Economic Fundamentals or Financial Panic?
An Empirical Study on the Origins of the Asian Crisis*

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[Abstract]

The existing discussions about the origins of the Asian crisis can be summarized into two broad views: the "economic fundamentals" view and the "financial panic" view. This paper attempts to distinguish between these two views empirically by testing external solvency and examining intertemporal borrowing constraints of the three most-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 in the case for Thailand with a sample extending to the 1990s when massive capital inflows took place and external liabilities of the economy became unsustainable. This suggests that poor economic fundamentals were the main origins of the Thai crisis while financial panic was a more plausible cause of the Indonesian and Korean crises.

Key words: Asian crisis, economic fundamentals, financial panic, external solvency, intertemporal 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 origins of the Asian crisis can be summarized into two broad views: the "economic fundamentals view" and the "financial panic view." In the economic fundamentals view, the Asian crisis is attributed to weak economic fundamentals such as inconsistent economic policies, overspending in the private sector, and vulnerable financial systems. It implies that the currency crisis was an inevitable consequence of bad fundamentals. In the financial panic view, it is believed that 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 would withdraw their investments), so that they refused to roll over credit. This resulted in bank runs and other forms of self-fulfilling financial panic that caused the crisis (see, e.g., Glick 1998 and Chang 1998).

There are at least two important policy implications that distinguish between the 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 for the policy package. If, on the other hand, the crisis was mainly caused by a financial panic, these reforms are not necessarily indispensable. Second, the two views also have different implications on the issue of whether there should be an international lender of last resort. If economic fundamentals were the primary origins, the existence of such facility may be of little use. Conversely, it could actually induce a government to continue bad policy practices. If, however, the financial panic explanation were more plausible, international investors would 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 credible explanation of the Asian crisis? The existing literature has not yet fully investigated this question, as we briefly survey in the next section. In particular, there seems to be no formal econometric assessment to compare these two views of the Asian crisis. This paper attempts to answer the above question by focusing on a summary indicator of economic fundamentals that helps identify the source of a crisis: external solvency. Suppose a country did not satisfy its intertemporal external borrowing constraint because of inconsistent macroeconomic policies or overspending in the private sector, and therefore became insolvent internationally. Then massive capital outflows and a subsequent crisis would be unavoidable due to bad fundamentals. If, on the other hand, a country satisfied the solvency condition but nevertheless a crisis broke out, then the crisis 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 financial sector.

To formally investigate external solvency, we apply testing procedures developed in the literature relating to government solvency problems (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 of 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. In particular, we examine the cases of three affected countries: Thailand, Indonesia and Korea. Note that in these countries, IMF rescue packages were needed and the crises were more severe than in neighboring countries such as Malaysia and the Philippines. Moreover, as is

discussed in the following section, the existing evidence actually suggests that these three countries were internationally illiquid just before the crisis broke out (Chang and Velasco 1998) and therefore satisfied the conditions of a liquidity crisis. For these reasons, our investigation is particularly focused on the cases of these three countries.

Anticipating the main findings here, our evidence indicates that while the external borrowing constraint was generally satisfied in Indonesia and Korea in the pre-crisis period, it was not in the case of Thailand with a sample extending to the 1990s when massive capital inflows took place and external liabilities of the economy became unsustainable. This suggests that economic fundamentals were the main origins of the Thai crisis and financial panic was the more likely cause of the Indonesian and Korean crises.

The structure of this paper is as follows. Subsequent to this introduction, 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. Brief Survey of the Origins of the Asian Crisis

This section briefly summarizes the existing explanations on the causes of the Asian crisis. As mentioned above, quite a few books, articles and proceedings have discussed the origins of the Asian crisis, and two broad views have emerged: the economic fundamentals view and the financial panic view.[1]

The economic fundamentals view asserts that the crisis can be attributed to poor economic fundamentals such as bad economic policy, overspending in the private sector, and associated weaknesses in the financial sector. In the traditional

[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.

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 outcome of inconsistent macroeconomic policies.

Following a similar line of argument, more recent first-generation literature emphasizes a different kind of policy inconsistency, that is, inconsistency between maintaining simultaneously the exchange rate peg and domestic financial stability in an open economy (e.g. Dooley 2000). 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 because they are insured by the government. As the economy becomes overheated and domestic credit expands, implicit insurance liabilities of the government also increase and eventually reach a limit (i.e. the amount of liabilities exceeds 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. This is a variant of the fundamentals view and is clearly motivated by recent episodes of crises in the emerging markets such as the Asian crisis.

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 other creditors (i.e. fear that other depositors withdraw their investments) 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 greater than short-term assets, any trigger – which may or may not be related to 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).

Determining which of these two alternative views is correct has important implications for public policy, as was stressed in the introductory section above. But the task is not as straightforward as it may seem.

Suppose one or more fundamental economic indicators deteriorated and subsequently a currency crisis broke out.[2] This does not necessarily mean that the crisis inevitably occurred because of bad fundamentals. It may also be the case that fundamentals were not so seriously weakened and therefore did not warrant a crisis, but they 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 study whether currency crises are predictable phenomena using one or several fundamental economic indicators (e.g. Kaminsky, Lizondo, and Reinhart 1998; Goldfajn and Valdes 1998; Berg and Pattillo 1999). Even when one can show that a set of fundamentals help predict currency crises, the evidence is not necessarily useful to determine which of the two views is the root cause for the same reason.

In the existing literature, Chinn, Dooley, and Shrestha (1999) for instance study the first hypothesis empirically. They examine a central implication of Dooley's insurance model (2000) and show that the ratio of foreign exchange reserves to domestic credit, a key variable that measures the relative size of contingent liabilities of the government, is highly significant in their panel regression of

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[2] There were actually many signs of deteriorating fundamentals prior to the Asian crisis in affected countries. They include slower export growth, increased current account deficits, appreciation of real exchange rates, increased recognition of vulnerable financial systems (such as risky lending practices by nonbank institutions), drops in stock and real estate prices, etc. See, e.g., Ito (1999) for a detailed overview of both common and idiosyncratic factors in the Asian crisis.

currency crises in Latin America and East Asia. Note, however, that while the evidence seems to support Dooley's version of the fundamentals view, it does not necessarily deny the financial panic hypothesis, either. To iterate, there is still a possibility that changes in fundamentals did not warrant a crisis, but caused a crisis due to a self-fulfilling panic.

Some studies, on the other hand, present empirical evidence that supports the second view. For example, Chang and Velasco (1998, Table 13) document the evidence of international illiquidity that is consistent with the financial panic hypothesis. They indicate the ratios of short-term foreign debt to international reserves in the five most-affected ASEAN countries (Indonesia, Korea, Malaysia, the Philippines, and Thailand) in the pre-crisis period. A ratio higher than one implies that the country is illiquid internationally in the sense that international reserves would be insufficient to repay the short-term external liabilities when international investors decide not to role it over. Table 1 replicates the evidence presented by Chang and Velasco. In fact, as of the end of June 1997, the ratio exceeded one in Thailand, Indonesia, and Korea, while it was less than one in Malaysia and the Philippines. Radelet and Sachs (1998) also examine several determinants of financial crises including the short-term debt to reserves ratio and show that the ratio is strongly significant in their probit analysis.

It is indeed suggestive that severe currency crises broke out and the IMF rescue packages were actually needed exactly in the three internationally illiquid countries in Chang and Velasco's evidence. But nevertheless we cannot fully assure that the evidence is in support of the financial panic view over the fundamentals view. To really support the financial panic view, we must further claim that these currency crises need not have happened. In other words, these affected countries must be shown as internationally solvent as well.

These considerations motivate our formal analysis of external solvency focusing on the three affected countries, namely, Thailand, Indonesia, and Korea. If these

countries satisfied the solvency condition, this would actually support the financial panic view as they were already indicated as internationally illiquid. If, however, they were shown as insolvent prior to the crisis, the fundamentals view would be a more reasonable explanation. A formal test of external borrowing constraints would therefore be a useful device to differentiate between these two hypotheses. The next section explains details of our econometric framework.

3. Econometric Framework

We now describe the analytical framework based on external borrowing constraints of an economy. We apply testing procedures developed in the literature relating to government solvency problems (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) discuss a more general, stochastic environment and examine the sustainability of external deficits as well as government deficits. This paper adopts these two approaches.

We first explain the framework presented by Ahmed and Rogers. The current period budget constraint of an economy is expressed as:

$$C_t + I_t + r_{t-1}B_{t-1} - Y_t = B_t - B_{t-1} \qquad (1)$$

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.[3]

Forward substitutions of (1) yield the intertemporal budget constraint with expectation at time t:

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

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[3] The term for changes in foreign currency reserves is abstracted from this derivation. The testing frameworks here will be unaffected as long as the series is stationary. And later in footnote 8, we actually confirm the stationarity of this series from unit root tests.

where X_t and M_t are exports and imports in real terms and $X_t - M_t = Y_t - C_t - I_t$. Then we denote $s_{t,j}$ as marginal rate of substitution between consumption in period t and t+j:

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

and assume that the Euler equation from the consumer's optimization problem holds, i.e. $E_t[(1+r_t)s_{t,1}] = 1$. As demonstrated by Bohn (1995), this yields:

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

When the limit term on the right-hand side of equation (4) is equal to zero, the external debt outstanding equals 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:

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

Under some certain (and plausible) conditions, Ahmed and Rogers demonstrated that the presence of a cointegrating relationship in $(X_t, M_t, r_{t-1}B_{t-1})$ 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) are zero).[4]

The approach by Trehan and Walsh (1991) is also based on a similar stochastic

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[4] Key assumptions are (i) X_t and M_t are characterized as a unit root stochastic process or integrated of order one (I(1)); (ii) marginal utility of consumption ($u'(C_t)$) follows a random walk; (iii) covariance between $s_{t,j}$ and future exports and imports series (i.e. X_{t+j} or M_{t+j}) takes a fixed time-invariant value; and (iv) the behavior of external debt (B_t) is considered as $B_t = \mu + B_{t-1} + \lambda^t + u_t$ where μ is a constant, $|\lambda| < 1$, and u_t is a covariance-stationary disturbance term.

setup. They demonstrate that if r_t is a stochastic process strictly bounded below δ $(\delta > 0)$ in expected value and $B_t - B_{t-1}$ 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 framework. [5] Note that in this approach no assumptions are required in terms of the data generating process of the individual X_t or M_t series. We will employ these two frameworks below for the case of the Asian crisis.

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 International Financial Statistics (IFS) of the IMF.[6] 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 other net investment, all from abroad. All the data are deflated by consumer prices.[7] The time series of these current account and

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[5] This is Proposition 2 of Trehan and Walsh (1991, p. 215). The basic argument here is that when $B_t - B_{t-1}$ is stationary, the expected value of external debt outstanding B_t, which is the numerator of the limit term, grows at most according to a linear trend. On the other hand, the discount rate of future external debt in expected value is $E_t \prod_{k=1}^{j}(1 + r_{t+k-1})$ and therefore the denominator of the limit term grows exponentially. Thus the present discounted value of future debt converges to zero and the budget constraint is satisfied.

[6] 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 the period each country introduced the floating exchange rate regime: July 1997 for Thailand, August 1997 for Indonesia, and December 1997 for Korea.

[7] The IFS codes for these data are as follows: *78aad* plus *78add* for exports, *78abd* plus *78aed* for imports, *78ahd* minus *78agd* for net interest payments, *78bjd* for changes in external debt, and *64* for consumer prices.

external debt data for three countries are displayed in Figures 1, 2, and 3. Graph A shows exports (solid line) and imports (dashed line), Graph B net interest payments, and Graph C external debt (i.e. the cumulative sum of the flow data with the initial value being set to zero).

4.2. Solvency test I: Cointegration test among exports, imports, and net interest payments

We first perform the solvency test by Ahmed and Roger (1995), i.e. testing whether a 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 step, we check whether each of the variables are treated as I(1). Here two unit root tests are implemented: the augmented Dickey-Fuller tests (1979) of a unit root against no unit root (ADF), and a modified Dickey-Fuller test based on GLS detrending series (DF-GLS), which is a powerful univariate test proposed by Elliott, 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 a time trend is not apparent, as indicated in Graphs A and B in Figure 2. The lag length is chosen by the Bayesian information criterion (BIC) for both of these tests (up to six lags).

Table 2 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).[8]

[8] As another preliminary step, we check the stationarity of changes in foreign currency

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 the BIC. In this analysis, we examine not only the full sample but also a subsample spanning before rapid capital inflows appeared in each country: 1976:1-1988:4 for Thailand, and 1981:1-1993:4 for Indonesia and Korea (see Graph C in each figure). Furthermore, we use a subsample that ends one year before the breakout of each crisis to see if the crises were anticipated a year before.

Table 3 shows the test results. The null is rejected by these two tests for almost all the cases in Indonesia and Korea (see Panels B and C). The results imply that the solvency condition was generally satisfied for the pre-crisis period in the two countries. As for Thailand, the null is rejected for the 1988 subsample, but not for the 1996 subsample and the full sample. This suggests that in Thailand, while the external borrowing constraint was satisfied until the late 1980s, this was not the case after massive capital inflows took place in the 1990s. We interpret this evidence as indicating that the Thai crisis in July 1997 inevitably occurred because Thailand was externally insolvent at that time. Accordingly, the fundamentals view may be credible in Thailand. For Indonesia and Korea, the financial panic view seems more plausible as these countries were shown as internationally solvent but nevertheless were hit by a currency crisis.

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reserves in each country (see footnote 3). We perform the same unit root tests for the series of changes in reserve assets, which is placed "below the line" on the balance of payment table (IFS code *79dbd*), and find that the null is rejected in each country. For instance, demeaned DF-GLS statistics are -2.54, -2.67, and -8.58 for Thailand, Indonesia, and Korea, respectively, and indicate strong rejections at 5 or 1% levels. We therefore interpret that the stationarity assumption is generally supported by the data.

4.3. Solvency test II: Unit root test for the changes in external debt

Next we conduct the 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 (ADF and DF-GLS) for $B_t - B_{t-1}$ series in each country. The tests include a constant and the lag is selected by the BIC. The same subsample periods are used in this exercise.

Table 4 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, which implies 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 subsample, no rejections are found from either of the two tests. This suggests that around 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 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 the two countries.

4.4. Analysis extending to the post-crisis period

This subsection extends our main analysis to the post-crisis period. We perform the same solvency 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 there is any change in the empirical results after the crisis episodes. The extended sample period is 1976:1-2001:2 for Thailand, 1981:1-2001:1 for Indonesia, and 1976:1-2001:3 for Korea.

Table 5 summarizes the test results. It is noteworthy that with this updated, post-crisis sample, we find strong rejections in Thailand from both tests. 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 internationally. This suggests that a currency crisis need not happen at this moment in any of these Asian countries.[9]

4.5. Further robustness check

We further perform several other exercises to check robustness of our main findings.[10] First, in solvency test I, we use different series for exports and imports that incorporate transfer receipts and payments, respectively.[11] With these exports and imports series, the same cointegration tests are performed for the same pre- and post-crisis sample periods. But the empirical results obtained above are all unaffected.

Next, in solvency test II, we employ different capital flows data that exclude direct investments from abroad.[12] This may be of interest because in the Asian crisis episodes, many observers emphasize the role of relatively short-term capital flows such as security investments and deposits rather than long-term direct investments. We conduct the same unit root tests for the new series, but again the results are similar with both pre- and post-crisis samples.

Third, back to solvency test I, we perform the cointegration analysis in an unrestricted $(X_t, M_t, r_{t-1}B_{t-1})$ system (i.e. without imposing the cointegrating

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[9] Note further that a liquidity crisis is not likely to happen, either, in any of these countries. The ratios of short-term external debt to foreign reserves (i.e. the data shown in Table 1) have been lowered considerably in the post-crisis period. As of June 2001, the ratios are 0.302, 0.649, and 0.320 for Thailand, Indonesia, and Korea, respectively, and are all well below one. They no longer indicate international illiquidity according to Chang and Velasco (1998).

[10] The detailed results in this subsection are available from the author on request.

[11] Both transfer series are taken from IFS (data codes are *78ajd* and *78akd*, respectively). Note that the transfer payments series in Indonesia is unavailable, so that only the exports series differs from the main analysis for Indonesia. Preliminary unit root tests indicate that the new exports and imports series can be characterized as I(1).

[12] We substract net direct investments (IFS code *78bdd* and *78bed*) from the financial account data used above.

vector (1, -1, -1)). We implement residual-based ADF tests for cointegration.[13] With this unrestricted model, some rejections indicated in Table 2 are not detected. We interpret this as primarily being due to low power of the tests in a larger three-variable system.[14] Actually when we conduct the similar tests under a bivariate (X_t, $M_t + r_{t-1}B_{t-1}$) model, some of these rejections reemerge. This suggests that the advantage in terms of power in a more restricted, smaller system is particularly significant for our finite-sample exercises. Accordingly, our main results based on the univariate tests, which presumably have the largest power, look all the more reliable.

5. Concluding Discussions

The paper has focused on two alternative views on the origins of the Asian crisis that have been stressed in the literature: the economic fundamentals view and the financial panic view. It has attempted to determine which of these hypotheses best applies to the Asian crisis by testing external solvency of the relevant countries. We have adopted procedures developed by Ahmed and Rogers (1995) and Trehan and Walsh (1991) and examined the three most-affected countries: Thailand, Indonesia, and Korea. The evidence indicates that while the external solvency condition was generally satisfied in Indonesia and Korea throughout the pre-crisis period, it was not in the case of Thailand for a pre-crisis sample extending to the 1990s when massive capital inflows took place and external liabilities of the economy became unsustainable. This suggests that the Thai crisis inevitably broke out due to weak fundamentals and that the crises in Indonesia and Korea were caused by the financial panic of international investors.

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[13] Detrended tests are performed for Thailand and Korea because their exports and imports series may contain a linear trend. As for Indonesia, we use demeaned tests because a time trend is not apparent in Indonesian exports and imports.

[14] This is most notably in Korea. Yet robust rejections are generally found in Indonesia.

The econometric approach may appear overly simple as the testing procedures involve only current account and capital account series. But arguably, it is not as simplistic as it would seem. As seen in equations (1) and (2), key macroeconomic variables such as private consumption and investment are at least implicitly incorporated in the framework. Thus, those external accounts profiles reflect current and expected spending (possibly overspending) by the private sector or the government.

Moreover, the spending behavior in turn can be linked with the general state of the economy and/or asset price fluctuations (such as the overheating of the economy and a subsequent burst of asset price bubbles), and this would affect the soundness of the financial system. These factors are usually seen as important in the Asian crisis episodes and are incorporated in the present framework through the spending behavior of the economy. Note further that spending decisions by the private sector are implicitly influenced by fluctuations in relative prices and real exchange rates that take place behind the scene.

The idea here is that all those interactions among key variables are summarized into the simple framework based on external borrowing constraints. We therefore view the present approach as not only simple and tractable but also reasonably general and suitable to investigate the origins of the Asian crisis.

Before we conclude, we have two additional remarks on the interpretations of our main findings. The first is that the evidence would also be consistent with the "contagion" of the Asian crisis.[15] The main results seem to indicate that the Thai crisis, which broke out for the fundamentals reasons, triggered a self-fulfilling panic in Indonesia and subsequently in Korea. Put differently, the Asian crisis spread from the solvency crisis in Thailand to the liquidity crises in Indonesia and

[15] There is also a large amount of literature on this issue. For instance, Baig and Goldfajn (1999) examined the contagion focusing on the correlation of the financial markets in the region.

Korea. This interpretation may provide additional insight on the mechanism of the Asian crisis episodes.

Second, it must be emphasized that with the present approach we are still unable to perfectly predict future crises. Even when a country is shown as externally solvent, we cannot rule out the possibility of a liquidity crisis just as suggested in the cases of Indonesia and Korea. Given that some crises are actually driven by self-fulfilling financial panic, institutional arrangements to strengthen the facility of an international lender of last resort must be seriously discussed. While such an effort intends to reduce the likelihood of liquidity crises, we should be fully aware that this could potentially induce moral hazard behavior of international investors or governments and consequently could raise the likelihood of solvency crises. Extra cautions therefore must be exercised to develop such an international architecture to prevent future crises of both types.

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Table 1. Short-Term External Debt to Reserves Ratio

Period	Thailand	Indonesia	Korea	Malaysia	Philippines
1990-Q2	0.535	2.238	1.128	0.222	3.232
1991-Q2	0.754	1.689	1.632	0.220	1.121
1992-Q2	0.743	1.474	1.796	0.253	0.901
1993-Q2	0.782	1.763	1.523	0.359	0.492
1994-Q2	0.992	1.724	1.610	0.252	0.405
1995-Q2	1.125	1.967	1.814	0.275	0.552
1996-Q2	1.233	1.899	1.706	0.391	0.704
1997-Q2	1.506	1.800	2.117	0.597	0.927

Notes: This table replicates the evidence on international illiquidity shown by Chang and Velasco (1998, Table 13). It reports the ratio of short-term external debt to international reserves at the end of the second quarter (June) of each year. Short-term debt is the series "liabilities to banks, due within a year" taken from the Bank for International Settlements (BIS) statistics on external debt, and international reserves series is retrieved from IMF International Financial Statistics (line 1d.d).

Table 2. Unit Root Test Results
— For exports, imports, and net interest payments —

Variable	ADF	DF-GLS
	A. Thailand	
X_t	-1.97(4)	-1.45(4)
M_t	-1.82(2)	-1.53(2)
$r_{t-1}B_{t-1}$	-0.54(3)	-1.30(3)
ΔX_t	-2.84(3) †	-2.83(3)**
ΔM_t	-4.12(1)**	-4.15(1)**
$\Delta r_{t-1}B_{t-1}$	-12.35(2)**	-1.36(4)
	B. Indonesia	
X_t	-2.18(4)	-0.96(4)
M_t	-1.91(5)	-1.35(5)
$r_{t-1}B_{t-1}$	-2.18(1)	-1.34(4)
ΔX_t	-3.25(3)*	-3.28(3)**
ΔM_t	-2.56(4)	-1.64(4) †
$\Delta r_{t-1}B_{t-1}$	-13.25(0)**	-12.83(0)**
	C. Korea	
X_t	-2.62(4)	-2.68(4)
M_t	-2.46(5)	-2.40(5)
$r_{t-1}B_{t-1}$	-1.73(3)	-1.80(3)
ΔX_t	-2.80(3) †	-2.06(3)*
ΔM_t	-3.31(6)*	-2.69(6)**
$\Delta r_{t-1}B_{t-1}$	-7.43(2)**	-6.80(2)**

Notes: This table reports statistics testing for a unit root for exports (X_t), imports (M_t), and net interest payments ($r_{t-1}B_{t-1}$), all deflated by CPI, in the three Asian countries. ADF is the augmented Dickey-Fuller test (1979) 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 the BIC (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

Table 3. Solvency Test I

— Cointegration tests among exports, imports, and net interest payments —

Period	ADF	DF-GLS
	A. Thailand	
76:1-88:4	-3.37(0)**	-2.83(0)**
76:1-96:2	-0.54(4)	-0.03(4)
76:1-97:2	-1.90(4)	-1.32(4)
	B. Indonesia	
81:1-93:4	-2.76(4) †	-2.05(4)*
81:1-96:2	-2.95(4)*	-1.88(4) †
81:1-97:2	-3.12(4)*	-1.99(4)*
	C. Korea	
76:1-93:4	-2.63(0) †	-2.41(0)*
76:1-96:3	-2.53(0)	-2.43(0)*
76:1-97:3	-3.05(0)*	-2.92(0)**

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 test (1979) 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 4. Solvency Test II

— Unit root tests for changes in external debt —

Period	ADF	DF-GLS
	A. Thailand	
76:1-88:4	-5.47(0)**	-5.43(0)**
76:1-96:2	-0.06(2)	0.29(2)
76:1-97:2	-2.20(1)	-1.94(1) †
	B. Indonesia	
81:1-93:4	-2.23(4)	-2.06(4)*
81:1-96:2	-2.46(4)	-2.03(4)*
81:1-97:2	-2.29(4)	-1.78(4) †
	C. Korea	
76:1-93:4	-2.49(1)	-2.28(1)*
76:1-96:3	-2.38(1)	-2.35(1)*
76:1-97:3	-2.49(1)	-2.45(1)*

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 test (1979) 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 the 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 5. Additional Results

— For samples extended to the post-crisis period —

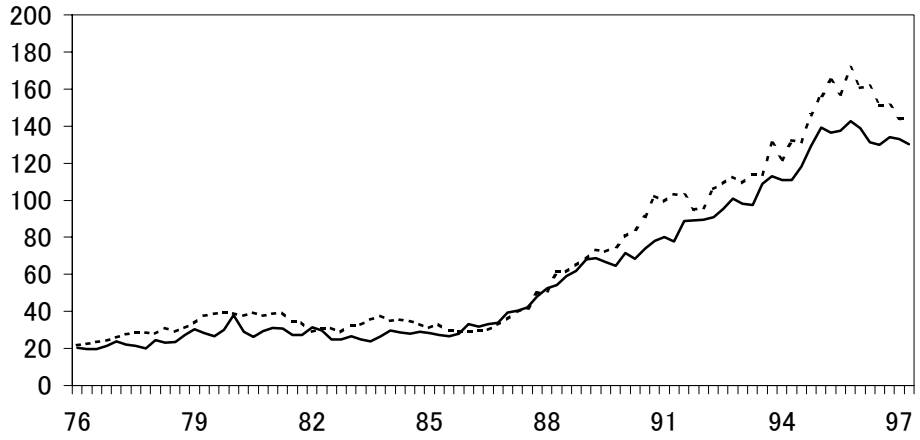
Variable	ADF	DF-GLS
	A. Thailand	
$X_t - M_t - r_{t-1}B_{t-1}$	-3.09(4)*	-2.91(4)**
$B_t - B_{t-1}$	-2.75(0) †	-2.74(0)**
	B. Indonesia	
$X_t - M_t - r_{t-1}B_{t-1}$	-2.60(4) †	-2.13(4)*
$B_t - B_{t-1}$	-4.05(0)**	-3.79(0)**
	C. Korea	
$X_t - M_t - r_{t-1}B_{t-1}$	-2.80(0) †	-2.54(0)*
$B_t - B_{t-1}$	-5.88(0)**	-5.67(0)**

Notes: This table reports statistics testing for a unit root for $X_t - M_t - r_{t-1}B_{t-1}$ and $B_t - B_{t-1}$ (i.e. the solvency tests I and II) for updated samples extending to the post-crisis period. The sample period is 1976:1-2001:2 for Thailand, 1981:1-2001:1 for Indonesia, and 1976:1-2001:3 for Korea. ADF is the augmented Dickey-Fuller test (1979) 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 the BIC (up to six lags). Critical values, tabulated by Fuller (1976) and Elliott, Rothenberg, and Stock (1996), are:

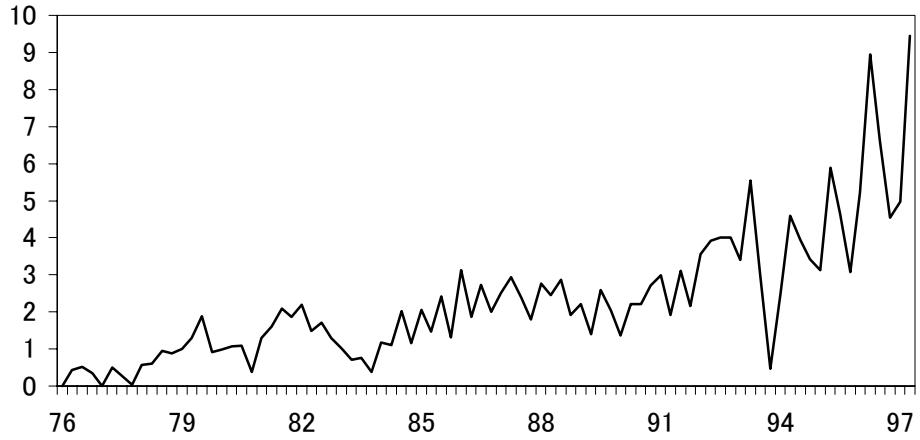
	10%(†)	5%(*)	1%(**)
ADF	-2.58	-2.89	-3.51
DF-GLS	-1.61	-1.95	-2.60

Figure 1. Current Account and External Debt in Thailand

A. Exports and imports



B. Net interest payments



C. External debt

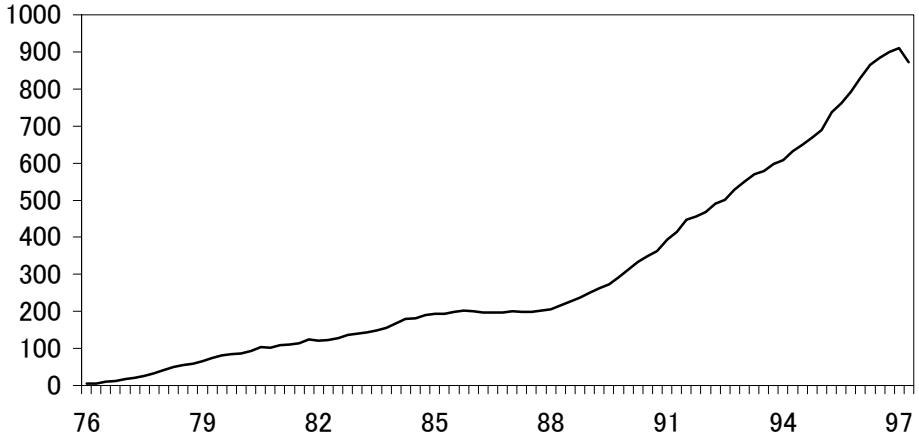
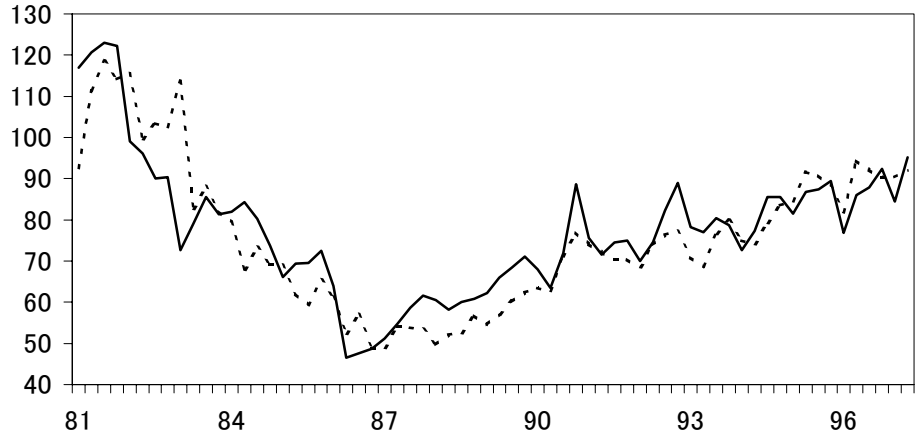
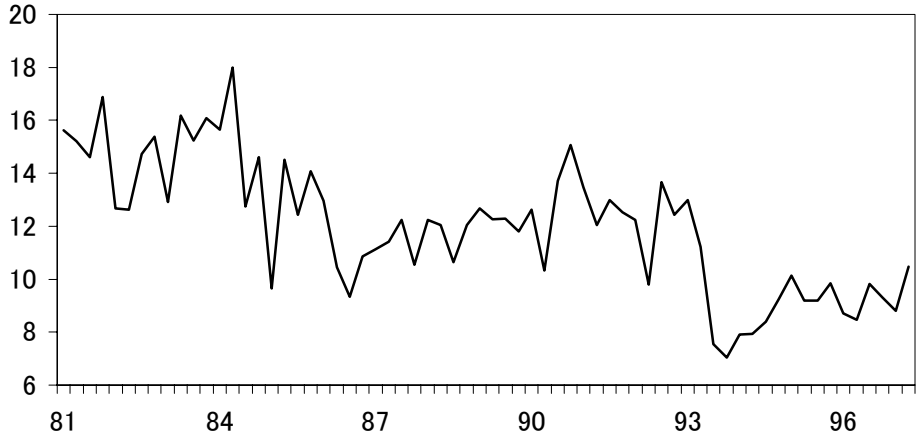


Figure 2. Current Account and External Debt in Indonesia

A. Exports and imports



B. Net interest payments



C. External debt

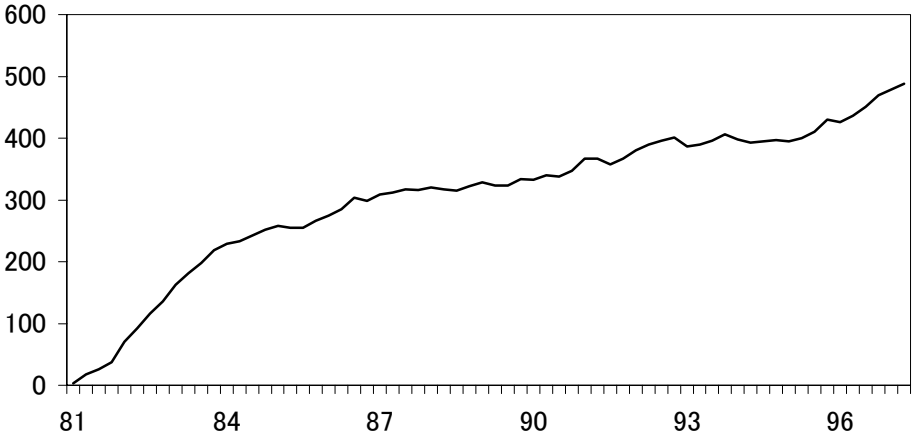
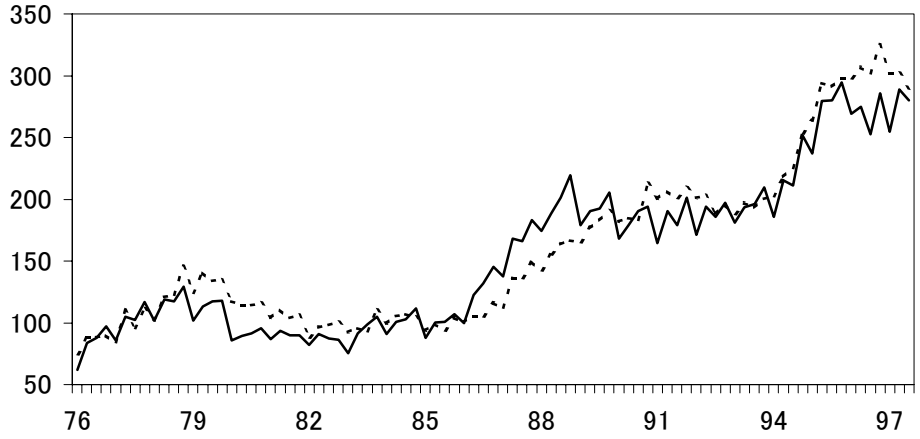
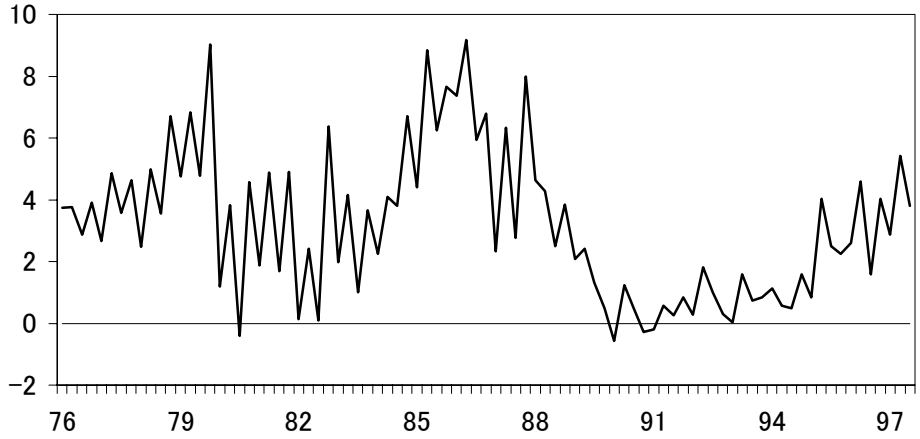


Figure 3. Current Account and External Debt in Korea

A. Exports and imports



B. Net interest payments



C. External debt