Capital Mobility Before and During the Currency Crisis: Experience of Four Asian Countries

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Introduction

Capital inflows contributed to the Asian miracle by bridging up the gap between the Asian countries' savings and investment, and by introducing new technology, products, and markets. Capital outflows brought down the assets and goods markets, and turned this miracle into a disaster over night in 1997 and 1998. Capital mobility thus is of vital importance for these countries and deserves much attention. The purpose of this article is to study the actual degrees of capital mobility before and during the crisis in four Asian countries, including Indonesia, Korea, Malaysia, and Thailand.

The Asian countries started to liberalize their capital accounts in the early 1980s. The liberalization of the financial sectors and the demolition of barriers for capital and trade flows encouraged inflows of foreign direct and portfolio investment, and greatly supported the high growth rates of these economies. The enhanced degree of capital mobility, nevertheless, also reduced the independence of these countries' domestic monetary and fiscal policies, and caused problems of over-heating and resource miss-allocation. Partly because of the reduced policy effectiveness, the

unsustainable and overheated economies were cooled down not by contracting policies, but by speculations.

It became rather obvious that less open economies (like China and Taiwan) were less directly hurt by capital outflows. Countries like Malaysia took measures to restrict capital outflows soon after the crisis broke out. In other countries, similar measures were also proposed, though not implemented openly. It is argued by some that in fighting against the crisis, constraints on capital mobility might be a dose that is less harming to the economy than the drastic contracting measures proposed by the IMF. While the change in capital mobility in Malaysia is worth investigating, it would also be interesting to see whether the capital account openness in other countries was also reduced.

The capital mobility is more difficult to measure accurately than it might sound. One difficulty is how to quantify capital account openness and capital mobility. Another difficulty relates to the changing degree of mobility, which invalidates many common regression methods. Yet another difficulty is caused by interest rate controls in many emerging markets, which reduce the usefulness of interest rates as indicators of the integration of domestic and foreign money markets.

This paper aims to trace the capital mobility and its changes (if any) before and after the crisis in the four countries. The above problems will be overcome in later sections. The findings will shed light on issues like: (1) how closely have these countries' money and capital markets been integrated with other countries' markets? (2) How did the integration change over time, particularly before and during the crisis? (3) How closely is the capital account openness related to the harms done by the crisis?

The four countries we choose bear some common features. They experienced gradual opening of the capital accounts in the 1980s and early 90s. They maintained one form or another of currency links to the US dollar before the crisis. They took measures to count-attack speculators during the crisis to defend their currency pegs and the domestic financial markets. They failed to maintain the links. Their domestic economies and financial markets were deeply affected. Some of the measures they took during the crisis might have an implication on capital flows, which is more obvious in the case of Malaysia.

Section Two reviews the existing literature and clarifies the theoretical and empirical definitions of capital mobility. Section Three establishes a model that is based on the money market equilibrium and derives the empirical equations. Section Four estimates the equations and discusses the empirical findings. Section Five concludes the paper.

Literature Review

One possible measure of capital mobility is a qualitative evaluation of legal restrictions over capital movements (Dooley and Isard, 1980). The difficulty with this approach is that changes in the intensity of legal restrictions are often associated with private initiatives to circumvent existing controls. The tightening of legal restrictions might be associated with an increase in capital market integration, because authorities often respond to private initiatives with a lag and with decreasing effectiveness. Moreover, restrictions tend to stay on the books long after their effectiveness has been eroded by financial innovations.

Full capital mobility can be quantified under a few definitions, which are summarized in Fischer and Reisen (1993). Under the *closed interest parity,* full mobility means that yield rates on comparable assets across countries are equal when converted into a common currency. Deviations from the parity can be caused by the political risk premium, which is a compensation for risks arising from the existence or expectation of capital controls, changes in assets gain taxation, and defaults. Under the *covered interest parity,* yields on comparable assets that are issued in different countries and denominated in different currencies are equal after being hedged against currency risks. In addition to the political risk premium, the cost of hedging (the forward premium or discount) drives a wedge between the foreign and domestic interest rates. Under the *uncovered interest parity,* expected returns on comparable assets are equal in spite of the exposure to foreign exchange risks. Under the *real interest parity,* the *ex ante* real (inflation adjusted) yield rates are equal across countries. Under the *Feldstein-Horioka (1980) definition,* full mobility means a zero correlation ratio between the national savings and investment, because the exogenous changes in national savings can be fully accommodated by variations in foreign borrowings, without affecting national investment.

Frankel (1989) and Blundell-Wingnall and Browne (1991) present two comprehensive studies on capital mobility in the OECD countries. They show that there existed large deviations from the closed interest parity, but these deviations disappeared soon after capital controls were removed. Likewise, deviations from the covered interest parity declined substantially during the 1980s. Nevertheless, the uncovered interest parity was denied. This indicates that although the country premium disappeared, a currency premium that arose from the exchange rate risk and

expected real currency depreciation remained. It drove a large wedge between the real interest rates of different countries. Besides, the real interest parity seemed to be a poor indicator of financial market integration, as it did not hold in most tests. Its failure might be due to sticky prices, which caused deviations from the purchasing power parity.

For developing economies, one particular difficulty in empirically measuring the capital mobility comes from the lack of market-clearing domestic interest rates and forward exchange rates (Edwards and Khan, 1985; Frankel, 1989; Glick and Hutchison, 1990). In these countries, domestic interest rates are often curbed by interest rate ceilings and credit rationing, and established forward foreign exchange markets do not exist. Some studies use the black market interest rates as a measure of the true domestic interest rates (Edwards, 1988; Reisen and Yeches, 1991). While these interest rates provide some information, there are serious limitations in their use. The lack of the volume of transactions in the black markets makes it difficult to assess the importance of such rates. Besides, these rates are influenced by the risk associated with borrowers that are excluded from the controlled credit market. Glick and Hutchison (1990) found that in the case of Taiwan, applying the curb rate in the econometric analysis of the open interest parity condition yielded impossible results.

The capital accounts of most developing countries are neither wholly closed nor fully open. Edward and Khan (1985) developed a model of uncovered interest parity to measure the actual degree of mobility. They assume that the domestic market-clearing interest rate (i) is a weighted average of the uncovered interest parity rate (i*) and the domestic market-clearing interest rate that would be observed if the private capital account were completely closed (i'):

$$i_t = gi_t^* + (1-g)i_t^{'} \qquad 0 \le g \le 1 \qquad (1)$$

In this formulation, parameter g is an index of capital mobility. When g = 1, the domestic market-clearing interest rate would be equal to the uncovered interest parity rate. External financial conditions would be the primary determinants of the domestic market interest rate. When g = 0, the capital account is effectively closed, and external factors play no role in determining the domestic interest rate. When the value of g rises, the effective degree of capital mobility increases.

Using an autoregressive conditional heteroscedasticity framework, Faruqee (1991) examined the evolution of capital mobility in several Asian countries during the 1980s. He focused on the differentials between money market interest rates of Korea, Malaysia, Singapore, and Thailand and the three-month Japanese yen LIBOR. He found that financial market liberalization in Asian countries had raised the level of integration between domestic and international financial markets.

Recently, Min (1999) used an approach similar to that of Faruqee (1991) to study capital mobility between seven Asian countries and Japan by estimating deviations from the uncovered interest parity for the period January 1990 and March 1998. Bigger deviations means lower mobility. This is because under perfect mobility and when there are no transaction costs and risk premia, the expected change of the spot exchange rate will be equal to the nominal interest differential. He found that six out of the seven countries experienced increases in capital mobility (smaller deviations) in the 90s, including in the first months of the financial crisis.

3. The Model and Data

The model should be capable of addressing our following main concerns. First, the capital accounts of the four countries might be far from fully open and fully closed. We need to have a measure of exactly how mobile the capital is. In this regard, the approach used by Faruqee (1991) and Min (1999) does not meet our need as it does not give a definition of the measure of closed capital account. In their studies, deviations from the uncovered interest parity in different countries have enormous differences, and are hardly comparable. Secondly, under the progressive financial reforms introduced in these countries, restrictions on capital flows were reduced gradually in the 1980s and the early years of 1990s. Restrictions were re-imposed openly in Malaysia in 1997 and 1998. We need to have a time-varying method to capture the dynamic effects of such changes.

In light of these considerations, we develop an empirical model based on the approaches used in Edwards and Khan (1985, 1988) and Reisen and Yeches (1991, 1993). The eventual work is how to use a time varying method to estimate equation (1). The estimated values of *g* represent the degree of mobility. However, before this estimation can be done, *i*', the hypothetical interest rate under the closed capital account, needs to be derived. The following equations are designed for this purpose.

Assume the following money demand function:

$$M^d / P = f(i, y, \pi^e, (M/P)_{-1}) \qquad (2)$$

where M^d is demand for money, P is the domestic price level, y is real output, and π^e is the expected inflation. Assume further equilibrium in the money market:

$$\ln(M^d / P) = \ln(M^s / P) = \ln(M / P) \qquad (3)$$

The observed domestic interest rate is given by:

$$i = f^{'}(y, \pi^{e}, M/P, (M/P)_{-1}) \qquad (4)$$

The stock of money can be written as

$$\begin{aligned} M &= R + DC = R_{-1} + DC + \Delta R \\ &= R_{-1} + DC + CA + KA_G + KA_P \end{aligned} \qquad (5)$$

where M is the domestic money stock, R is the domestic currency value of foreign exchange reserves, DC is the stock of domestic credit, Δ is the first difference operator. CA, KA_G, and KA_P are the domestic currency values of the balances of the current account, the public sector capital account, and the private sector capital account respectively. The money supply that would correspond to the hypothetical situation of a closed private capital account is

$$M^{'} = M - KA_p \qquad (6)$$

The hypothetical money supply would be less than the actual supply by the amount that is created by private capital inflows (KA_p). The hypothetical interest rate ($i^{'}$) must satisfy the following money market equilibrium condition:

$$\ln(M^{'}/P) = \ln(M^{d}/P) \qquad (7)$$

Therefore,

$$i^{'} = f^{'}(y, \pi^{e}, M^{'}/P, (M/P)_{-1}) \qquad (8)$$

The empirical procedures are as follows. First, we run the following regression to obtain the elasticities of money demand:

$$\ln(M^{d}/P) = \alpha_0 + \alpha_1 i + \alpha_2 \ln y + \alpha_3 \pi^{e} + \alpha_4 r_D + \alpha_5 \ln(M^{d}/P)_{-1} \qquad (9)$$

where r_D the rate of interest paid on time deposits. The stability of the equation and parameters so estimated is important for deriving the interest rate under closed capital

account. Considering that the studied countries all experienced significant economic reforms and structure changes during the sample period, careful tests and consideration of the possibility of instability are needed. In addressing this issue, we run the forecast Chow test and χ^2 test. Besides, we also obtain the Kalman filter estimates of the parameters, which are time-varying and can better capture the changing economic and monetary conditions.

Secondly, we derive the hypothetical *i*'under closed capital account. Its estimates are obtained by calculating the following equation

$$i' = \frac{\alpha_0}{\alpha_1} + \frac{\alpha_2}{\alpha_1}\ln y - \frac{\alpha_4}{\alpha_1} r_D + \frac{a_3}{\alpha_1}\pi^e + \frac{\alpha_5}{\alpha_1}\ln(\frac{M}{P})_{-1} - \frac{\ln(M'/P)}{\alpha_1} \qquad (10)$$

Here we have two sets of results. One set is obtained by assuming stable parameters of the money demand equation. The other set is obtained by utilizing the varying parameters estimated in the first-stage Kalman filter tests.

Thirdly, we estimate the degree of openness, *g* by running equation (1). The closed interest rate is derived as stated above. The uncovered interest parity foreign rate has three components. (1) The three-month US treasury bill rate. The substitution of the treasury bill rate by the Euro-dollar LIBOR rate does not change the results significantly. (2) The one-period-ahead change in the exchange rate. This is a proxy for the expected change in the spot exchange rate. (3) The Hong Kong dollar-US dollar interest spread, defined to be the spread between the three-month HIBOR and LIBOR rates. This is a proxy for the exchange risk premium, chosen on two main considerations. One is that in the financial crisis, most Asian countries were significantly affected. In fact, the exchange risk is more an Asian risk than individual

country's risk. Another consideration is that since the HK dollar was linked to the US dollar and did not depreciate, the HKD-USD interest spread reflects better the exchange risk premium. The ex-post data of the interest spreads of other countries reflects both the exchange-rate depreciation and exchange risk, and is not a good candidate for capturing the effects of the exchange risk only.

To measure the dynamic development in the degree of capital mobility, we apply the Kalman filter again in running equation (1) to obtain the estimates for g. It is expected that the range of the value of g is between 0 and 1. A large value of g means higher capital mobility. When the value of g is close to 1, it means near perfect mobility. On this basis, not only can we track the development in any single country, we can also make a comparison between different countries.

Quarterly data between 1985.1 and 1998.4 are used in this study. There is not sufficient annual data to test the effects of the 1997-98 financial crisis. Monthly data, while desirable, is not available for several key variables, including the measures for income and money. Most data are from the IFS. The deposit rates of Indonesia, Malaysia, and Thailand, the three-month US dollar LIBOR rate, and the three-month HK dollar HIBOR rate are from the Data Stream. The domestic money market rates are the inter-bank offer rates. The foreign interest rate is taken to be the US treasury bill yield rate. The money stock is defined to be M2. The real money stock is measured by M2 divided by the consumer price index. Capital inflows include the value of errors and omissions item in the balance of payments to reflect the unauthorized capital flows in these countries under capital account regulations. Following Wickens's (1982) errors-in-variables approach to estimating rational expectation models, the expected rate of inflation is approximated by the one-period-

ahead rate of inflation. All variables, except the interest rates and inflation rates, are in natural logs.

4. Empirical results

We first test the partial-adjustment money demand functions for the four countries, and obtain the following results (figures in brackets are t-statistics):

Korea:

$$\ln(M/P)_t = -1.406 - 0.006R_t + 0.415\ln(y)_t + 0.669(M/P)_{t-1}$$
$$\quad\quad (-2.12)\ \ (-1.74)\ \ (2.58)\ \ (5.78)$$

$R^2 = 0.96$, $h = 0.12$

Forecast χ^2 (12)/12 = 15.84 Chow F (12, 36) = 4.43

Malaysia:

$$\ln(M/P)_t = -1.186 - 0.006R_t + 0.371\ln(y)_t + 0.745(M/P)_{t-1}$$
$$\quad\quad (-2.33)\ \ (-1.90)\ \ (2.63)\ \ (8.02)$$

$R^2 = 0.99$, $h = 3.21$

Forecast χ^2 (12)/12 = 1.28 Chow F (12, 36) = 0.97

Thailand:

$$\ln(M/P)_t = -0.65 - 0.005R_t + 0.291\ln(y)_t + 0.7(M/P)_{t-1}$$
$$\quad\quad (-2.33)\ \ (-3.59)\ \ (2.69)\ \ (6.76)$$

$R^2 = 0.99$, $h = -2.38$

Forecast χ^2 (12)/12 = 15.52 Chow F (12, 36) = 1.73

Indonesia:

$$\ln(M/P)_t = -1.09 - 0.001R_t + 0.384\ln(y)_t + 0.651(M/P)_{t-1}$$
$$\quad\quad (-3.726)\ (-1.746)\ \ (4.132)\ \ (7.173)$$

$R^2 = 0.98$, $h = 1.99$

Forecast χ^2 (12)/12 = 2.63 Chow F (12, 36) = 1.69

From the estimated equations, we see that most of the variables are of signs and parameters to our expectations. The properties of the equations are also largely satisfactory. The results of the stability test, however, deserve a special notion. The equations of Indonesia and Malaysia are stable by both the forecast χ^2 test and Chow test. The test results for Thailand are mixed: the equation passes the Chow test but fails the forecast χ^2 test. The equation of Korea fails in both tests, indicating absolute instability.

In light of such findings, we further run the Kalman filter estimation of the above equations (results omitted due to their large volume) to obtain the time-varying parameters. We then use two sets of parameters to derive the hypothetical interest rate (i') under closed capital account, and arrive at two hypothetical rates series. One is directly calculated by referring to equation (10) and the parameters estimated above. Another one is calculated by referring to equation (10) and the varying parameters estimated under the Kalman filter approach.

The two derived interest series for each country are then fitted into equation (1) and Kalman filter estimations are run to obtain the varying parameters of *g*, the degree of openness. Results are plotted in Graphes 1 to 4. Note that although our sample period starts from 1986, observations for the first few years are used for initializing the one-stage Kalman filter tests, and results of *g* before 1991 are not reported. For the two-stage Kalman filter tests, observations of a few more years are used in initialization, so the values of *g* obtained by applying such tests are reliable only after 1992.

[Figures 1 – 4]

We have the following findings. First, the degrees of openness obtained by both the one-stage and two-stage Kalman filter tests lead to similar results, though the two-stage results generally indicate somewhat higher mobility. This finding indicates that the money demand functions we estimate are largely stable and applying the Kalman filter does not alter the results significantly.

Secondly, the degrees of capital mobility remained stable in the period after 1990 and before the currency crisis in all countries except Malaysia. The degree of mobility in Malaysia also remained largely stable after 1992. The values of the degrees are similar for Indonesia, Korea, and Thailand and are in a range of 0.85 to 0.95, indicating high and similar degrees of openness. The openness for Malaysia, nevertheless, is lower and in a range of 0.75 to 0.80.

Thirdly, it is obvious that the degrees of mobility declined significantly in all countries after the crisis started. The biggest decline happened in Malaysia where the value of g dropped from about 0.78 to about 0.60. Nevertheless, it seems that starting from the second half of 1998, the decrease stabilized.

Overall, it seems that after the financial reforms and liberalization in the Asian countries in the 1980s, high international capital mobility was achieved and the degrees of mobility stabilized at a pretty high level in the 1990s. This finding conforms to that of the earlier studies (by, for example, Reisen and Yeches, 1993 and Min, 1999). Nevertheless, the crisis started in 1997 gave an instant shock to these countries and caused instant declines in their capital mobility. This finding is in contrast to the finding by Min (1999) who finds that the mobility declined

significantly in the cases of Indonesia and Korea, but marginally in the case of Malaysia.

That results indicate that as the crisis passes by, the mobility stabilized in all countries. In Malaysia, this is easy to explain. Starting from 1997, the Malaysian government declared a series of measures, including administrative interventions in the stock and foreign exchange markets, to curb capital outflows. Most of the measures were reversed in late 1998 and the first half of 1999 when the financial markets calmed down. In other countries, we do not observe such obvious measures. The decline in capital mobility could have been caused by the massive pull-out of foreign investors, particularly portfolio investors, and by the stringent restructuring policies introduced in these countries. We would expect that as these economies recover from the crisis and as foreign investment flows again into these countries, their capital mobility will rise from the low levels during the crisis.

Concluding remarks

Based on estimates of the hypothetical interest rate under closed capital account, this article applies the time-varying method to estimate the degree of capital mobility in four emerging Asian economies. The uncovered interest parity (UIP) is assumed to hold under full capital mobility. Under the UIP, the domestic interest rate, after taking into account the exchange rate depreciation and the exchange risk, should be equal to the foreign interest rate. In this study, the exchange risk for the studied countries is proxied by the HK dollar – US dollar interest rate spread, which reflects

the Asian exchange premium during the crisis under the HK dollar link to the US dollar.

We find that after implementing the strong liberalizing measures of capital accounts in the 1980s, all four countries achieved high and stable degrees of mobility before the crisis. The degrees dropped dramatically after the crisis started, but stabilized approaching the second half of 1998. The country that experienced the biggest drop was Malaysia, conforming to its restrictive policies on capital flows.

Asian economies prospered under strong capital inflows before the crisis, and were deeply affected by the crisis. The high level of capital mobility indicates that these economies had very little monetary autonomy in executing macroeconomic control. The lack of prudential control contributed to the overheated economy and the severity of speculative attack. How to balance between high capital mobility and effective monetary control will remain to be a challenge for these economies in recovery.

References

Blundell-Wignall A. and Frank Browne (1991), "Increasing financial market integration, real exchange rates and macroeconomic adjustment," Working Papers, OECD, no. 96.

Dooley, Michael P. and Peter Isard (1980), "Capital controls, political risk, and deviations from interest parity," Journal of Political Economy, 88, pp 370-84.

Edwards, Sebstian (1988), "Financial deregulation and segmented capital markets: the case of Korea," World Development, 16, pp 185-94.

Edwards, Sebstian and Mohsin Khan (1985), "Interest rate determination in developing countries: a conceptual framework," Staff Papers, International Monetary Fund, 32, pp 277-403.

Faruqee, Hamid (1991), "Dynamic capital mobility in pacific basin developing countries: estimation and policy implications," Working Paper, International Monetary Fund.

Fischer, Bernard and Helmut Reisen (1993), Liberalising Capital Flows in Developing Countries: Pitfalls, Prerequisites and Perspectives, OECD.

Frankel, Jeffery (1989), "Quantifying international capital mobility in the 1980s," NBER Working Papers, no. 2856, Cambridge, MA.

Glick, Reuven and Michael Hutchison (1990), "Financial liberalization in the pacific basin: implications for real exchange rate linkages," Journal of Japanese and International Economics, 4, pp 30-48.

Min, Hong G. (1999), "Dynamic capital mobility, capital market risk and exchange rate misalignment: evidence from seven Asian countries," Working Paper, the World Bank.

Reisen, Helmut and Helene Yeches (1993), "Time-varying estimates on the openness of the capital account in Korea and Taiwan," Journal of Development Economics, 41, pp 285-305.

Figure 1. Degree of Capital Mobility in Indonesia

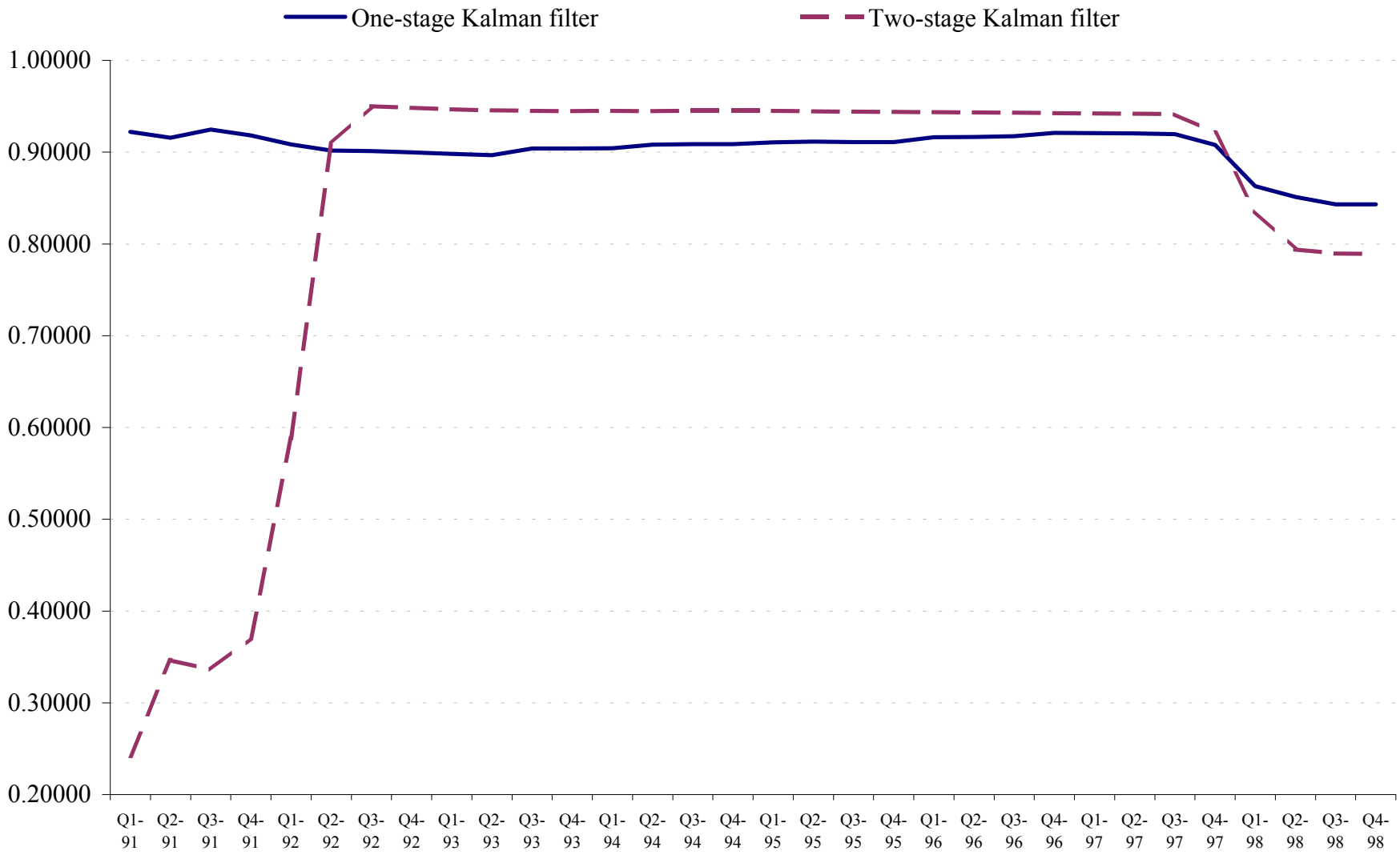

Figure 2. Degree of Capital Mobility in Korea

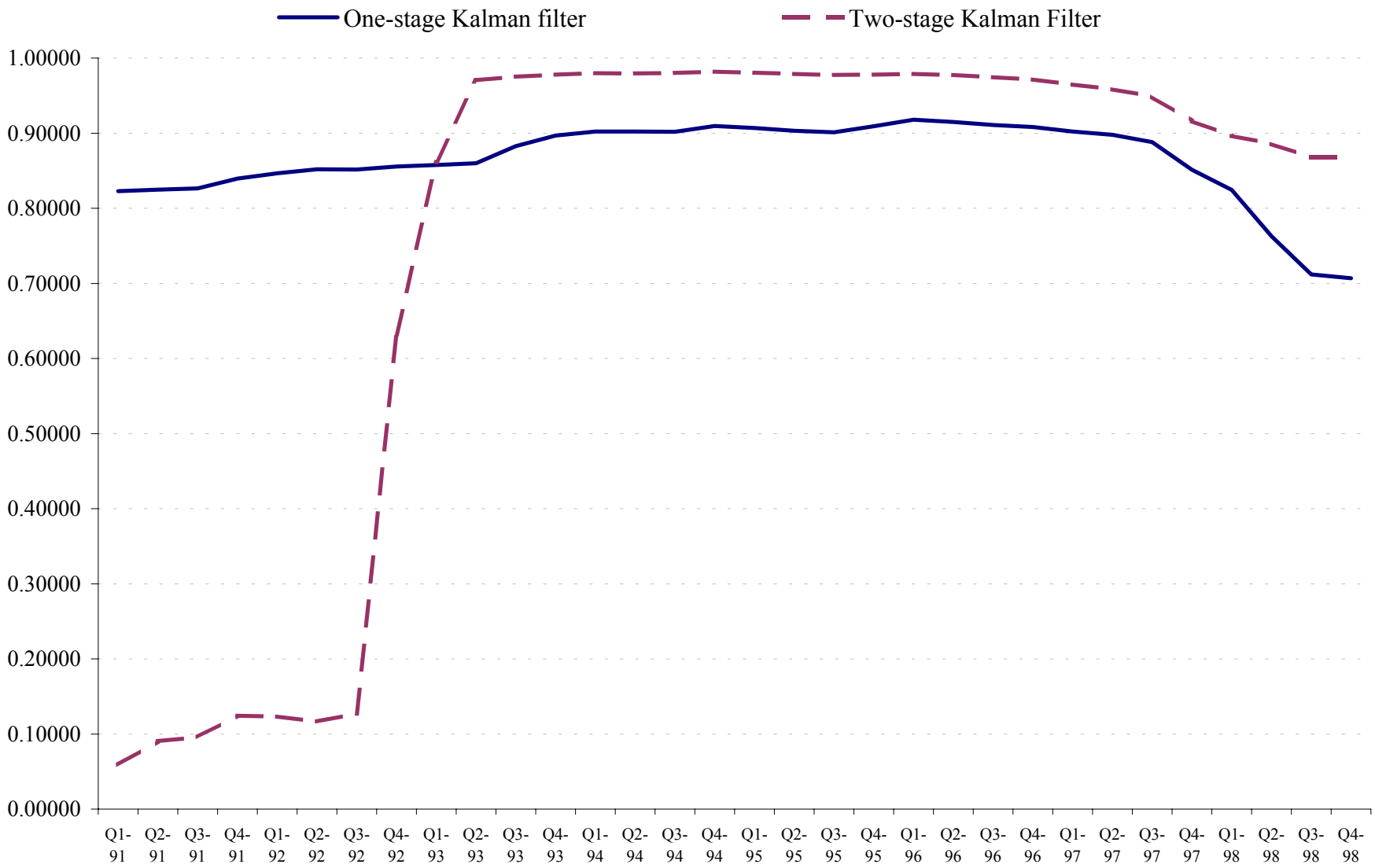

Figure 3. Degree of Capital Mobility in Malaysia

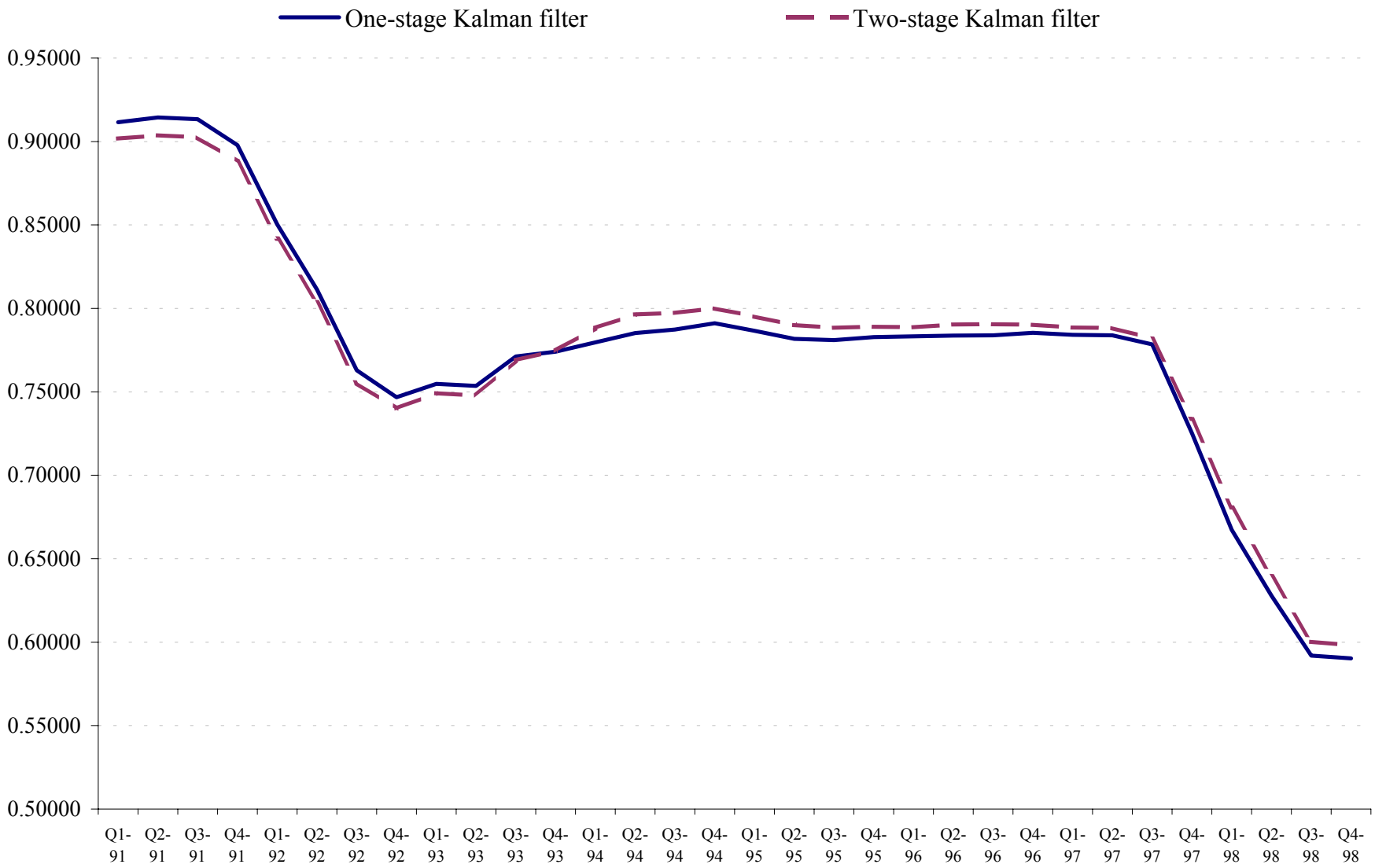

Figure 4. Degree of Capital Mobility in Thailand