Lessons of the Asian Financial Crisis: What Can an Early Warning System Model Tell Us?

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Using an early warning system model, this paper provides empirical evidence on the causes of the 1997 Asian financial crisis, with a view to shedding light on policy lessons. The model shows that there were warning signals of heightened economic and financial vulnerabilities in each of the five most affected countries prior to the crisis, suggesting that weaknesses in economic and financial fundamentals in these countries played an important role in causing the crisis. The warning signals point to fundamental weaknesses, including real appreciation of domestic currencies, deterioration in current account positions, excessive external borrowing by banks and currency mismatches in their balance sheets, excessive growth of domestic credit, economic slowdown, and burst of asset price bubbles.

I. INTRODUCTION

In the last few years there have been considerable discussions of the causes of the 1997 Asian financial crisis. Two main views have emerged. The first attributes the initial financial turmoil in some Asian countries in 1997 and its propagation over time mainly to sudden shifts in market expectations and confidence followed by regional contagion (Radelet and Sachs 1998, Marshall 1998, Chang and Velasco 1999). While admitting the worsening of the macroeconomic performance of some crisis-affected countries in the mid-1990s, this view suggests that the extent and depth of the crisis should not be attributed to deterioration in fundamentals, but rather to panic on the part of domestic and international investors.

The second argues that the crisis occurred primarily as a result of structural and policy distortions (Corsetti, Pesenti, and Roubini 1998; Dooley 1999). According to this view, fundamental imbalances triggered the currency and financial crisis in 1997 even though after the start of the crisis, market overreaction and herding caused the plunge of exchange rates, asset prices, and economic activity to be more severe than warranted by the initial weak economic and financial conditions.

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It is important to establish which of these hypotheses is more plausible. If the Asian crisis was caused more by weak fundamentals, policy and institutional reforms should be designed mainly to address these weaknesses; while if the crisis was caused more by investor panic, policy reform should perhaps focus more on ways to prevent and contain investor panic. Therefore, discriminating between the two hypotheses could help the crisis-affected countries draw policy lessons, and have important policy implications for the prevention of future crises.

Several studies have attempted to provide empirical evidence of economic and financial fragility in the crisis-affected Asian countries in the years prior to the 1997 crisis (e.g., Corsetti, Pesenti, and Roubini 2001). By comparing indicators of fragility in the affected countries at the onset of the crisis with those in nonaffected or less-affected emerging economies, mostly using cross-sectional regression analyses, these studies have shown that the affected countries were on average more fragile than others, although a few nonaffected countries were also found to be vulnerable according to the indicators used. This type of study, however, cannot discriminate between the two hypotheses described above. Doing this requires testing not only whether there was fragility in the affected countries, but also whether such fragility had reached some "crisis-triggering level."

This paper attempts to provide more empirical evidence on economic and financial fragility in the affected Asian countries prior to the 1997 financial crisis using an early warning system (EWS) model. EWS models could be useful in discriminating between the two hypotheses and determining what actually happened in Asia in 1997. This is because EWS models involve estimating "crisis-triggering" threshold values for economic and financial indicators from historical data. If, in cases of the affected Asian countries, there were warning signals from such models of a heightened probability of a financial crisis prior to the 1997 crisis, then there are good reasons to suggest that weak fundamentals played an important role in triggering the crisis.

The literature on EWS models has received new impetus in recent years from the work on the signaling approach[1] by Kaminksy and Reinhart (see Kaminsky, Lizondo, and Reinhart 1998; and Goldstein, Kaminsky, and Reinhart 2000). The signaling approach involves monitoring a set of high-frequency leading indicators that tend to behave differently prior to a crisis and examining whether they individually or collectively have reached "threshold" values that are historically associated with the onset of a financial crisis. The EWS model used in this paper follows the signaling approach, but differs from the existing studies in a number of ways. First, to cut down on the problem of heterogeneity, the paper focuses only on a small number of countries that were at the center of the 1997 Asian crisis. Second, to enable better discrimination between the two hypotheses, the paper does not consider unsuccessful speculative attacks in foreign exchange markets in

[1]As opposed to the traditional regression approach.

defining the left-hand side variable of the EWS model. Third, the model uses a number of explanatory variables that have not been used by other studies but could be relevant for the 1997 Asian financial crisis, such as the ratio of foreign liabilities to foreign assets of the banking sector, as a measure of currency mismatch, and the real exchange rate of the Japanese yen against the US dollar.

The EWS model is constructed using monthly data from 1970 to 1995 for Indonesia, Republic of Korea (Korea), Malaysia, Philippines, Singapore, and Thailand. Most of these countries, with the exception of Singapore, have been known as the "countries worst hit by the crisis", with Thailand being the origin of the crisis. The model is then applied to data from 1996 to 1997 to test whether there were warning signals in each of the six countries prior to the 1997 financial crisis.

The rest of this paper is organized as follows. Section II describes methodology, Section III empirical results, and Section IV concludes.

II. METHODOLOGY

The signaling approach to constructing EWS models involves the following steps: identifying historical crisis episodes, selecting leading indicators as predictors of crisis episodes, setting threshold values of the selected leading indicators, constructing composite leading indices, and predicting crises. Goldstein, Kaminsky, and Reinhart (2000) provide technical details of these steps.

A. Identifying Historical Crisis Episodes

The first step is to determine what constitutes a crisis. This paper focuses only on currency crises. A crisis episode is considered to occur in a particular month if the month-over-month percentage change in a bilateral nominal exchange rate (e.g., local currency/US dollar) exceeds its sample mean by two or three standard deviations. In practice, it is often the case that a large movement in an exchange rate is followed closely by another or several large movements, some of which may still be part of the crisis associated with the first instance of depreciation. Therefore, only a depreciation episode that takes place 12 months or more after the previous one is considered a separate crisis.

B. Selecting Leading Indicators

Leading indicators as predictors of currency crises are often chosen based on economic rationales as well as the availability of data. Kaminsky, Lizondo, and Reinhart (1998) made a comprehensive survey of various types of indicators used in empirical studies of EWS models. Most indicators used in this paper are observed at monthly intervals. But some are available only on a quarterly or annual

basis. For these indicators, monthly observations were interpolated from annual/quarterly data.

Some leading indicators need to be transformed to ensure that they are stationary and free from seasonal effects. For each indicator in this paper, three forms of specifications are considered: level, change (or percentage change) over 12 months, and deviation from its trend. The level form is adopted as long as an indicator is nontrending and has no discernible seasonality. In addition, either change (or percentage change) over 12 months or deviation from the trend is used as the second specification, depending on relative performance of the two in predicting crises, and as long as the second specification improves the predictability of the EWS model. To estimate trends and deviations from trends, we used the Hodrick-Prescott (HP) filter (Enders 1995).

C. Setting Leading Indicators' Thresholds

For each leading indicator, a threshold divides its distribution into a region that is considered normal and a region that is considered abnormal and associated with a heightened probability of crises. For each month, if the observed outcome of an indicator falls into the abnormal region, that indicator is said to be sending a warning signal. A warning signal could be true, if a crisis follows within 24 months (denoted as *A*), or false, if no crisis follows within 24 months (denoted as *B*).[2] The latter is usually referred to as Type-II error. Similarly, when the observed outcome of an indicator stays in the normal region and hence issues no warning signals, this could be false, if a crisis follows within 24 months (denoted as *C*); or true, if no crisis follows within 24 months (denoted as *D*). The former is referred to as Type-I error (see Table 1).

Table 1. **True and False Warning Signals**

	A Crisis Follows within 24 Months (Type-I Error)	**No Crisis Follows within 24 Months (Type-II Error)**
Signal	*A* (true signal)	*B* (false signals)
No signal	*C* (missed crises)	*D* (correct prediction)

There is a tradeoff between the Type-I and Type-II errors. Widening the abnormal region will increase the number of false signals (*B*) but reduce the num-

[2]An EWS model should issue warning signals well in advance of the onset of a crisis. This lead time could vary by indicators, and differ among crisis episodes and across countries. But in order to classify warning signals into true or false ones, a maximum lead time, termed the crisis window, has to be set. In the literature, this crisis window has commonly been set at 24 months and we follow this practice.

ber of missed crises (*C*). On the other hand, narrowing the abnormal region will increase the number of missed crises but reduce the number of false signals. Kaminsky, Lizodon, and Reinhart (1998) proposed the setting of the optimal threshold for an abnormal region so as to minimize the so-called noise-to-signal ratio, *NSR*, which is defined as the ratio of the probability of an indicator signaling during noncrisis or tranquil times to the probability of the indicator signaling during crisis times, that is,

$$NSR = [B/(B+D)]/[A/(A+C)] \tag{1}$$

where *A, B, C,* and *D* are defined in Table 1. Empirically, the minimum *NSR* and the associated threshold of each indicator are estimated using a grid search procedure. This involves calculating *NSRs* assuming different thresholds and finding the minimum one. The grid search is usually limited to a region between the 10th and 20th percentile of an indicator's frequency distribution: at the upper tail if the indicator is positively correlated with the crisis probability, and lower tail if the two are negatively correlated. In the grid search, the frequency distribution is assumed to be country-specific for each indicator—to control for country-specific effects that may not be related to financial vulnerability but nevertheless influence an indicator's absolute value—but the same percentile is applied to all sample countries at each iteration. Therefore, in the model, each indicator's threshold in percentile terms is uniform across sample countries, but that in actual value is country-specific.

With threshold values, actual observations of leading indicators can be converted into zero (if the actual value does not cross the threshold value) or one (if the actual value crosses the threshold value) signals. On the basis of the historical crisis episodes, these signals can be classified into true or false as shown in Table 1. The minimum *NSR*, calculated by pooling all the sample countries together, provides a measure of the predictive power of each leading indicator. The lower this ratio, the more powerful is a leading indicator in predicting crises. A second, but closely related, performance measure is the conditional probability, which is defined as

$$P(C \mid S) = A/(A+B) \tag{2}$$

where $P(C|S)$ is the probability of a crisis occurring within 24 months conditional on a warning signal from a leading indicator. The higher the conditional probability, the greater is the predictive power.

D. Constructing a Composite Leading Index

Based on the assumption that the greater the number of leading indicators signaling a crisis, the higher the probability that such a crisis would actually occur, Kaminsky (2000) proposed a number of composite leading indices. One such composite index, I_t, which is used in this paper, is a weighted average of zero/one signals by individual leading indicators, S_{it}, with weights being inverses of their respective minimum *NSR*s, defined as

$$I_t = \sum \frac{S_{it}}{\varepsilon_i} \tag{3}$$

where ε_i is the minimum *NSR* of the leading indicator *i*. Therefore, this composite index gives more weights to better performing (with smaller minimum *NSRs*) indicators.

E. Predicting Crises

As composite leading indices contain more information and are in general more reliable than single indicators, they are usually used for predicting crisis probabilities. The thresholds, minimum *NSR*s, and conditional probabilities of composite leading indices can be estimated following the same grid search procedure as applied to individual indicators. A composite leading index will issue a warning signal, with a conditional probability attached, if its observed outcome in a particular month exceeds its threshold.

III. RESULTS

The EWS model was estimated using monthly data of Indonesia, Korea, Malaysia, Philippines, Singapore, and Thailand from 1970 to 1995. The model was then applied to data from 1996 to 1997 to test whether there were warning signals in the six countries prior to the onset of the 1997 financial crisis. The data appendix provides details of variable definitions and data sources.

The cut-off level of currency depreciation used for defining a crisis episode estimated using sample data from 1970 to 1995 is 8.8 percent for Indonesia, 4 percent for Korea, 3 percent for Malaysia, 7.8 percent for the Philippines, 2.7 percent for Singapore, and 2.5 percent for Thailand.[3] Based on these cut-off levels, during 1970-1997, Indonesia had six currency crisis episodes, Korea had four, Malaysia eight, Philippines six, Thailand three, and Singapore seven.

[3]They were defined as sample means plus two standard deviations and estimated in terms of domestic currency per US dollar.

On the basis of the composite leading index's optimal threshold (where the noise-to-signal ratio is at the minimum), we can estimate the number of its warning signals issued during the 24 months prior to the 1997 Asian financial crisis. Table 2 reports the optimal threshold of and warning signals issued by the composite leading index. The figure in parentheses is months of lead time of its first warning signal. The composite leading index has an optimal threshold at the 88th percentile of its frequency distribution. At this threshold, it has a minimum *NSR* of 0.137, meaning that, in the sample, the likelihood of the composite leading index signaling during tranquil times is only a little over one tenth of the likelihood of its signaling during crisis times. The corresponding conditional probability is 77 percent, meaning that, once this index signaling, the probability of a crisis following within 24 months is 77 percent. These measures suggest that the composite leading index has a significant predictive power.

The composite leading index issued seven warning signals in Indonesia during 24 months prior to the 1997 crisis, with a lead time of 11 months. The number of signals is nine in Korea, with a lead time of 10 months; 13 in Malaysia, with a lead time of 13 months; 10 in the Philippines, with a lead time of 11 months; and 10 in Thailand, with a lead time of 10. But there is no warning signal in the case of Singapore. The fact that there were strong and persistently early warning signals in not just Thailand, the origin of the crisis, but all the five countries most affected by the 1997 crisis appears to lend support to the "weak fundamentals" hypothesis. In the case of Singapore, however, the evidence suggests that the depreciation of the Singaporean dollar was more a result of regional contagion than weak fundamentals. This appears consistent with the fact that Singapore was less affected by the 1997 financial crisis.

To take the analysis of weak fundamentals a bit further, Table 2 also reports warning signals issued by individual leading indicators. During the 24 months prior to the 1997 crisis, almost half of the 38 leading indicators of the model issued at least one warning signal in each of the five countries most affected by the crisis, with the total number of signals ranging from 108 for Indonesia to 151 for Thailand. In the case of Singapore, the number of signaling indicators and total number of warning signals are much less, only 12 and 57, respectively. Across the six indicator categories, although there were signals from every category in every country, most of them were issued by the current account, capital account, financial sector, and real sector indicators.

Table 2. **Warning Signals During the 24 Months Prior to the 1997 Asian Financial Crisis in the EWS Model**

Leading Indicators	Number of Warning Signals						Noise-to-Signal Ratio	Conditional Crisis Probability (percent)
	Indonesia	Korea	Malaysia	Philippines	Thailand	Singapore		
Composite Leading Index	7 (11)	9 (10)	13 (13)	10 (11)	10 (10)	0 (0)	0.137	77.4
Current Account								
Real exchange rate, deviation from trend ($/local currency)	7	21	13	11	17	4	0.132	77.8
Real effective exchange rate, deviation from trend (JP Morgan)	9	7	15	11	10	2	0.176	72.4
Current account balance/GDI	0	0	0	0	0	0	0.447	50.5
Imports, 12-month percent change	0	0	0	1	0	0	0.551	45.5
Trade balance/GDP, 12-month change	0	1	1	4	1	0	0.655	41.2
Trade balance/GDP	7	0	11	23	10	0	0.765	37.7
Exports, 12-month percent change	0	7	0	0	6	4	0.779	37.1
Current account balance/GDI, 12-month change	0	0	0	0	0	12	0.869	34.1
Capital Account								
Short-term debt/foreign reserves	1	0	2	0	0	0	0.222	64.6
Deposits in BIS banks/foreign reserves	0	0	0	0	0	0	0.324	56.7
M2/foreign reserves	10	0	1	0	0	0	0.391	54.2
Foreign liabilities/foreign assets	19	0	8	0	23	0	0.434	51.6
M2/foreign reserves, deviation from trend	1	1	4	0	2	0	0.479	49.1
Short-term debt/foreign reserves, deviation from trend	1	0	5	0	0	0	0.493	45.1
Foreign liabilities/foreign assets, deviation from trend	9	1	8	7	9	0	0.573	44.7
Deposits in BIS banks/foreign reserves, 12-month change	0	10	0	6	0	7	0.590	38.9
Foreign reserves, 12-month percent change	0	5	8	0	4	6	0.823	35.8

continued.

Table 2. continued.

Leading Indicators	Number of Warning Signals						Noise-to-Signal Ratio	Conditional Crisis Probability (percent)
	Indonesia	Korea	Malaysia	Philippines	Thailand	Singapore		
Composite Leading Index	7 (11)	9 (10)	13 (13)	10 (11)	10 (10)	0 (0)	0.137	77.4
Financial Sector								
Central bank credit to the public sector/GDP	0	0	0	0	0	0	0.413	49.5
Real commercial bank deposits, 12-month percent change	0	0	0	0	0	0	0.494	48.2
Lending-deposit rate spread, 12-month change	0	0	0	0	1	0	0.531	44.3
Real interest rate, deviation from trend	20	0	2	0	0	0	0.532	41.1
Lending-deposit rate spread	0	0	0	1	0	0	0.612	38.8
Ratio of real M1 to trend	4	3	10	1	5	2	0.631	42.3
Central bank credit to the public sector/GDP, 12-month change	0	10	12	0	6	0	0.646	37.9
Real interest rate	4	0	0	0	0	0	0.668	35.7
M2 multiplier, 12-month percent change	2	16	0	7	0	1	0.975	32.0
Domestic credit/GDP, 12-month percent change	0	13	6	23	5	0	1.119	29.1
Real Sector								
Industrial production index, 12-month percent change	2	1	0	3	4	0	0.771	37.4
Stock price index, 12-month percent change (US$)	4	10	0	2	13	3	0.784	32.0
Stock price index ,12-month percent change (local currency)	1	10	0	8	17	3	0.945	28.1
Global Economy								
World oil price, 12-month percent change	0	0	0	0	0	0	0.517	47.0
US real interest rate	0	0	0	0	0	0	0.558	45.3
Real dollar/yen exchange rate, deviation from trend	6	6	6	6	6	6	0.569	44.8
US annual GDP, 12-month percent change	0	0	0	0	0	0	0.643	41.7
Fiscal Sector								
Fiscal balance/GDP	0	0	0	0	0	0	0.761	37.8
Government consumption/GDP	0	0	0	23	0	0	0.794	36.8
Government consumption/GDP, deviation from trend	1	0	0	6	0	0	0.811	36.3
Fiscal balance/GDP, 12-month change	0	10	0	0	12	7	0.890	34.0

Note: Noise-to-signal ratios and conditional crisis probabilities were estimated from sample data of 1970-1995.
Source: Author's estimation.

The real exchange rate against the US dollar and real effective exchange rate against the basket of currencies of major trading partners,[4] both measured in deviations from their trends, issued warning signals in all the six countries, suggesting that there were real appreciations in currencies of all these countries prior to the 1997 crisis. The number of signals indicates that the real appreciation was more persistent and pronounced for the Thai baht, Malaysian ringgit, Korean won, and Philippine peso than for the Indonesian rupiah and Singaporean dollar. Real currency appreciation was accompanied by a worsening of trade and current account positions in these countries, as indicated by warning signals from the trade balance/gross domestic product (GDP) ratio, the current account balance/gross domestic investment (GDI) ratio, and/or export growth. These results suggest that in all the five affected countries, not only were there apparent deteriorations in current account positions prior to the 1997 crisis, but the deteriorations also reached critical levels that historically had often been associated with the onset of currency crises.

There were also warning signals from the capital account indicators in all the six countries. The ratio of foreign liabilities to foreign assets of the banking sector, a measure of currency mismatch, issued persistent signals in Thailand (23), Indonesia (19), and Malaysia (8) prior to the 1997 crisis. In Korea and the Philippines, although this ratio itself did not signal, its deviation from its trend signaled. These results suggest that banks in all these countries were borrowing heavily from abroad prior to the 1997 crisis, leading to serious currency mismatches. Notably, however, there were no warning signals from this measure, either the ratio itself or its deviation from its trend, in the case of Singapore.

The ratio of M2 to foreign reserves measures a country's ability to withstand the pressure of substituting local currency for foreign currency by investors. This ratio issued signals in Indonesia and Malaysia, and its deviation from its trend signaled in Korea and Thailand. The ratio of short-term debt to foreign reserves, a measure of liquidity mismatch, is the best performing among the capital account indicators according to our estimation. This ratio and its deviation from its trend issued warning signals in Indonesia and Malaysia. The ratio of residents' deposits in the Bank of International Settlement (BIS) banks to foreign reserves measures the extent of capital flight. The fact that this measure (in terms of its deviations from its trend) issued warning signals in Korea, Philippines, and Singapore suggests there was capital flight in these countries prior to the 1997 crisis. Finally, the foreign reserves position deteriorated in Korea, Malaysia, Thailand, and Singapore prior to the 1997 crisis, as indicated by warning signals from the foreign reserves growth.

Financial sector indicators in Table 2 can be divided into two groups: macroeconomic indicators and aggregated microprudential indicators. Macroeconomic

[4]We used the JP Morgan estimates.

indicators, including the M2 money multiplier (which is the ratio of M2 to M0), the ratio of domestic credit to GDP, the ratio of the real M1 balance to its trend, and the ratio of central bank credit to the public sector to GDP, measure domestic credit growth. Warning signals by some of these indicators in Table 2 suggest evidence of excessive growth of domestic credit prior to the 1997 crisis, particularly in Korea, Malaysia, Philippines, and Thailand. Aggregated microprudential indicators, including growth of real commercial bank deposits, the lending-deposit rate spread, and the real interest rate, measure the health of individual financial institutions. Table 2 shows that warning signals from these indicators are far fewer than those from indicators of credit growth. Nevertheless, the real interest rate issued warning signals in Indonesia and Malaysia and the lending-deposit rate spread issued signals in the Philippines and Thailand. A major reason why there are very few warning signals from indicators of the health of individual financial institutions could be that we have not used many direct indicators of financial health, such as NPL ratios, capital adequacy ratios, and bank lending portfolios, due to data constraints.

Table 2 also suggests deteriorations in the real sector in the countries under consideration prior to the 1997 crisis, with the exception of Malaysia and Singapore. Growth of industrial production issued warning signals in Indonesia, Korea, Philippines, and Thailand, suggesting economic slowdown in these countries in certain months before the crisis. Stock prices also fell, reflecting perhaps bursts in asset prices bubbles, particularly in Korea and Thailand, where stock price indices in both US dollars and local currency issued warning signals persistently.

Although the ratio of fiscal balance to GDP issued no warning signals, the 12-month change in this ratio signaled in Korea, Thailand and Singapore. In the Philippines, the ratio of government consumption to GDP issued persistent warning signals.

Finally, among the four global economy indicators, the real US dollar/Japanese yen exchange rate issued six warning signals during 24 months prior to the 1997 crisis. This suggests that the yen's real depreciation against the US dollar contributed to some extent to the stress in many economies in East Asia in the years prior to the crisis.

IV. CONCLUSIONS

Using a signaling approach-based EWS model, this paper has attempted to provide more empirical evidence on the causes of the 1997 Asian Financial crisis, with a view to discriminating between the two hypotheses of "weak fundamentals" and "investors' panic" and shedding light on policy lessons. The results show that the composite leading index of the EWS model issued persistent warning signals prior to the 1997 crisis in not just a few, but all of the five countries most affected by the crisis. This finding appears to support the hypothesis that

weaknesses in economic and financial fundamentals in these countries played an important role in causing the crisis. In the case of Singapore, however, there were no signals from the composite leading index, suggesting that the depreciation of the Singaporean dollar was more a result of regional contagion than weak fundamentals.

The results also show that almost half of the 38 individual leading indicators of the EWS model issued warning signals in every affected country during the 24 months prior to the 1997 crisis. These warning signals point to the sources of fundamental weaknesses. First, in most countries under consideration, there were appreciations in the real exchange rate against both the US dollar and the basket currencies of their major trading partners. The real appreciations appeared to have contributed to the deteriorations in these countries' trade and current account positions. Second, there were apparent problems in the capital account, as indicated by persistent warning signals by the ratio of M2 to foreign reserves in the case of Indonesia, and the ratio of foreign liabilities to foreign assets of the banking sector in Indonesia, Malaysia, and Thailand. Third, there was strong evidence of excessive growth of domestic credit, particularly in Korea, Malaysia, Philippines, and Thailand. Last, there was also evidence of deteriorations in the real sector in most countries, and the burst of asset price bubbles, especially in Korea and Thailand.

Appendix

Indicator	Source and Definition
Real exchange rate	Nominal exchange rate (IMF's International Financial Statistics [IFS] line 00ae) adjusted for relative consumer prices (IFS line 64)
Real effective exchange rate	JP Morgan website
Exports	Exports in dollars (IFS line 70d)
Imports	Imports in dollars (IFS line 71d)
Current account balance/GDI	Current account (IFS line 78ald) divided by GDI (IFS lines 93e plus 93I) converted into dollars using IFS line 00af
Trade balance/GDP	Trade balance (IFS lines 70d less 71d) divided by gross domestic product (IFS line 99b) converted into dollars using IFS line 00ae
Foreign reserves	Gross international reserves less gold (IFS line 1L.d)
M2/foreign reserves	M2 (IFS lines 34 plus 35) converted into dollars using IFS line 00ae divided by foreign reserves (IFS line 1L.d)
Short-term debt/foreign reserves	Foreign debt with maturity of less than 1 year (data from World Bank Global Development Finance Statistics) divided by foreign reserves (IFS line 1L.d)
Deposits in BIS banks/foreign reserves	Deposits in BIS banks (IIF data) divided by foreign reserves (IFS line 1L.d)
Foreign liabilities/foreign assets	Foreign liabilities (IFS line 26c) divided by foreign assets (IFS line 21)
M2 multiplier	M2 (IFS lines 34 plus 35) divided by base money (IFS line 14)
Domestic credit/GDP	Domestic credit (IFS line 32) divided by GDP (IFS line 99b)
Excess real M1 balances	Real M1 (IFS line 34 divided by IFS line 64) divided by its trend derived using HP filter
Domestic real interest rate	Nominal interest rate (IFS line 60p) less inflation rate (IFS line 64x)
Lending-deposit rate spread	Lending rate (IFS line 60p) less deposit rate (IFS line 60l)
Real commercial bank deposits	Commercial bank deposits (IFS lines 24 plus 25) divided by consumer prices (IFS line 64)
Central bank credit to the public sector/GDP	Central bank credit to the public sector (IFS lines 12a to 12c) divided by GDP (IFS line 99b)
Industrial production	Index of industrial production (IFS line 66c)
Equity prices	Stock price index (Bloomberg data)

continued.

Appendix. continued.

Indicator	Source and Definition
US real interest rate	Nominal interest rate (IFS line 60p) less inflation rate (IFS line 64x)
US GDP	GDP (IFS line 99b)
World oil price	Spot oil price (IFS line 00176aaz)
Real yen/dollar exchange rate	Nominal yen/dollar exchange rate (IFS line 00ae) adjusted for relative consumer prices (IFS line 64)
Fiscal balance/GDP	Fiscal balance (IFS line 80) divided by GDP (IFS line 99b)
Government consumption/GDP	Government consumption (IFS line 91f) divided by GDP (IFS line 99b)

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