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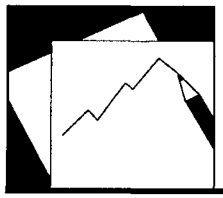

IMF Working Paper

The Output Decline in Asian Crisis Countries: Investment Aspects

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The Output Decline in Asian Crisis Countries: Investment Aspects

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Abstract

This paper examines whether capital outflows may have contributed to output declines during the Asian Crisis by reducing the financing available for domestic investment. Panel data regressions suggest a positive, short-term relationship between net capital inflows and investment during the period before 1997 in five Asian countries once real net capital flows are netted out from real flows of private bank credit. In addition, net real private inflows and real private investment appear to have been cointegrated in at least three of these countries, suggesting a long-term relationship as well.

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I. Introduction

Among the consequences of the crisis affecting many economies in East Asia has been a sharp decrease in aggregate output. The large capital outflows that began in the second half of 1997 caused many economies that had grown rapidly since the 1980s to suffer painful declines in real GDP from late 1997 through early 1999. Indonesia, Korea, Malaysia, the Philippines, and Thailand, each of which had real growth exceeding 5 percent for much of the 1990s, experienced declines in real GDP during 1998 (Table 1). For Korea, Malaysia, and Thailand, the declines ranged from 6.7 to more than 10 percent; for Indonesia, the decline is recorded at 13.1 percent. In the Philippines, the decline was much smaller, on the order of 0.6 percent. Even those Asian economies not experiencing large capital outflows suffered a noticeable weakening in GDP performance, however. In Singapore, for example, real GDP growth fall from 7.5 percent in 1996 to -0.4 percent in 1997, before recovering to 9.3 percent in 1998. In Hong Kong SAR, real GDP growth fell from 5.0 percent in 1997 to -5.3 percent in 1998.

To outside observers, the output decline was arguably the most serious consequence of the Asian Crisis. However, relatively little research has appeared on the subject. In particular, not much has been written about the failure of most forecasters to anticipate the decline, although some researchers have noted that many past currency crises have not led to output declines (P. Gupta and others, 2001). To date, research has focused on the link between currency crisis and financial sector weakness in lowering GDP by reducing investment. This paper also explores the role of capital flow reversals in reducing investment. However, it focuses on a different channel of influence: the role that private capital flows may have played in promoting investment by providing external financing. Net private capital flows are hypothesized to supplement domestic credit as a source of investment financing. Thus, a reversal of net private capital flows could be expected to reduce net private investment and, hence, real GDP. Sections three and four of this paper present econometric evidence on this hypothesis. Before presenting this material, however, section two reviews the various ways in which net capital outflows might have reduced real output. Conclusions are presented in the final section of the paper.

II. Capital Flows and Output Decline in East Asia: Channels of Influence

There seems broad agreement that a fall in investment played a major role in the output decline that occurred during the Asian Crisis, owing to the high weight of investment in GDP in these countries (see, for example, Lane and others, 1999). Research to date has focused on one way that a reversal of capital flows could have reduced investment in these countries: through a weakening of corporate balance sheets and a rise in non-performing loans, as capital outflows led to currency crisis and higher interest rates. Claessens and others (1999), for example, have simulated the effects of plunging exchange rates and rising interest rate spreads on end-1996 balance sheets of some 400 large firms in Indonesia, Malaysia, Korea, the Philippines, and Thailand. According to their simulations, the exchange rate and interest rate movements that occurred during 1997 would have made more than 30 percent of these firms insolvent, with the exchange rate depreciations explaining about two thirds of the impact. Although insolvencies emerged in all five countries, their simulations showed an unusually large proportion of the firms in their sample from Indonesia (75 percent) and Korea (40 percent) becoming insolvent. In addition, more than 60 percent of the firms would have been unable to meet their debt service

obligations, including more than 75 percent of the companies in Indonesia and more than 60 percent of those in Malaysia and Thailand. The exchange rate depreciations and wider interest rate spreads were also predicted to raise non-performing loans to more than 25 percent of bank assets in Indonesia, Korea, and Thailand. In a similar way, Calvo and Reinhart (1999) have shown that a currency crisis accompanied by a sudden stop or reversal of external capital flows can trigger output loss through a rise in non-performing loans, when loans for investment projects have a shorter maturity than the projects themselves. Kim and Stone (1999) have developed a model and provided data suggesting that highly leveraged firms in East Asia halted investment as a way of avoiding bankruptcy following a cutoff of foreign capital inflows. In addition, Stone and Weeks (2001) find links between balance sheet difficulties and financial crises. Finally, Gupta, Mishra, and Sahay (2001), in reviewing the effects of some 278 currency crises on output in 125 countries, have found that output contractions are typically larger the higher the amount of private capital a country receives and the weaker are its restrictions on current and capital account transactions, among other factors.

Table 1. Percent Change in Real GDP, Selected Asian Economies, 1990–98

	1990	1991	1992	1993	1994	1995	1996	1997	1998
Indonesia	7.2	7.0	6.5	6.5	7.5	8.2	7.8	4.7	-13.1
Korea	9.0	9.2	5.4	5.5	8.3	8.9	6.8	5.0	-6.7
Malaysia	9.0	9.5	8.9	9.9	9.2	9.8	10.0	7.3	-7.4
Philippines	3.0	-0.6	0.3	2.1	4.4	4.7	5.8	5.2	-0.6
Thailand	11.2	8.6	8.1	8.7	8.6	8.8	5.5	-0.4	-10.2
China	3.8	9.2	14.2	13.5	12.7	10.5	9.6	8.8	7.8
Hong Kong SAR	3.4	5.1	6.3	6.1	5.4	3.9	4.5	5.0	-5.3
Singapore	9.0	7.1	6.5	12.7	11.4	8.0	7.5	-0.4	9.3

Sources: IMF, *International Financial Statistics Yearbook, 2001.*

However, the "balance sheet" channel is not the only way in which a capital outflow may have triggered an output decline. Output may also have fallen, for example, because the reversal of capital outflows reduced the funding for private investment and contributed to higher interest rates, thus reducing investment and triggering an output decline.

It was widely argued, for example, that net capital inflows had played an important part in financing private investment in all of the Asian crisis countries, particularly during the 1990s. Although savings rates in most of these countries were relatively high—recent data indicate that, during 1990–96, private saving averaged 22 percent of GDP in Thailand and 26 percent of GDP in Korea, for example (Table 2)—domestic investment was even greater. During this period investment averaged 32 percent of GDP in Indonesia, 37 percent in Korea, 38 percent in Malaysia, and 41 percent in Thailand. Even with fiscal surpluses in most of these countries, domestic savings failed to cover these large levels of investment. Thus, large capital inflows had to play an important role in financing private investment.

During much of the period from the early 1980s through 1995–96, real net private capital flows and real private investment (private investment divided by the GDP deflator) were closely correlated in four of the five countries – Indonesia, Malaysia, the Philippines, and Thailand – and moderately correlated in Korea (Table 3). Real private investment was also closely correlated with real *gross* capital flows, and in Korea and Thailand even more so than with net capital flows (in Korea, this may reflect the repayment of considerable external debt toward the end of the 1980s, when growth and investment were also high). During 1992–96 net private capital inflows to the five countries were especially large relative to GDP, ranging from an average of 3.2 percent of GDP in Korea to 10.5 percent of GDP in Malaysia. In addition, short-term flows represented more than 45 percent of total private capital flows in four of the five Asian crisis countries (Table 4). To the extent that short-term as well as longer-term flows provided investment financing in these countries (as compared with China, where foreign direct investment has represented the bulk of all net capital inflows in recent years), the high share of short-term capital inflows might have suggested a strong likelihood that investment would decline significantly if net private capital flows turned negative. Such a decline, in turn, could have been expected to have a downward impact on real GDP, given the high weight of investment in GDP in most of the countries.

Output may also have declined because the sharp reversals in net capital outflows inevitably forced a large turnaround in the current account balances of these countries. Published data indicate that, for Korea, Malaysia, and Thailand, all of which recorded current account deficits of at least 4.4 percent of GDP in 1996, the current account balance registered an improvement of more than 15 percent of GDP between then and 1998 (Table 5). Unlike in Mexico during 1996, however, virtually all of the improvement in these countries reflected a sharp compression of imports. As noted in Table 6, between 1996 and 1998 imports fell by more than 25 percent in Indonesia, Korea, Malaysia, and Thailand. Exports, by contrast, rose by only 2 percent in Korea during this period, and fell by some 2 percent in Indonesia and Thailand and by over 6 percent in Malaysia. The failure for exports to rise, despite large exchange rate depreciations, no doubt reflected the heavily intra-regional nature of Asian trade, including the key role of Japan as a major importer for all of these countries. With the Japanese economy itself in recession and capital outflows triggering a fall in domestic demand in a number of Asian countries, export volumes in the Asian crisis countries were unlikely to show much increase, even with sharp exchange rate depreciations. Compounding this effect was a decline in world prices of many of the goods exported by these countries. In Korea, for example, export unit values fell by some 30 percent between 1996 and 1998, offsetting most of its gains in export volumes. In Indonesia and Thailand, export unit values declined by 26 percent and 16 percent, respectively. With imports reduced so sharply and important segments of national industry dependent on imports as intermediate production goods, a significant fall in production was inevitable, even with considerable substitution of local products for imported goods.

Table 2. Private Saving and Investment in Selected Asian Countries, Average, 1990–96

	Private Saving (In percent of GDP)	Investment
Indonesia	...	32
Korea	26	37
Malaysia	...	38
Philippines	16	23
Thailand	22	41

Source: IMF, *World Economic Outlook,* October 1998.

Table 3. Correlations between Gross Real Private Investment and Real Private Capital Flows in Selected Asian Countries

	Correlation with: Net Capital Flow	Gross Capital Flow
Indonesia	0.794	0.283
Korea	0.439	0.855
Malaysia	0.709	0.570
Philippines	0.815	0.710
Thailand	0.886	0.948

Source: Computations based on author's data set.

Table 4. Average Net Private Capital Flows To Selected Asian Countries, 1992–96

(In percent of GDP)

	All flows	Short-term Liabilities	Short-term liabilities as percent of total
Indonesia	4.8	2.4	50.0%
Korea	3.2	2.7	84.4%
Malaysia	10.5	3.5	33.3%
Philippines	4.8	2.3	47.9%
Thailand	8.8	4.7	53.4%

Source: IMF, *World Economic Outlook,* October 1998.

Table 5. Current Account Balances for Selected Asian Countries, 1996–98

(In percent of GDP)

	1996	1997	1998	Rise to 1998 from: 1996	1997
Indonesia	-3.4	-2.3	3.3	6.7	5.6
Korea	-4.4	-1.7	12.8	17.2	14.5
Malaysia 1/	-4.6	-4.8	12.9	17.5	17.7
Philippines	-4.8	-5.3	2.4	7.2	7.7
Thailand	-8.1	-2.0	11.5	19.6	13.5

1/ Data for 1998 are estimates.

Sources: IMF, *World Economic Outlook,* October 1999*;* and calculations based on *International Financial Statistics Yearbook, 1999 and 2000.*

Table 6. Changes in Exports and Imports in Selected Asian Countries, 1996–98

(In billions of U.S. dollars)

	Exports			Imports, c.i.f.		
	1996	1998	Percent Change	1996	1998	Percent Change
Indonesia	49.814	48.847	-1.9%	42.929	27.337	-36.3%
Korea	129.715	132.313	2.0%	150.339	93.282	-38.0%
Malaysia	78.327	73.304	-6.4%	78.418	58.319	-25.6%
Philippines	20.408	29.414	44.1%	34.126	31.496	-7.7%
Thailand	55.721	54.456	-2.3%	72.332	42.971	-40.6%

Source: IMF, *International Financial Statistics*, December 2000.

Finally, output may also have declined because the drop in imports and fall in investment demand triggered a decline in personal incomes that further reduced domestic demand. In many countries massive layoffs followed the start of the crisis, raising unemployment rates to unprecedented levels. In Korea, for example, the unemployment rate was estimated to have risen from 2.6 percent in 1997 to 6.8 percent in 1998 and 6.3 percent in 1999 (International Monetary Fund, 2001b). In Indonesia and Thailand, where unemployment rates are not readily available, the number of unemployed persons was estimated to have more than doubled from 1996 to 1998 (Gupta and others, 1998). Poverty rates also rose. In Korea, new middle-class households were particularly affected, while in Indonesia the decline especially hurt poor households in rural areas. Rising joblessness and poverty sharply reduced personal consumption spending, thereby compounding the initial effects of falling investment.

This paper focuses on the link between capital outflows with output declines resulting from real net private capital flows as a source of financing for private investment. As noted earlier, net private capital flows, both through direct borrowing by firms from abroad and through on-lending by domestic banks, provided critical financing for private investment. Thus, a disruption of this financing could have been expected to curtail private investment and reduce GDP, since private investment represented a substantial fraction of GDP in these countries. Section III of the paper examines this hypothesis for the period leading up to the Asian Crisis, using ordinary least squares (OLS) regressions with pooled cross-section, time-series data for all five countries. These regressions provide some support for the view that net private capital inflows tended generally to raise real private investment in these countries, suggesting that private investment was vulnerable to a decline in capital inflows. Section IV of the paper examines this hypothesis using cointegration analysis, to see whether longer-term relationships between real net private capital flows and real private investment can be identified. A final section presents the main conclusions of the paper.

III. Capital Inflows and Investment Levels: Panel Regressions for Nominal and Real Private Investment

To examine the relationship between net private capital inflows and private investment in the five Asian crisis countries, OLS regressions were performed using panel data with observations on nominal and real private investment and other variables for each country over the period 1983–96. For each equation a variable related to the level of private investment was regressed on a variable reflecting the level of net private capital flows and on certain other explanatory variables that could also be expected to affect investment levels in the country.[2] Because most of the raw data series contained unit roots in level but not in first differences, the basic approach was to estimate equations in first differences, with separate equations for the first difference in nominal private investment (DIP) and real private investment (DIPR), the latter defined as the first difference of the ratio of nominal private investment to the GDP deflator:

[2] This specification of private investment was chosen because regressions using the ratio of private investment to GDP yielded much poorer results, whether private capital flows were entered as nominal variables or as a percent of GDP. The GDP deflator was used to deflate investment, because deflators for private sector investment were not readily available.

$$DIP = a_0 + a_1 DPNCF + a_2 DCPSFL + \sum_i (b_i X_i),\ i = 1, ..., n;\ \text{and} \quad (1a)$$

$$DIPR = a_0 + a_1 DPNCFR + a_2 DCPSFLR + \sum_i (b_i X_i),\ i = 1, ..., n \quad (1b)$$

where DPNCF represents the first difference of net private capital flows, as shown in the country's balance of payments; DCPSFL is the first difference of the flow of bank credit to the private sector; X represents a vector of other explanatory variables related to private investment; and the suffix R on a variable denotes the first difference of the real value of that variable, defined as the nominal variable divided by the GDP deflator. Separate equations for the first difference of nominal private investment (DIP) and real private investment (DIPR) were estimated because initial regressions for the latter showed a significant relationship with first differences in nominal, but not real, net private capital flows.

The variables in the vector X were largely chosen from a set of variables found in past research to affect the rate of private investment in developing countries generally (see Greene and Villanueva, 1991). These variables included the inflation rate, as measured by the percent change in the average value of the consumer price index for the year (CPI); the growth rate of real GDP (GR); the real interest rate (RI), defined using the GDP deflator as the measure of inflation, to avoid collinearity with the CPI inflation rate; and the ratio of public investment expenditure to GDP (IPUBGDP) or the level of public investment expenditure (IPUB), the latter entered using its real value (IPUBR) in the DIPR equations. Regressions also tested the ratio of external debt service payments to exports of goods and services (DSXGS), a measure of current debt service burdens.[3] Moreover, the percent change in a country's real bilateral exchange rate vis-à-vis the U.S. dollar (RER) was included, since an appreciation in this rate, signaling a decline in competitiveness, could reduce the attractiveness of investment in the country. To allow comparability across countries, data in local currencies were rescaled so that data magnitudes were similar for all countries. In addition, all real variables were deflated using the GDP deflator.

To enable regressions to reflect "fixed effects," *i.e.*, the equivalent of a separate constant for each country, a country's observations for each variable were entered as the difference from its mean value for that country. Moreover, to eliminate unit roots several of the explanatory variables – GR, IPUBGDP, IPUB, RI, and RER – were entered as first differences, rather than in level form.

The following equations show the expected signs for each of the explanatory variables:

$$DIP = f(\underset{+}{DPNCF}, \underset{+}{DCPSFL}, \underset{-}{CPI}, \underset{+}{DGR}, \underset{-}{DRI}, \underset{?}{DIPUBGDP \text{ or } DIPUB}, \underset{?}{DSXGS}, \underset{-}{DRER}, \underset{-}{}) \quad (2a)$$

$$DIPR = f(\underset{+}{DPNCFR}, \underset{+}{DCPSFLR}, \underset{-}{CPI}, \underset{+}{DGR}, \underset{-}{DRI}, \underset{?}{DIPUBGDP \text{ or } DIPUBR}, \underset{?}{DSXGS}, \underset{-}{DRER}, \underset{-}{}) \quad (2b)$$

[3] The ratio of debt to GDP was excluded as having a unit root in both level and first difference form.

The rationales for the expected signs are as follows:

DPNCF(R) (+): higher real net private capital flows should be positively related to real private investment, because they increase available financing;

DCPSFL(R) (+): a higher flow of private sector credit from the banking system also means more financing for private investment and thus should be positively related to it, whether measured in nominal or in real terms;

CPI (-): investment should be lower at higher inflation rates, because higher inflation increases the uncertainty of returns from investment;

DGR (+): faster growth should correspond with higher investment, either because higher growth rates make investment more attractive (under adaptive expectations), or because investment is seen as promoting growth (reverse causality);

DRI (-): above some minimum positive real level, higher real interest rates should reduce investment, because they indicate a higher cost of capital;

DIPUBGDP (?): the ratio of public investment to GDP can have either a positive or negative effect on real private investment, depending on its productivity. Some studies (*e.g.*, Aschauer, 1989) have shown that certain types of public investment have had a positive effect on private investment in industrial countries such as the United States, because of the complementarity of public spending for infrastructure with private investment. However, other studies (*e.g.*, Khan and Kumar, 1993) have found negative relationships between public and private investment in developing countries, arguably because much of that investment has been unproductive and not supportive of private sector activity.

DIPUB(R) (?): The same arguments for DIPUBGDP apply to this variable.

DSXGS (-): higher debt service burdens reduce funds available for investment spending;

DRER (-): an appreciation in the real exchange rate might reduce net capital inflows, because the appreciation reduces the country's competitiveness.

To reduce the risk of simultaneous equations problems involving private investment and bank credit to the private sector, the equations were estimated using only lagged values of the latter variable. However, both current and once lagged values for net private capital flows were used, on the theory that causality was more likely to run from private capital flows to private investment than the reverse (although in the IS-LM model higher investment would raise interest

rates and thus stimulate capital inflows).[4] In addition, the equations for DIP were tested for heteroskedasticity using the White test, since the logarithmic transformations of the key variables had unit roots, in part reflecting the need to eliminate observations with negative net private capital flows from the data set. The results of the regressions for DIP appear in Table 7. Those for DIPR are in Table 8. Both tables show that the lagged value of the dependent variable and the first difference of real growth have positive and generally significant coefficients, while variables representing public investment have negative and significant coefficients. The variables representing consumer price inflation (DCPI), the debt service ratio (DDSXGS), and the real exchange rate (DRER) have insignificant coefficients.

The equations in Table 7 show the change in nominal net private capital flows (DPNCF), current and lagged one period, having a positive effect on the change in nominal private investment in the five countries over the sample period, although the estimated coefficients are significant in only certain specifications. Where DIPUBGDP appears in the equation, coefficients on DPNCF are significant at the 10 percent level once the nonsignificant variables (DRI, DDSXGS, and DRER) are removed (equations 3 and 4). However, the coefficient is significant at the 5 percent level only when the lag of DPNCF and the variable representing the lag of the flow of bank credit to the private sector (DCPSFL(-1)) are also removed (equation 5). There appears to be some collinearity between DPNCF and DCPSFL (-1), because the latter variable is significant when the former disappears from the equation (equation 6) and vice-versa (equation 5). When DIPUB replaces DIPUBGDP, the coefficient of DPNCF is again significant at the 5 percent level only when its lag, the generally insignificant variables (DRI, DDSXGS, and DRER), and DCPSFL(-1) are removed from the equation (equation 11). As before, there appears to be collinearity between DPNCF and DCPSFL(-1), because the latter variable becomes significant when the former disappears from the equation (equation 12) and vice-versa (equation 11).

Overall, these equations explain only a modest amount of the variance in DIP, with R^2 statistics of about 0.61-0.65. However, the risk of heteroskedasticity can be discounted, since the White test statistic is rejected throughout at the 5 percent level. Thus, the equations in nominal private investment provide some support for a significant relationship between net private capital flows and private investment in these countries during the period leading up to the Asian crisis. Where coefficients for DPNCF are significant, they are close to 0.30. This would suggest that a one unit increase in net private capital flows was, on average, associated with a rise in private investment of about 30 percent that amount in the five countries.

The equations in Table 8, which relate the change in real private investment (DIPR) to the change in real net private capital flows (DPNCFR), provide much less support for the hypothesis.

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[4] However, rudimentary Granger causality tests on the panel data, relating each of the variables to its first two lags and the lag of the other, suggested causality from the first difference of private investment to private net capital flows, but not the reverse.

Table 7. Results from Panel Regressions for DIP 1/ 2/
Time period for estimation is 1983–96, except for equations (1) and (7), where it is 1987–96

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
DIP(-1)	0.4732**	0.6087**	0.6153**	0.6749**	0.6775**	0.7326**	0.5658*	0.7286**	0.7331**	0.7717**	0.7660**	0.8199**
	(3.19)	(5.09)	(5.25)	(6.66)	(6.68)	(7.58)	(3.99)	(5.92)	(6.04)	(7.41)	(7.28)	(8.40)
DIPUBGDP	-1.9640**	-1.2897**	-1.2705**	-1.2560**	-1.2065*	-1.2562*						
	(-2.93)	(-2.71)	(-2.72)	(-2.69)	(-2.59)	(-2.65)						
DIPUB							-0.9424**	-0.7527**	-0.7258**	-0.7387**	-0.6778**	-0.7743**
							(-3.80)	(-3.46)	(-3.39)	(-4.49)	(-3.22)	(-3.67)
DPNCF	0.2530	0.2375	0.2625#	0.2382#	0.3180*		0.2173	0.1653	0.1914	0.1756	0.2851*	
	(1.47)	(1.57)	(1.84)	(1.69)	(2.61)		(1.33)	(1.12)	(1.37)	(1.28)	(2.41)	
DPNCF(-1)	0.1297	0.1412	0.1397				0.0640	0.0826	0.0844			
	(0.83)	(1.00)	(1.01)				(0.43)	(0.60)	(0.63)			
DCPSFL(-1)	0.0409	0.0737	0.0724	0.0626		0.1104*	0.0546	0.0902	0.0892	0.0840		0.1204*
	(0.64)	(1.26)	(1.28)	(1.12)		(2.26)	(0.91)	(1.59)	(1.61)	(1.54)		(2.56)
CPI	0.5648	0.0478					0.5410	0.0756				
	(1.56)	(0.40)					(1.60)	(0.66)				
DRI	0.1696						0.0832					
	(0.96)						(0.52)					
DGR	1.0575*	0.3815#	0.3565#	0.3703*	0.3780*	0.3833*	1.0439*	0.4309*	0.3802*	0.3877*	0.3978*	0.3957*
	(2.54)	(1.76)	(1.96)	(2.04)	(2.08)	(2.08)	(2.69)	(2.07)	(2.16)	(2.22)	(2.25)	(2.25)
DDSXGS	0.0626	-0.0733					0.1550	-0.0683				
	(0.32)	(-0.55)					(0.83)	(-0.53)				
DRER	-0.0080	0.0138					0.0016					
	(-0.23)	(0.49)					(0.05)					
R^2	0.6723	0.6454	0.6388	0.6325	0.6249	0.6150	0.7109	0.6697	0.6599	0.6576	0.6442	0.6483
F	7.98	12.74	20.87	25.82	33.87	32.48	9.56	14.19	22.90	28.81	36.81	37.48
D.W.	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
S.E.E.	6.74	6.66	6.66	6.66	6.66	6.66	6.74	6.66	6.66	6.66	6.66	6.66
No. of obs.	50	70	70	70	70	70	50	70	70	70	70	70

1/ For definitions of explanatory variables, see text. Figures in parentheses are t-statistics.
2/ Dependent variable is first difference of gross private investment (DIP).

* Significant at the 5 percent level.
# Significant at the 10 percent level.

Table 8. Results from Panel Regressions for DIPR 1/ 2/
Time period for estimation is 1983–96, except for equations 1 and 6 (1987–96)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
DIPR(-1)	0.3476*	0.4626**	0.4622**	0.5083**	0.5521**	0.3783**	0.5281**	0.5289**	0.5462**	0.5817**
	(2.35)	(3.80)	(3.88)	(4.62)	(5.16)	(2.82)	(4.59)	(4.67)	(5.33)	(5.90)
DIPUBGDP	--1.4333*	-1.1820**	-1.1534**	-1.1359**	-1.1014**					
	(-2.59)	(3.08)	(-3.05)	(-3.01)	(-2.89)					
DIPUBR						-0.8575**	-0.7870**	-0.7741**	-0.7820**	-0.7908**
						(-4.00)	(-4.43)	(-4.42)	(-4.54)	(-4.57)
DPNCFR	0.1507	0.1696	0.1983	0.1723		0.1012	0.1086	0.1396	0.1305	
	(0.94)	(1.32)	(1.67)	(1.49)		(0.70)	(0.91)	(1.26)	(1.22)	
DPNCFR(-1)	0.1581	0.1175	0.1201			0.0631	0.0368	0.0420		
	(1.08)	(0.95)	(1.00)			(0.46)	(0.32)	(0.37)		
DCPSFLR(-1)	0.0821	0.1107*	0.1071*	0.1005#	0.1198*	0.0853	0.1113*	0.1081*	0.1061*	0.1213**
	(1.39)	(2.14)	(2.10)	(1.99)	(2.43)	(1.60)	(2.31)	(2.28)	(2.27)	(2.68)
CPI	0.2788	-0.0718				0.2991	-0.0525			
	(0.94)	(-0.76)				(1.11)	(-0.60)			
DRI	0.1570					0.1193				
	(1.07)					(0.93)				
DGR	0.8352*	0.2690	0.3292*	0.3333*	0.3397*	0.8161*	0.3178#	0.3591*	0.3601*	0.3636*
	(2.40)	(1.52)	(2.22)	(2.24)	(2.27)	(2.61)	(1.94)	(2.60)	(2.63)	(2.65)
DDSXGS	-0.0342	-0.0538				0.0217	-0.0520			
	(-0.20)	(-0.48)				(0.14)	(-0.50)			
DRER	-0.0072	0.0170				-0.0002	0.0203			
	(-0.25)	(0.76)				(-0.01)	(0.97)			
R^2	0.6009	0.5709	0.5604	0.5530	0.5365	0.6733	0.6286	0.6178	0.6169	0.6075
F	5.85	9.31	15.05	18.56	23.54	8.01	11.85	19.08	24.16	31.47
D.W.	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
S.E.E.	5.04	4.85	4.85	4.85	4.85	5.04	4.85	4.85	4.85	4.85
No. of obs.	50	70	70	70	70	50	70	70	70	70

1/ For definitions of explanatory variables, see text. Figures in parentheses are t-statistics.
2/ Dependent variable is first difference of real gross private investment (DIPR),
the first difference of gross private investment divided by the GDP deflator.

* Significant at the 5 percent level.
# Significant at the 10 percent level.

Although the regressions generally show positive coefficients for the current and lagged values of DPNCFR, the coefficients are not significant, particularly when DIPUBR, rather than DIPUBGDP, appears in the specification. The only specification in which a coefficient for DPNCF approaches significance is equation (3), where the t-statistic falls just short of significance at the 10 percent level. However, the coefficients on the lagged value of the change in real bank credit to the private sector, DCPSFLR(-1), are positive and generally significant at the 5 percent level, suggesting an important role for real bank credit flows in supporting real private investment. Overall, the equations for DIPR have a somewhat poorer fit than do the equations for DIP. When DIPUBR appears in the equation for DIPR, the R^2 statistics are only about 0.61–0.67. When DIPUBGDP appears instead, the R^2 statistics are about 0.54–0.60.

The results from these regressions suggest that, during the period leading up to the Asian crisis, there may well have been a relationship between net private capital flows and private investment in the five Asian countries. However, the evidence is hardly robust, because a significant relationship exists only between nominal variables, and then only when variables reflecting the flow of bank credit to the private sector are removed from the equations. In this case, a one unit rise (fall) in net private capital flows is associated, on average, with a rise (fall) in private investment of about 0.30 unit. There is also a question about the direction of the relationship, since it is hard to test for causality using panel data. Thus, the results from the panel regressions can only be considered suggestive of a link between net private capital flows and private investment in the five countries surveyed.

One could ask whether the failure to find a significant relationship between the change in real private investment and the change in real private net capital flows could be traced to mutilcollinearity between the latter variable and bank credit to the private sector. Banks were heavily involved in intermediating credit to domestic customers in at least one of the countries (Thailand), borrowing from abroad and then on-lending funds to domestic clients to finance investment projects. In this case, one would expect domestic bank credit to the private sector and net private capital flows to be closely correlated. However, as Table 9 indicates, in none of the five countries were the first differences of real net private capital flows significantly correlated with the first differences of the real flow of bank credit to the private sector during the observation period. Indeed, for several countries, the correlations of these variables were negative, suggesting that, on average, a rise in the first difference (i.e., change) in one variable was correlated with a decline in the first difference of the other. Thus, it is hard to establish multicollinearity between net private capital flows and changes in real bank credit to the private sector from these data.

Table 9. Correlations between First Differences of Net Private Capital Flows and Real Private Credit in Selected Asian Countries, 1983–96

	Correlation between Net Private Capital Flows and Private Sector Credit: Nominal Variables (DPNCF, DCPSFL)	Real Variables (DPNCFR, DCPSFLR)
Indonesia	0.0213	-0.0228
Korea	0.2698	-0.0336
Malaysia	-0.2344	-0.2169
Philippines	0.2472	0.2474
Thailand	-0.3494	-0.3178

Source: Calculations using author's data.

For a further look at this question, the regressions for DIP and DIPR were re-estimated using a modification of the bank credit variable. For these re-estimates, the flow of bank credit to the private sector was reduced by the value of net private capital flows, on the presumption that a significant amount of the bank credit provided to private companies during the period in question represented the intermediation of private capital inflows. As noted earlier, this seems a good supposition in at least some of the countries (for example, Thailand). Unit root tests ruled out investigating the first difference of the flow of net nominal credit to the private sector, DCPSFLNT (the flow of nominal credit minus nominal net private capital flows). However, the real counterpart to this variable—the real flow of bank credit to the private sector, less real net private capital flows (DCPSFLRNT)—satisfied unit root tests. The results of regressions using this variable in place of DCPSFLR appear in Table 10.

Replacing DCPSFLR with DCPSFLRNT improves the fit of the equations. The replacement also raises the significance of coefficients on real net capital flows (DPNCFR) when DIPUBGDP appears in the equation. The coefficients on DPNCFR are now significant at the 10 percent level in four of the five specifications (equations 1-4) and at the five percent level once DCPSFLRNT is dropped from the equation (equation 5). However, the significance of the coefficients on the flow of bank credit is reduced. With DCPSFLRNT in the equations, the coefficients are now significant at only the 10 percent level in two specifications (equations 2 and 3) and insignificant in the others (equations 1 and 4). When DIPUBR is in the specification, the coefficients on DCPSFLRNT are significant at the 10 percent level in three equations (7–9) and at the 5 percent level once DPNCFR is eliminated (equation 10). The net private capital flows variable remains insignificant when DIPUBR appears in the equations in place of DIPUBGDP. Thus, there is slightly stronger evidence of a relationship between net private capital flows and private investment once these flows are "netted out" from the flow of bank credit to the private sector. The coefficient estimates for real net private capital flows, about 0.19–0.23, are somewhat smaller than those for nominal flows reported in Table 7. They would suggest that a one unit rise (fall) in real net private capital flows is associated, on average, with a rise (fall) in real private investment of somewhat less than 0.25 unit.

Table 10. Results from Panel Regressions for DIPR Using Adjusted Bank Credit Measure 1/ 2/
Time period for estimation is 1983-96, except for equations 1 and 6 (1987-96)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
DIPR(-1)	0.1202	0.3139**	0.3303**	0.3921**	0.3727**	0.1640	0.3796**	0.3883**	0.4301**	0.4717**	0.4000**
	(0.82)	(2.75)	(3.07)	(3.84)	(3.69)	(1.20)	(3.40)	(3.72)	(4.44)	(5.13)	(4.14)
DIPUBGDP	-1.3188*	-1.3744**	-1.3543**	-1.3208**	-1.3073**						
	(-2.55)	(-3.84)	(-3.89)	(-3.75)	(-3.71)						
DIPUBR						-0.7718**	-0.7968**	-0.7901**	-0.8048**	-0.8176**	-0.7707**
						(-3.70)	(-4.72)	(-4.81)	(-4.91)	(-4.96)	(-4.67)
DPNCFR	0.3115#	0.2274#	0.2096#	0.1906#	0.2307*	0.2504	0.1514	0.1467	0.1346		0.1915#
	(1.95)	(1.88)	(1.91)	(1.73)	(2.20)	(1.67)	(1.32)	(1.41)	(1.30)		(1.93)
DPNCFR(-1)	0.2549	0.1960	0.2055			0.1709	0.1222	0.1286			
	(1.68)	(1.50)	(1.63)			(1.20)	(0.98)	(1.07)			
DCPSFLRNT(-1)	0.0589	0.0826#	0.0853#	0.0476		0.0663	0.0888#	0.0895#	0.0664#	0.0833*	
	(1.05)	(1.68)	(1.80)	(1.13)		(1.28)	(1.90)	(1.99)	(1.67)	(2.21)	
CPI	0.3144	0.0343				0.3059	0.0219				
	(1.15)	(0.37)				(1.21)	(0.25)				
DRI	-0.1000					-0.1198					
	(-0.69)					(-0.93)					
DGR	1.1828**	0.6109**	0.5614**	0.5836**	0.6155**	1.0697**	0.5437**	0.5201**	0.5348**	0.5329**	0.5794**
	(3.43)	(3.36)	(4.02)	(4.14)	(4.44)	(3.32)	(3.16)	(3.93)	(4.05)	(4.02)	(4.42)
DDSXGS	0.1903	0.0485				0.2166	0.0216				
	(1.10)	(0.45)				(1.36)	(0.21)				
DRER	-0.1336	0.5868				0.5127	0.8336				
	(-0.05)	(0.28)				(0.21)	(0.42)				
R^2	0.6520	0.6282	0.6261	0.6092	0.6008	0.7031	0.6638	0.6622	0.6556	0.6460	0.6396
F	7.28	11.83	19.76	23.38	30.60	9.21	13.82	23.13	28.56	37.10	36.08
D.W.	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
S.E.E.	5.04	4.85	4.85	4.85	4.85	5.04	4.85	4.85	4.85	4.85	4.85
No. of obs.	50	70	70	70	70	50	70	70	70	70	70

1/ For definitions of explanatory variables, see text. Figures in parentheses are t-statistics.
2/ Dependent variable is first difference of real gross private investment (DIPR), the first difference of gross private investment divided by GDP.

* Significant at the 5 percent level.
# Significant at the 10 percent level.

To provide some perspective on these results, it may be worthwhile comparing them with those of Bosworth and Collins (1999), who in a recent paper have analyzed the effect of total (private and public) capital inflows on 61 developing countries over the period 1979–95. In their study the ratios to GDP of investment, saving, and the current account were each regressed on total financial flows, the change in the terms of trade, and the once and twice lagged values of real GDP, both for the full sample of 61 countries and for a subset of 18 countries defined as emerging markets, a group including the five Asian countries in the present study plus China, Taiwan, India, South Africa, Morocco, and eight countries in Latin America. To address the endogeneity of capital inflows, Bosworth and Collins have also estimated equations in which actual capital flow data are replaced by instrumental variables estimates, using as instruments total gross capital flows to developing countries and a number Although Bosworth and Collins find the ratio of total capital flows to GDP and the lagged values of GDP are all significant in explaining country investment-to-GDP ratios, the size of the coefficient on total capital flows is much larger when instrumental variables estimates are used. In their instrumental variables equations every one unit rise in the ratio of total capital flows to GDP raises the investment-to-GDP ratio by about half that amount, both for the entire sample and for the subset of emerging market countries. This compares with figures of 20 percent, for all 61 countries, and 27 percent, for the emerging market subset, when actual figures for total capital flows are used. In addition, the current account-to-GDP ratio deteriorates by 69 percent of the rise in the ratio of total capital flows to GDP for the entire data set, and by about 53 percent for the subset of emerging market countries. Since these results relate total capital flows and total investment, the relationship between private investment and purely private capital flows could be even larger. In any event, the work of Bosworth and Collins (1999) supports the idea of a strong link between capital flows and investment in developing countries generally, and in emerging market countries in particular.

In addition, it is worth recalling the results of ongoing research of P. Gupta and colleagues regarding currency crises and output loss cited earlier (P. Gupta and others, 2001). Their analysis of output response during and after currency crises shows that output loss is positively and significantly related to the prior receipt of private capital inflows. Countries that had received a higher volume of private capital inflows relative to GDP experienced, on average, a substantially greater decline in real GDP growth after a currency crisis than did those countries with smaller relative amounts of private capital inflows. Thus, their findings go a step further, suggesting that greater volumes of private capital inflows make a country more vulnerable to real GDP losses when a crisis erupts.

IV. Tests for the Cointegration of Net Private Capital Flows and Private Investment in the Five Countries

To supplement the results of the OLS regressions, tests were performed to see if net private capital flows and private investment were cointegrated. Separate tests were performed on data for each country, to avoid the difficulties involved in testing for cointegration with panel data. The tests were performed using natural (i.e., unlogged) variables, because net capital flows for several countries were negative during portions of the pre-1997 observation period. Because of limited observations, it was not possible to examine cointegrating relationships among all the likely variables in each country. The cointegrating vectors identified from these tests are summarized in Table 11. Additional results are available from the author.

Table 11. Cointegrating Vectors for the Five Countries 1/

Country	IPR	CPSR	Real Growth	PNCFR	Intercept	Trend
Indonesia	1.00			-0.6627*	Yes	-3.49
				(-4.69)		
Indonesia	1.00	0.1030*		-1.0795*	Yes	-4.35*
		(3.14)		(-6.12)		(-11.51)
Korea	1.00	-0.5081*	0.2012*	-0.2952^	Yes	No
		(-40.03)	(7.96)	(-2.15)		
Malaysia	1.00	-0.2570*	-0.0407*	-0.3668*	No	No
		(-14.74)	(-8.59)	(-4.34)		
Philippines	1.00	-0.1402*	0.5264*	0.5719	Yes	No
		(-2.75)	(61.57)	(0.18)		
Philippines	1.00	-0.4065*		1.8043*	Yes	No
		(-5.15)		(5.56)		
Thailand	1.00	-0.1258*		-2.9355*	Yes	No
		(-3.39)		(-6.50)		
Thailand	1.00			-6.0417*	No	No
				(-10.55)		

1/ For definitions of variables, see text.
* denotes coefficients significant at the 5 percent level.
^ denotes coefficients significant at the 10 percent level.

As Table 11 indicates, cointegrating vectors relating real private net capital flows (PNCFR) to real private investment (IPR) were identified for all five countries. In four of these countries, the estimated coefficient on PNCFR had the correct negative sign. Of these four, the estimated coefficients were significant at the 5 percent level or better for three countries (Indonesia, Malaysia, and Thailand) and significant at the 10 percent level for the fourth (Korea). Thus, the cointegration tests support the view that real net private capital flows and real private investment bore a significant, long-term relationship in most of these countries, even if regressions showed that the short-term relationships were generally insignificant.

Table 12, which reports selected vector error correction models for these cointegrating equations, confirms the last point. For Indonesia and Malaysia, the coefficient for the cointegrating vector is significant at the 5 percent level. For Thailand, it is significant at about the 10 percent level. For Indonesia and Malaysia, only the change in real private investment is significant among the short-term variables. For Thailand, even this variable is not significant. These results may explain why the regressions reported in Tables 7 and 8 showed few significant relationships between private net capital flows and private investment, whether in real or nominal form, despite the expectation – and validation for several countries – of a long-term relationship between these two variables.

V. Conclusions

The strong correlation among real private investment, net private capital flows, and bank credit to the private sector in several of the countries most affected by the Asian Crisis suggests that a sharp reversal of net private capital flows could well have reduced private investment in at least some of these countries, thereby triggering a growth slowdown, or even an outright decline in real GDP. Regressions using panel data for these countries provide only limited support for this hypothesis, and then only when nominal net capital flows are related to nominal private investment. However, there is some evidence that real private investment is related to real net private capital flows once the value of these flows is deducted from net bank credit to the private sector, on the basis that most net private capital flows in these countries went to banks that in turn on-lent these funds to private firms. The equations suggest that, on average, a one unit rise (fall) in nominal net private capital flows was associated with about a 0.25-0.30 unit rise (fall) in nominal private investment. In addition, a one unit rise (fall) in real net private capital flows was associated, on average, with a rise (fall) in real private investment of perhaps 0.20 to 0.25 units. Thus, these last regressions support the view that the reversal of net private capital flows to these countries during 1997–98 could have been expected to reduce real GDP by lowering financing for real private investment.

Table 12. Vector Error Correction Equations for Real Private Investment in Selected Countries

	Indonesia	Indonesia	Korea	Malaysia	Thailand
Cointeg. Eq.	-1.0741^	-1.3022*	0.1350	-0.4074*	0.3038^
	(-1.96)	(-2.46)	(0.53)	(-3.69)	(1.66)
DIPR(-1)	1.0928*	1.2595*	-0.3881	0.3206*	0.4157
	(2.50)	(2.58)	(0.62)	(2.21)	(1.51)
DCPSR(-1)	0.1103		0.7407^	-0.0557	0.0426
	(0.15)		(1.71)	(-1.10)	(0.05)
DGR(-1)			0.0228	-0.0007	
			(0.03)	(0.01)	
DPNCFR(-1)	-0.1656	-0.0658	-0.0896	-0.1123	0.2263
	(0.41)	(-0.22)	(-0.33)	(-1.18)	(0.56)
C	-0.9790	1.1520			
	(-0.34)	(0.06)			
TREND		-0.0361			
		(-0.44)			
R^2	0.56	0.70	0.40	0.68	0.38
F	2.89	5.37	2.35	10.67	4.35

1/ For definitions of variables, see text.
* denotes coefficients significant at the 5 percent level.
^ denotes coefficients significant at the 10 percent level.

Results from the cointegration tests provide additional support for a relationship between net private capital flows and private investment, at least over the long-run. Real private net capital flows and real private investment appear to have been cointegrated in at least three of the five countries during the period before 1997. While vector error correction models indicate that the cointegrating relationships were significant to varying degrees in Indonesia, Malaysia, and Thailand, variables for the short-term impact of real private net capital flows were not significant determinants of real private investment in any of these equations. This suggests the need for further analysis to determine the strength of the relationship between private net capital inflows and net private investment in these countries. Overall, however, the results of this paper support the role of capital inflows as a financing source in the build-up and later collapse of private investment in the countries most affected by the Asian crisis.

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