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SAVING-INVESTMENT RELATIONSHIP, FINANCIAL CRISIS AND STRUCTURAL CHANGES IN EAST ASIAN COUNTRIES

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ABSTRACT. In this article, the impact of the Asian crisis on the saving-investment relationship of selected East Asian countries with the rest of the world is examined using a Markov switching regression on East Asian countries. As a first result, estimates of the saving retention coefficients show that for most Asian countries, the Asian crisis period marks a shift from high saving retention coefficients during the pre-crisis period to low ones up to the end of the sample period. Low saving retention coefficients are also observed during the 1980s decade. For some countries, these coincide with certain phases of their development. A second result of interest is that periods with relatively low coefficient estimates, implying relatively higher capital mobility, are associated with current account surpluses. This result can be more explained by high and stable domestic saving rates than by low investment rates.

JEL Classification: E2; F21; F36.
Keywords: Saving-investment relationship;
Financial integration; Asian crisis; Markov-switching model.

RÉSUMÉ. Dans cet article, nous examinons l'impact de la crise asiatique sur la relation épargne-investissement des pays asiatiques avec le reste du monde. Pour ce faire, nous appliquons la méthode dite de *Markov-switching* aux principaux pays d'Asie du Sud Est. Le premier résultat de notre étude est le fait que la crise asiatique s'est accompagnée d'une réduction significative de la corrélation entre l'épargne et l'investissement pour la plupart des pays asiatiques. Ces faibles coefficients sont également observés pendant la décennie des années 80, période caractérisée par une phase de développement importante. Notre second résultat est paradoxal : pendant les périodes où les coefficients de rétention sont faibles, *i.e.* où la mobilité du capital est relativement élevée, les soldes du compte courant sont positifs. Ce résultat s'explique principalement par de forts taux d'épargne nationaux plutôt que par de faibles taux d'investissement.

Classification *JEL* : E2 ; F21 ; F36.
Mots-clés : Relation épargne-investissement ;
intégration financière; crise asiatique ; méthode *Markow-switching*.

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Introduction

During the 1980 and 1990 decades, most of the East Asian economies embarked on trade and financial liberalization programs which encouraged foreign capital flows. This was because international investors were attracted by the perceived sound macroeconomic fundamentals (small fiscal deficits, stable exchange rates, high domestic savings rates, and a highly regarded workforce) of these economies. During this period, Japanese investments that were backed up by a strong Yen chose these economies as low cost manufacturing hubs, thus helping stimulate economic activity in these areas. This, together with low world interest rates and the recessions in industrial countries seemed to help make the choice of investing in these economies easier. As a result, short-term capital increased from 49 billion US dollars in 1991 to 133 billion in 1997. The share of FDI inflows relative to other capital flows likewise increased (see Baharumshah and Thanoon, 2006). Table 1 shows how holdings of foreign assets and liabilities in South East Asia have risen between the periods 1990-1997 and 1998-2004. In general, the ratios of FDI assets to GDP for East Asian countries have increased between the two periods. They range between 0.3% and 5.96% for the period 1990-1997 and between 0.17% and 15.39% for the period 1998-2004. For the period under consideration, the ratios went down for Philippines and Thailand but increased for South Korea and Singapore. The FDI liabilities in East Asian countries also increased on the average since the financial crisis, except for Indonesia and Malaysia. For the latter country however, the ratio remains as high as those of Brazil and Mexico in 1998-2004.

The ratios of portfolio investment (*i.e.* equity and debt) assets and liabilities are close to the ratios of FDI assets in the 1990-1997 period. Portfolio investment assets increased enormously in the 1998-2004 period. The ratio of portfolio equity holdings held abroad increased 4-fold for South Korea, 2-fold for the Philippines and 9-fold for Thailand. The ratios of portfolio debt assets also rose: doubling in South Korea and Thailand and increasing by 30% for the Philippines. In Singapore, the ratio of portfolio investment assets doubled. However, the ratio of portfolio investment liabilities decreased in most of East Asian countries except, for South Korea and Singapore.

These results are reinforced by Table 2 which shows the size of the domestic financial sectors in 1996 and in 2004 for these countries. The size of domestic bond markets significantly increased between 1996 and 2004. It increased by 25% in Malaysia, doubled in Hong Kong and Korea, increased 3 times in Singapore, 4 times in Thailand and by more than 5 times in Indonesia. This reflects the concerted efforts, undertaken the ASEAN+3 group (ASEAN countries + China, Japan, South Korea) since December 2002 to develop the regional bond markets (Ghosh, 2006, p. 34-43). The evolution of the size of domestic equity markets is more heterogeneous. Between 1996 and 2004, it increased in Hong Kong (by 85%), in South-Korea (by 130%), in Singapore (by 23%) and in Thailand (by 35%). However, it fell in Indonesia (by 29%), in Malaysia (by 49%) and in the Philippines (by 26%). In 2004, the size of the domestic banking sector is still quite

Table 1 - Holdings of foreign assets and liabilities with the rest of the world (percent of GDP)

	Foreign direct investment (in % of GDP)				Portfolio equity (in % of GDP)				Portfolio debt (in % of GDP)			
	1990-1997		1998-2004		1990-1997		1998-2004		1990-1997		1998-2004	
	A	L	A	L	A	L	A	L	A	L	A	L
Hong Kong	NA	NA	15.39	16.00	NA	16.00	NA	–15.4	NA	–23.5	NA	19.61
Indonesia	NA	1.61	NA	–0.80	NA	0.29 (93-97)	0.04 (2004)	–0.54	NA	0.59	0.18 (2004)	0.34
South Korea	0.57	0.32	0.79	1.23	0.05	0.75	0.20	1.76	0.26	1.42	0.47	0.30
Malaysia	NA	6.30	1.57 (99-04)	3.20	NA	NA	0.01 (02-04)	1.60 (02-04)	NA	NA	0.33 (02-04)	NA
Philippines	0.42 (93-97)	1.61	0.22	1.69	0.03 (96-97)	1.02 (96-97)	0.07	0.36	0.59	1.49	0.76	0.99
Singapore	5.96	11.20	8.11	14.13	8.34*	1.19*	14.3*	2.33*	NA	NA	NA	NA
Thailand	0.30	1.79	0.17	2.97	0.01 (94-96)	0.91	0.09 (02-04)	0.65	0.05 (1997)	0.87	0.11	–0.58
Brazil	0.12	0.80	0.39	3.98	0.02 (95-97)	0.65	0.13	0.37	0.14 (93-97)	1.86	0.04	0.20
France	1.98	1.40	6.02	2.83	0.15	0.62	1.96	1.68	1.73	0.96	6.20	6.11
Germany	1.37	0.25	2.23	2.77	0.86	0.18	2.38	1.13	0.80	2.90	3.53	4.77
Japan	0.66	0.03	0.69	0.17	0.17	0.66	0.50	1.06	1.42	0.73	2.39	0.71
Mexico	NA	2.08	0.42 (01-04)	3.05	NA	1.19	NA	0.05	0.40	1.43	0.13	0.61
UK	2.96	2.04	7.92	4.35	0.65	1.00	2.06	3.94	4.81	2.61	3.21	4.45
US	1.03	0.77	1.72	1.81	0.68	0.16	0.94	0.89	0.59	2.00	0.22	3.30

* Portfolio Investment Assets and Liabilities.

Note: A and L respectively stand for Assets and Liabilities.

Source: IMF, IFS and World Development Indicators 2006.

Table 2 - Financial sector profile

	Size of domestic bond market (in % of GDP)*		Size of domestic equities market (in % of GDP)**		Size of domestic banking sector*** (in % of GDP)	
	1996	2004	1996	2004	1996	2004
Hong Kong	23.76	47.97	286.92	528.51	152.57	146.65
Indonesia	3.52	22.40	39.96	28.45	54.02	50.12
South Korea	42.86	83.64	24.95	57.37	56.90	92.73
Malaysia	72.58	90.18	303.58	153.48	142.42	133.50
Philippines	33.43	29.56	97.12	33.82	67.92	53.82
Singapore	26.78	73.58	166.02	203.71	66.47	75.88
Thailand	10.24	41.13	52.78	71.37	146.36	116.30
Brazil	34.11	528.51	32.97	54.70	45.39	81.01
France	78.72	104.33	70.24	119.28	NA	114.65
Germany	77.02	81.21	27.27	32.37	NA	138.02
Japan	101.70	191.80	75.62	98.92	293.83	305.97
Mexico	7.60	26.15	47.04	25.42	27.08	35.33
United Kingdom	61.01	48.99	138.06	134.87	125.66	156.87
United States	149.63	163.82	108.88	139.38	77.16	94.23

Sources: * World Federation of Exchanges (Domestic market capitalization); For Japan the Osaka SE is excluded in 1996; for the United States, data include AMEX, NASDAQ and NYSE.
** AsianBondsOnline for Asian countries and BIS, *Quarterly Review* (for Dec. 1997, table 15 (Domestic Debt Securities) and for Dec. 2004, table 16A (Domestic debt securities)) for the other countries.
*** International Financial Statistics, IMF (the size of Domestic banking sector is measured by domestic credits).

important in East Asian countries. It represents more than 100% of GDP in Hong Kong, Malaysia and Thailand. Except for South Korea and Singapore, the size slightly decreased between 1996 and 2004 by 4% for Hong Kong and by 20% for the Philippines and Thailand.

This quantitative assessment shows that, with the exception of the Philippines, the size of financial markets and volume of capital flows have increased since the crisis of 1997. This study examines the possible effects of the financial crisis of 1997 on the degree of financial integration of selected East Asian countries with the global economy by looking at saving-investment relationships using the Feldstein-Horioka framework. Here, it is recognized that in the short-term, the crisis had a negative impact on integration as can be seen by the huge capital flight which, as is well known, was a temporary phenomenon. The interest of this paper is the long-run effect and the extent to which the crisis has hindered or hastened the move towards tighter financial integration. This can be examined most conveniently by looking at structural breaks in the process of integration. Unlike recent studies on the saving-investment relationship of East Asian countries which use panel data analysis where no breaks are considered, the study takes advantage of the Markov-switching model's ability to endogenously determine the presence of structural changes in the pattern of relationships being studied. This method also allows for a heterogeneous treatment of the countries because Markov-switching regressions can be done for each country.

This paper proceeds as follows. In the next section, a survey of literature on the saving-investment relationship focusing on Asian country studies is done. The Markov-switching regression methodology and how it is used within the Feldstein-Horioka framework are briefly explained in the next section. In section 4, the data for seven Asian countries – Indonesia, Korea, Hong Kong, Malaysia, Philippines, Singapore and Thailand – and the results of the empirical exercises are shown.[2] The last section concludes.

Empirical analysis of the saving-investment relation

The simplest to state but arguably the most difficult to solve puzzle in international macroeconomics has to do with the relation between investment and saving. In a closed economy, changes in investment must be accompanied by changes in national saving in the same direction to attain macroeconomic equilibrium. One would therefore expect a high positive correlation between these two macroeconomic aggregates. When the economy is open and capital is mobile, foreign saving could be tapped and investment is no longer constrained by domestic saving. Hence, the high correlation should no longer be expected to hold and domestic saving and investment need not travel the same paths as the economy runs current account imbalances to gain from trade opportunities. Empirical evidence for developed economies however runs counter to this notion.

Feldstein and Horioka (1980, hereafter FH) were the first to show strong positive co-movement between saving and investment that contradicts other evidence of capital mobility, notably the small and insignificant differences in interest rates of similar assets in different countries. FH proposed a measure of economic integration based on the idea that "with perfect world capital mobility, there should be no relation between domestic saving and domestic investment: saving in each country responds to the worldwide opportunities for investment while investment in that country is financed by the worldwide pool of capital" (FH, 1980, p. 317). The FH regression that seeks to quantify the degree of integration may be written as follows:

$$\bar{I}_i = \alpha + \beta \bar{S}_i + \varepsilon_i; i = 1, ..., N \quad \text{where} \quad \bar{I}_i = \frac{1}{T}\sum_{t=1}^{T} I_{it} \quad \text{and} \quad \bar{S}_i = \frac{1}{T}\sum_{t=1}^{T} S_{it} \qquad (1)$$

where I_{it} is the domestic investment rate and S_{it} the domestic saving rate of country i at time t.

When the saving retention ratio, β, is equal to 1, it can be interpreted as a sign of non-integration and investment is financed entirely by domestic saving. At the other extreme, when β is equal to 0, perfect economic integration takes place, *i.e.*, capital is perfectly mobile internationally. FH takes the value of the saving retention coefficient between 0 and 1 to reflect the degree of integration.

2. China and India are not included in this study because they were less affected by Asian crisis as compared to countries in East Asia (see Lane and Schmukler, 2006).

FH estimated the above regression using the time-averaged cross-section data of sixteen OECD countries for the period 1960–1974 and find β to be closed to 1, which was contrary to conventional wisdom that capital is mobile across countries.

Since then, a number of articles have been written attempting to explain or to suggest solutions to what has come to be known as the Feldstein-Horioka puzzle – a high correlation between domestic saving and investment in the presence of capital mobility (see for example, Murphy, 1984, Krol, 1996, Baxter and Crucini, 1998; Coakley *et al*. (1998) review the literature).

The more recent interest in the literature has mainly been driven by the availability of new data and the recent developments in econometric methodology. Some of these studies follow the original FH strategy of conducting regressions on averaged country data. Modern methods in panel regression and cointegration analysis have been used to provide better insights into the relation for developed countries (see Coitieux and Olivier, 2000; Corbin, 2001, Jansen, 2000; Ho, 2002).

There have been several studies that cover developing Asian countries during the last three decades. Isaksson (2001) considers seventeen Asian countries from 1975 to 1995. In all cases and using a variety of panel data techniques, the saving retention coefficients Isaksson obtained are unusually large[3], implying weak integration.

Sinha (2002) studies the saving-investment relation for several of the Asian countries[4] over the period 1950 and 1999. His cointegration tests show that only the saving and investment rates of Japan and Thailand are cointegrated. For Malaysia, Singapore, Sri Lanka and Thailand, Granger causality analysis shows that an increase in the saving rate implies a rise in the investment rate. Hence, the degree of integration appears to be weak.

Kim *et al*. (2005) use the "between-group" fully modified OLS (FMOLS) and dynamic OLS (DOLS) panel cointegration techniques[5] and data from 1960 to 1998 for 11 Asian countries. The estimated coefficients are 0.39 and 0.42, using FMOLS and DOLS respectively, for the period 1980–1998. These values are much smaller than the estimates of 0.58 and 0.76 for 1960–1979. The small coefficients suggest that capital mobility increased in Asian countries in the 1980s and in the 1990s. Kim *et al*. (2007) use differenced data on saving and investment for 10 Asian countries[6] between 1980 and 2002. Controlling for the impact of shocks on both saving and investment, they find that, contrary to other studies, the saving retention ratio is weaker for Asian countries than for most OECD countries and seems to have decreased over time. These results are very heterogeneous but it seems that the saving retention coefficient has decreased since the 1980's for most of Asian countries. The estimates of saving retention coefficients from the different studies are summarized in TABLE 3.

3. In his study, he introduces another variable that is the foreign aid. However, this variable does not appear to be significant.
4. The countries are Hong Kong (1961-1999), India (1960-1998), Japan (1955-1998), Malaysia (1955-1999), Myanmar (1961-1998), Pakistan (1960-1999), Philippines (1948-1999), Singapore (1957-1999), South Korea (1953-1998), Sri Lanka (1950-1999) and Thailand (1950-1999).
5. See Pedroni (2000, 2001) and Kao and Chiang (2000) for a detailed discussion of this recently developed method.
6. These are China, Hong Kong, Indonesia, Japan, Korea, Malaysia, Philippines, Singapore, Taiwan and Thailand.

Table 3 - Summary of empirical studies on S–I correlation of Asian countries

Study	Data	Method	Estimation results
Isaksson (2001)	17 Asian countries 1975-1995	Panel:	
		OLS	0.803***
		IV	1.057***
		Fixed effect model (FEM)	0.691***
		Random effect model (REM)	0.766***
		IV- FEM	0.372***
		IV- REM	0.802***
Sinha (2002)	11 Asian countries 1950-1999	Time series Granger causality tests	
		$\Delta \ln SR \rightarrow \Delta \ln IR$	Japan (0.29), Hong-Kong (5.88), India (0.22), Malaysia (10.37***), Myanmar (3.95), Pakistan (2.47), Philippines (1.55), Singapore (11.54***), South Korea (3.55), Sri Lanka (10.33***), Thailand (11.55***)
		$\Delta \ln SR \rightarrow \Delta \ln IR$	Japan (0.26), Hong-Kong (12.48***), India (0.71), Malaysia (4.15***), Myanmar (7.05), Pakistan (1.61), Philippines (0.17), Singapore (29.27***), South Korea (0.90), Sri Lanka (0.69), Thailand (6.08)
Kim *et al.* (2005)	11 Asian countries 1960-1998	Cointegrating Panel with time dummy:	
		GM FMOLS	1960-1998: 0.54***, 60-79: 0.58***, 80-98: 0.39***
		GM DOLS	1960-1998: 0.62***, 60-79: 0.76***, 80-98: 0.42***
		Cointegrating Panel without time dummy:	
		GM FMOLS	1960-1998: 0.69***, 60-79: 0.61***, 80-98: 0.37***
		GM DOLS	1960-1998: 0.84***, 60-79: 0.76***, 80-98: 0.44***
Kim *et al.* (2006)	10 Asian countries 1980-2002	Time series	
		OLS (control)	China (0.82***), Hong-kong (0.66), Indonesia (1.23*), Japan (1.07***), Korea (1.39***), Malaysia (0.82), Philippines (1.01), Singapore (1.15), Taiwan (0.63), Thailand (2.10*)
		GLS (control)	China (0.02), Hong-Kong (0.27***), Indonesia (0.26***), Japan (0.71***), Korea (0.47***), Malaysia (0.11*), Philippines (1.07***), Singapore (0.08), Taiwan (0.39***), Thailand (0.68***)

Note: ***, **, * mean that the null hypothesis is respectively rejected at a 1%, 5% or 10% level.
FMOLS stand for Fully Modified OLS and DOLS for Dynamic OLS. "Control" denotes the case when all shocks up to lag length 2 taken into account by the considered study are controlled.

Methodology

Most of the recent studies reviewed above make use of panel data analysis to take advantage of new econometric methods. However, only a few recognize the presence of structural changes in the pattern of relationships being studied. This study pursues a different empirical strategy. By using the Markov-switching model, the study recognizes the presence of nonlinearities, which can be endogenously determined, that reflect a dynamic relationship between saving and investment. Instead of forming panel data sets where cointegration techniques with multiple heterogeneous endogenous structural breaks are not available yet for the regression we need to implement, each individual country relation with endogenous shifts is analyzed and modeled as Markov-switches.

Markov-switching regressions are used to estimate the saving retention coefficients and determine in which periods it may have shifted. The FH regression specification is adopted in this study. However, instead of running a linear regression using a panel or time-averaged cross-section of country investment ratios against the corresponding saving ratios, time series regressions are done for each country. Here, nonlinearities are accommodated by allowing the slope, intercept and the error variance to vary according to a first-order, two-state Markov process. By this, one is able to determine how and when shifts in the degree of capital mobility occurred.

Equation (1) is modified to permit Markov regime switching in the slope and intercept as follows:

$$I_t = \alpha\left(s_t\right) + \beta\left(s_t\right)S_t + \varepsilon_t \tag{2}$$

The dependent variable, I_t, is the investment to GDP ratio while the independent variable, S_t, is the saving to GDP ratio; $\varepsilon_t \approx N[0, \sigma(s_t)]$ is the error term. β is, as in equation (1), the saving retention coefficient and is the parameter of interest in this study. The binary variable s_t is assumed to represent either a high or low degree (or state) of capital mobility in an economy at date t. In both states, β is expected to lie between 0 and 1. The probability that state i is followed by state j is given by the transition probability: $p_{ij} = \text{Prob}(s_t = j \mid s_{t-1} = i)$, where $\sum_j p_{ij} = 1$. For a two-state model such as this, one can collect these probabilities and write the transition matrix as:

$$\begin{bmatrix} p_{11} & p_{21} \\ p_{12} & p_{22} \end{bmatrix} \tag{3}$$

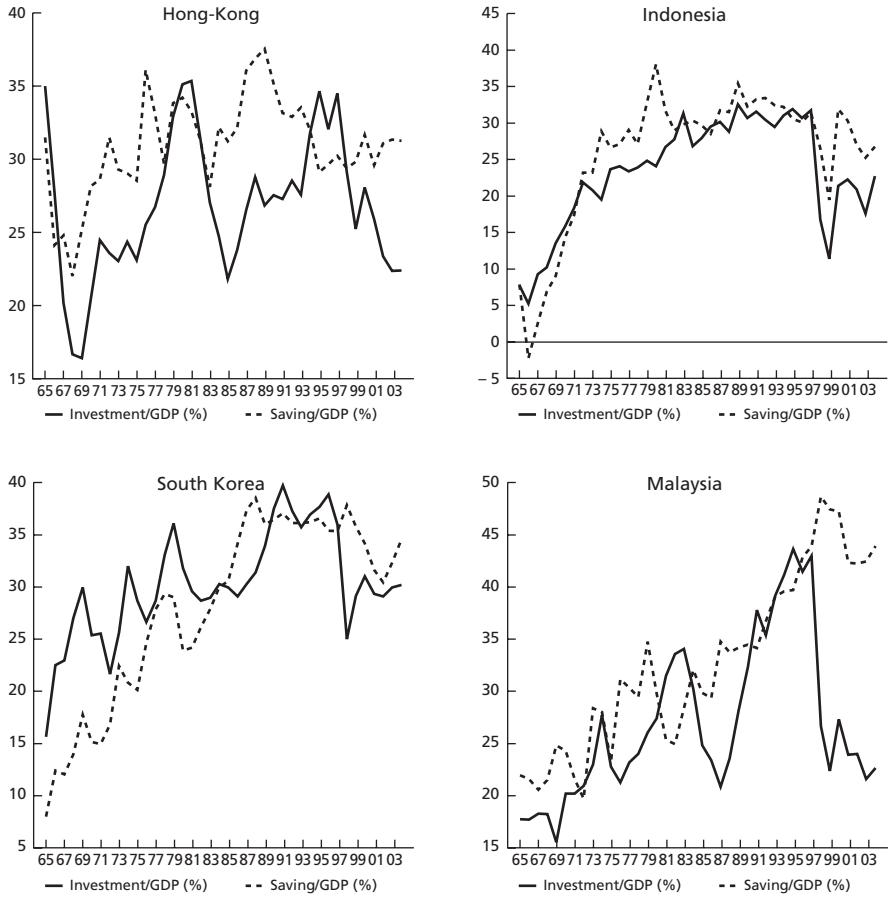
An auxiliary output of Markov regime-switching regressions is a set of time series showing the probability of occurrence of each state for each period given information from the whole sample. This is known as the smoothed probability of a state and is the basis of analysis in the next section. Since the seminal article of Hamilton (1989), a number of algorithms and computer programs have been developed to solve Markov-switching problems similar to

equation (2). In this study, Krolzig's (1997) MSVAR package that runs on the OX programming environment, console version 3.4, is used.[7]

Data and empirical results

All the annual data on the investment and saving ratios from 1965 to 2004 are provided by the 2006 World Bank development data. Seven East Asian countries are considered: Hong Kong, Indonesia, South Korea, Malaysia, Philippines, Singapore and Thailand. Data, shown graphically in Figure 1, indicate that saving-investment relationships are heterogeneous. However, they suggest a fall of investment rate after the 1997 crisis in most Asian countries whereas saving rates remain constant.

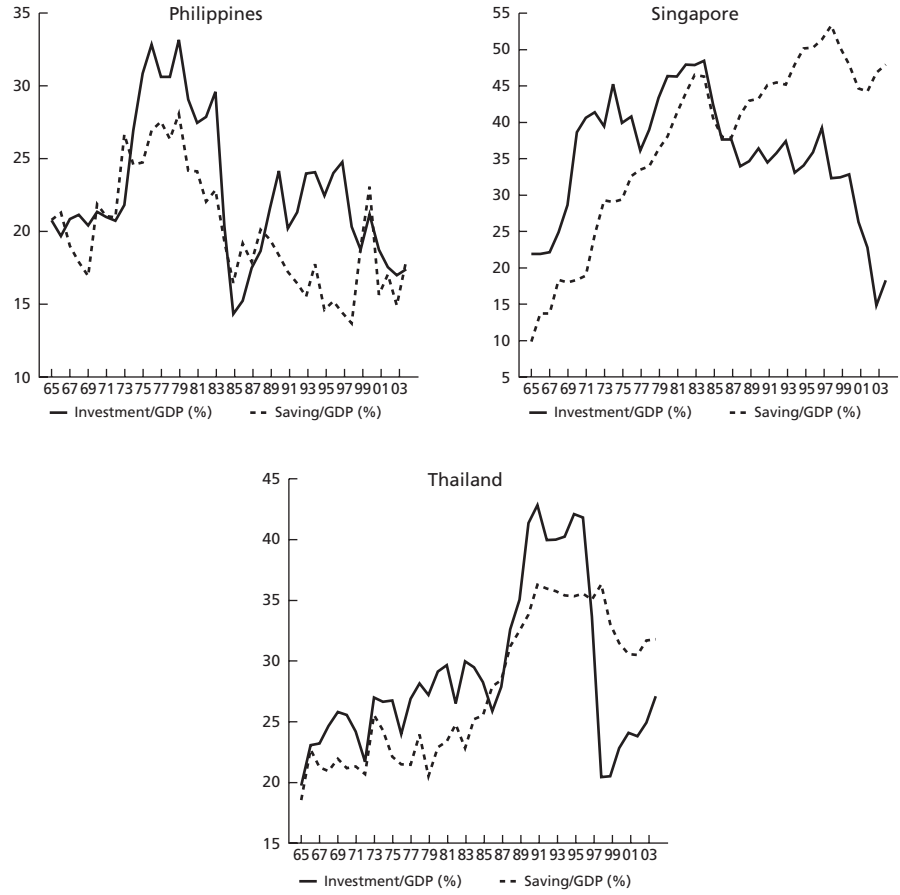
Figure 1 - Saving and Investment, as percent of GDP



Source: World Bank development data.

7. See Appendix 1 for further discussions on the method.

Figure 1 - Saving and Investment, as percent of GDP *(next)*



Source: World Bank development data.

TABLE 4 shows the tests for unit roots using the KPSS (Kwiatkowski *et al.*, 1992) and the DF-GLS (a modified ADF test due to Elliot *et al.*, 1996) tests. The KPSS tests cannot reject the null hypothesis of stationarity at a 10% level. The DF-GLS tests reject the unit root hypothesis in general and are consistent with the KPSS tests.

TABLE 5 shows the coefficient estimates of 2-state Markov-switching regressions for the 7 countries under study. The results seem reasonable for most countries as can be seen from the significant t-values for most of the estimated parameters. However, results associated with Thailand are surprising as the saving retention coefficient is superior to 1 in state 1 and negative in state 2. These results could be interpreted by high shocks in investment as FIGURE 1 suggests it.

State 1 is the state where the saving retention coefficient is low, which implies a higher degree of capital mobility relative to state 2. The average value of the coefficient across countries in state 1 is 0.36 while it is 0.63 for state 2.

The transition probability matrices for the corresponding country estimates, shown in TABLE 6, indicate that shifts are significant for all countries.

Table 4 - Unit root tests (with drift but no time trend)

	Series	KPSS test H0: series is stationary	DF-GLS test H0: series has a unit root
Hong Kong	S	0.31	–2.62**
	I	0.18	–2.58**
Indonesia	S	0.43*	–1.34
	I	0.36*	–1.40
South Korea	S	0.67**	–0.38
	I	0.52**	–1.58
Malaysia	S	0.72**	–0.68
	I	0.37*	–1.55
Philippines	S	0.41*	–2.11**
	I	0.21	–1.68*
Singapore	S	0.68**	–0.32
	I	0.24	–0.99
Thailand	S	0.64**	–0.74
	I	0.27	–1.90*

Note: ***, **, * mean that H0 is respectively rejected at a 1%, 5% or 10% level.

Table 5 - Markov-switching estimates of saving retention coefficients

	Hong Kong		Indonesia		South Korea		Malaysia	
State 1	Coef	*t*-val	Coef	*t*-val	Coef	*t*-val	Coef	*t*-val
Intercept	1.87	0.58	6.32	2.14	29.42	7.12	16.15	8.33
Slope	0.72	7.13	0.54	0.08	0.001	0.01	0.20	3.48
Standard error	1.87		2.62		1.52		2.71	
State 2	Coef	*t*-val	Coef	*t*-val	Coef	*t*-val	Coef	*t*-val
Intercept	9.15	1.32	5.99	1.27	15.07	9.97	14.36	2.63
Slope	0.75	3.32	0.77	0.04	0.61	11.11	0.64	4.34
Standard error	2.06		1.46		2.42		2.80	
	Philippines		Singapore		Thailand			
State 1	Coef	*t*-val	Coef	*t*-val	Coef	*t*-val		
Intercept	10.85	3.12	21.34	5.33	42.13	12.31		
Slope	0.44	2.58	0.23	2.39	–0.58	–4.90		
Standard error	1.77		6.12		1.61			
State 2	Coef	*t*-val	Coef	*t*-val	Coef	*t*-val		
Intercept	11.42	5.73	32.34	10.90	0.19	0.09		
Slope	0.73	8.49	0.30	3.51	1.12	15.48		
Standard error	1.59		2.81		2.10			

Table 6 - Transition matrices

		State 1	State 2
HongKong	state 1	0.920	0.080
	state 2	0.220	0.780
South Korea	state 1	0.890	0.110
	state 2	0.101	0.899
Malaysia	state 1	0.925	0.075
	state 2	0.177	0.823
Philippines	state 1	0.899	0.101
	state 2	0.125	0.875
Singapore	state 1	0.957	0.043
	state 2	0.066	0.934
Thailand	state 1	0.924	0.077
	state 2	0.085	0.915

FIGURE 2 graphs the smoothed probability of being in state 1 (where the saving retention coefficient is low) on the left scale and the current account in million US dollars on the right scale. The shift in state from a high to a low coefficient value in the late 1990s (corresponding to the Asian crisis period) can be observed for crisis countries – Hong Kong, Indonesia, South Korea, Malaysia, the Philippines and Thailand. Hence, it appears that, except for Singapore, the Asian crisis has something to do with the path of financial integration.

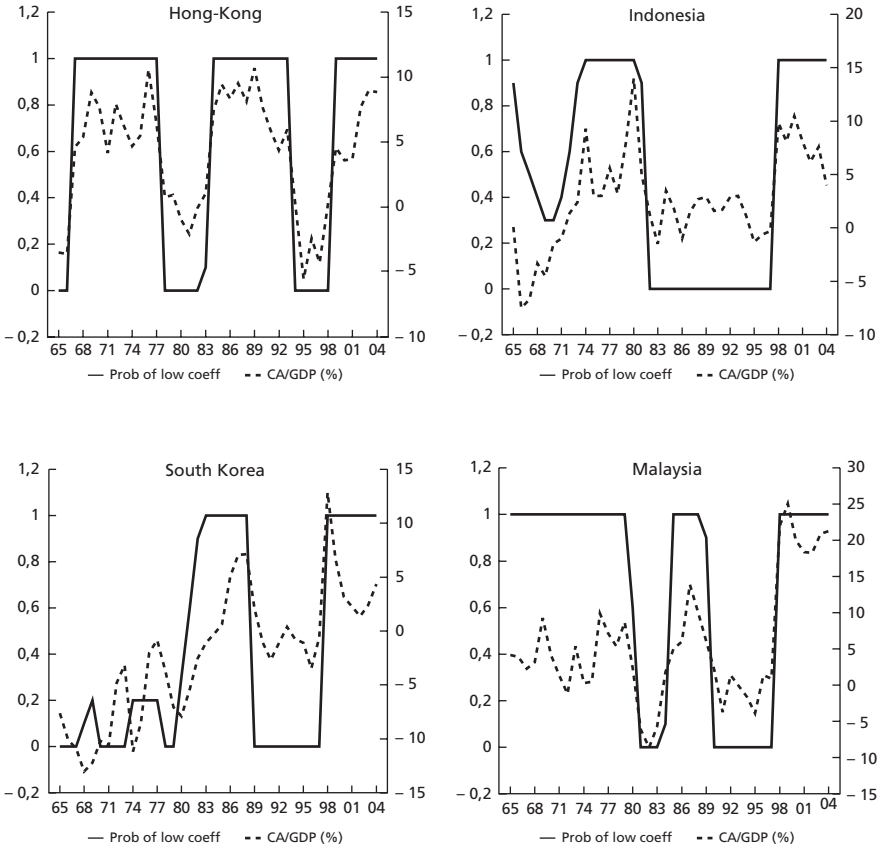
For countries most affected by the Asian crisis, the resulting decline in output and slack in economic activity produced current account surpluses as imports declined considerably.[8] Using the Feldstein-Horioka framework, the econometric estimates imply that for these crisis countries – Hong Kong, Indonesia, South Korea, Malaysia, the Philippines and Thailand – financial integration increased after the Asian crisis. As the data presented in the introduction shows, it was observed that the Asian crisis deepened the financial integration of Asian countries (see also Shiller, 2000 and Plummer *et al.*, 2005). Hence, the Asian crisis provided enough motivation for governments to strengthen their financial system through further reforms that encourage more integration.

Note however that the results also show current account surpluses being accompanied by high probabilities of low saving retention coefficients. This is a surprising finding because the conventional wisdom is for capital to flow in the opposite direction: insufficient domestic saving is augmented by foreign saving to match investment demand, *i.e.*, capital flows

8. All crisis episodes covered by the study were followed by current account surpluses; they are the 1997 Asian crisis and the 1984-86 BOP crisis in the Philippines.

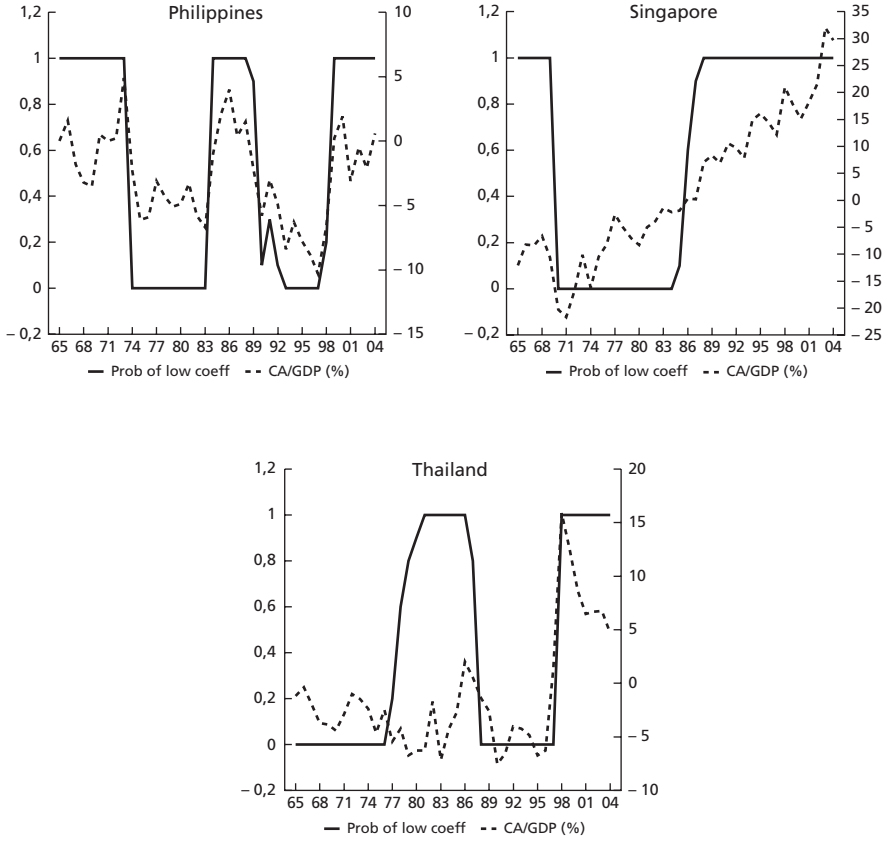
in, and this should be reflected by a current account deficit. Jeffrey Sachs, in a 1981 paper shows a negative relation between investment and the current account balance for 14 developed economies and this result has been taken to mean evidence for high capital mobility. The present study's results can also be contrasted with other studies. One can look at the case of the Euro area although the circumstances are totally different from Asia. Blanchard and Giavazzi (2002), in a study of the Euro area show that for Portugal and Greece who were in the process of catching up with their relatively wealthier neighbors through financial and goods market integration, current account deficits were seen as a reflection of the integration process where declining saving retention coefficients were observed.

Figure 2 - Smoothed probability of low retention coefficient and the current account, in percent of GDP



Source: World Bank development data.

Figure 2 - Smoothed probability of low retention coefficient and the current account, in percent of GDP *(next)*



Source: World Bank development data.

TABLE 7 shows that the crisis of 1997 has little impact on domestic saving rates of East Asian countries; indeed, the average savings rates are not really different for the periods 1990-1997 and 1998-2004. These rates stood at more than 30% for both periods in most East Asian countries. This situation is unlike those of other developing countries as Brazil and Mexico whose savings rates are below 18% before and after 1997. For most industrialised countries, there is a wide variation in domestic saving rates all of which are much lower than those of the Asian countries. Hence, the positive current accounts are mainly explained by the falling domestic investment rates which, as shown in TABLE 7, have significantly decreased since 1997. These rates range between 19% for the Philippines and 29% for South Korea during the period 1998-2004 (which nonetheless rates remain higher than those of other

developing countries and industrialised ones.) Thus the puzzling result of low saving retention coefficients and current account surpluses in South East Asian countries appears to be due to high domestic saving rates and low, decreasing domestic investment rates.

Table 7 - Gross domestic investment and gross domestic saving

	Average of domestic investment rates (in %)		Average of domestic saving rates (in %)	
	1990-1997	1998-2004	1990-1997	1998-2004
Hong Kong	30.50	25.22	31.98	30.60
Indonesia	30.95	19.01	31.97	26.76
South Korea	37.47	29.10	36.17	33.83
Malaysia	39.25	24.07	38.81	44.90
Philippines	23.12	18.71	16.20	17.33
Singapore	35.80	25.69	47.37	47.90
Thailand	40.25	23.38	35.41	32.21
Brazil	16.22	15.24	16.32	15.15
France	23.28	23.48	23.92	24.87
Germany	24.83	21.48	25.04	24.07
Japan	33.50	29.01	34.99	30.47
Mexico	17.89	19.21	16.24	17.30
United Kingdom	18.20	19.55	17.27	17.19
United States	20.40	23.03	19.35	19.29

Source: World Bank development data.

Concluding remarks

In this article, the impact of the Asian crisis on the financial integration of selected East Asian countries with the rest of the world is examined. Financial integration is measured by analyzing the saving-investment relationship using the Feldstein-Horioka framework. The framework however is not without faults. The source of several criticisms of the Feldstein-Horioka result is due to its simplicity in both exposition and empirical testing. Responding to these criticisms, e.g., endogeneity of saving, lack of a general equilibrium framework, lack of theoretical foundations or estimation of an identity, would introduce intricacies which this study avoided. Here, the simplicity of the framework is retained but the econometric implementation is radically changed.

Markov-switching estimates of the saving retention coefficients for selected East Asian economies show that periods with relatively low estimates, implying relatively higher capital mobility, are associated with current account surpluses. With this, one can interpret switches from one state to another as movements of saving and investment to satisfy the intertemporal budget constraint by each individual country. Hence, the results obtained in this study show that the saving-investment association is not at all mysterious. The findings of the

study are consistent with the work of Corbin (2001) who found that the heterogeneity of countries may be more important than common characteristics in finding a significant saving-investment relationship. This can be seen from the study's results where implementation of policies and/or phases of development at different times during the 1980s coincided with shifts in the coefficients.

The puzzling result – low saving retention coefficients that are accompanied by current account surpluses – that runs counter to conventional wisdom was shown to be the result of declining investment rates in the face of high and stable savings rates. At this point, one can only make conjectures to shed more light on this puzzle. For example, the study did not consider the fiscal policy stance of countries which definitely has important implications on saving-investment patterns. It could also be surmised that the Asian crisis implied a decline in Tobin's q and hence, in the capability to invest. At the microeconomic level, many other factors that affect the savings rate may be examined that can potentially help explain the results, like reorganization efforts in post-Asian crisis firms that shifted the input mix toward less capital and more skill and knowledge-intensive type of production in these countries (Lee *et al*., 2004). Or perhaps a shift in the demographic transition toward an older population observed in these countries may explain the fall of investment rates. All these can be explored in more detail and may be fruitful areas for further research.

C. C. B. & S. M.-T.[9]

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Appendix 1
Markov-Switching regression

The original MS model by Hamilton (1989) is an AR model of the form:

$$y_t = \mu_{s_t} + \phi_1\left(y_{t-1} - \mu_{s_{t-1}}\right) + \ldots + \phi_k\left(y_{t-k} - \mu_{s_{t-k}}\right) + \varepsilon_t \tag{1}$$

where y_t is the variable of interest; in this study, this variable is output growth; the $\phi_k s$ are the k autoregression parameters and ε_t is a white noise process. μ_{s_t} is the mean of y_t when the economy is in state s_t. The state of the economy is assumed to be the outcome of an unobserved first-order M-state Markov process (*i.e.*, $s_t = 1,\ldots,M$). Its evolution can be described by transition probabilities, $Pr\left(s_t = j \middle| s_{t-1} = i\right) = p_{ij}$, where $\sum_{j=1}^{M} p_{ij} = 1$. Each element shows the probability that state i is followed by state j. The process is assumed to depend on past values of y_t and s_t only through s_{t-1}. Note that since only y_t is observed but not the state of the economy, a way must be found to form optimal inferences about the current state based on the observed values of y_t. Given the number of states, Hamilton (1989) shows how to estimate the parameters of the model and the transition probabilities governing the motion of the variable of interest. He provides a recursive method for drawing probabilistic inferences about what state the economy is in (the value of s_t) given the history of y_t.

Extensions of the original model have been done by Krolzig (1997, 2000) in a number of articles. One can re-specify the model to include strongly exogenous variable. Hence, the probability of being in a particular state is:

$$p\left(y_t \middle| y_{t-1}, x_{t-1}, s_t\right) = \begin{cases} f\left(y_t \middle| y_{t-1}, x_{t-1}; \Omega_1\right) & \text{if} \quad s_t = 1 \\ \vdots & \\ f\left(y_t \middle| y_{t-1}, x_{t-1}; \Omega_M\right) & \text{if} \quad s_t = M \end{cases} \tag{2}$$

Ω_m is the parameter vector and the xs are the strongly exogenous variables. Krolzig's extension allows for a system of equations to be driven by the Markov process, hence y_t is a vector and the system becomes a Markov-switching VAR. The model in this study is a special case of the MS-VAR and is simply an MS regression model defined as follows:

$$y_t = \begin{cases} x_t\beta_1 + u_t, u_t \middle| s_t \sim NID\left(0, \Sigma_1\right) & \text{if} \quad s_t = 1 \\ \vdots & \\ x_t\beta_M + u_t, u_t \middle| s_t \sim NID\left(0, \Sigma_M\right) & \text{if} \quad s_t = M \end{cases} \tag{3}$$

See Krolzig (1997, 2000) for a fuller discussion of VAR systems with MS processes and the special cases covered by the method. More detailed technical discussions of Markov-regime switching methods can be found in Kim and Nelson (1999). This book discusses MS implementations using state-space techniques that include extensions of Kalman filtering methods.

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