The Effects of Exchange Rate and Interest Rate Shocks on Bank Lending in Indonesia

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Abstract

Krugman used the Bernanke-Gertler model to explain the Asian Crisis. This model implies that macroeconomic shocks can decrease credit creation by reducing firms' creditworthiness or by eroding bank capital. Foreign banks in Indonesia should be less likely to restrict credit following macroeconomic shocks than domestic banks because they employed better risk management practices, they were less vulnerable to disintermediation, and their customers were largely hedged. Thus foreign banks were used as the control group. We found that interest and exchange rate shocks reduced bank capital and bank lending more greatly in domestic banks than in foreign banks. This indicates that the crisis curtailed the loan supply in Indonesia, forcing firms to reduce spending and output.

1. INTRODUCTION[1]

Economists have struggled to explain the virulence of the Asian financial crisis. With little warning, "the East Asian Miracle" was replaced by contagion and economic implosion. In the hardest hit country, Indonesia, real output fell 14% in 1998 after growing 7% annually between 1970 and 1996. By 2002 output had not returned to pre-crisis levels. The exchange rate depreciated from 2,400 rupiah per U.S. dollar in June 1997 to 15,000 rupiah per dollar in June 1998 after depreciating only 5% annually from January 1990 to June 1997. In 2002, the rupiah still hovered around 9,000 per dollar. The percentage of the population living below the poverty line rose to 21% in 1998 after falling to 11% in 1996. By 2002, it remained at 18%. Trying to explain the crisis, Krugman (1999) said it could be understood as an open economy application of the Bernanke-Gertler model.[2]

Bernanke and Gertler have shown that the effects of an adverse macroeconomic shock may be amplified if it restricts the flow of credit.[3] A decline in credit creation could occur because a negative shock worsens firms' balance sheets and thus their access to credit or because it restricts the ability of banks to supply loans. In a world of asymmetric information, firms with healthier balance sheets can obtain credit on better terms. Their ability to post collateral and provide down payments reduced the agency costs associated with borrowing. If a negative shock worsens firms' financial positions, it might impair their access to credit. Similarly, an adverse shock might reduce bank capital and thus banks' ability to provide loans. When firms' balance sheets deteriorate or banks' loan supplies decline, the reduction in credit forces firms to reduce spending and output.

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[1] This paper is part of a research project entitled "Linking Firm and Bank Behavior with Macroeconomic Shocks," sponsored by the Asian Development Bank Institute (ADB-I), Tokyo. We thank Reid Clark, Fawzy Siddik and seminar participants at the Asian Development Bank Institute and the Spring 2002 Washington Area Finance Conference for their valuable comments.

[2] There are of course other explanations for the crisis. Among Washington Consensus supporters the favorite is that it was caused by crony capitalism. "In particular, the lack of arm-length transactions between the Asian banks and their biggest shareholders and borrowers (a situation enabled by the patronage practices of the political systems in these countries) resulted in irrationally large amounts of investments directed at high-risk projects, prestige projects, and projects kept viable by regulations. The meltdown of the Asian financial crisis came when investors fled into foreign assets upon recognition that the contingent losses had exceeded the fiscal ability and political willingness of the state to bail out these projects. The claim, in short, was that the absence of market infrastructural institutions (e.g. honest, capable state financial supervisory body) had caused the East Asian economies to implode..." See Woo, 2004.

[3] See Bernanke, Gertler, and Gilchrist, 1996.

Krugman (2001) emphasized the role of deteriorating balance sheets in propagating the Asian crisis. Firms were saddled with short-term foreign currency denominated debt. This debt was largely unhedged against exchange rate risk. Depreciating exchange rates thus multiplied businesses' liabilities and reduced their retained earnings (equity). As companies' net worth plummeted, their access to credit declined and they were forced to curtail spending.[4]

Krugman (2001) also stated that, in the case of Indonesia, bank runs and a freezing up of the credit system played important roles. Declines in bank capital and disintermediation reduced the willingness of banks to supply loans. Business borrowers facing a once in a generation crisis lost their credit lifelines and were forced to curtail spending and production.

When spillovers from Thailand's currency crisis reached Indonesia, the Central Bank of Indonesia (BI) sought to preserve foreign currency reserves first by widening the exchange rate bands and then by floating the exchange rate. As pressure on the exchange rate continued, BI raised the interest rate on its certificates (Sertifikat Bank Indonesia or SBI's). At the same time, the Minister of Finance directed state enterprises to transfer 3.5 trillion rupiah of bank deposits into SBI certificates. These moves further damaged the banking sector (Djiwandono; 2000; Nasution, 2002; and McLeod, 2003). Banks were again harmed in October 1997 when the IMF demanded the closure of 16 banks which led to a bank run.[5] Azis (2001) and Enoch et al. (2001) discussed how depositors reacted with a "flight to quality", withdrawing funds from private domestic banks and depositing them in foreign and also state banks. Deposits in private domestic banks fell almost 20% between July 1997 and the beginning of 1998 while deposits in foreign banks doubled over this period (see **Figures 1** and **Figures 2**). As a result, private banks but not foreign banks were forced to curtail lending (see **Figures 3** and **Figures 4**).[6]

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[4]   The decline in retained earnings pushed debt/equity ratios unacceptably high, making creditors unwilling to provide loans.

[5]   Note that there were no bank closures in the early stages of the crises in Thailand and Korea. When these did occur, unlike in Indonesia, it was only with full deposit guarantees in place (see Greenville, 2004).

[6]   Believing banks were solvent but illiquid, BI extended overdraft facilities, *Bantuan Likuiditas Bank Indonesia* (BLBI). The amount of extended BLBI quickly soared, and some went to politically powerful banks, creating a strong moral hazard. Some recipient banks even used BLBI to transfer funds abroad.

Figure 1
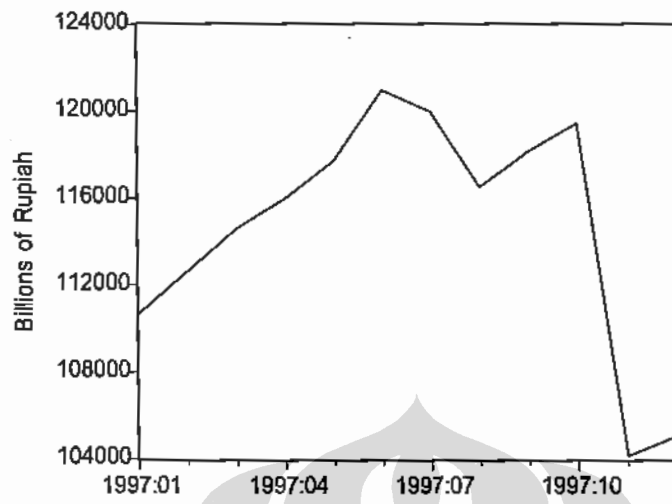*Saving and Time Deposits at Private Commercial Banks in Indonesia in 1997*

Figure 2
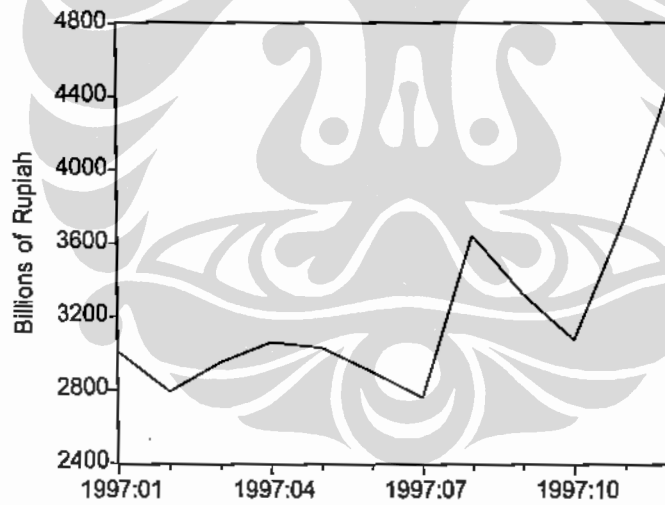*Saving and Time Deposits at Foreign Banks in Indonesia in 1997*

Figure 3
Loans of Private Commercial banks in Indonesia in 1997
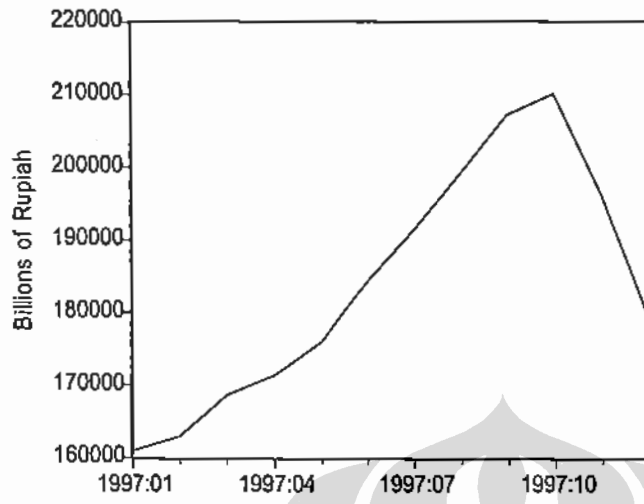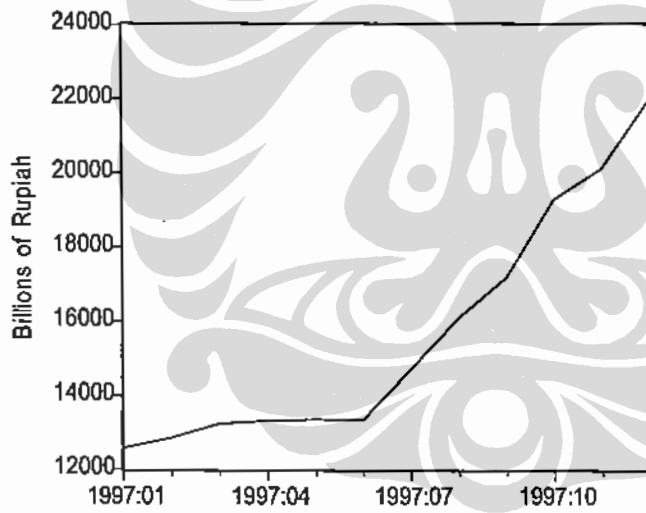

Figure 4
Loans of Foreign Banks in Indonesia in 1997

The depreciating exchange rates, high interest rates, and flight to quality, by eroding the balance sheets of domestic firms and the capital of domestic banks, caused aggregate lending to plummet. Aggregate credit creation fell because the decrease in loans by domestic banks was not offset by an increase in loans by foreign banks (see **Figure 5**).

Figure 5
*Loans of Private and Foreign Banks in
Indonesia During the Crises*
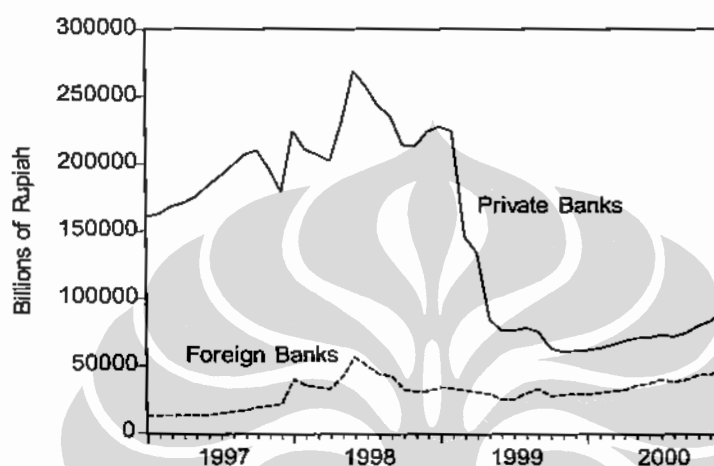
The objective of this paper is to measure the effects of exchange rate and interest rate shocks on the flow of bank lending in Indonesia. To do this, it examines the differential response of foreign and private domestic banks to macroeconomic shocks. Compared to domestic banks, foreign banks lent to businesses that were more creditworthy and more likely to be hedged against foreign exchange risk. Foreign banks should thus be more willing to lend following exchange rate depreciations since the balance sheets of their clients were healthier. In addition, foreign banks employed better risk management practices than domestic banks. They were thus better equipped to preserve bank capital and continue lending in the face of exchange rate and interest rate shocks. Finally, foreign banks were less vulnerable than domestic banks to bank runs that would force them to curtail lending and rebuild liquidity. Foreign banks can thus serve as a control group to measure the effects of macroeconomic shocks on bank lending.

Evidence indicates that interest rate increases and especially exchange rate depreciations decreased the capital of domestic banks relative to foreign banks. The results also indicate that these shocks reduced loan growth by domestic banks more greatly than loan growth by foreign banks. The findings imply that macroeconomic shocks restricted the flow of bank credit in Indonesia during the crisis and indicate that these effects were quantitatively important.

The next section examines the problems associated with identifying the loan supply. Section 3 then discusses the data and methodology employed in this research. Section 4 presents the results of the analysis and, finally, Section 5 provides a synthesis of the conclusions drawn from the research.

2. IDENTIFYING THE EFFECTS OF MACROECONOMIC SHOCKS ON BANK LOAN SUPPLY

For several reasons foreign banks in Indonesia were less vulnerable to the Bernanke-Gertler effects discussed above than private domestic banks. Foreign banks employed more professional loan application standards than private domestic banks. Consequently their loan pool includes more creditworthy customers. Foreign banks' customers, such as joint ventures or multinational corporations, were highly hedged against exchange rate risk before the crisis while domestic banks' customers, such as domestic firms, were largely unhedged.[7] Exchange rate shocks thus worsened balance sheets and access to credit more significantly for firms borrowing from private banks than for firms borrowing from foreign banks. Further, foreign banks tended to have better risk management practices than Indonesian banks. Foreign banks were thus better able than domestic banks to weather exchange rate and interest rate shocks, preserve bank capital, and continue lending. Finally, foreign banks were less vulnerable to bank panics than domestic banks because depositors knew they were reputable and could be recapitalized from abroad, meaning that foreign banks were less likely to experience bank runs that would force them to rebuild liquidity and curtail lending. Therefore, investigating differences in lending behavior between domestic and foreign banks in Indonesia can shed light on how the crisis affected bank credit.

This paper uses lending by foreign banks as a control group to identify the effects of macroeconomic shocks on lending by domestic banks. Examining whether exchange rate and interest rate shocks restricted lending at domestic banks relative to foreign banks can help explain how the crisis affected bank lending.

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[7]   Djiwandono (2000) also discusses the fact that domestic firms were largely unhedged.

The effect of the crisis on loan supply is represented in **Figure 6**. In a world of imperfect information, an exchange rate depreciation that worsens clients' balance sheets should increase risk premia and make domestic banks less willing to supply loans at existing interest rates. Thus domestic banks' loan supply curves will shift up and to the left. If at the same time macroeconomic shocks erode bank capital or trigger financial disintermediation, the loan supply curve will shift further up and to the left.

Figure 6a
*Response of SBI Rate to a One Standard
Deviation Positive Shock to Inflation*
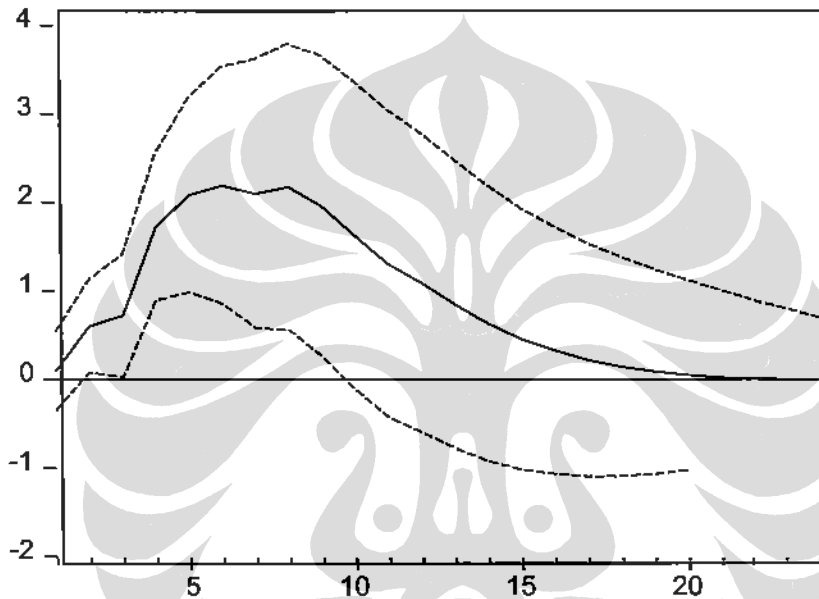
For foreign banks there will be some effect of exchange rate and interest rate shocks on loan supply. However, as discussed above, foreign bank customers were largely hedged, foreign banks had better risk management practices, and foreign banks were less vulnerable to disintermediation. Thus their loan supply response will be attenuated. To the extent that foreign bank loan supply also decreases, our tests would be biased against finding an effect of macroeconomic shocks on the domestic loan supply.

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It is also necessary to consider loan demand. An exchange rate depreciation that decreases retained earnings would cause an increase in loan demand by firms facing short term financing requirements. This would cause the demand curve in **Figure 6** to shift up and to the right.

Figure 6.b
Loan Market
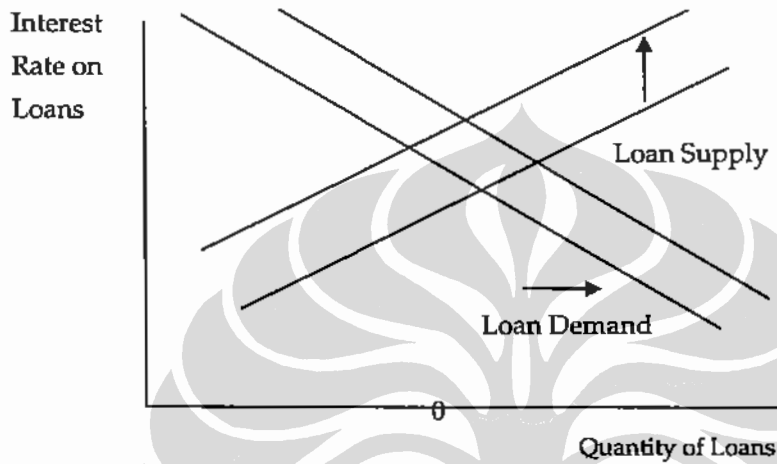
Since foreign banks lent to firms that were largely hedged while domestic banks lent to firms that were largely unhedged, customers of domestic banks should experience larger drops in retained earnings following exchange rate depreciation. Customers of domestic banks would thus have greater needs for short term credit, causing loan demand curves for domestic banks to increase more than loan demand curves for foreign banks. The greater increase in loan demand at domestic banks relative to foreign banks implies that our tests will understate the effect of exchange rate shocks on the domestic loan supply. This will increase the probability of a type II error, implying that our tests will be too conservative. They will tend to fail to reject the null hypothesis that exchange rates changes do not affect domestic loan supply even when exchange rate changes do have this effect.

3. DATA AND METHODOLOGY

3. Data and Methodology

Since exchange rates and interest rates are endogenous it is difficult to infer how changes in these variables affect bank lending and other economic variables. To solve the simultaneous causality problem we need components of exchange rates and interest rates that are exogenous to the state of the economy. These can be obtained by employing a vector autoregression (VAR). A VAR is a regression of an n by 1 vector of endogenous variables, y_t, on lagged values of y_t:

$$y_t = A_1 y_{t-1} + \ldots + A_p y_{t-p} + \epsilon_t, \ E(\epsilon_t \epsilon_t') = \Omega. \ \ldots\ldots\ldots (1)$$

Equation (1) can be inverted and represented as an infinite-vector moving average process:

$$y_t = \epsilon_t + C_1 \epsilon_{t-1} + C_2 \epsilon_{t-2} + C_3 \epsilon_{t-3} + \ldots\ldots (2)$$

One problem with equation (2) is that the individual error terms in ϵ_t may be contemporaneously correlated. The Cholesky factorization can be used to obtain orthogonalized innovations. This approach involves finding a lower triangular matrix P such that $\Omega = PP'$, where Ω is the variance-covariance matrix of ϵ_t. In this case equation (2) can be rewritten as:

$$y_t = PP^{-1}\epsilon_t + C_1 PP^{-1}\epsilon_{t-1} + C_2 PP^{-1}\epsilon_{t-2} + \ldots = \Gamma_0 \upsilon_t + \Gamma_1 \upsilon_{t-1} + \Gamma_2 \upsilon_{t-2} + \ldots \ \ (3)$$

where $\Gamma_i = C_i P$, $\upsilon_t = P^{-1}\epsilon_t$, and $E[\upsilon_t \upsilon_t'] = I$. Equation (3) represents the macroeconomic variables (y_t) as functions of the orthogonalized residuals (υ_{t-i}). If components of υ_t represent shocks to exchange rates or interest rates, impulse-response functions can trace out the dynamic responses of variables such as bank capital or bank lending to exchange rate or interest rate shocks.

The variables we use include the first difference of the rupiah/dollar exchange rate, the consumer price index inflation rate, the return on the Jakarta Stock Exchange Index, the interest rate on 1-month central bank certificates (the SBI rate), and measures of bank capital and bank lending by domestic and foreign banks. For bank capital we use the

difference between the capital/asset ratio of foreign and domestic banks. For bank lending we use the difference between the growth rates of foreign and domestic bank loans. We obtained these data from the Indonesian Central Statistical Bureau (BPS), the Central Bank (BI), and the Jakarta Stock Exchange (JSX). The sample period extends from April 1993 to January 2002. This means that each equation has 106 observations. To preserve degrees of freedom, we use three lags of each variable. The results, though, are similar when we employ two or four lags.

In calculating impulse-response functions, the ordering of the variables is important. The variables ordered prior are assumed to affect within the month the variables ordered later but not be affected by them. We assume that changes in the exchange rate are causally prior. The exchange rate was often driven by contagion effects, riots, and changes in confidence during our sample period. We then assume that the central bank SBI interest rate responds to the exchange rate, the inflation rate, and a measure of real activity. We thus place the SBI rate after these variables in the recursive ordering. To measure real activity, since there are no monthly data on output, unemployment, or industrial production in Indonesia, we use the return on the JSX index. Stock prices in theory equal the expected present value of future cash flows. Thus changes in stock prices should provide information on shocks to future cash flows and economic activity. After the SBI rate we include the bank capital or bank lending variables.

4. RESEARCH RESULTS

Figure 7 shows the effect of an exchange rate shock on inflation. As expected, depreciation in the exchange rate tends to increase the inflation rate. The middle line represents point estimates and the outer lines represent plus and minus two standard deviation bands. The results indicate that the predicted effect of an exchange rate shock on inflation remains two standard deviations greater than zero for all but one of the first seven months.

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Figure 7
*Response of Inflation to a One Standard
Deviation Shock to the Exchange Rate*
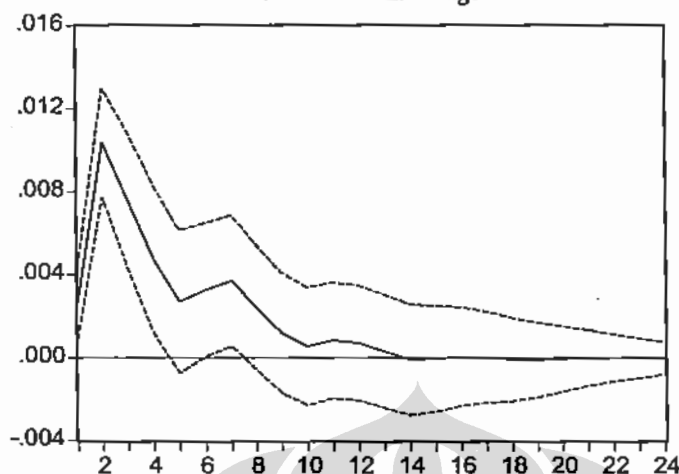
Figures 8 and Figures 9 show the effects of exchange rate shocks and inflation shocks on the SBI rate. As expected, the results indicate that both a depreciation of the currency and an increase in inflation increase the rate on central bank certificates. This implies that the Indonesian Central Bank responds to an unexpected depreciation or increase in inflation by raising the SBI interest rate. For the exchange rate the interest rate response remains two standard deviations above zero for 12 months and for the inflation rate the interest rate response remains two standard deviations above zero for ten months.

Figures 10 and Figures 11 show the effect of exchange rate and interest rate shocks on the difference between the capital/asset ratio of private domestic banks and foreign banks. In the first case, a one standard deviation unexpected depreciation in the exchange rate causes the capital/asset ratio of private banks to fall by 1.7 percentage points more than the capital asset ratio of foreign banks. A one standard deviation shock represents a depreciation of 868 rupiah per dollar. In the second case, a one standard deviation unexpected increase in the interest rate causes an upward blip in the capital/asset ratio of domestic banks relative to foreign banks and then decreases it by 0.5 percentage points. A one standard deviation shock represents an increase in the SBI rate of 2.13 percentage points. For both exchange rate and interest rate shocks the responses are two standard deviations below zero. Exchange rate depreciations and interest rate increases thus reduce the capital of domestic banks relative to the capital of foreign banks.

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Figure 8
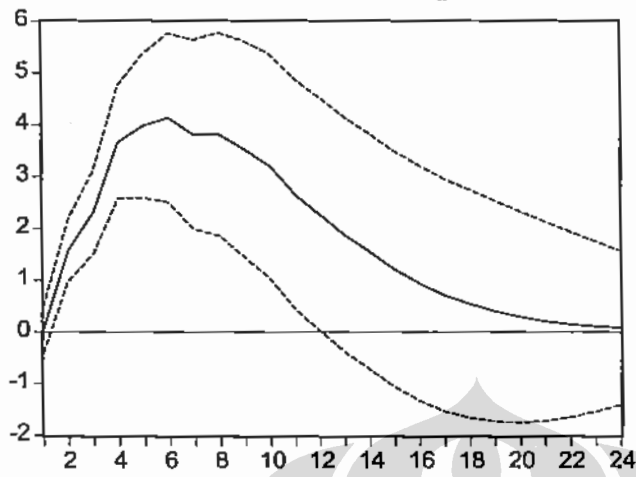*Response of the SBI Rate to a One Standard*
Deviation Shock to the Exchange Rate

Figure 9
Response of the SBI Rate to a One Standard
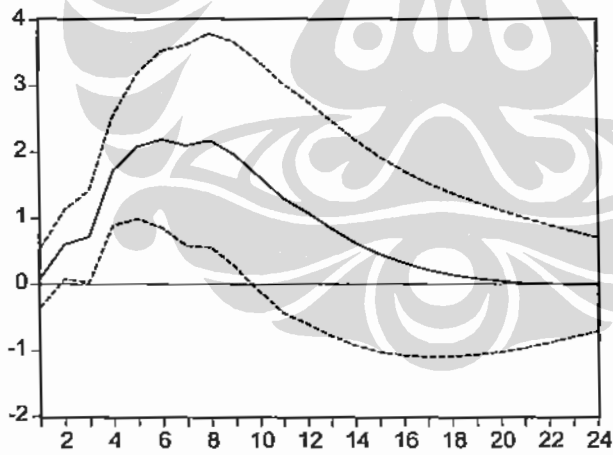*Deviation Shock to the Inflation*

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Figure 10
Respons of the Difference Between Loan Growth at Private and
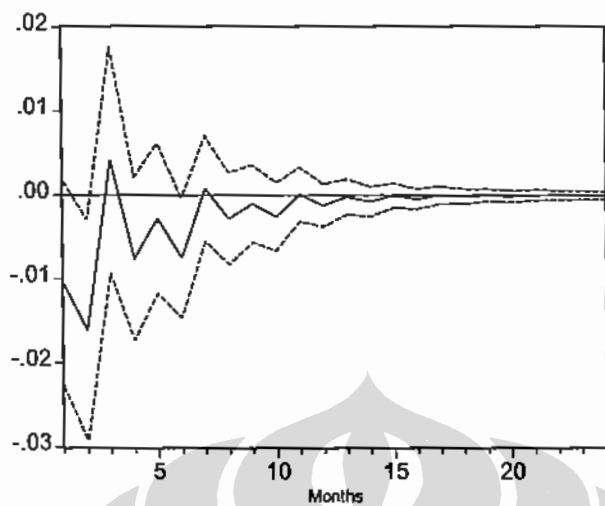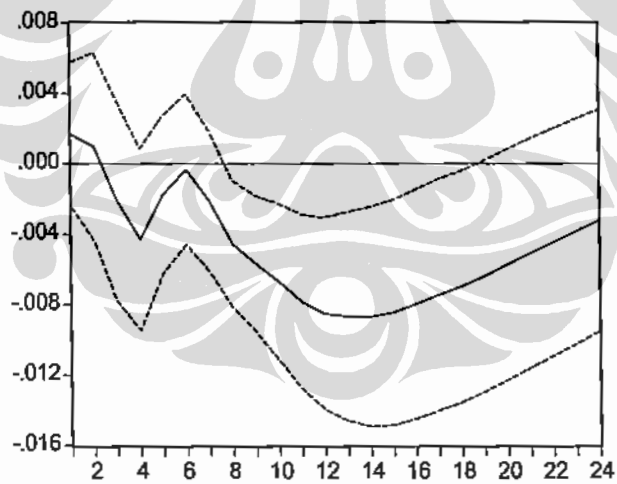*Foreign Banks to a One Standard Deviation Positive SBI Shock*

Figure 11
Response of the Difference Between the Capital Asset Ratio of Private and
Foreign Bank to a One Standard Deviation Positive Inflation Shock

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Exchange rate depreciations and interest rate increases also decrease loan growth at domestic banks relative to foreign banks. In the first case, a one standard deviation unexpected exchange rate depreciation causes a shortfall of domestic loan growth relative to foreign loan growth of 4.6% in the initial period. The associated t-statistic is 6.68. In the second case, a one standard deviation unexpected interest rate increase causes a shortfall of domestic loan growth relative to foreign loan growth of 1.1% in the initial period and 1.6% in the second period. The associated t-statistics are 1.74 and 2.45 respectively.

There is thus a large and statistically significant difference between the response of domestic banks and foreign banks to macroeconomic shocks. Exchange rate depreciations and interest rate increases greatly reduce capital at domestic banks much more than at foreign banks. They also decrease loan growth at domestic banks relative to foreign banks. The important implication of these findings is that macroeconomic shocks during the crisis curtailed the ability of domestic banks to supply loans. Since domestic banks provided twenty times more loans than foreign banks, the increase in loans by foreign banks could not offset the decrease in loans by domestic banks. The crisis thus caused a large reduction in the amount of credit channeled through the banking system, forcing firms to curtail spending and production.

5. CONCLUSION

This paper has sought to test and quantitatively measure the effects of exchange rate and interest rate shocks on the bank loan supply in Indonesia. To do this, it has investigated whether domestic commercial banks and foreign banks respond differently to exchange rate and interest rate shocks. Compared to domestic banks, foreign banks have customers who are more likely to be hedged against exchange rate risk; foreign banks employ better risk management practices; and foreign banks are less vulnerable to bank panics. Thus foreign bank loan supply should respond less to macroeconomic shocks than the domestic bank loan supply. Examining differences in lending behavior between domestic and foreign banks in Indonesia can shed light on how the crisis affected bank loan supply. Evidence from impulse-response functions indicates that interest rate increases and especially exchange rate depreciations caused a much larger decrease in the capital of domestic banks than of foreign banks. The evidence also indicates that these shocks reduced lending at domestic banks relative to lending at foreign banks, leading to a large decrease in the supply of loans during the crisis.

This decrease in intermediation played an important role in exacerbating the crisis. The depreciating exchange rate provided

opportunities for exporting firms to sell cheaply abroad. To cover production costs, however, they needed letters of credit and short term financing. The erosion of bank capital and firms' balance sheets prevented exporting firms from obtaining this credit. They were thus forced to curtail production and forego exporting opportunities.

Future research could incorporate the findings of this paper into a financial computable general equilibrium model (Azis, 2001 and Azis 2002). This would make it possible to trace the channels through which a decrease in credit supply affects the economy. It would also make it possible to quantify the effects of a decrease in loan supply on investment, exports, and output during a crisis.

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