on the cointegrating equation is negative and significant—indicating any absence of bubble activity. It suggests that as the actual investment moved away from the equilibrium level of investment, the actual investment moved to correct the difference.

The equilibrium level of investment is estimated using the Granger-Gonzalo method from the error correction model (estimated above). The result is in the following graph.



Note: There are signs of over-investment in the 1990s.

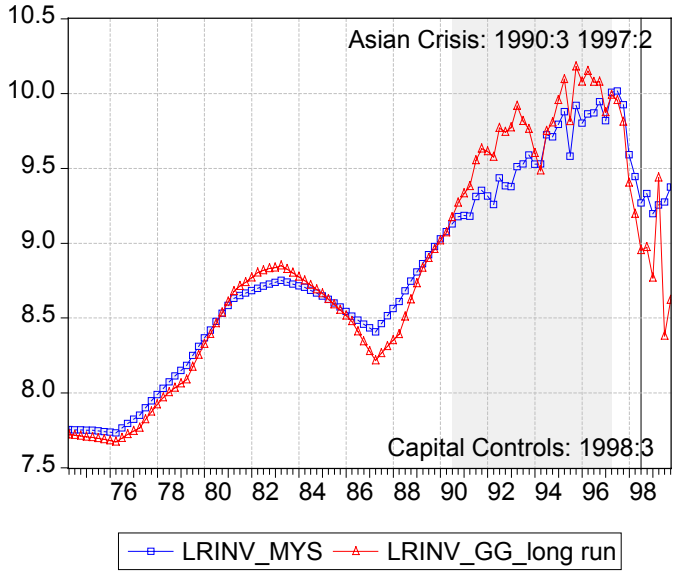
Malaysia

Table 1 reports the estimation results. The signs can be interpreted as follows:

- An increase in capital inflows increases investment (hence, capital controls help an increase in investment).
- Higher growth encourages investment.
- Higher inflation hurts investment.
- Higher real interest rates decrease investment as they raise borrowing costs.
- Higher public expenditures increase investment—suggesting productivity of government spending.
- Higher debt service discourages investment.
- An appreciation of real exchange rate encourages investment—suggesting an increase in productivity of the economy, which might have encouraged capital inflows as well.

The sign on the cointegrating equation is negative and significant—indicating any absence of bubble activity. It suggests that as the actual investment moved away from the equilibrium level of investment, the actual investment moved to correct the difference.

The equilibrium level of investment was estimated using the Granger-Gonzalo method from the error correction model (estimated above). The result is in the following graph.



The equilibrium level of investment doesn't indicate any overinvestment since 1990.

Comparison of empirical results: From the empirical results, it is clear that Malaysia didn't show any over-investment in the 1990s. In fact, when accounting for fundamentals of investment in the cointegration approach, it shows an under-investment of 18%.

For Thailand, over-investment varies between 8% (cointegration approach) and 20% (unobserved components model) in the 1990s. While the regime switching model doesn't show any signs of over-investment, it clearly shows long periods of expansion (and hence optimism). For Thailand, this optimism may have turned into a bubble stage, as evidenced by the positive error correction term in the cointegration approach.

In the 1990s, Korea suggests an over-investment of 4% (regime switching approach) and 9% (cointegration approach). Since the probability of expansion was high throughout the sample period, Korea exhibited high investment levels. But this does not indicate any kind of bubble, as the actual level of investment was moving toward the equilibrium in the cointegration approach.

Hence, in this empirical part of the paper, we find that the probability of permanent expansion is high in all three countries (Thailand, Korea and Malaysia) indicating periods of high optimism, which led to high investment in the 1990s. However, only Thailand seems to indicate over-optimism (which is found in the positive error correction term).

Table 1: Results from the Cointegrating Equations
(Dependent Variable is LRINV)

Variable	Thailand	Korea	Malaysia
Real net capital inflows	0.0031 ***	-0.0001 ***	0.0038 ***
Real domestic credit		1.0254 ***	
Growth		2.5768 ***	3.9471 ***
Inflation		1.0886 ***	-0.1210 ***
Real public expenditure	0.8755 ***	-0.6642 ***	1.6188 ***
Real debt service 1/	-0.7773 ***	-0.3712 ***	-0.2714 ***
Real exchange rate	-2.1454 ***	0.4169 ***	0.6757 ***
Real interest rate	0.0435 ***		-0.0886 ***
Constant	-10.2007	7.7395	-3.8529
Cointegrating equation	0.1544 ***	-0.3621 ***	-0.1258 **
Sample	77:4 00:3	77:1 00:3	75:3 99:4
No. of Observations	92	95	98
Adjusted R^2 (Investment)	0.4416	0.4075	0.2159

Note: *** and ** Asterisks indicate significance at 1% and 5% level.
1/ Debt service is nominal for Thailand

7. Concluding Remarks

In this paper, we suggested a theory to explain the financial crisis that existed in many Asian countries in 1997. We emphasized that it had many new features that distinguished it from most previous crises that hit other countries in areas such as South America, Europe, and Russia. In this paper, we focused on some of the variables in the real sectors of these countries that had led to over-investment and over-borrowing from abroad.

We distinguished between the sources of over-investment: growth-induced over-investment and policy-induced over-investment. Both of them are related to the impressive growth rate in these countries before the crisis. In the former approach, growth is taking as exogenous but it induces over-optimism, herding, over-investment, and then vulnerability of the economy. In the latter approach, growth is promoted by some government policies, but these policies at the same time encourages over-investment and eventually could hurt the economy.

We then used three different approaches to examine whether aggregate private investment of Thailand, South Korea, and Malaysia showed over-investment. Our results are preliminary, but they do suggest the existence of over-investment in some cases, especially in Thailand and Korea.

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