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Working Paper

East Asia in the aftermath: Was there a crunch?

Research notes in economics & statistics, No. 00-5

Provided in cooperation with:
Deutsche Bank Research

Research Notes in Economics & Statistics

East Asia in the Aftermath: Was there a Crunch?

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The findings highlight the dynamics associated with a credit crunch. We find evidence of a »credit crunch« in all three crisis countries (Indonesia, Korea, Thailand) in the period immediately following the crisis as the banking system distress deepened, and the supply of (real) credit declined. Thereafter, however, credit demand also fell sharply as economic recession took hold and corporate bankruptcies increased. By the end of the first quarter of 1998, therefore, the constraining factor was the demand for credit.

We conclude that, beyond the initial crisis period, there is little evidence of a credit crunch at the aggregate level, although high real interest rates – and credit rationing of individual firms – may have continued to contribute to the difficulties of the corporate sector.

Swati R. Ghosh and Atish R. Ghosh

East Asia in the Aftermath:

Was there a Crunch?

Swati R. Ghosh[*] and Atish R. Ghosh[**]

September 2000

Abstract

This paper investigates whether there was a credit crunch in East Asia during the recent financial and economic crises. Motivated by widespread concern that, over and above any increases in real interest rates, corporates may have also faced credit rationing, we adopt an explicit disequilibrium framework for analyzing the behavior of real credit with a view to assessing whether the supply of, or demand for credit has been a binding constraint. The findings highlight the dynamics associated with a credit crunch. We find evidence of a »credit crunch« in all three crisis countries (Indonesia, Korea, Thailand) in the period immediately following the crisis as the banking system distress deepened, and the supply of (real) credit declined. Thereafter, however, credit demand also fell sharply as economic recession took hold and corporate bankruptcies increased. By the end of the first quarter of 1998, therefore, the constraining factor was the demand for credit. We conclude that, beyond the initial crisis period, there is little evidence of a credit crunch at the aggregate level, although high real interest rates – and credit rationing of individual firms – may have continued to contribute to the difficulties of the corporate sector.

Keywords: emerging markets, credit crisis

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1. Introduction

There has been much discussion about tightening credit conditions and the possibility of a credit crunch in the immediate aftermath of the financial crisis in the three East Asian countries – Indonesia, Korea and Thailand.

Although the level of domestic credit did not decline in the immediate aftermath of the crisis in any of the countries, its growth rate did. Moreover, in *real terms*, the level of credit did decline (Figure 1). At the same time, nominal interest rates shot up. In Korea, the overnight inter-bank rate rose from 14 percent prior to the crisis (October 1997), to 24 percent immediately following the crisis (December 1997), and peaked at around 30 percent in January 1998, while average nominal lending rates rose from 12 percent in October 1997 to 18 percent in January 1998. In Indonesia, the overnight inter-bank rate increased from 14 percent in July 1997 to 58 percent in August, while average nominal lending rates rose from 18 percent to 25 percent in the same period. Finally, in Thailand, where the crisis broke out first, the nominal overnight inter-bank rate rose from 9 percent in April 1997 to 20 percent in July 1997, although average nominal lending rates only rose from 12 percent to 14 percent.

The rise in *real* interest rates, however, was both less marked and considerably lagged. In fact, in Indonesia, real rates were actually negative from the third quarter of 1997 through the third quarter of 1998. This raised the possibility that, beyond any rise in interest rates (in Korea and Thailand), or in lieu of increases in interest rates (in the case of Indonesia), borrowers may have faced a »credit crunch« – whereby interest rates failed to equilibrate supply and demand for credit, and there was *quantity rationing* in addition or instead. As argued by Stiglitz and Weiss (1981), such rationing might occur when asymmetric information and adverse selection make banks unwilling to lend to creditworthy borrowers even at higher interest rates. Such rationing might also have occurred as banking system deposits shrunk and banks were forced to hold greater reserves and increase their capital provisioning to meet the more rigorous capital adequacy standards adopted post-crisis.
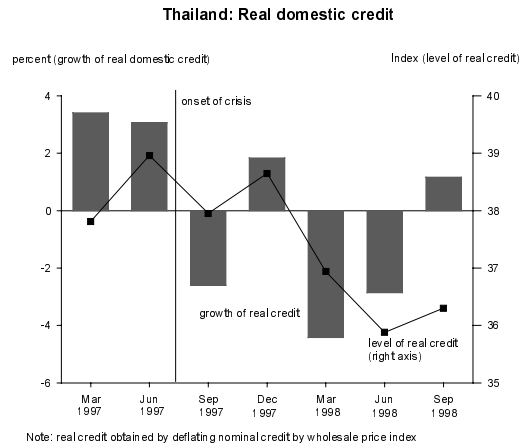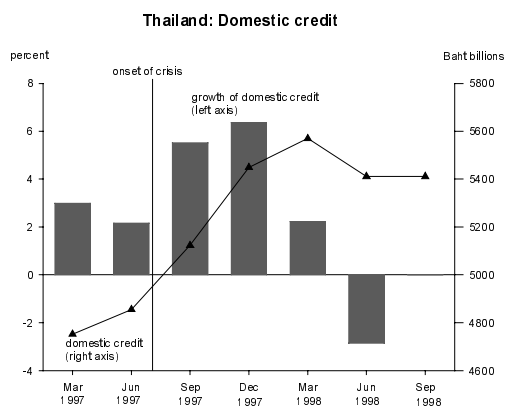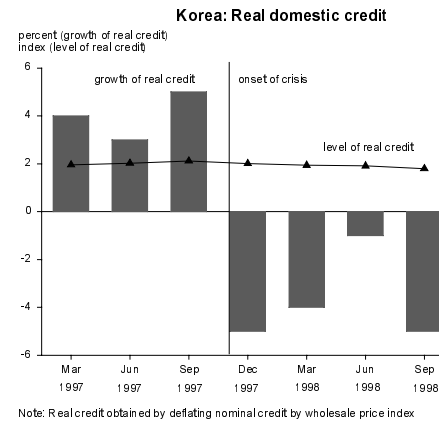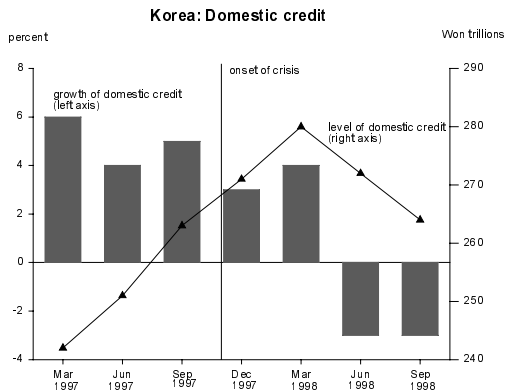
Indonesia: Domestic credit

percent

Rp trillions

40

30

20

10

0

-10

-20

onset of crisis

growth of domestic credit (left axis)

domestic credit (right axis)

700

600

500

400

300

200

Mar 1997   Jun 1997   Sep 1997   Dec 1997   Mar 1998   Jun 1998   Sep 1998

Indonesia: Real domestic credit

percent (growth of real domestic credit)
index (level of real domestic credit)

15

10

5

0

-5

-10

-15

-20

-25

onset of crisis

level of real credit

growth of real credit

Mar 1997   Jun 1997   Sep 1997   Dec 1997   Mar 1998   Jun 1998   Sep 1998

Note: real credit obtained by deflating nominal credit by wholesale price index

Korea: Domestic credit

percent

Won trillions

8

6

4

2

0

-2

-4

growth of domestic credit (left axis)

onset of crisis

level of domestic credit (right axis)

290

280

270

260

250

240

Mar 1997   Jun 1997   Sep 1997   Dec 1997   Mar 1998   Jun 1998   Sep 1998

Korea: Real domestic credit

percent (growth of real credit)
index (level of real credit)

6

4

2

0

-2

-4

-6

growth of real credit

onset of crisis

level of real credit

Mar 1997   Jun 1997   Sep 1997   Dec 1997   Mar 1998   Jun 1998   Sep 1998

Note: Real credit obtained by deflating nominal credit by wholesale price index

Thailand: Domestic credit

percent

Baht billions

8

6

4

2

0

-2

-4

onset of crisis

growth of domestic credit (left axis)

domestic credit (right axis)

5800

5600

5400

5200

5000

4800

4600

Mar 1997   Jun 1997   Sep 1997   Dec 1997   Mar 1998   Jun 1998   Sep 1998

Thailand: Real domestic credit

percent (growth of real domestic credit)

Index (level of real credit)

4

2

0

-2

-4

-6

onset of crisis

growth of real credit

level of real credit (right axis)

40

39

38

37

36

35

Mar 1997   Jun 1997   Sep 1997   Dec 1997   Mar 1998   Jun 1998   Sep 1998

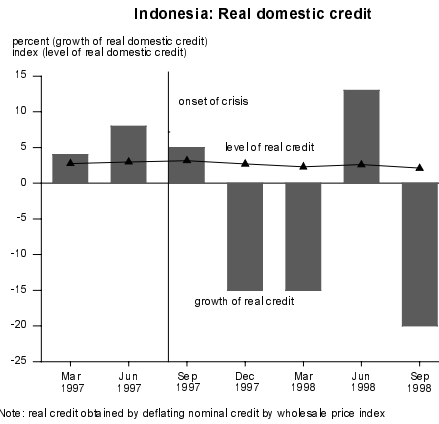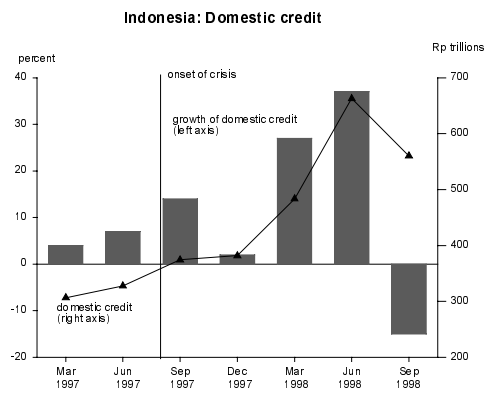Note: real credit obtained by deflating nominal credit by wholesale price index

Figure 1: Domestic credit developments in Indonesia, Korea and Thailand.

In this paper, therefore, we adopt an explicit disequilibrium framework that allows for *(but does not impose)* non-market clearing of interest rates, with a view to examining whether borrowers were facing quantity rationing or a »credit crunch« in the aftermath of the crisis in Indonesia, Korea and Thailand. Specifically, we estimate a *credit supply* function – which depends upon interest rates, the commercial banks' lending capacity, and the level of economic activity, and a *credit demand* function – which depends upon the interest rate and indicators of current and expected economic activity, in order to analyze the behavior of real private credit and assess the extent to which the supply of credit was a binding constraint.

Our results may be summarized briefly. We find evidence of a credit crunch (or quantity rationing) in all three countries immediately following the onset of the crisis. Thus, in Thailand and Indonesia, where the crisis erupted in July and August 1997 respectively, we find evidence of a credit crunch in the third and fourth quarters of 1997. In Korea, which experienced the financial crisis a few months later (November 1997), we find evidence of a credit crunch in the last quarter of 1997.

By the end of the first quarter of 1998, however, corporate distress and bankruptcies and the deepening economic recession had led to a sufficient decline in the demand for credit, that the decline in actual credit reflected a lack of credit demand, rather than constrained supply in all three countries. Thus, although the supply of credit remained significantly below pre-crisis levels, the binding factor was (the lack of) demand.

Two points bear emphasizing. First, the concept of a »credit crunch« in this paper refers to a situation in which credit is unavailable at prevailing interest rates – high interest rates themselves, of course, impose a burden on borrowers. Second, the results presented here pertain to the aggregate economy – thus even when there is no evidence of a credit crunch at the aggregate level, at the *microeconomic* level, individual firms that were otherwise creditworthy may well have been unable to obtain credit at prevailing interest rates.

The paper is organized as follows. Section 2 briefly outlines the macroeconomic conditions just prior to the crisis through to the second end of the quarter of 1998

(when our analysis ends). Section 3 describes the methodology (and the appendix, the data). Section 4 presents the empirical results. Section 5 offers some brief concluding remarks.

2. Macroeconomic Developments

We begin with a brief description of the macroeconomic events prior to the onset of crisis and developments in the immediate aftermath, as this helps to place the empirical results of this paper in context.

A. Thailand

On July 2 1997, in the face of large sustained capital outflows, Thailand abandoned its exchange rate peg against the US dollar and allowed the Thai baht to float. The currency immediately depreciated by about 10 percent to the US dollar and then continued to weaken in the following weeks, amidst growing concerns about the uncertain political situation and delay in adopting a comprehensive economic package to support the new exchange rate regime and address weaknesses in the financial system (Figures 2a-c). Nominal overnight rates rose from 12.7 percent in May 1997 to over 26 percent in September. The rise in real interest rates was lagged, but substantial – involving an increase from 9.3 percent in May 1997 to 16.6 percent in November 1997.

Although property prices had already begun to decline prior to the crisis – after a period of rapid expansion resulting in an oversupply of real estate –the onset of the crisis entailed a sharp and sustained decline in asset prices. Because of heavy investments in the property sector, the fall in property prices compounded the adverse effects of the rise in interest rates and depreciation of the exchange rate on the corporate sector. Moreover, since Thailand's non-bank financial sector was particularly heavily

exposed to the real estate sector (especially the finance companies), its difficulties were transmitted to the rest of the economy: thus firms that were not directly exposed to the property sector were still affected indirectly through a curtailment in the supply of credit.
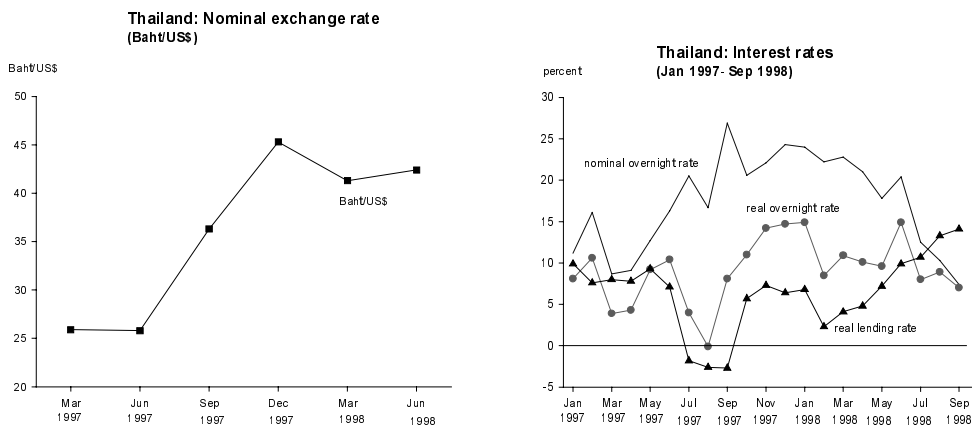
Thailand: Nominal exchange rate
(Baht/US$)

Thailand: Interest rates
(Jan 1997- Sep 1998)

Figure 2a: Within 8 weeks of the onset of the crisis, the exchange rate had depreciated by more than 26 percent, and nominal interest rates had risen sharply. The rise in real rates however did not occur until the end of the third quarter 1997.
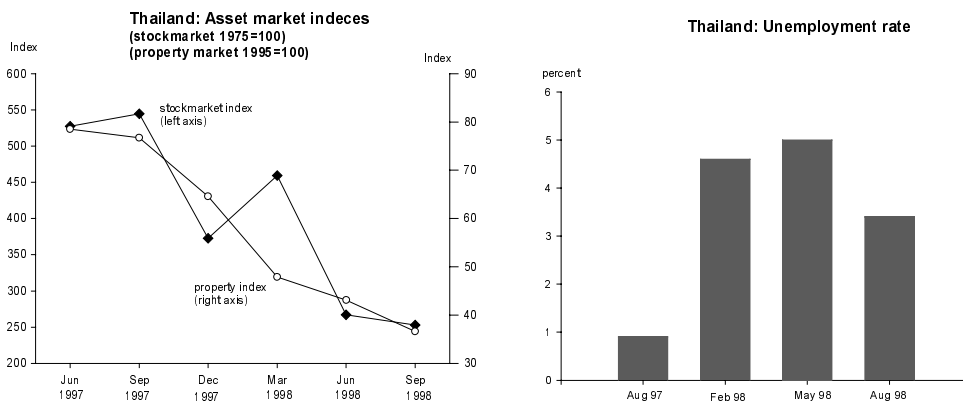
Thailand: Asset market indeces
(stockmarket 1975=100)
(property market 1995=100)

Thailand: Unemployment rate

Figure 2b: Asset prices plunged. Together with the rising unemployment, slowdown in wage growth and curtailment in credit from finance companies, this led to a sharp decline in consumption in third and fourth quarters of 1997.
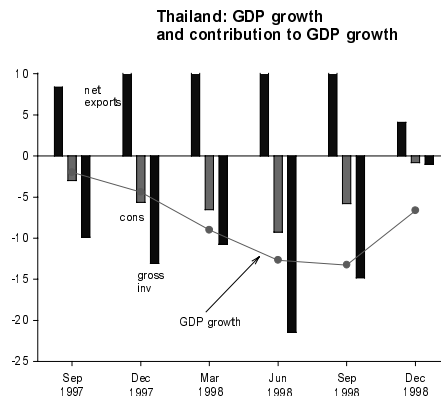
7

**Thailand: GDP growth
and contribution to GDP growth**

Figure 2c: In turn, the decline in domestic demand added to the corporate sector's difficulties arising from the exchange rate depreciation, higher interest rates and collapse in property prices. From the fourth quarter of 1997 onwards, therefore, investment declined sharply. Moreover, in the second quarter of 1998 the decline in exports reduced the contribution of net exports to growth. As a result, GDP declined by 9 percent in the first quarter of 1998 and a further 12.6 percent in the second quarter.

Private consumption was also affected by the decline in asset prices, and by depressed wage growth, rising unemployment and cutback in credit from the finance companies. Consumption fell by 4.6% in the third quarter (yoy) and by 9 percent in the fourth quarter. In turn, the decline in domestic demand further exacerbated the difficulties of the corporate sector and investment fell by 31 percent (yoy) in the last quarter of 1997.

In the first two quarters of 1998, consumption decreased by 10 percent and 14 percent respectively. This continued sharp fall in consumption reflected not only the decline in current income and wealth, but also probably a decline in expected permanent income as macroeconomic uncertainty and severity of the crisis increased. Investment also fell further, by 30 percent (yoy) in the first quarter and by as much as 59 percent (yoy) in the second quarter. The first half of 1998 also saw a sizable decline in export growth, which reduced the contribution of net exports to growth. As a result, GDP declined by 9 percent (yoy) in the first quarter of 1998, and by 12.6 percent (yoy) in the second quarter.

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B. Indonesia

Within one month of the Thai crisis, Indonesia experienced massive capital outflows (World Bank (1998)). Following the devaluation of the Thai baht in July, the Indonesian authorities had widened the exchange rate band on the rupiah from 8 percent to 12 percent – whereupon the currency depreciated by 7 percent. By the following month, it became obvious that the exchange rate regime could no longer be defended and the rupiah was floated on August 14. Simultaneously, the authorities tightened monetary policy sharply, driving nominal interest rates up to 58 percent from 15 percent in July (Figures 3a-c). However, this failed to prevent a continued depreciation of the currency, as other factors – stemming from the interaction of the initial depreciation and underlying weaknesses in the economy – came into play, as discussed below.

In particular, although Indonesia's macroeconomic performance had been relatively strong prior to the crisis, one source of macroeconomic vulnerability was the fact that Indonesian corporates had accumulated un hedged short-term external debt very rapidly between 1993-96. (This, in turn, was in large part the outcome of the macroeconomic policy mix that had been used to deal with the domestic economic
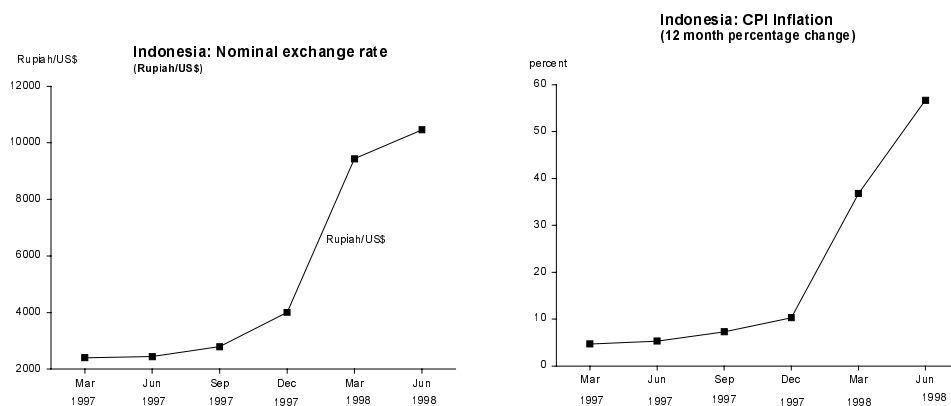

Figure 3a: The rapid and sustained depreciation of the Indonesian rupiah fueled sharp increases in inflation.

Indonesia: Interest rates
(Jan 1997- Sep 1998)

Indonesia: Stockmarket index
(1988=100)

Note: real interest rates based on estimates of contemporaneous inflation,
a three month moving average of monthly consumer price changes
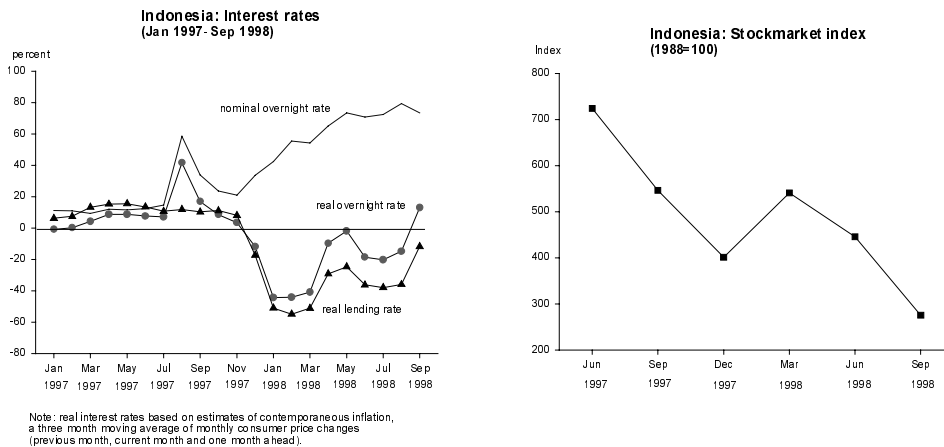(previous month, current month and one month ahead).

Figure 3b: Nominal interest rates rose sharply – although the rise in real interest rates lagged – and there was a steep decline in asset prices ...

Indonesia: GDP growth
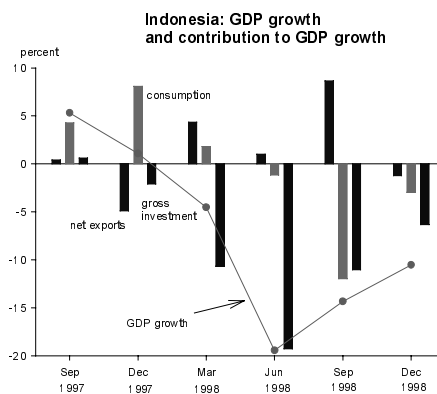**and contribution to GDP growth**

Figure 3c: The depreciation of the exchange rate, together with the decline in asset prices, increased corporate sector distress – given the magnitude of the short-term external liabilities of Indonesian corporates and their heavy investments in real estate and the stock market. There was a cutback in investment in the first instance, followed by a sharp decline in consumption by the first quarter of 1998 in the face of rising unemployment, declining real incomes and falling wealth.

overheating and capital inflows that occurred in late 1994-96).[1] While the depreciation may have been triggered in the first instance by investor funds reducing their ex-

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1   From late 1994 to 1996, the Indonesian economy experienced excess demand pressures that were manifested in a pick-up in inflation and a sharp widening of the current account deficit. Asset prices also rose quite sharply. Indeed, a reinforcing cycle of asset price inflation was created as the rise in asset prices increased in the collateral value of banks' clients, against which banks lent further for investments in real estate and in the non-tradeables sector in general. In dealing with the domestic overheating, primary reliance was placed on monetary policy. This exacerbated the rise in

posure to South East Asia, it was the pressure from these unhedged corporates to cover their short-term external debt obligations that propelled further depreciation. In particular, when the rupiah began to depreciate faster than the historical trend rate and the exchange rate band was widened, the potential foreign exchange losses arising from these unhedged borrowings became obvious, prompting corporates to buy foreign exchange to hedge their future liabilities. When the exchange rate band was removed, the demand for foreign exchange by these corporates escalated, and the depreciation of the exchange rate accelerated, especially as by this time many creditors were unwilling to lend to Indonesian corporate borrowers. On October 13, 1997, the Government turned to the IMF for assistance.

The second phase of the currency depreciation came in December 1997, with the closure of 16 weak banks. Weaknesses in the Indonesian banking system had meant that numerous banks had been seriously undercapitalized even prior to the crisis and thus unable to absorb the losses when the exchange rate began to depreciate. The closure of these banks – intended to demonstrate the Government's determination to deal with the financially troubled banks decisively – actually served to reduce confidence in the banking system overall. As a result, private national banks began to see large and sustained withdrawals of deposits, prompting Bank Indonesia to issue emergency credits in ever increasing amounts. Thus, from November 1997 onwards the earlier corporate crisis was overlaid with a banking crisis. Even the healthier banks found it increasingly difficult to cope. First, as the currency depreciated, banks saw their for-

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domestic interest rates that had resulted from the aggregate demand pressures. Furthermore, while remaining conservative in a medium-term structural sense, fiscal policy actually turned expansionary in cyclically-adjusted terms, which placed further upward pressures on interest rates. This provided a strong impetus for corporates to borrow abroad. Moreover, the high domestic interest rates were sustained through sterilization efforts, which, in turn, encouraged further inflows of short-term private capital (as short-term capital tends to be the most responsive to interest rate differentials). There was, moreover, little incentive to hedge these external liabilities, as Indonesia's exchange rate policy had implied relatively predictable nominal rates. Not only was the movement of the central rate relatively small, but the fluctuations around the central rate were also limited (although Indonesia had begun progressively widened the band around the central parity since 1994). As a result, Indonesia saw a rapid buildup in short-term unhedged external liabilities. See Ghosh and Pangestu (1999) for details on the buildup in macroeconomic and financial sector vulnerabilities in Indonesia.

eign exchange denominated liabilities rise; moreover the rupiah value of their dollar-denominated loans climbed and their capital-asset ratios fell. Second, their assets deteriorated rapidly as loan default rates climbed. And third, as mentioned, private national banks began to see large withdrawals of deposits – although in aggregate this was made up by liquidity infusions from BI (liquidity credits rose from Rp 17 trillion at end-September 1997 to Rp 127 trillion – almost 3 times the level of base money – in April 1998).

This was followed by a period of relative calm in the foreign exchange markets between January 1998 and May 1998, with the announcement of a plan to restructure the financially troubled banks and an initiative to deal with the private debt overhang. In May 1998, however, further complications arose with student protests against price rises and the Suharto regime. When four students died in Jakarta, this sparked massive demonstrations that eventually escalated into widespread riots. Between May 1998 and June 1998 the exchange rate collapsed from Rp 8,000 /US$1 to Rp 16,000 /US$1.

The immediate effect of the exchange rate was a sharp fall in domestic demand. Initially the decline was due a sharp cutback in investment: unhedged corporates were having to pay higher levels of external debt service which cut into investment expenditures, and lower credit availability meant fewer investment resources. Moreover, there was an »accelerator effect« whereby lower investment by some corporations affected their suppliers who subsequently lowered their own investment. Construction and real estate were the first (and hardest) hit, but other non-tradeables, such as transport and domestic trade, followed. Thus investment declined by 6 percent (yoy) in the last quarter of 1997, by 31 percent in the first quarter of 1998 and by 57 percent in the second quarter of 1998. By the second quarter of 1998, consumption had also plummeted, reflecting the rising unemployment, falling incomes, collapse in asset values and wealth, and increasing economic distress.[2] As a result, GDP, which had declined by 4 percent (yoy) in the first quarter of 1998, fell by a further 20 percent (yoy) in the second quarter.

C. Korea

In Korea, the crisis erupted several months later, in November 1997 (World Bank, 1999). Although the strong macroeconomic performance prior to the crisis had helped mask some of the underlying weaknesses in the economy, the rates of return on assets and the profitability of Korean corporates had been relatively low and declining for some time. (Real rates of return had fallen from 4.4 percent in 1988 to 3.5 percent in 1996). Concurrently, on the liabilities side, borrowing by the corporate sector, which had always been relatively high, increased significantly from the mid-1990s onwards. (Leverage ratios had been increasing from an average of 2.8 in the late 1980s to 3.7 in 1995, while that of the 30 largest averaged over 4 from the late 1980s onwards).[3] When in 1995-96 Korea experienced a sharp terms of trade deterioration and there was a cyclical slowdown in the economy, underlying fragility gave way to corporate sector distress.

The first evidence of corporate sector distress surfaced in end 1996-early 1997, when Hanbo, the 14th largest chaebol declared bankruptcy with debts estimated at US$ 6 billion. This was followed by a string of other business failures – and by mid-1997 it became clear that the corporate sector difficulties would have significant repercussions on the financial sector. The devaluation of the Thai bath in July had already raised investor concerns; and the increasing likelihood that the private banking crisis would become a sovereign problem, heightened investor nervousness. The decision to bail out the near-bankrupt Kia on October 22, 1997, which was followed by the stock market crash in Hong Kong the following day, would appear to have been the spark that initiated the beginning of the large outflows of capital. As foreign banks began to refuse to roll over loans, Korean banks and corporates were forced to buy dollars in the foreign exchange market to service their obligations – placing further pressures on the exchange rate. The Government's initial response in August 1997 was to guarantee the foreign liability of financial institutions; this called into

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2 Estimation of a private consumption function shows it to be quite sensitive to changes in permanent income – which includes financial wealth. See Ghosh and Pangestu (1999).

question the ability of BOK to act as a lender of last resort and thus failed to reassure foreign investors. Attempts to maintain the exchange rate by intervening in the foreign exchange market led to BOK losing US$10 billion in foreign reserves from the end of August to end of November; such efforts were abandoned on November 17, 1997. A few days later, Korea sought emergency support from the international community to avoid a debt moratorium.

Monetary policy was tightened and nominal interest rates (overnight call rates) rose by over 10 percentage points in December. The announcement that an agreement had been reached with foreign banks on the rescheduling of the external debt halted any further declines in the exchange rate by the end of the first quarter of 1998, when the exchange rate stood at Won 1363/US dollar – albeit still at 43 percent below the pre-crisis level (Figures 4a-c).

However, the economy went into severe recession. The same factors that had made Korea vulnerable to a crisis also exacerbated the severity of the downturn. In particular, the high leverage of the corporate sector made it very susceptible to the interest rate increases. Combined with the initially weak position of many corporates prior to the crisis, the increase in interest rates led to a sizable proportion of corporates having less than 100 percent interest coverage – i.e. being unable to meet their interest rate
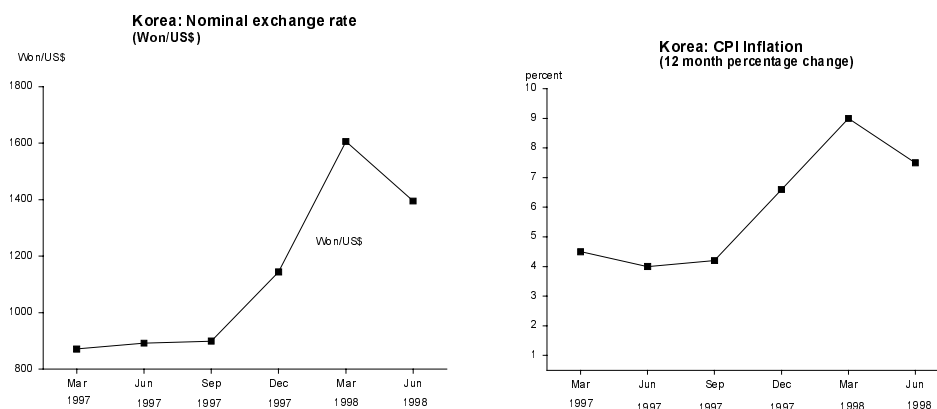

Figure 4a: The Korean won depreciated by over 42 percent during Oct 97-March 98; however, the exchange rate pass through was limited and inflationary pressures were relatively mild and short-lived.

3   By comparison, corporate leverage ratios in both industrial countries and others in the region have tended to be below 2.
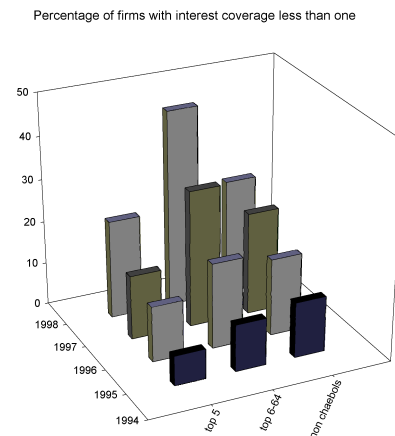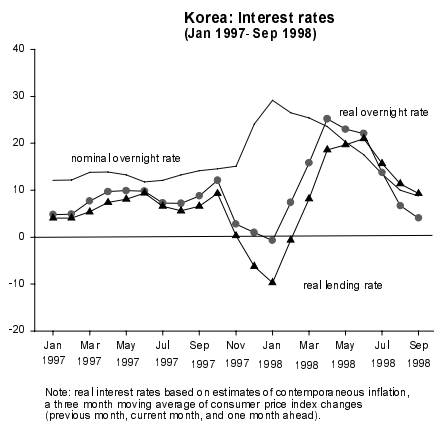
Korea: Interest rates
(Jan 1997- Sep 1998)

40
30
20
10
0
-10
-20

real overnight rate

nominal overnight rate

real lending rate

Jan 1997 Mar 1997 May 1997 Jul 1997 Sep 1997 Nov 1997 Jan 1998 Mar 1998 May 1998 Jul 1998 Sep 1998

Note: real interest rates based on estimates of contemporaneous inflation, a three month moving average of consumer price index changes (previous month, current month, and one month ahead).

Percentage of firms with interest coverage less than one

50
40
30
20
10
0

1998 1997 1996 1995 1994

top 5   top 6-64   non chaebols

Figure 4b: Interest rates rose, which, given the high leverage ratios of Korean corporates, exacerbated corporate sector distress…

Korea: bankruptcies
(total number of firms)

3500
3000
2500
2000
1500
1000
500
0

Nov 1997 Dec 1997 Jan 1998 Feb 1998 Mar 1998 Apr 1998 May 1998 Jun 1998

Korea: GDP growth
and contribution to GDP growth

percent

20
15
10
5
0
-5
-10
-15
-20

net exports

consumption

gross investment

GDP growth

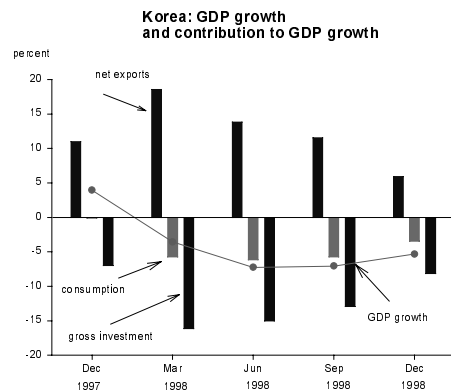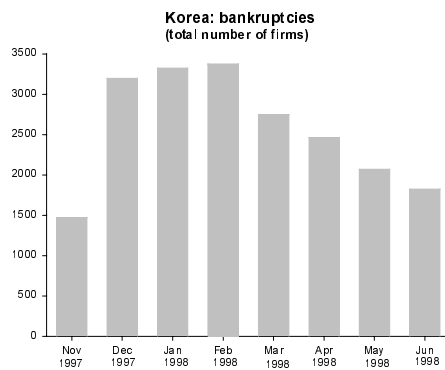Dec 1997 Mar 1998 Jun 1998 Sep 1998 Dec 1998

Figure 4c: ...leading to a peak of bankruptcies in Jan-Feb 98, and a sharp decline in aggregate investment. The increase in unemployment, falling real wages and wealth, and increasing macroeconomic uncertainty led to an even sharper decline in consumption by the end of the first quarter of 1998.

payments through current earnings. Corporate bankruptcies peaked in January 1998, including of those of SMEs. More than half of the SMEs have subcontracting relationships with larger chaebols and when the crisis hit, SMEs' payments for trade receivables were increasingly made in the form of promissory notes, the terms of which lengthened from the two to three months that was the practice prior to the crisis, to six months. Second, banks – the primary source of finance for SMEs – became reluctant to transact with SMEs without established credit records or collateral. Consequently, most enterprises encountered difficulties in short-term rollovers and promissory notes discounts at their banks even though the discount rates had doubled. In turn, the diffi-

culties of the corporate sector were transmitted to the banking sector, which, faced with mounting NPLs, and need to restructure and recapitalize, reduced new lending and restored to loan recalls.

The corporate sector distress was evident in the contribution of investment to GDP growth of negative 7 percent in the last quarter of 1997. By the first quarter of 1998, consumption had nose-dived as well. This, in turn was the result of the unprecedented increase in unemployment – the unemployment rate, which had averaged 2-3 percent prior to the crisis, rose rapidly during the period (eventually peaking at almost 9 percent in February 1999) – and the sharp decline in real wages. Given the severe macroeconomic uncertainty, Korean households also increased their savings rate, rather than undertaking any »consumption-smoothing« in the face of the decline in incomes. The contribution of consumption to growth was thus a minus 5.7 percent in the first quarter of 1998 and minus 6 percent in the second quarter of 1998. The decline in consumption and reduced sales prospects further dampened investment activity – leading to declines in the contribution of gross investment to GDP growth of around 16 percent in the first and second quarters of 1998. Overall GDP declined by 3.5 percent (yoy) in the first quarter of 1998 and a further 7.3 percent (yoy) in the second quarter of 1998 – a very large swing from the over 7 percent growth rates seen in the years prior to the crisis.

3. Methodology

As the crisis deepened, and the growth of credit slowed, a key issue was the possibility that firms were facing a »credit crunch«. However, an observed decline in credit is consistent with falling supply of and/or demand for, credit. Distinguishing between the cases, and hence determining whether a credit crunch developed, requires a framework that allows explicitly for market disequilibrium. The methodology we adopt is a switching regression framework, in which we estimate both the demand for, and supply of, real credit. It is important to note that this framework allows for,

but does not impose, non-market clearing interest rates. To the extent that interest rates are clearing the market, of course, the estimated supply and demand will be »very close«, and the estimates will not suggest that either side of the market is binding. If interest rates do not clear the market, the methodology identifies which is the constraining side of the market (supply or demand). As such, this methodology is ideally suited to examining the behavior of the loan market in these countries, both in the period prior to the crises, and in their aftermath.

As mentioned, an observed decline in credit to the private sector is consistent with falling supply of credit, falling demand for credit, or both. The key identification problem lies in attributing the observed changes in actual private sector credit to underlying movements of the credit supply and credit demand function. This identification problem is resolved in this paper by imposing reasonable *a priori* exclusion restrictions, such as that the bank's lending capacity affects the supply of credit but does not affect the demand for credit.

The framework developed in this paper also allows for an explicit distinction to be made between *banks' ability to make loans* – as captured by their lending capacity and *their willingness to make loans*, which depends on such factors as interest rates and their perceptions of borrowers' ability to pay and risk.[4]

If the market for bank loans clears continuously, the interest rate adjusts to ensure that the supply of credit equals the demand for credit. If interest rates do not adjust (sufficiently), or if there are directed credits or credit rationing, demand for bank credit, C^d need not equal its supply, C^s, with the actual level of credit given by:[5]

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4 Pazarbasioglu (1997) also uses a disequilibrium model to analyze the banking crisis in Finland. However, the approach of this paper differs in that the lending capacity is taken as an explicit determinant of the supply of bank credit. This allows a distinction to be made between banks' lending capacity on the one hand, and factors that may affect their willingness to lend, at a given lending capacity, on the other. As mentioned in the text, this also helps to reduce the potential problem of identification. For other approaches to the credit crunch see Bernanke and Lwon (1992).

5 In this framework, there can be disequilibrium whenever supply does not equal demand at the prevailing interest rate (for whatever reason), with the quantity traded determined by the short side of the market. The framework thus does not require a specific model of *why* there may be credit rationing (e.g. perceived risk by lenders) or excess credit supply. More generally, a dynamic equation determining the evolution of the interest rate to disequilibrium may be specified, although this is

$$C_t = \min(C_t^s, C_t^d)\qquad\qquad(1)$$

The real supply of bank credit is assumed to depend upon the real interest rate, r_t, relative to the cost of funds (proxied by the deposit rate); current output y_t, as a measure of firms' ability to repay and commercial banks' real lending capacity, l_t. (In order to allow for a structural break in the supply of credit, dummies were included for the respective crisis periods: 1997:3 onwards for Indonesia and Thailand, and 1997:4 for Korea.).

It is, of course, quite difficult to gauge the true lending capacity of banks in a crisis and post-crisis context. In general, two factors determine the maximum amount that a bank may lend: its liquidity position and its capital adequacy (of course, simply because a bank has the capacity to lend, it does not necessarily mean it will lend – thus lending capacity is just one argument in the credit supply function). Banks' lending capacity is the *minimum* of what might termed their »liquidity capacity« and their »capital capacity«, where the latter depends upon the prevailing capital adequacy regulations.

Banks' *liquidity* capacity, is given by total liabilities minus cash in vault minus required reserves. In essence, these are funds that are available to make loans. To arrive at a conservative estimate of banks' *capital capacity*, it is assumed that banks were already attempting to set aside sufficient capital to meet the 8 percent capital adequacy ratio on a risk-weighted basis – even though, in reality, some forbearance may have been taking place. The »capital capacity« is then simply 1/0.08 x bank capital.[6] Finally, as noted above, *lending capacity* is the minimum of liquidity capacity and capital capacity. Thus a bank that is otherwise flush with liquidity, may not be able to make loans because it is constrained by having too little capital to meet its capital adequacy requirements. Conversely, a bank with sufficient capital may be constrained

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not done here. Instead, as a robustness check, the interest rate variables are instrumented (using their own lags).

6   To the extent that banks have excess capital (i.e. their capital exceeds the amount required to meet the capital adequacy ratio on a risk-weighted basis), this excess capital can also be used for making loans. During the crisis period, however, the banking system in the East Asian countries generally had inadequate capital to meet prevailing capital adequacy requirements.

in its lending operations if deposits are withdrawn (without corresponding injection of liquidity from the central bank) and the liquidity constraint binds.

The credit supply function is then given by:

$$C_t^s = \beta_0^s + \beta_1^s (r_t - r_t^d) + \beta_2^s l_t + \beta_3^s y_t + \beta_4^s d + \varepsilon_t^s \tag{2}$$

where r is the real (lending) interest rate, r^d is the deposit rate, l_t is the lending capacity (as defined above) y_t is output and d is the dummy variable for the crisis period.

Specifying the demand function is trickier. The need for working capital presumably depends upon production, with higher output requiring greater credit. Greater uncertainty regarding the economic situation and prospects, on the other hand, is likely to reduce the demand. With these considerations in mind, the demand for real credit is assumed to depend upon the real interest (lending) rate, r_t; current output, y_t, to capture both working capital requirements and as an indicator for future output; the price of the stock market as a proxy for future expected output, S^p; and the variance of the growth in output y^σ, and inflation, π_t, both as indicators of the general macroeconomic environment:

$$C_t^d = \beta_0^d + \beta_1^d r_t + \beta_2^d y_t + \beta_3^d y_t^\sigma + \beta_4^d s_t^p + \beta_5^d \pi_t + \varepsilon_t^d \tag{3}$$

The probability that any observation t is supply constrained (i.e. quantity is determined by credit supply) is simply:

$$\theta_t = Prob(C_t^d > C_t^s) = \Phi((C_t^d - C_t^s)/(\sigma^{s2} + \sigma^{d2})) \tag{4}$$

where σ^s and σ^d are the estimated standard errors of the credit supply and credit demand functions and $\Phi(\cdot)$ the cumulative normal distribution function.

If observation t is on the demand function, then $C_t = C_t^d < C_t^s$ and the density of C_t, $h(C_t)$ is given by:

$$h(C_t | C_t = C_t^d) = \int_{c_t}^{\infty} \phi(C_t, C_t^s)/\theta_t \, dC_t^s \tag{5}$$

where $\phi(\cdot)$ is the joint density of C_t^d and C_t^s. Conversely, if in period t there is a credit crunch, then $C_t = C_t^s < C_t^d$ and:

$$h(C_t \mid C_t = C_t^s) = \int_{C_t}^{\infty} \phi(C_t^d, C_t)/(1 - \theta_t) \, dC_t^d \tag{6}$$

Hence

$$h(C_t) = \theta_t h(C_t \mid C_t = C_t^d) + (1 - \theta_t) h(C_t \mid C_t = C_t^s) \tag{7}$$

$$= \int_{C_t}^{\infty} \phi(C_t, C_t^s) d \, C_t^s + \int_{C_t}^{\infty} \phi(C_t^d, C_t) d \, C_t^d \tag{8}$$

and the associated log likelihood is $\Sigma^{T}_{i=0} \, \log h(C_i)$.

    As discussed by Maddala (1989), for certain parameter values the likelihood function may be unbounded, but in practice we encountered few difficulties in estimation. A more subtle issue concerns the stationarity of the data, since observed real credit (in both countries) exhibits a unit root. In much of the literature on disequilibrium models, the issue of stationarity appears to be ignored and the model estimated in *levels* (see e.g. Maddala and Nelson (1974), Pazarbasioglu (1997)). In part, this is because estimation in first differences loses too much information. (Simply put, just because the *growth* of credit supply exceeds the *growth* of credit demand, it does not necessarily follow that credit supply is not the binding constraint.) Estimation in levels *is* legitimate as long as the determinants of credit supply and credit demand form a cointegrating vector. Once the model's parameters have been estimated via maximum likelihood, this can readily be tested by checking whether the implied credit demand, C_t^d, is cointegrated with observed real credit, C_t (and, likewise, that C^s is cointegrated with C_t). Since these are cointegrating vectors, however, the reported *t-statistics* provide a measure of the precision of estimation of individual parameters, rather than of formal statistical »significance«.

4. Empirical Results

The data are quarterly and cover the period 1990:3 to 1998:2 for Indonesia and Korea, and 1993:1 to 1998:2 for Thailand; data sources are described in appendix 1.

Based on these quarterly data, it is not possible to reject a unit root in real private sector credit for either of the countries, with Augmented Dickey-Fuller test statistics ranging from about -1.97 in Thailand and Korea to -2.1 in Indonesia. Accordingly, it is useful to check that, for each country, the determinants of the credit supply (demand) function form a co-integrating vector with observed real private sector credit. These tests are based on the Reimers small-sample correction of the Johansen statistics (with 95 percent critical values for the maximum eigenvalue and the trace given by 14.1 and 15.4 respectively). For Indonesia, both credit supply and credit demand are found to be cointegrated with actual real private sector credit. For Korea, the trace statistic readily rejects the hypothesis that the rank of the cointegrating vector is zero (ρ=0) for both credit supply and credit demand, but the maximum eigenvalue is just below the critical value for credit demand at $\lambda_{max} = 13.7$.[7] Finally, for Thailand, where the available data span is rather shorter, estimated credit supply is found to be cointegrated with actual real credit. The maximum eigenvalue statistic rejects the null of cointegration for credit demand, but not the trace statistic.

Table 1 reports the parameter estimates for Indonesia. All coefficients are of the expected signs in the *credit supply* function, except for the dummy, which is also not statistically significant. The coefficients on both the interest rate and output are significant at the 10 percent level.

All coefficients are of the expected signs in the *credit demand* function as well. The coefficient on output is highly significant, with higher output associated with higher credit demand. Higher interest rates are associated with lower real credit demand, as expected, although the coefficient is not significant. The stock market price is also positively related to real credit demand and is significant at the 5 percent level. Finally, both the variance in output growth and inflation – taken as indicators of the general macroeconomic environment – are negatively related with real credit demand, as expected, with the former statistically significant at the 5 percent level.

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7   Korea, credit demand ($\lambda_{max} = 13.7$, $\lambda_{tr} = 16.7^*$); credit supply ($\lambda_{max} = 29.5^*$, $\lambda_{tr} = 33.1^*$) Indonesia, credit demand ($\lambda_{max} = 44.6^*$, $\lambda_{tr} = 51.2^*$); credit supply ($\lambda_{max} = 23.0^*$, $\lambda_{tr} = 32.1^*$) Thailand, credit demand ($\lambda_{max} = 14.2^*$, $\lambda_{tr} = 15.3$); credit supply ($\lambda_{max} = 17.5^*$, $\lambda_{tr} = 27.1^*$).

Table 2 reports the estimates for Korea. In the *credit supply* function, the coefficients on both the lending capacity and output are of the expected signs and highly significant. Neither the coefficient on interest rates nor the dummy are of the expected signs, but again, neither are statistically significant.

In the *credit demand* function, the coefficient on output is positive as expected and is highly significant, while that on the interest rate is negative and is marginally significant. The coefficient on the variance of output growth is also of the expected sign and is also marginally significant. Neither the coefficient on stockmarket prices, nor that on inflation, are of the expected signs (both are negatively correlated with real credit demand), but neither are statistically significant. (The negative coefficient on stock mar-ket prices, in any case, may reflect two opposing factors at work. A high stock market price may portend buoyant economic conditions and therefore a greater need for credit to provide working capital as enterprises expand production. On the other hand, if stock prices are high, firms may be better positioned to tap the capital markets directly).

Finally, turning to the results for Thailand, we note that the fact that quarterly GDP data are available only from 1993 onwards severely limits the estimation results. Nonetheless, Table 3 reports the results. In the *credit supply* function, all coefficients are of the expected signs, although only the coefficient on the lending capacity is statistically significant. Similarly, in the *credit demand* function, all coefficients are of

	Real Loan Supply	Real Loan Demand
Constant	-8.11 (-1.54)	-11.8 (-4.71)
Lending rate	1.05 (1.73)*	-0.64 (-0.43)
Lending capacity	0.35 (1.06)	—
Stock market prices	—	0.46 (2.04)*
Actual output	1.14 (1.67)*	1.65 (7.73)*
Variance of output growth	—	-7.30 (-1.96)*
Inflation	—	-0.49 (-1.01)
Dummy	0.17 (0.55)	—
σ supply function	0.23 (4.33)*	—
σ demand function	—	0.20 (2.85)*
Log Likelihood	74.9	74.9
No of observations	31	31

Table 1: Estimates for Indonesia, 1990:3-1998:2.

	Real Loan Supply	Real Loan Demand
Constant	-9.8 (-4.8)	-19.6 (-55.12)
Lending rate	-1.75 (-1.29)	-0.98 (-1.54)*
Lending capacity	0.76 (4.70)*	—
Stock market prices	—	-0.0014 (-0.06)
Actual output	0.87 (4.44)*	1.82 (53.2)*
Variance of output growth	—	-0.24 (-1.55)*
Inflation	—	-0.0002 (-0.03)
Dummy	0.06 (0.13)	—
σ supply function	0.13 (0.37)	—
σ demand function	—	0.018 (4.14)*
Log Likelihood	93.2	93.2
No of observations	31	31

Table 2: Estimates for Korea, 1990:3-1998:2.

	Real Loan Supply	Real Loan Demand
Constant	9.11 (1.6)	-26.55 (-0.21)
Lending rate	0.80 (1.29)	-2.42 (-0.56)
Lending capacity	0.86 (5.15)*	—
Stock market prices	—	-0.007 (-0.01)
Actual output	-.13 (-0.30)	2.74 (0.28)
Variance of output growth	—	-2.8 (-0.02)
Inflation	—	-0.71 (-0.09)
Dummy	0.03 (0.18)	—
σ supply function	0.01 (3.4)*	—
σ demand function	—	0.012 (0.04)
Log Likelihood	54.8	54.8
No of observations	19	19

Table 3: Estimates for Thailand, 1993:1-1998:2.

the expected signs; as mentioned above, the coefficient on stock market prices could be either positive or negative, and the negative coefficient on stock market prices could reflect the fact that high stock prices place firms in a better position to tap the capital markets directly, thereby reducing the demand for credit.

Note that, as a robustness check, to correct for potential endogenity of the interest rate variables, these were instrumented using two lags of the respective variables in each of estimations. The parameter estimates and resulting supply and demand functions were found to be very similar to those reported here.

Given these estimated credit supply and credit demand functions, the *probability* that there is a supply-side credit crunch is given by θ_t, while the extent of the (supply-

side) credit crunch is given by (C_t^d - C_t^s). If the estimated supply and estimated demand are sufficiently close, then the market is essentially in equilibrium, and the probability that it is either supply or demand »constrained« will be close to 50 percent. In fact, the magnitude of the deviations are found to be usually quite large, so that when $C_t^d > C_t^s$, the probability that supply was indeed the constraining factor is high (i.e. above 95 percent) and *vice versa*.

Figures 5a-c shows the estimated supply and credit demand functions, as well as actual credit to the private sector. The overall fit of the model may be judged by the correspondence between the actual private sector credit and the *minimum* of the contemporaneous credit supply and demand functions.

As can be seen from Figures 5a-c, in Indonesia there is evidence of ex-cess demand – i.e. a credit crunch – in the third and fourth quarters of 1997 – amounting to 9 percent and 13 percent respectively. Although the demand for credit had also fallen by the fourth quarter of 1997, the contraction in the supply of credit was sharper. The contraction in the supply of credit re-flected both banks' unwillingness to lend (accounting for about 10 percent of the decline in the estimated supply of credit) and a decline in their lend-ing capacity. The decline in their lending capacity, in turn, largely reflected a deterioration in their capital position (»capital« crunch), although there was a decline in liquidity as well.

The situation had started to reverse by the first quarter of 1998, however (and had completely reversed by the second quarter of 1998), with the de-mand for credit falling off by more than the supply – reflecting the corporate distress that had taken place and the poor prospects.
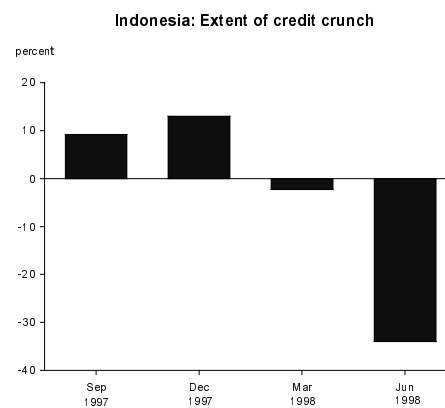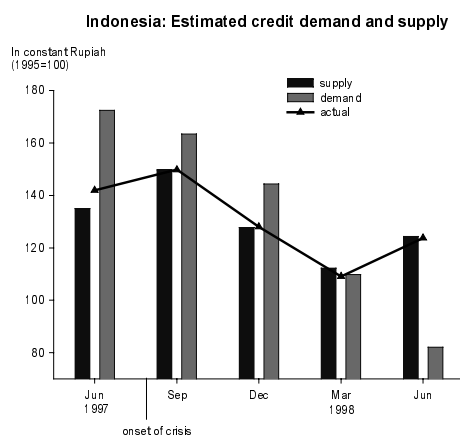
In Korea, too, we find evidence of a credit crunch at the end of 1997. The demand for credit rose in the fourth quarter of 1997, while the supply declined sharply – entailing excess demand of around 7 percent – equivalent to more than 5 percent of GDP. Moreover, had real interest rates not increased, the extent of credit rationing would have been around 10 percent. Again, the decline in the estimated supply of credit reflected banks' unwillingness to lend (accounting for about 13 percent of the
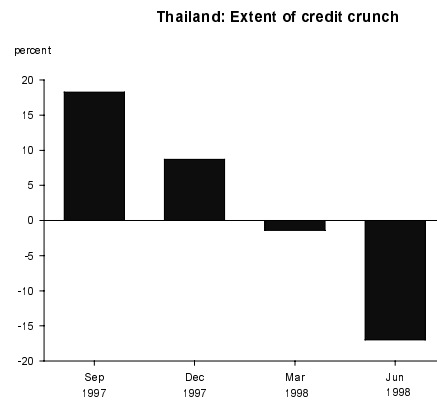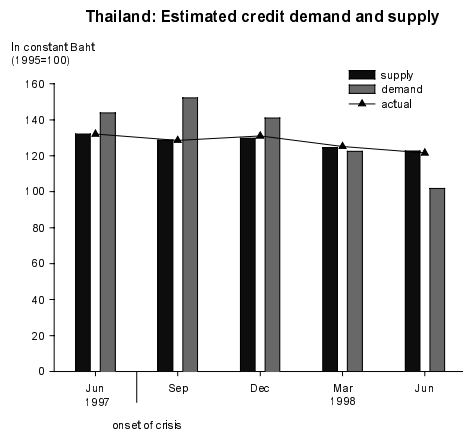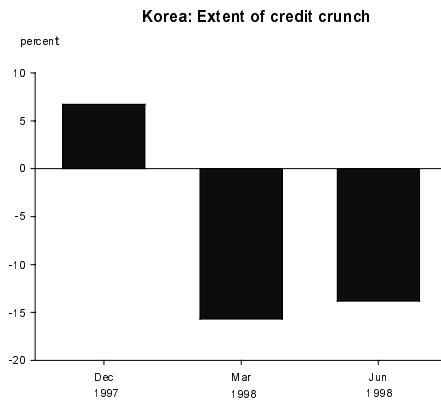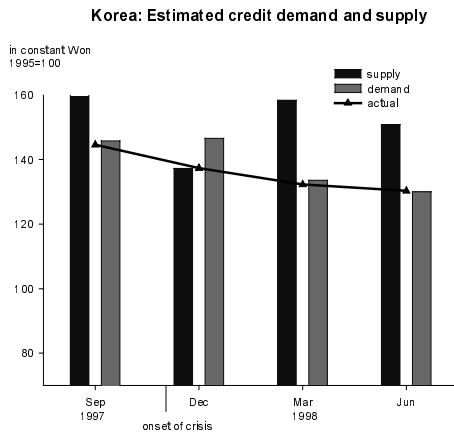
decline in supply) as well as a decline in their lending capacity, which in turn, was due to a deterioration in their capital position.

By the end of the first quarter of 1998, though, the demand for credit had fallen off sufficiently that the supply of credit was no longer the binding constraint. Thus the demand for credit decreased by almost 9 percent in the first quarter of 1998, and further by 2 percent in the second quarter, presumably reflecting the severity of the economic downturn and the extent of corporate bankruptcies that had already occurred (see Figures 3a-c).

In Thailand, we find evidence of a credit crunch following the onset of the crisis through the end of 1997, as Figures 5a-c shows. By the end of the first quarter of 1998, the demand for credit had fallen sufficiently so that the market was in equilibrium, and, by the end of the second quarter of 1998, the decline in the demand for credit had outpaced the decline in the supply of credit, as in Indonesia and Korea.

It bears emphasizing that the results of this paper pertain at the aggregate level and to the *aggregate economy*. Thus no distinction is made in the supply of credit between credit that is rolled over and the provision of new credit. Clearly, the provision of fresh lending is a key element for the restoration of firms' health. Also, even when there is no evidence of quantity rationing at the aggregate level, at the *microeconomic* level, individual firms that are otherwise creditworthy may well have found that their demand for credit at prevailing interest rates was unmet. In particular, smaller firms are likely to be more prone to a credit crunch arising from informational problems. In Korea, for example, the Credit Bureau of the Korea Federation of Banks only collects

Indonesia: Estimated credit demand and supply

Indonesia: Extent of credit crunch

Korea: Estimated credit demand and supply

in constant Won
1995=100

- ■ supply
- ■ demand
- —▲— actual

Sep 1997 · onset of crisis · Dec · Mar 1998 · Jun

Korea: Extent of credit crunch

percent

Dec 1997 · Mar 1998 · Jun 1998

Thailand: Estimated credit demand and supply

In constant Baht
(1995=100)

- ■ supply
- ■ demand
- —▲— actual

Jun 1997 · onset of crisis · Sep · Dec · Mar 1998 · Jun

Thailand: Extent of credit crunch

percent

Sep 1997 · Dec 1997 · Mar 1998 · Jun 1998

Figures 5a-c: Actual credit and estimated supply of, and demand for, private sector credit and extent of the credit crunch (in constant local currency, index 1995=100).

credit information on borrowers with loans above a certain threshold, which excludes most small and medium sized enterprises (SME). Thus SMEs that were primarily dependent on the weaker banks prior to the crisis, would have found it difficult – once they were cut off from these weak banks – to establish a credit record with stronger banks that were more flush with liquidity and/or less capital constrained. Two points that emerge from the analysis are worth noting:

First, there are dynamics associated with a credit crunch. In the immediate aftermath of the crisis, there is evidence of a sizable credit crunch – that is, over and above any increases in interest rates, there is evidence of quantity rationing. However, as corporate bankruptcies rose, and aggregate demand declined, leading to a deepening

recession and worsening economic prospects, the demand for credit also declined. In all three countries, the decline in the demand for credit outpaced the decline in the supply of credit (at the aggregate level) by the first quarter of 1998.[8] Nonetheless, as noted, the supply of credit in all three countries was considerably lower post-crisis.

Second, that lending rates did not come down by as much as deposit rates – despite the fact that, at the aggregate level, the demand for real credit was lower than the supply by the first quarter of 1998 – indicates that there was a risk premium making lending rates downwardly sticky.[9] As long as these risk perceptions persisted, lending rates remained relatively high, even if there were no credit rationing.

5. Conclusions

In this paper we examine whether a credit crunch – defined as a situation in which there is excess demand for credit at prevailing interest rates – developed in the aftermath of the East Asian currency crises. The paper uses a disequilibrium framework for analyzing the behavior of real private credit in Indonesia, Korea, and Thailand, with a view to assessing whether the supply or demand for credit has been the *binding constraint*.

The framework developed in this paper is particularly relevant for the formulation of macroeconomic policies as the implications for the priorities and sequencing of

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8 It is interesting to note that the Bank of Korea attributed the decline in the ratio of bank lending to deposits during July-November 1998 to the prolonged economic recession and subsequent low corporate demand for funds. (The ratio had averaged 80-90 percent between 1989 and 1997, had soared to 98 percent at the end of January 1998, i.e. in the immediate aftermath of the crisis, and declined to a record low of 74 percent in November 1998). »Due to the low demand for loans, banks were having difficulty in managing their extra funds and increasingly investing their excess funds in bonds and securities« (reported in Korea Herald, March 17, 1999).

9 In Korea for example, lending rates were found to have incorporated a risk premium that was strongly correlated with macroeconomic developments as well as events and perceptions regarding the financial and corporate sectors during November 1997-April 1998 (Ghosh (1998)).

such policies will vary according to which of the factors are at play at a particular point in time.

In principle, an observed decline in real credit growth rates could reflect three factors. First, banks' *ability* to lend may be curtailed – both as they try to meet new (or newly enforced) capital adequacy ratios (the »capital crunch«) and as withdrawals of bank deposits shrink banking system liabilities in real terms. Second, banks' *willingness* to lend might fall if weakening economic activity makes lending too risky (with interest rates inadequate to compensate for the risk). Third, in the context of bankruptcies, and weakening aggregate demand and activity, credit demand might fall as well. The disequilibrium framework adopted here (together with the capital crunch constraint) allows for each of these possibilities to be distinguished.

Evidence of a credit crunch at the aggregate level resulting from a decline in banks' lending capacity might call for the provision of greater liquidity – to the extent that this does not undermine the stability of the exchange rate. If it is the capital constraint that is the binding factor in banks' lending capacity, greater emphasis on bringing capital into the system would need to be the priority. However, the provision of greater capital at the aggregate level would be unlikely to resolve the issue – even if there was a credit crunch – if this credit crunch were not due to a decline in banks' lending capacity, but rather their unwillingness to lend. In that case the prescription would be for initiatives that reduce the uncertainty and increase the information base to encourage banks to be willing to lend to creditworthy borrowers. This is especially likely to be the case for SMEs – making the design of schemes that reduce uncertainty and encourage banks to lend to these borrowers particularly important.

On the other hand, once (the lack of) demand becomes the binding constraint (i.e. is lower than the supply of credit), this presumably reflects poor prospects for firms, which would call for greater emphasis on reflationary fiscal policy to increase aggregate demand. With poor earnings prospects, firms are unlikely to use the credit, even if this credit were made available.[10] Fiscal policy could also help reduce the risk

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10 To the extent that certain borrowers/sectors (e.g. SMEs) face a credit crunch or quantity rationing, it is important to identify the underlying factors (such as informational problems) in order that any

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premium and hence lending rates – to the extent that the risk premium is in part dependent on firms' earnings prospects, and fiscal policy is successful in exerting reflationary pressures and improving these prospects of firms.

Finally, once the recovery process is underway, there may be a period during which the demand for credit may outpace the increase in the supply of credit – particularly if many financial institutions are still struggling to meet prudential regulations. This requires close monitoring of the capital adequacy of financial institutions in order to prevent the occurrence of a »credit crunch« as the demand for credit picks up, which could otherwise jeopardize the recovery process.

specific schemes introduced may address the problem effectively. For evidence on the impact on SMEs, see Domac and Ferri (1998).

Appendix

r_t	Real interest rate. Average lending rate, deflated by average WPI inflation between periods (t+1,t) and (t,t-1)	Indonesia: and Thailand *International Finance Statistics.* Korea: Bank of Korea, *Monthly Bulletin.*
C_t	Real credit to the private sector. Nominal credit deflated by WPI; logarithm	Indonesia and Thailand: *International Finance Statistics.* Korea: Bank of Korea, *Monthly Bulletin*
l_t	Real lending capacity. Minimum of capital and liquidity. Liquidity = total commercial bank liabilities - cash in vault - required reserves. Deflated by WPI; logarithm;	Thailand: Bank of Thailand: *Monthly Bulletin.* Indonesia: Bank Indonesia: *Indonesian Financial Statistics* Korea: Bank of Korea, *Monthly Bulletin.*
y_t	Gross domestic product; logarithm.	Indonesia: *Biro Pustat Statistik.* Korea: Bank of Korea, *National Statistical Office.*
S^p	Stockmarket price index; logarithm.	Indonesia: Jakarta Stock Exchange. Korea: Korea Stock Exchange
π	Consumer price inflation; $\Delta\ln(CPI)$.	*International Finance Statistics*

Data are quarterly and cover the period 1990:3 to 1998:2 (1993:1 to 1998:2 for Thailand).

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