Another Look at Origins of the Asian Crisis:
Tests of External Borrowing Constraints

Ryuzo Miyao
Research Institute for Economics and Business Administration
Kobe University
Rokko, Nada, Kobe 657-8501 JAPAN
Phone: +81-78-803-7014
Fax: +81-78-861-6434

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Economic and Social Research Institute
Cabinet Office
Tokyo, Japan
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[Abstract]
The existing discussions about origins of the Asian crisis can be summarized into two broad views: "economic fundamentals" view and "financial panic" view. This paper attempts to distinguish these two views empirically by testing external solvency of the country using intertemporal borrowing constraints. It adopts the procedures developed by Ahmed and Rogers (1995) and Trehan and Walsh (1991) and examines three affected countries: Thailand, Indonesia and Korea. The evidence indicates that while the external solvency condition was generally satisfied in Indonesia and Korea in the pre-crisis period, it was not the case for Thailand with a sample extending to the 1990s when massive capital inflows took place. This suggests that economic fundamentals were the main origins of the Thai crisis while a financial panic was a more plausible explanation of Indonesian and Korean crises.

Key words: Asian crisis, solvency, external borrowing constraints

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1. Introduction

Numerous research papers, books and proceedings have been produced attempting to identify the potential sources of the Asian crisis in 1997. The existing discussions on causes or origins of the Asian crisis can be summarized into two broad views: "economic fundamentals view" and "financial panic view." In the fundamentals view, the crisis is attributed to weak economic fundamentals such as inconsistent economic policies or vulnerable financial systems. Note that the currency crisis was an inevitable consequence of bad fundamentals. In the financial panic view, even though economic fundamentals were basically sound and did not warrant a crisis, international creditors suddenly changed their expectations and lost confidence about the behavior of other creditors (i.e. fear that other depositors withdraw their money), so that they refused to roll over credit. This resulted in a financial panic such as bank runs in a self-fulfilling manner and caused the crisis (See e.g. Glick (1998) and Chang (1998)).

There are at least two important policy implications to distinguish these two alternative views. First, in planning post-crisis recovery, if bad fundamentals were the main sources of the crisis, macroeconomic policy and financial sector reforms are crucial ingredients in the policy package. If, on the other hand, the crisis was mainly caused by a financial panic, these reforms are not necessarily indispensable. Second, on the issue of whether there should be an international lender of last resort, two views also have different implications. If fundamentals were the primary origins, the existence of such facility may be of little use. It would rather induce a government to continue bad policy practices. If, however, a financial panic explanation was more plausible, international investors have no reason to panic with the presence of an international lender of last resort, and therefore it would be helpful to prevent crises.

Which view is a more relevant explanation of the Asian crisis? To the best of my knowledge, the existing studies have not yet fully investigated this question. This paper attempts to answer this question by focusing on one summary indicator of economic fundamentals that has an inevitable implication of a crisis: external solvency. If a country
did not satisfy its intertemporal external borrowing constraint and therefore became insolvent internationally, massive capital outflows and a subsequent crisis were unavoidable due to the fundamentals reason. If, on the other hand, the country satisfied the external solvency condition but nevertheless suffered from a crisis, this may be attributed to a self-fulfilling panic under international illiquidity, where there was a maturity mismatch between short-term liabilities and long-term assets in the country's financial system.

To formally investigate external solvency of the country, we apply testing procedures developed in the literature of a government's solvency problem (e.g. Hamilton and Flavin (1986), Hakkio and Rush (1991), Haug (1991), Trehan and Walsh (1991) and Ahmed and Rogers (1995)). Among others, Trehan and Walsh (1991) and Ahmed and Rogers (1995) discussed a more general, stochastic environment and examined the sustainability of external deficits as well as government deficits in developed countries. Sawada (1994) adopted a similar approach to the international debt problems in the heavily indebted countries in Latin America and Asia in the 1980s. Following this line of research, this paper investigates the external solvency in East Asia in the context of the recent crisis episodes. In particular, we examine the case of three affected countries: Thailand, Indonesia and Korea, where the IMF rescue packages were needed.

Summarizing the main findings here, our evidence indicates that while the external solvency condition was generally satisfied in Indonesia and Korea in the pre-crisis period, it was not the case for Thailand with a sample extending to the 1990s when massive capital inflows took place. This suggests that economic fundamentals were the main origins of the Thai crisis and the financial panic view was a more relevant explanation for Indonesian and Korean crises.

The plan of this paper is as follows. Section 2 provides a brief survey on the origins of the Asian crisis. Section 3 explains the econometric framework. Section 4 offers the empirical evidence. The final section gives concluding remarks.
2. A Brief Survey on the Origins of the Asian Crisis

This section briefly summarizes the existing explanations on the causes of the Asian crisis. While quite a few books, papers and proceedings have discussed the origins of the Asian crisis episodes, two broad views have emerged in the literature: "economic fundamentals" view and "financial panic" view.

The fundamentals view asserts that a crisis can be attributed to economic fundamentals such as bad economic policy or weakness of the financial systems. In the traditional literature on balance of payment crises, the "first-generation" models (e.g. Krugman (1979)) argue that a fixed exchange rate regime has to be abandoned if a government has a limited international reserve and runs a persistent fiscal deficit by printing money. Hence a currency crisis is an inevitable consequence of inconsistent macroeconomic policy.

Following a similar line of argument, a more recent first-generation literature emphasizes a different kind of policy inconsistency, that is, inconsistency of maintaining the exchange rate peg and domestic financial stability simultaneously in an open economy setting (e.g. Dooley (2000), Chinn, Dooley and Shrestha (1999)). A government insures domestic private liabilities to stabilize its financial system. Given that the exchange rate is fixed, foreign as well as domestic investors are willing to purchase these liabilities that are insured by the government. As the domestic credit expands, implicit insurance liabilities of the government also increase and eventually reach a limit (i.e. exceed the amount of the government's reserve assets or "insurance fund"), when the speculative attack occurs. Thus a currency crisis is unavoidable and fully anticipated in this version of the fundamentals view.

The financial panic view, on the other hand, argues that economic fundamentals were generally sound, or, if not entirely satisfactory, they did not warrant a crisis. Instead international investors suddenly changed their expectations and lost confidence about

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1 Furman and Stiglitz (1998) and Ito (1999), among others, provide general discussions on the Asian crisis. See e.g. Glick (1998), Chang (1998), and Radelet and Sachs (1998) for related discussions on these two views.
other creditors (i.e. fear that other depositors withdraw their money) and refused to roll over credit, which resulted in a self-fulfilling panic and caused a crisis (e.g. Chang and Velasco (2000, 2001)). Note that a crisis need not happen in this view. Nonetheless it can happen when the economy is solvent but illiquid internationally. Given that there is a maturity mismatch where short-term international liabilities are much greater than short-term assets, any trigger — which may or may not be related with economic fundamentals — could cause a self-fulfilling panic and a subsequent crisis. This self-fulfilling mechanism and its emphasis on the role of market expectations resemble the "second-generation model" of currency crises such as Obstfeld (1986).

Distinguishing these two alternative views has important implications for public policy, as mentioned in the introductory section above, and therefore must be of great interest. But it is also true that the task is not so straightforward. Suppose one or more economic indicators representing fundamentals deteriorated and subsequently a currency crisis took place. This does not necessarily mean that the crisis inevitably occurred due to fundamentals reasons. It may also be the case that weak fundamentals triggered a self-fulfilling panic of international investors, which resulted in a crisis. There is a large body of literature on "crisis prediction," in which researchers explore whether currency crises are predictable phenomenon using one or several indicators of fundamentals (e.g. Kaminsky, Lizond and Reinhart (1998), Goldfajn and Valdes (1998), Berg ad Pattillo (1999)). It should be noted that even when one can show a set of fundamentals help predict currency crises, the evidence itself would be of little help to distinguish these two views.

Chang and Velasco (1998, Table 3) provide suggestive evidence of international illiquidity that is consistent with the financial panic view. They show that the ratio of short-term

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2 There were actually many signs of deteriorating fundamentals prior to the Asian crisis in each of the affected countries: slower export growth and increased current account deficits, appreciation of real exchange rates, the slump in the semiconductor industry, increased recognition of vulnerable financial systems (e.g. risky lending practices by nonbank institutions), drops in stock and real estate prices, etc.
debt to international reserves for the Asean-five countries (Indonesia, Korea, Malaysia, Philippines and Thailand) in the pre-crisis period. A ratio higher than one implies a situation of international illiquidity, and in fact, as of June 1997, the ratio exceeds one in Indonesia, Korea and Thailand, where the crises were regarded as most severe in the region and the IMF rescue packages were actually needed (the ratios are 1.70, 2.06 and 1.45, respectively). But, to claim the financial panic view, we need to show that these countries are not only illiquid internationally but also solvent in the long term.

For these reasons, we perform a formal analysis of solvency for these three affected countries using the external borrowing constraints. If these countries satisfied external solvency, this would actually be in support of the financial panic view. If, however, they were insolvent prior to the crisis, the fundamentals view would be a more relevant explanation. We therefore examine external borrowing constraints in these three countries to identify these two views. The next section explains details of our econometric framework.

3. Econometric Framework

We now describe the analytical framework based on external borrowing constraints of the economy. We apply testing procedures developed in the literature of a government’s solvency problem (e.g. Hamilton and Flavin (1986), Hakkio and Rush (1991), Haug (1991), Trehan and Walsh (1991) and Ahmed and Rogers (1995)). Among others, Trehan and Walsh (1991) and Ahmed and Rogers (1995) discussed a more general, stochastic environment and examined the sustainability of external deficits as well government deficits.

Following Ahmed and Rogers (1995), the current period budget constraint of the economy is expressed as:

\[ C_t + I_t + r_t B_{t-1} - Y_t = B_t - B_{t-1} \]  

where \( C_t \) is consumption, \( I_t \) is investment, \( r_t \) is the one-period interest rate, \( B_t \) is external debt and \( Y_t \) is output, all in real terms.
Forward substitutions of (1) yield the intertemporal budget constraint with expectation at time $t$:

$$B_0 = E_t \sum_{j=1}^{\infty} \prod_{k=1}^{j} \left( \frac{1}{1 + r_{t+k-1}} \right) (X_{t+j} - M_{t+j}) + \lim_{j \to \infty} E_t \prod_{k=1}^{j} \left( \frac{1}{1 + r_{t+k-1}} \right) B_{t+j}$$  \hspace{1cm} (2)

where $X_t$ and $M_t$ are exports and imports in real terms and $X_t - M_t = Y_t - C_t - I_t$.

Denote $s_{t,j}$ as marginal rate of substitution between consumption in period $t$ and $t+j$:

$$s_{t,j} = \beta^j u'(C_{t+j}) / u'(C_t)$$  \hspace{1cm} (3)

The Euler equation from the consumer's optimization problem also holds, i.e.

$$E_t [(1 + r_t) s_{t,1}] = 1.$$  Then, $E_t s_{t,j} = E_t \prod_{k=1}^{j} (1/(1 + r_{t+k-1}))$ Hence,

$$B_t = E_t \sum_{j=1}^{\infty} s_{t,j} (X_{t+j} - M_{t+j}) + \lim_{j \to \infty} E_t s_{t,j} B_{t+j}$$  \hspace{1cm} (4)

When the limit term on the right-hand side of equation (4) is equal to zero, the external debt outstanding equals to the expected present value of the future net surplus. This rules out the possibility of bubble financing of the economy and is also known as no-Ponzi game condition. The country is solvent if this condition is satisfied.

To derive a testable implication, we take the first difference of (4), yielding:

$$\Delta B_t = \Delta E_t \sum_{j=1}^{\infty} s_{t,j} (X_{t+j} - M_{t+j}) + \lim_{j \to \infty} E_t s_{t,j} B_{t+j} - \lim_{j \to \infty} E_t s_{t-j-1,j-1} B_{t+j-1}$$  \hspace{1cm} (5)

Under some certain (and plausible) conditions, Ahmed and Rogers (1995) demonstrated that the presence of a cointegrating relationship in $(X_t, M_t, r_t, B_{t-1})$ with the cointegration vector $(1, -1, -1)$ is a necessary and sufficient condition for the present-value budget constraint to hold (i.e. the limit term in equation (4), and therefore two limit terms in equation (5), to be zero).

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3 Key assumptions here include (i) $X_t$ and $M_t$ are characterized as a unit root stochastic process or integrated of order one ($I(1)$), and (ii) marginal utility of consumption ($u'(C_t)$) follows a random walk, and (iii) the behavior of external debt ($B_t$) is considered as $B_t = \mu + B_{t-1} + \lambda' + u_t$ where $|\lambda| < 1$, $u_t$ is a covariance-stationary disturbance term
In a similar stochastic setup, Trehan and Walsh (1991) also showed that if \( r_t \) is a stochastic process strictly bounded below by \( 1 + \delta (\delta > 0) \) in expected value and \( \Delta B_t \) is a stationary process, the external budget constraint is satisfied. Thus stationarity of \( B_t - B_{t-1} \) is a sufficient condition for the external solvency in the Trehan-Walsh approach.\(^4\)

We will employ these two test procedures for the case of the Asian crisis below.

4. Empirical Results

4.1 Data

We use quarterly observations for the pre-crisis period of 1976:1-1997:2 for Thailand, 1981:1-1997:2 for Indonesia and 1976:1-1997:3 for Korea, taken from the IMF's International Financial Statistics (IFS).\(^5\) The series for \( X_t, M_t \) and \( r_{t-1}B_{t-1} \) are exports of goods and services, imports of goods and services, and net interest payments, respectively. The change in external debt \( (B_t - B_{t-1}) \) is measured as the financial account in the IFS which includes net direct investment, net portfolio investment and net other investment, all from abroad. The time series of these current account data as well as external debt for three countries are displayed in Figures 1, 2 and 3. Graph A displays exports (real line) and imports (dashed line), Graph B net interest payments, Graph C current account, and Graph D external debt (i.e. the sum of the flow values).

4.2 Cointegration test among exports, imports and net interest payments

We first perform a cointegration test of Ahmed and Roger (1995), i.e. testing whether \( a \) and \( \mu \) is a constant.

\(^4\) This is Proposition 2 of Trehan and Walsh (1991, p.215). Note that this proposition does not rely on any assumptions about the individual \( B_t \) and \( X_t - M_t \) series.

\(^5\) The starting date for each country is given due to the availability of the IFS dataset. The sample period ends in the quarter prior to each country introduced the floating exchange rate regime: July 1997 for Thailand, August 1997 for Indonesia, and December 1997 for Korea.
cointegrating relation among exports, imports and net interest payments with the cointegrating vector \((1, -1, -1)\) is supported by the pre-crisis data in the three countries.

As a preliminary, we check whether each of the variables are treated as \(I(1)\). Here two unit root tests are implemented: the augmented Dickey Fuller (1979) tests of a unit root against no unit root (ADF), and a modified Dickey-Fuller test based on GLS detrending series (DF-GLS), a powerful univariate test proposed by Elliot, Rothenberg and Stock (1996). Those tests include a constant term and a linear trend for the series in levels (i.e. detrended tests) and a constant term only for the series in first differences (i.e. demeaned tests). For Indonesia, demeaned tests are performed for these series in levels because the presence of a linear time trend is not apparent in Figure 2. The lag length is chosen by BIC for both of these tests (up to six lags).

Table 1 presents unit root test results (see the notes to the table for the appropriate critical values used here). While each of the two tests does not reject the null of a unit root for the level series, strong rejections are generally found for the first differenced series. We therefore consider that the variables \(X_t, M_t\), and \(r_{t-1}B_{t-1}\) can be all characterized as \(I(1)\).

Then we test for a cointegration among those three variables with the cointegrating vector \((1, -1, -1)\). When that cointegrating vector is imposed, the cointegration test here simply becomes a unit root test for the univariate \(X_t - M_t - r_{t-1}B_{t-1}\) series. The two unit root tests (ADF and DF-GLS) are again used in this analysis. The tests include a constant term and the lag is chosen by BIC. In this analysis, we examine not only the full sample but also a subsample spanning before rapid capital inflows appeared to take place for each country: 1976:1-1988:4 for Thailand, 1981:1-1994:4 for Indonesia, and 1976:1-1993:4 for Korea (see Figures 1, 2 and 3).

Table 2 shows the cointegration test results. The null is rejected by these two tests for almost all the cases. The only exception is Thailand with the full sample where the null is not rejected from each of the tests.

The results imply the external solvency condition had been generally satisfied for the
pre-crisis period in Indonesia and Korea. As for Thailand, the present-value budget constraint was satisfied until late 1980s, but after massive capital inflows took place in the 1990s, the solvency condition did not hold any longer. This suggests that the Thai crisis in July 1997 inevitably occurred because the country was externally insolvent at that time. Thereby the fundamentals view may be relevant in Thailand. For Indonesia and Korea, the financial panic view seems more plausible as these countries were internationally solvent but nevertheless were hit by a currency crisis.

4.3 Unit root test for the changes in external debt

We further conduct a solvency test of Trehan and Walsh (1991), where the stationarity of $B_t - B_{t-1}$ is examined. We once again use the two unit root tests for $B_t - B_{t-1}$ series in each country. The tests include a constant and the lag is selected by BIC. In this exercise, we use another subsample that ends in 1996:4 to take into account that capital outflows already took place in early 1997 as suggested in the case of Thailand (see Figure 1).

Table 3 shows the test results. In the case of Thailand (Panel A), the null of a unit root is strongly rejected for the 1976:1-1988:4 period, implying that the country’s external solvency condition had been satisfied before massive capital inflows began. With the full sample, we detect a weak rejection (10% level) by DF-GLS, while with the 1996:4 subsample, no rejections are found from either of the two tests. This suggests that around late 1996, the economy was actually insolvent and capital outflows began in the early 1997 period, which may lead to this weak rejection result with the full sample. For Indonesia and Korea, we consistently find rejections from DF-GLS tests with all the sample periods examined. Since DF-GLS is a more powerful procedure than ADF, we interpret this evidence as indicating that the external solvency is generally supported in these countries.

4.4 Analysis extending to the post-crisis period

As a final analysis, we extend our sample period to the post-crisis period and perform the same tests as above (i.e. unit root tests for $X_t - M_t - r_{t-1} B_{t-1}$ and $B_t - B_{t-1}$ to see whether

Table 4 summarizes the test results. It is noteworthy that with this updated, post-crisis sample, we find strong rejections in Thailand. This actually indicates that in a couple of years of post-crisis adjustments, the Thai economy again becomes externally solvent. For Indonesia and Korea, the tests generally detect rejections, and therefore the economies remain solvent and sound in that respect. This implies that a currency crisis need not happen at this moment in any of these countries. If a crisis should take place, this must be attributed to a financial panic of international investors.

5. Concluding Remarks

This paper has focused on two alternative views on the origins of the Asian crisis in the literature: economic fundamentals view and financial panic view, and it has attempted to distinguish these views by testing external solvency of the country. We have adopted procedures developed by Ahmed and Rogers (1995) and Trehan and Walsh (1991) and examined the three affected countries: Thailand, Indonesia and Korea. The evidence indicates that while the external solvency condition was generally satisfied in Indonesia and Korea in the pre-crisis period, it was not the case for Thailand for the pre-crisis period extending to the 1990s when massive capital inflows took place. This suggests that the Thai crisis inevitably happened due to the fundamentals reason, while the crises in Indonesia and Korea were caused by a financial panic of international investors.

The evidence would also seem suggestive of the “contagion” of the Asian crisis. It seems probable that the Thai crisis that occurred from the fundamentals reason triggered a self-fulfilling panic in Indonesia and subsequently in Korea, which can be interpreted as a contagion of crises in East Asia. Hence examining the solvency condition may be a useful device to provide us with additional insights on the mechanism and origins of the Asian crises.

6 For example, Baig and Goldfajn (1999) examine the contagion of the Asian crisis focusing on the correlation of the financial markets in the region.
crisis episodes.
References


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Hakkio, Craig S. and Mark Rush, "In the Budget Deficit Too Large?" Economic Inquiry, 29 (1991), 429-445.


Trehan, Bharat and Carl E. Walsh, "Testing Intertemporal Budget Constraints:
<table>
<thead>
<tr>
<th>Variable</th>
<th>ADF</th>
<th>DF-GLS</th>
</tr>
</thead>
<tbody>
<tr>
<td>A. Thailand</td>
<td></td>
<td></td>
</tr>
<tr>
<td>$X_t$</td>
<td>-1.97(4)</td>
<td>-1.45(4)</td>
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<tr>
<td>$M_t$</td>
<td>-1.82(2)</td>
<td>-1.53(2)</td>
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<tr>
<td>$r_{1-t}B_{1-t}$</td>
<td>-0.54(3)</td>
<td>-1.30(3)</td>
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<tr>
<td>$\Delta X_t$</td>
<td>-2.84(3)+</td>
<td>-2.83(3)**</td>
</tr>
<tr>
<td>$\Delta M_t$</td>
<td>-4.12(1)**</td>
<td>-4.15(1)**</td>
</tr>
<tr>
<td>$\Delta r_{1-t}B_{1-t}$</td>
<td>-12.35(2)**</td>
<td>-1.36(4)</td>
</tr>
<tr>
<td>B. Indonesia</td>
<td></td>
<td></td>
</tr>
<tr>
<td>$X_t$</td>
<td>-2.18(4)</td>
<td>-0.96(4)</td>
</tr>
<tr>
<td>$M_t$</td>
<td>-1.91(5)</td>
<td>-1.35(5)</td>
</tr>
<tr>
<td>$r_{1-t}B_{1-t}$</td>
<td>-2.18(1)</td>
<td>-1.36(4)</td>
</tr>
<tr>
<td>$\Delta X_t$</td>
<td>-3.25(3)*</td>
<td>-3.28(3)**</td>
</tr>
<tr>
<td>$\Delta M_t$</td>
<td>-2.56(4)</td>
<td>-1.64(4)+</td>
</tr>
<tr>
<td>$\Delta r_{1-t}B_{1-t}$</td>
<td>-13.25(0)**</td>
<td>-12.83(0)**</td>
</tr>
<tr>
<td>C. Korea</td>
<td></td>
<td></td>
</tr>
<tr>
<td>$X_t$</td>
<td>-2.62(4)</td>
<td>-2.68(4)</td>
</tr>
<tr>
<td>$M_t$</td>
<td>-2.46(5)</td>
<td>-2.40(5)</td>
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<tr>
<td>$r_{1-t}B_{1-t}$</td>
<td>-1.73(3)</td>
<td>-1.80(3)</td>
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<tr>
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<td>-2.80(3)+</td>
<td>-2.07(3)*</td>
</tr>
<tr>
<td>$\Delta M_t$</td>
<td>-3.31(6)**</td>
<td>-2.69(4)**</td>
</tr>
<tr>
<td>$\Delta r_{1-t}B_{1-t}$</td>
<td>-7.43(2)**</td>
<td>-6.80(2)**</td>
</tr>
</tbody>
</table>

Notes: This table reports statistics testing for a unit root for exports ($X_t$), imports ($M_t$), and net interest payments ($r_{1-t}B_{1-t}$), all deflated by CPI, in the three Asian countries. ADF is the augmented Dickey-Fuller (1979) test of a unit root against no unit root and DF-GLS is a Dickey-Fuller test based on GLS-detrended series, proposed by Elliott, Rothenberg and Stock (1996). The tests include a constant and a linear trend for the series in levels (i.e. detrended tests) and a constant term only for the series in first differences (i.e. demeaned tests). As for Indonesia, demeaned tests are performed for the series in levels since a linear trend is not apparent in Figure 2. The sample period is 1976:1-1997:2 for Thailand, 1981:1-1997:2 for Indonesia and 1976:1-1997:3 for Korea. The lag lengths shown in the parentheses are chosen based on BLC (up to six lags). Critical values, tabulated by Fuller (1976) and Elliott, Rothenberg and Stock (1996), are: 10%(+)  5%(*)  1%(**)  

Detrended ADF  | -3.15  | -3.45  | -4.40  
DF-GLS         | -2.74  | -3.03  | -3.58  
Demeaned ADF   | -2.58  | -2.89  | -3.51  
DF-GLS         | -1.61  | -1.95  | -2.60  

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### Table 2. Cointegration Test Results
- Among exports, imports and net interest payments -

<table>
<thead>
<tr>
<th>Period</th>
<th>ADF</th>
<th>DF-GLS</th>
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<tbody>
<tr>
<td><strong>A. Thailand</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>76:1-88:4</td>
<td>-3.80(0)**</td>
<td>-3.15(0)**</td>
</tr>
<tr>
<td>76:1-97:2</td>
<td>-1.90(4)</td>
<td>-1.32(4)</td>
</tr>
<tr>
<td><strong>B. Indonesia</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>81:1-94:4</td>
<td>-2.81(4)+</td>
<td>-2.08(0)*</td>
</tr>
<tr>
<td>81:1-97:2</td>
<td>-3.12(4)*</td>
<td>-1.99(4)*</td>
</tr>
<tr>
<td><strong>C. Korea</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>76:1-93:4</td>
<td>-2.63(0)+</td>
<td>-2.41(0)*</td>
</tr>
<tr>
<td>76:1-97:3</td>
<td>-3.05(0)**</td>
<td>-2.92(0)**</td>
</tr>
</tbody>
</table>

**Notes:** This table reports statistics testing for cointegration among exports, imports and, net interest payments with cointegrating vector \((1, -1, -1)\), i.e. testing for a unit root for \(X_t - M_t - r_{t-1} B_{t-1} \). ADF is the augmented Dickey-Fuller (1979) test of a unit root against no unit root and DF-GLS is a Dickey-Fuller test based on GLS-detrended series, proposed by Elliott, Rothenberg and Stock (1996). Those tests include a constant term (i.e. demeaned tests). The lag lengths shown in the parentheses are chosen based on BIC (up to six lags). Critical values, tabulated by Fuller (1976) and Elliott, Rothenberg and Stock (1996), are:

- 10\% (+)  5\% (*)  1\% (**)  
  - ADF     -2.58   -2.89   -3.51  
  - DF-GLS  -1.61   -1.95   -2.60
### Table 3. Unit Root Test Results
- For changes in external debt -

<table>
<thead>
<tr>
<th>Period</th>
<th>ADF</th>
<th>DF-GLS</th>
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<tr>
<td><strong>A. Thailand</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>76:1-88:4</td>
<td>-5.08(0)**</td>
<td>-5.10(0)**</td>
</tr>
<tr>
<td>76:1-96:4</td>
<td>-1.24(2)</td>
<td>-0.87(2)</td>
</tr>
<tr>
<td>76:1-97:2</td>
<td>-2.20(1)</td>
<td>-1.94(1)+</td>
</tr>
<tr>
<td><strong>B. Indonesia</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>81:1-94:4</td>
<td>-2.13(4)</td>
<td>-2.05(4)*</td>
</tr>
<tr>
<td>81:1-96:4</td>
<td>-2.32(4)</td>
<td>-1.89(4)+</td>
</tr>
<tr>
<td>81:1-97:2</td>
<td>-2.29(4)</td>
<td>-1.78(4)+</td>
</tr>
<tr>
<td><strong>C. Korea</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>76:1-93:4</td>
<td>-2.49(1)</td>
<td>-2.28(1)*</td>
</tr>
<tr>
<td>76:1-96:4</td>
<td>-2.30(1)</td>
<td>-2.24(1)*</td>
</tr>
<tr>
<td>76:1-97:3</td>
<td>-2.49(1)</td>
<td>-2.45(1)*</td>
</tr>
</tbody>
</table>

Notes: This table reports statistics testing for a unit root for changes in external debt ($B_t-B_{t-1}$). ADF is the augmented Dickey-Fuller (1979) test of a unit root against no unit root and DF-GLS is a Dickey-Fuller test based on GLS-detrended series, proposed by Elliott, Rothenberg and Stock (1996). The tests include a constant term (i.e. demeaned tests). The lag lengths shown in the parentheses are chosen based on BIC (up to six lags). Critical values, tabulated by Fuller (1976) and Elliott, Rothenberg and Stock (1996), are:

- 10%($+$)  5%($*$)  1%($**$)
  - ADF     -2.58  -2.89  -3.51
  - DF-GLS  -1.61  -1.95  -2.60
Table 4. Additional Test Results  
- For samples extended to the post-crisis period -

<table>
<thead>
<tr>
<th>Variable</th>
<th>ADF</th>
<th>DF -GLS</th>
</tr>
</thead>
<tbody>
<tr>
<td>A. Thailand</td>
<td></td>
<td></td>
</tr>
<tr>
<td>$X_t-M_t-r_{t-1}B_{t-1}$</td>
<td>-3.24(4)*</td>
<td>-2.95(4)**</td>
</tr>
<tr>
<td>$B_t-B_{t-1}$</td>
<td>-2.64(0) +</td>
<td>-2.63(0)**</td>
</tr>
<tr>
<td>B. Indonesia</td>
<td></td>
<td></td>
</tr>
<tr>
<td>$X_t-M_t-r_{t-1}B_{t-1}$</td>
<td>-2.72(4)+</td>
<td>-2.11(4)*</td>
</tr>
<tr>
<td>$B_t-B_{t-1}$</td>
<td>-4.23(0)**</td>
<td>-3.90(0)**</td>
</tr>
<tr>
<td>C. Korea</td>
<td></td>
<td></td>
</tr>
<tr>
<td>$X_t-M_t-r_{t-1}B_{t-1}$</td>
<td>-2.47(0)</td>
<td>-2.27(0)*</td>
</tr>
<tr>
<td>$B_t-B_{t-1}$</td>
<td>-5.70(0)**</td>
<td>-5.44(0)**</td>
</tr>
</tbody>
</table>

Notes: This table reports statistics testing for a unit root for $X_t-M_t-r_{t-1}B_{t-1}$ and $B_t-B_{t-1}$ for updated samples extending to the post-crisis period. The sample period for each country is: 1976:1-2000:2 (Thailand), 1981:1-2000:1 (Indonesia) and 1976:1-1999:4 (Korea). ADF is the augmented Dickey-Fuller (1979) test of a unit root against no unit root and DF-GLS is a Dickey-Fuller test based on GLS-detrended series, proposed by Elliott, Rothenberg and Stock (1996). The tests include a constant term (i.e. demeaned tests). The lag lengths shown in the parentheses are chosen based on BIC (up to six lags). Critical values, tabulated by Fuller (1976) and Elliott, Rothenberg and Stock (1996), are:

<table>
<thead>
<tr>
<th>10% (+)</th>
<th>5%(*)</th>
<th>1%(**)</th>
</tr>
</thead>
<tbody>
<tr>
<td>A D F</td>
<td>-2.58</td>
<td>-2.89</td>
</tr>
<tr>
<td>D F-GL S</td>
<td>-1.61</td>
<td>-1.95</td>
</tr>
</tbody>
</table>
Figure 1. Current Account and External Debt in Thailand

A. Exports and imports

B. Net interest payments
Figure 1. (continued)

C. Current account

D. External debt
Figure 2. Current Account and External Debt in Indonesia

A. Exports and imports

B. Net interest payments
Figure 2. (continued)

C. Current account

D. External debt
Figure 3. Current Account and External Debt in Korea

A. Exports and imports

B. Net interest payments
Figure 3. (continued)

C. Current Account

D. External debt