Contagion, Monsoons, and Domestic Turmoil in Indonesia: A Case Study in the Asian Currency Crisis

By

Valerie Cerra

International Monetary Fund

and

Sweta Chaman Saxena[1]

University of Washington

November 15th, 1998

[1]The authors can be reached by e-mail at vcerra@imf.org or ssaxena@u.washington.edu. A major part of the paper was written while Saxena was a summer intern at the FSPEU Department at the World Bank. The authors would like to thank Simeon Djankov for providing the data on the political risk variable. The authors are also grateful for helpful comments from Stijn Claessens, Simeon Djankov, Charles Engel, Keon Lee, Paul Masson and Eric Zivot. The authors acknowledge Chang-Jin Kim for assistance with econometric issues and programs. All errors are, however, ours. The views expressed in this paper are solely those of the authors and do not necessarily represent the views of the International Monetary Fund or of the World Bank.

Table of Contents

SUMMARY

This paper studies the case of Indonesia in the recent Asian currency crisis. The objective is to investigate empirically whether the crisis can be attributed to domestic fundamentals, common external shocks (monsoons), or contagion from neighboring countries. First, in order to determine if Indonesia's exchange rate had become overvalued relative to its "equilibrium" level, we estimate the “equilibrium” real effective exchange rate (REER) using the Johansen cointegration technique. The evidence points to a moderate degree of overvaluation, although not enough to explain the severity of the recent devaluation.

Next, we construct a Market Pressure Index (MPI) as a measure of the degree of speculative pressure on the exchange rate. This measure includes actual changes in the exchange rate as well as increases in interest rates or loss of foreign exchange reserves required to defend the value of the currency. Results from OLS and Probit estimations suggest that domestic political and financial sector factors played a role in the crisis, as did contagion from speculative pressures in Thailand and Korea. However, probit models have some drawbacks. First, there is a loss of information resulting from the formation of a discrete measure of crisis. More importantly, the definition of a crisis as speculative pressure above an arbitrary threshold level leads to an exclusion of episodes of moderate speculative pressure, which biases the sample against those episodes that could be partly anticipated from the behavior of economic fundamentals. Therefore, Markov Switching Models are estimated to use the full information contained in the continuous dependent variable and endogenously determine the switch in regime. The results from a Time Varying Transitional Probability Markov Switching Model show that inclusion of exchange rate pressures from Thailand and Korea in the transitional probability improves the conditional probabilities of crisis in Indonesia. We also find evidence of contagion in the stock market.

I: INTRODUCTION

This decade has witnessed a currency crisis in Asia as well as other parts of the world. The decade began with the ERM breakdown in 1992, followed by the Mexican Peso crisis in 1994, which spread to Latin America, and then the latest 1997 crisis in South East Asia, which engulfed countries like Thailand, Indonesia, Malaysia, South Korea and the Philippines. The magnitude of the crisis in Asia was unexpected by most observers—Asia had been praised as a miracle for its outstanding growth performance since the late 1980s and early 1990s; some of the economies involved in the crisis had earned the title of "Asian Tiger". These Asian economies were consistently praised for their openness, and the economies prospered as liberalization drives led to large inflows of capital.

Following the crisis that began in July 1997, economists have begun to look more closely at the underlying fundamentals. High growth rates of the Asian economies contributed to an underestimation of risks from weak financial systems, questionable political governance, and an over-reliance on external debt. In addition to these domestic factors, some economists argue that there were common external shocks that contributed to the crisis. In particular, slow growth in Japan and low world interest rates are believed to have been responsible for the magnitude of capital inflows that left these countries vulnerable to reversals of sentiment. In addition, swings in the dollar-yen exchange rate may have affected export competitiveness of countries pegged to the dollar. Finally, there are new models of currency crises, which emphasize contagion through multiple equilibria or a "wake-up call" to investors.[2]

This paper focuses on the case of Indonesia, and tries to separate the contributions of domestic and external fundamentals from contagion in the development of events. Indonesia has been selected as the country of interest because it has suffered the most severe economic consequences in the year following the onset of the crisis as measured by the magnitude of currency depreciation and contraction of economic activity. This outcome occurred despite macroeconomic fundamentals leading up to the crisis that are believed to have been among the strongest of the crisis countries. Indonesia could be arguably one of the clearest cases of contagion from neighboring countries.[3] The rest of the paper is structured as follows. Section II provides a longer-term perspective on economic trends and policy reforms in Indonesia. Section III focuses on events leading up to and following the onset of the crisis. Had fragility increased? What were the triggering events domestically and from the region? Section IV discusses some models of currency crises and outlines the characteristics of the Asian crisis. An overvalued exchange rate is one potential contributing factor to an attack on the currency. Section V estimates the "equilibrium" real effective exchange rate to be compared with Indonesia's actual real effective exchange rate. Section VI extends the econometric analysis to identify the roles of domestic and external factors in the crisis. A market pressure index is constructed for

[2] Corsetti, Pesenti, and Roubini (1998a) propose these arguments. Masson (1998) provides a framework for grouping causes of a crisis into common shocks, spillover effects, and (pure) contagion. We employ his terminology of "monsoons" to refer to common external shocks.

[3] Radelet and Sachs (1998a) support this view.

Indonesia as well as Thailand and Korea. Markov-Switching Models are estimated to determine the factors that are responsible for an increase in the average speculative pressure. Finally, section VII concludes.

II: INDONESIA: ECONOMIC BACKGROUND[4]

Indonesian economic reforms began in the mid-1980s. Over the next decade, reforms were aimed at opening the real economy by promoting the direct investment flows and rationalizing the tariff system. In addition to the investment and trade reforms, measures were taken to liberalize the financial sector, increase competition, and promote growth of capital markets including through capital account liberalization. To foster economic growth through increased openness, the payment and transfer system for current international transactions was liberalized. Foreign exchange spot and swap markets were developed. The government also aimed to support these reforms with improved macroeconomic management, including through an attempt to maintain a competitive and stable exchange rate.

Macroeconomic conditions and management:

Over the two and a half decades beginning in 1970, the Indonesian economy sustained high real GDP growth rates averaging about 7 percent annually, while the rate of inflation was held consistently below 10 percent annually. This performance reflected prudent macroeconomic policies, high investment and saving rates, and liberalization efforts. According to official data, the incidence of poverty declined from 60 percent in 1970 to 11 percent of the population in recent years.

Agricultural production grew strongly and Indonesia benefited from rising oil prices during the 1970s. However, the decline of oil prices in the 1980s led to a slowdown in growth, an increase in fiscal deficits, and a rise in external debt. The government took steps to reduce the budget deficit through tax reforms and cuts in current expenditures as well as scaling down or canceling of large investment projects. Export competitiveness was supported by major devaluations of the Rupiah in 1983 and 1986. The adoption of a market-oriented development strategy spurred rapid growth from the mid-1980s, led by non-oil manufacturing exports. Macroeconomic policies were tightened promptly to counteract occasional bouts of excess demand and to relieve strains on the current account from rapid import growth. However, the authorities were not able to contain inflation to the stated 5 percent target on an enduring basis and external debt indicators remained high.

The central government's financial position strengthened over the past decade, primarily as a result of firm expenditure control. Fiscal discipline benefited from the balanced budget rule, which had been in effect since 1968. It requires that total budgetary expenditure should be equal to budgeted revenue including external loans and grants. The

[4] This section draws from discussion in EIU (1997), IMF (1997a), IMF (1997b), Johnston, et al (1997), and Kochhar, et al (1998).

rule also requires domestic revenue to cover current expenditure, including amortization of government debt and a portion of development expenditure. These rules prevent domestic private bank and nonbank financing of the central government. To the extent that development expenditure exceeds public saving, the gap can normally be filled only by external borrowing.

Monetary policy, conducted in the context of an open capital account since 1970, has been complicated during the 1990s by large private capital inflows and the long-standing exchange rate policy of gradually depreciating the Rupiah against the U.S. dollar with a view to maintaining external competitiveness. Since capital markets in Indonesia have not been deep enough to support sustained sterilized intervention, this strategy has resulted in monetary and credit growth well in excess of preannounced targets. Bank Indonesia accumulated substantial foreign exchange reserves, partly as a result of the interventions to limit nominal exchange rate appreciation.

External developments, particularly the cyclical downturn in economic activity and the associated decline in interest rates in the industrial countries during the early 1990s, played a role in the initial surge in capital flows to many emerging market countries. Although Indonesia was not at first a major recipient of these flows, over more recent years, stock price movements in Indonesia have been more closely related to changes in industrial country interest rates and developments in other emerging markets.

Recent macroeconomic developments:

Overheating in the Indonesian economy, which had characterized developments in 1995, subsided in 1996, after the central bank raised interest rates and again raised the minimum reserve requirement. Real GDP growth eased slightly to 7.8 percent and inflation declined to under 7 percent. To maintain the competitiveness of exports, the central bank accelerated the depreciation of Rupiah, and widened the Rupiah's trading band to increase the holding. But the current account deficit remained over 3 percent of GDP, mostly financed by short-term inflows of portfolio capital.

After inflation moderated, Bank Indonesia lowered interest rates in December 1996 and again in March 1997. These actions were meant to reduce upward pressure on the Rupiah to maintain export competitiveness, and moderate capital inflows to lessen the debt burden on Indonesian firms. Yet, Indonesian firms continued to borrow heavily in international capital markets. The offshore borrowing was not reported correctly, hence there was an underestimation of foreign borrowing.

Foreign investment inflows continued in the first half of 1997. Consequently, the central bank took steps to prevent credit growth through sterilization from sales of central bank certificates, increase in reserve requirements, and reduction in subsidized credit to private enterprises.

Investment and FDI inflows:

Liberalization of direct investment inflows involved expanding the industries where they were permitted, liberalizing equity ownership rules in certain sectors, and increasing the length of time after which a company was required to revert to domestic ownership. Foreign direct investors were also allowed to sell foreign exchange directly to commercial banks. As a result of the improved climate for foreign direct investment, foreign investment approvals have increased rapidly since 1989. Recent investment projects are widespread across sectors, although the largest increases by value were concentrated in resource-based manufacturing, services, and infrastructure. Infrastructure investment was also encouraged through tax incentives; in 1996, the government announced a 10-year tax holiday for investment in infrastructure development to compete against neighboring countries, which were giving these incentives. The holiday would apply to investment projects that would be completed within 5-7 years of obtaining a license.

The financial sector:

Financial sector reforms began with liberalization of interest rates and removal of direct credit controls on banks in 1983. In 1987, reforms concentrated on strengthening the capital markets and introducing new capital market instruments. In 1988, reforms emphasized improving the functioning of the banking system and developing the money markets. The role of private sector banks relative to state banks was enhanced and foreign participation in the financial sector was encouraged through the licensing of new foreign banks and branches. The scope and coverage of directed credit schemes was greatly reduced, although some limits were put on banks' other financial business activities and lending requirements to small businesses and the export sector were introduced.

Functioning of the capital market was improved by increasing the role of the market in raising funds for investments, increasing the maturity of money market instruments, and broadening the range of market makers. Portfolio capital inflows were liberalized in 1989 by removing the quantitative limits on borrowing from non-residents by banks. Foreigners could invest in the stock market, up to 49 percent of ownership of listed stocks.

Despite some backtracking in reforms in 1991 to stem the interference of capital inflows with macroeconomic management, development of financial markets continued through the mid-1990s. Banking reforms were codified in the banking law of 1992, which unified and replaced the 1967-68 banking acts. In addition to describing the more liberal framework, the new banking law officially removed the traditional functional specialization between various types of banks and the major areas of specialization for state-owned banks.

In capital markets, middle class Indonesians were increasingly attracted to stock market investment, but the government also tried to attract foreign investors through public relations efforts. In recent years, Indonesia's equity markets, particularly the Jakarta Stock Exchange, has been bolstered by the surge in portfolio capital inflows. Inflows have

contributed to strong increases in market capitalization, trading volumes, and share prices. Market activity was also boosted by improvements in clearing and settlement systems, and growth of mutual funds. By around 1995, the government aimed to implement a coherent strategy for privatizing the state-owned enterprises, first by floating shares of some large state-owned enterprises and then by privatization of the largest state-owned commercial bank, Bank Negara Indonesia (BNI). However, this had the unintentional effect of making public the extent of bad debt in the banking sector--bad debts amounted to 2.35 percent of total bank credit, and of this almost 70 percent was held by the state banks.

The Indonesian domestic bond market remained relatively small in comparison with the equity market, although mutual funds grew rapidly following deregulation introduced in the Capital Market Law of 1995. The legislation permitted these institutions to be wholly foreign owned and granted them income tax exemptions for investments in the domestic bond market.

The relatively fast pace of banking sector liberalization over the past decade and a half was not matched by increased prudential oversight. As liberalization progressed, the number of banks and the increased complexity of their business activities led to several episodes of banking distress, such as the collapse and closure of Bank Summa in 1992. Although Bank Indonesia responded by redesigning the prudential framework, attempts to deal with identified problem banks have been slower. Violations of prudential regulation have sometimes been met with regulatory forbearance, and few banks have been closed or merged. In recent years, the banking sector showed signs of weakness including a high share of non-performing loans, increased exposure to foreign exchange risk, concentrated bank ownership, connected lending, and weak compliance with prudential requirements. In addition, exposure of banks to the property sector rose to around 20 percent in early 1997 from around 12 percent three years earlier.

The Political Environment:

Strong linkages between the government, businesses, and the banks, what is generally referred to as “crony capitalism” in the press, has contributed to economic distortions and misallocation of resources. Policies taken to benefit politically well-connected monopolies have created controversy and mistrust of the government. For example, one stated initiative on the part of the government was to improve the efficiency and competitiveness of the export sector. However, the specific measures were highly controversial since they were devised to benefit the family and friends of President Suharto.

- The Asri Petroleum Group (established under Suharto's son Bambang Trihatmojo) received heavy tariff support, and there were worries that this might increase the costs for downstream producers.

- Despite the AFTA trade liberalization date being moved to 2003, in December 1995, Suharto insisted on a list of exemptions on goods such as cloves, rice, wheat flour, and sugar, which were the monopolies owned by Suharto's family or close friends.

- In February 1996, the National Car policy specified that qualified "pioneer" firms would be exempt from sales tax and tariffs on imported components. The only firm that received these benefits was the firm of Suharto's youngest son (Hutomo Tommy Mandala Putra), which collaborated with a Korean firm to initially import cars duty-free and then start to manufacture them at home. This treatment was not extended to any other firm even if they demonstrated the expertise needed for another three years. The controversy was heightened when the EU, Japan and the USA lodged a complaint with the World Trade Organization (WTO) for violating certain WTO rules.

- Nepotism also cast suspicion on efforts to privatize a state-owned bank--shares were considered to be under-priced and half of the issue went to people linked to the first family. In April 1997, the inspection of all commercial cargoes entering Indonesia was handed back to the country's customs service--a step viewed as breeding inefficiency, red-tape and corruption.

These initiatives demonstrated the lack of government commitment to seriously address the economic problems pressing the country. This helped Indonesia earn the title of the "most corrupt country in Asia" in March 1997, according to the private Hong Kong-based Political and Economic Risk Consultancy survey of expatriate businessmen operating in various Asian countries.

In addition to economic distortions caused by political nepotism, Indonesia has suffered from concerns about political stability and election fairness. There were several recent incidents of political sabotage, media tampering, and clashes between protestors and the military.[5] Allegations of electoral fraud and the limitation of political competition has also led to public riots, mainly by Indonesian youth. Episodes of political unrest have often been associated with declines in the stock market.

Regarding political developments in the period leading up to the crisis, in May 1997, Golkar (the majority party) had an unprecedented victory in the DPR (the national legislature) elections. Since Suharto belonged to Golkar and the president is elected by the DPR plus appointees who reflect the composition of the DPR, this overwhelming victory ensured a smooth re-election of Suharto for his seventh term in 1998. This political stability brought with it the up trend in the stock market. During the Asian crisis, various reports of Suharto's ill health again brought uncertainty and declines in asset and exchange markets.

III: THE CRISIS UNFOLDS

[5] For specific examples, see Saxena (1998).

The first country to come under attack in the Asian crisis was Thailand. The defense of its peg to the US dollar was difficult--with a weak and vulnerable financial system, high interest rates could not be used to prevent capital outflows. Adding to the pressure, speculators short-sold baht. The peg was defended until July 2, 1997 after which the Baht was permitted to float. Thereafter, Thailand sought help from the international community.

Indonesia withstood the initial contagion from Thailand mainly because of its strong fundamentals. Measures were also taken to resist pressure on asset markets. In July 1997, banks were banned from making loans to property developers for land purchases and land developments, and to prevent speculation, Indonesia widened the trading band for exchange rate against US dollar to 12 percent from 8 percent. The government also limited nonresidents' transactions in the forward market, and banks' net open positions. Despite a vigorous initial defense of the exchange rate from severe speculative pressure, the Rupiah was allowed to float on August 14, 1997, owing to government concerns about the adverse impact of high interest rates on the stability of the banking system. Soon after this move, the currency underwent a massive depreciation and Indonesia sought assistance from the IMF in October. The financial contagion from Thailand also spread to Singapore, Korea, Malaysia, Taiwan, and Hong Kong.

When Indonesia signed its IMF program in October 1997, the Rupiah initially strengthened. But the abrupt bank closures and concomitant bank runs, financial fragility caused by high interest rates, and the government's initial lack of commitment to implement the agreed IMF policy measures led to a severe depreciation of Rupiah and decline in stock market values. This was heightened by the closure of a bank belonging to Suharto's son who publicly balked and threatened to take legal action. The government further lost credibility when it first cancelled 150 investment projects to gain international confidence, and then a few days later reversed its decision.

In December, a drought led to high food prices and food shortages. It was becoming increasingly difficult to manage the situation as the import of food became expensive with the exchange rate crisis, and displaced urban day laborers could not return to rural areas to find work. Simultaneously, the fall in petroleum prices decreased Indonesia's export earnings, which further added to the pressure on exchange rate.

Uncertainty in the region grew when Korea signed its IMF program in December 1997. It was revealed that Korea had very little usable foreign reserves, and fear mounted that low debt rollover rates would lead to corporate defaults. The illness of Suharto, without a successor in sight, added to the panic. In January 1998, the Rupiah depreciated severely after Indonesia announced its fiscal budget, which contained economic assumptions that were seen as unrealistic. The budget also was viewed as reneging on several structural reforms that had been agreed to in the IMF program.

The crisis was then both political and economic. Especially in Indonesia's case, lack of commitment to implement structural reforms prevented recovery. Political and social

unrest continued through the first half of 1998, eventually leading to the resignation of Suharto.

IV: MODELS OF CURRENCY CRISIS AND THE ASIAN EXPERIENCE:

Previous episodes of currency crises tended to stem from unsustainable fiscal deficits financed by seigniorage or were induced by trade-off between short-run macroeconomic flexibility and longer-term credibility. The first generation of currency crisis models such as Krugman (1979) and Flood and Garber (1984) fit the experience of Latin American crises in response to monetization of debt from unsustainable fiscal imbalances. In these models, the central bank attempts to maintain a fixed exchange rate with limited foreign exchange reserves and high monetary growth and inflation resulting from growth of domestic credit. Anticipation of future devaluation leads to an accelerated drawdown of reserves as speculators attack the currency. In the Asian crisis countries, however, fiscal budgets were generally in surplus and as a result, inflation was low.

The second generation models explained the crises as self-fulfilling outcomes. While Diamond and Dybvig (1983) present a stylized model of financial intermediation in which there are two equilibria: one in which agents have confidence in the solvency of financial intermediaries; and the one in which lack of confidence leads to a bank run, Obstfeld (1986) emphasized the tension between the government's motives to defend and abandon an exchange rate peg. Modeled largely on the experience of European countries, the focus is on the desire of the government to use expansionary monetary policy to reduce unemployment. Even if reserves are sufficient to defend a fixed exchange rate, market confidence in the commitment of the government to defend the peg may weaken if the costs are believed to be higher than the benefits. However, this explanation also does not appear to be relevant for the Asian case as cyclical weakness did not emerge until after the crisis was well underway.

New generation models of currency crisis emphasize financial sector weaknesses, and investor behaviors. Goldfjan and Valdes (1997) focus on the role of financial intermediaries in currency crises. These intermediaries provide liquidity, which is attractive to foreign investors with short-term incentives for investment, hence aiding capital inflows. However, due to exogenous shocks, when the foreign investors want to withdraw their deposits, these intermediaries, being locked in illiquid assets, face the risk of failure. Hence, a bank run leads to the capital outflows and exchange rate collapse. Their model provides role for the banking system in magnifying the shocks to fundamentals (productivity and international interest rates), but does not assume any kind of inconsistency in the policy making, like the first and second generation models.

While Goldfjan and Valdes (1997) capture the illiquidity in domestic financial markets, leading to a panic and crisis, Agenor and Aizenman (1997) analyze the transmission process of contagious shocks by capturing the imperfections on both world capital markets and domestic credit markets.

Other models emphasize rational herding or multiple equilibria resulting from imperfect information and moral hazard. Froot, Scharfstein and Stein (1992) show that speculators with short horizons may herd on the same information, trying to learn what the other informed traders know. These could lead to multiple equilibria, and herding speculators may even choose to study information that is completely unrelated to fundamentals. So the large perceived penalty of missing a bull market leads managers to follow the pack even if fundamentals do not warrant it; conversely, the penalty of losses during a bear market is lower as all managers are losing money as well.

Krugman (1998) and Corsetti, et al (1998b) explain the Asian crisis using moral hazard models. Krugman (1998) analyses the case of over-guaranteed and under-regulated financial intermediaries, that encourage excessive investment in the economy. If the economy does not have access to the world financial market, then excessive investment demand by intermediaries would show up in higher interest rates and not excessive investment. But the access to world market allows the moral hazard in the financial sector to translate into real excess capital accumulation. Corsetti, et al (1998b) also consider the case of moral hazard fueling over-investment, excessive borrowing, and current account deficits. Unprofitable projects and cash shortfalls are re-financed through external borrowing as long as foreign creditors lend to domestic agents against future bail-out revenue from the government. The government deficits need not be high before the crisis, but refusal of foreign creditors to re-finance the debt forces the government to step in and guarantee the outstanding stock of external liabilities. The government might have recourse to seigniorage revenues. Expectations of inflationary financing thus cause a collapse of the currency and anticipate the event of a financial crisis.

The Asian crisis showed no signs of predictability based on the traditional crisis models. The government deficits and inflation were low, unemployment was not a problem, capital inflows continued, credit ratings were high from all agencies, and risk premia on bonds were low. Indeed, the current crisis in Asia is thought to have different characteristics from previous episodes. The crisis is attributed mainly to the excesses in the financial sector, which--combined with poor supervision and lax accounting standards--have led to the collapse of a speculative bubble. The prolonged maintenance of pegged exchange rates and record of high economic growth rates encouraged massive inflows of capital. Poor financial sector supervision and weak prudential regulations allowed excessive lending, much of it directed toward real estate, construction, stock purchase and consumer loans. The ratio of short-term debt to foreign exchange reserves rose to high levels prior to the crisis. While this indicated vulnerability to a crisis, it did not guarantee the onset of one. Furthermore, these vulnerability indicators were ignored since the economies had sustained high rates of economic growth. When investors lost confidence in the economy and currency, the ensuing depreciation and rise in interest rates led to bankruptcies of banks and finance companies as loans soured.

In short, proposed causes for the Asian financial crisis include the following:[6]

[6] See Berg (1998), IMF (1997), Kochhar, et al (1998), Corsetti, et al (1998a), and Radelet and Sachs (1998a) for overviews of the origins, onset, and spread of the Asian crisis.

- They all suffered from real appreciation of currencies. Since they all had de-facto exchange rate pegs to the US dollar or to currency baskets that gave a high weight to the US dollar, these currencies became overvalued when the US dollar appreciated relative to other major currencies (especially the yen). All these countries gained from the appreciation of Japanese yen in 1993-95, but lost their competitive edge when the Japanese yen depreciated against the US dollar in 1996.

- Prolonged maintenance of fixed exchange rates weakened the ability of central banks to use monetary policy to react to overheating pressures.

- The implicit guarantee of exchange value encouraged over-borrowing in foreign debt. Since much of this was short-term, banks and private companies were vulnerable to refusals of creditors to rollover the debt.

- Weak prudential regulations and poor financial supervision permitted a deterioration in bank loan portfolios.

- The severity of the crisis owed to a "competitive devaluation" game, as devaluation in one country decreased the export competitiveness of other currencies, leading to further rounds of exchange rate adjustments.

- An investment boom led to current account imbalances and huge foreign debt. Investment rose sharpest in the non-traded sectors (non-traded goods, real estate, speculative asset purchases). Since borrowing and lending was directed toward speculative assets, there was a price bubble, which burst in 1997 and the simultaneous currency fall aggravated the debt problem as the burden increased in real terms.

- Implicit government bailout guarantees created "moral hazard" problems, whereby banks borrowed too much and financed marginal projects, which turned out to be unprofitable later.

- The governments were weak, lacked credibility and were not committed to structural reforms. Corrupt and nepotistic governments created distortions in the economy, which came under increased scrutiny after the crisis began.

- Political uncertainty reduced investor confidence and increased reluctance to roll over short-term debt.

- In 1995-96, there was a drop in demand for semi-conductors, the major export of these Asian countries. Also, economic stagnation in Japan in 1990s was another factor responsible for decrease in exports (roughly one-third of exports went to Japan).

- Low international interest rates (especially in Japan) led to elevated capital flows to developing countries in search of higher returns.

- Limited availability of economic data and lack of transparency increased vulnerability to capital flow reversals (and contagion) when problems became evident.

Contagion, Panic and Crisis in Indonesia:

Despite Indonesia's own internal problems, which included under-supervised banks, extensive crony capitalism, corruption, monopoly power and growing short-term debt, this country has been viewed as the clearest case of contagion, as it had least severe imbalances[7]. Indonesia's current account deficit was the lowest of the Asian-5 and export growth in 1996 was the second highest. The budget surplus averaged over one percent in the previous four years, while credit growth was modest. Foreign liabilities of commercial banks were below the other affected economies (although corporate foreign debts were high) and there were no major corporate bankruptcies. The stock market continued to rise through early 1997 until the onset of the crisis in Thailand.

In short, the crisis in Indonesia does not appear to have been caused by poor traditional economic fundamentals. The crisis appears to relate to a weak financial sector and political uncertainty, combined with contagion from economies in the region.

V: ESTIMATING THE EQUILIBRIUM REAL EFFECTIVE EXCHANGE RATE

An overvalued exchange rate is one potential contributing factor to an attack on the currency. Therefore, this section estimates the Equilibrium Level of Real Effective Exchange Rate (REER) for Indonesia to determine if the exchange rate was overvalued before the onset of the recent Asian crisis. The equilibrium REER is defined here as the permanent or trend component of the REER. Depending on the time series properties of the REER, this component may consist of a single point in the case of a stationary variable without a deterministic trend or a point on a time trend in the case of a stationary variable with a deterministic trend. If the REER is nonstationary, the equilibrium value is the stochastic trend component. The REER is defined to be over/under valued by the extent to which its value deviates from this permanent (equilibrium) component. Equilibrium is therefore a concept of sustainability in this analysis. The intuition behind this definition is as follows. Suppose the REER is stationary without a deterministic trend. If the value of the REER moves above its mean in response to a temporary shock, there will be a tendency to decline back toward the mean after the temporary shock dissipates. Although the temporary increase may be justified or explained by some economic variable, the deviation is not sustainable. Analogously, if the REER is trend stationary, deviations from its time trend would represent cyclical movements, which by definition of stationarity would not be permanent.[8] If the REER is nonstationary, deviations are measured relative to its stochastic trend component.

[7] See Radelet and Sachs (1998a) for detailed arguments supporting this view.

[8] This discussion abstracts from structural change that results in permanent one-time shifts in the mean or slope of the time trend.

The purpose of this section is to gauge if the REER had moved temporarily above its permanent component just prior to the onset of the crisis. If so, the subsequent depreciation could be explained as a sudden reversal of this cyclical deviation. Moreover, the magnitude of the reversal could be compared to the initial deviation as an indication of overshooting.

Unit root tests for the REER (in logs, LREER), as shown below, indicate that the LREER is non-stationary. However, unit root tests are notorious for having low power and it has been shown that several decades of data are often required to reject the unit root half of the time when it is false. Therefore, the finding of nonstationarity must be treated with caution. On the one hand, there could be more harm in treating nonstationary variables as stationary, compared to the converse. On the other hand, there are econometric arguments for believing the REER could be stationary even if unit root tests do not indicate this. It is for this reason that alternative measures of equilibrium are constructed based on assumptions of both stationarity and nonstationarity.

Chart 1 shows the REER (in logs, LREER) relative to its sample mean, a fitted time trend, and a trend created by a Hodrick-Prescott filter, based on the assumption that the REER is stationary or trend stationary. Based on these measures of the "equilibrium" levels, the REER was undervalued by 21 percent, overvalued by 22 percent, and overvalued by 4 percent, respectively, in 1996; the REER was undervalued by 26 percent, overvalued by 21 percent, and undervalued by 1 ½ percent, respectively, in 1997.

Based on the finding that the REER is nonstationary, we employ the methodology of Montiel (1997b), which determines the stochastic trend component at each point in time as a function of economic variables believed to share a common stochastic trend. Fundamental economic variables that affect the equilibrium REER are consistent with both internal and external balance. The equilibrium REER is estimated using the Johansen reduced rank vector auto regression (VAR) maximum likelihood estimation (MLE). The equilibrium value is constructed as the fitted value of the cointegrating equation between the REER and the fundamental economic determinants. The equilibrium value will therefore change each period based on movements in these variables. The variables and the estimation technique used consist of the following.

Explanatory Variables:

Theoretical models for open economies indicate a number of factors which would change the equilibrium value of the REER. These include the following (Montiel 1997a):

- Changes in the composition of government spending affect the long run equilibrium REER on different ways depending on whether the spending is directed toward traded or non-traded goods. Spending directed mainly toward non-traded goods and services generate excess demand in the non-traded sector. To restore the sectoral balance, there must be an appreciation of the REER, which can be defined as the relative price of non-tradables to tradables (since we use an increase in the ratio as an appreciation). The expected sign on the coefficient is positive. Conversely, if government spending

is directed mainly toward traded goods and services, the trade balance deteriorates. To bring the external balance in equilibrium, the REER must depreciate. The expected sign on the coefficient is negative.

- As the economy opens up, the demand for imports leads to external and internal imbalance which require real depreciation to correct them. The expected sign is negative.
- As the terms of trade improve, there is an increase in the real wage in the export sector, due to which labor from the non-tradable sector moves to tradable sector, which leads to a trade surplus. For external balance the REER must appreciate. Hence, expect a positive coefficient.
- The Balassa-Samuelson effect: Higher differential productivity growth in the traded goods sector leads to increased demand, hence higher real wages for labor in that sector. The traded goods sector expands, leading to an incipient trade surplus. To restore both internal and external balance, the relative price of non-traded goods must rise (REER appreciation).
- Changes in the availability of foreign capital or shifts in the risk premium can affect the equilibrium REER. Reductions in real world interest rates or reductions in the perceived political or economic risks of the country induce capital inflows, which reduce the country's net creditor position. The long run loss of net interest receipts requires the real depreciation to maintain external balance.

Quarterly data covering the period from 1980:1 through 1997:4 are used to estimate the parameters of the ECM. Based on the theory discussed above, the explanatory variables for the ECM consist of the ratio of government consumption to GDP (GCONSGDP), the ratio of government investment to GDP (GINVGDP), openness (OPEN), terms of trade in logs (LTOT), and a time trend as a proxy for productivity growth. The data appendix contains the sources and construction of these variables.

Time Series Properties of the Data

Prior to estimating the cointegrating vector, the time-series properties of the REER (in logs, LREER) and the explanatory variables are checked using standard unit root tests. The results from the Unit Root testing are described in the table below.

		ADF Test	PP Test
	K	Test Statistic	Test Statistic
LREER	1	-0.638606	-0.654257
LTOT	3	-3.115713**	-2.397927
OPEN	4	-2.442619	-2.559876
GCONGDP	3	-0.151235	-2.066636
GINVGDP	2	-0.761226	-2.400429

Note: Variables are as defined in Appendix 1. Estimation period is 1980:1-1997:4. The lag length for ADF test is determined by a backward selection criterion (starting at 5 lags). The value of k corresponds to the highest-order lag for which the corresponding t-

statistic in the regression is significant. The truncation lag for PP test was 3 for all the series. Asterisks *, **, and *** denote rejection of null hypothesis of a unit root in levels at 10 percent, 5 percent, and 1 percent significance levels, respectively. Critical values are from MacKinnon. All series are stationary in first differences.

Based on the results of the ADF tests, all the variables are non-stationary in levels, but stationary in their first differences (I(1)), except LTOT, for which the unit root hypothesis can be rejected at the 5 percent level. All variables are nonstationary according to the PP tests.[9] Based on the economic relationships discussed above, they all are potential candidates for the determination of equilibrium LREER.

Estimation of the Cointegrating Vector

When some non-stationary variables share a common stochastic trend, they are said to be cointegrated. The deviation of these cointegrated variables from their long-run equilibrium value is transitory. To determine if the above variables are cointegrated, a Johansen Cointegration Test is performed by estimating the following model.

$$\Delta y_t = DV_t + Ay_{t-1} + \sum_j \beta_j \Delta y_{t-j} + u_t$$

where y= 5x1 vector containing the REER and the potential fundamentals, DV is a vector of deterministic variables (a constant and a trend), A and β are 5x5 matrices of estimated coefficients, and u is serially uncorrelated random shock. The rank of matrix A gives the number of cointegrating vectors. The Johansen Test reveals that the variables LREER, GCONGDP, GINVGDP, OPEN, LTOT, and a time trend are cointegrated with one cointegrating vector (there is one linear combination of the variables that is stationary). The results from the Johansen Cointegration Test are presented below.

Eigenvalue	Likelihood Ratio	5% Critical Value	1% Critical Value	Hypothesized No. of CE (s)
0.56	118.48	87.31	96.58	None**
0.36	61.73	62.99	70.05	At most 1

Note: *(**) denotes rejection of the hypothesis at 5% (1%) level. L.R. Test indicates 1 cointegrating equation(s) at 1% significance level.

Thus the long-run REER depends on the factors government consumption, government investment, openness of the economy, the terms of trade and differential productivity growth rates.

Results: Since we find one cointegrating vector, we estimate it via Johansen reduced rank VAR MLE. This is estimated using a VAR in ECM form by imposing one cointegrating vector. The lag length of the ECM was determined by backward selection, beginning at a lag length of four to economize on degrees of freedom. The Likelihood Ratio Statistic

[9] In addition to the notorious low power of unit root tests, some of these variables are bounded (at least from below) by construction and possibly stationary by construction. However, the authors believe that there could be a range in which the variables move as a random walk even if there is some threshold beyond which the variables would return to the range.

was calculated and ECM(1) was found out to be the most appropriate. The results are presented below[10].

Cointegrating Equation:

LREER = 3.52*GCONGDP + 22.38*GINVGDP + 0.69*LTOT – 5.03*OPEN + 0.01*TREND – 1.35

(0.99) (3.61***) (2.88***) (-2.00**) (1.37)

Note: T-stats are in parentheses. Asterisk *, **, and *** denote significance at the 10 percent, 5 percent, and 1 percent level, respectively.

It can be seen from the above results that GINVGDP, LTOT and OPEN are highly significant in the cointegrating equation, while GCONGDP and TREND are not. All variables have the expected signs except the GINVGDP. The latter result suggests that government investment expenditures may be directed toward non-tradables. In fact, IMF (1997b) states that in fiscal year 1996/97, increases in government investment (development expenditure) could be attributed primarily to increases in spending on health, education, and social welfare. These are generally non-tradeable items. Government infrastructure investment (which may rely on imported inputs) had apparently become less important in recent years as these activities had been transferred in part to the private sector. Therefore, the sign on GINVGDP may be correct if it measures the opposite of the original intention. The trend used as a proxy for total factor productivity growth, is positive, although insignificant in the cointegrating equation.

The Equilibrium REER was constructed as the fitted values from the cointegrating equation. Chart 2 shows the actual and the fitted values of LREER from the cointegrating equation. It is evident that the REER for Indonesia was over-valued vis-à-vis what the fundamentals would suggest at the onset of the crisis last year. The REER was overvalued by 13 and 27 percent on average in 1996 and 1997, respectively. Notably, the overvaluation was mainly caused by a decline in the equilibrium measure rather than an increase in the actual REER. The variable GINVGDP had a major contribution to the decline of the equilibrium level in 1996, and a partial contribution to the decline in 1997. If the effect of this variable on the equilibrium level was removed, the magnitude of overvaluation would correspondingly decline. Based on this evidence and the results from comparison of the REER to the alternative stationary measures of equilibrium, the degree of overvaluation was never as large as the amount of depreciation that followed in the wake of the Asian crisis.

VI: ECONOMETRIC EVIDENCE OF CONTAGION IN INDONESIA

Although the above estimation of equilibrium REER shows that the exchange rate of Indonesia was above the level that would have been supported by the fundamentals, it does not fully explain the depreciation that took place in mid-1997. This section

[10] Real world interest rates (proxied by both real interest rates in the US and Japan) and a measure of the perceived political risk in Indonesia (discussed in the next section) were included in preliminary estimations of the ECM, but were found to be completely insignificant and were dropped from the equation.

decomposes the causes of the pressure on the domestic currency into domestic and external fundamentals and contagion. The domestic fundamentals are of three kinds; financial, non-financial and political.

Data and Linear Estimation:

The term "crisis" in this paper refers to an intense increase in speculative pressure on the country's currency. Therefore, we construct a measure of exchange rate pressure termed the Market Pressure Index (MPI) as follows:

$$MPI_{i,t} = (\%\Delta e_{i,t}) / \sigma_{\Delta e_{i,t}} + (\Delta i_{i,t}) / \sigma_{\Delta i_{i,t}} - (\%\Delta r_{i,t}) / \sigma_{\Delta r_{i,t}}$$

where e is the U.S. dollar exchange rate (domestic currency/US$) and the changes in the exchange rate, interest rate and reserves are weighted by their respective standard deviations.[11]

This index is high when there is pressure on the currency and low otherwise. The intuition is that if there is an attack on the currency, either the exchange rate would depreciate, or interest rates would be raised to prevent the attack, or the central bank would sell foreign currency to support the exchange rate. Chart 3 shows the MPI for Indonesia, Korea and Thailand. Thailand and Korea were chosen for comparison since they experienced macroeconomic problems, which forced them to seek IMF programs in 1997[12]. It is clear from the chart that the MPI increased for all the three countries in 1997. There are two substantial spikes in MPI in 1997. The first one is around mid-1997, when a large increase in MPI for Thailand was followed by a larger increase in MPI in Indonesia. The second spike is towards the end of 1997, when again an increase in Indonesian MPI follows an increase in Korean MPI. Hence, both times Indonesia experienced pressure on its currency after Thailand and Korea.

To decompose the causes of the severe crisis in Indonesia, a number of domestic and foreign fundamentals are investigated. The domestic variables considered in this study are of three kinds: financial (private claims to GDP, domestic credit to GDP, foreign liabilities to GDP, foreign assets to M1 and interest rate spread), non-financial (trade balance and terms of trade) and political (political risk).[13] Private claims to GDP and domestic credit to GDP are a proxy for how extended the banking system is.[14] An

[11] See e.g. Eichengreen, Rose, and Wyplosz (1996), Sachs, Tornell, and Velasco (1996), Frankel and Rose (1996) and Kaminsky, Lizondo, and Reinhart (1997) for similar constructions of exchange rate pressure.

[12] In addition, Granger Causality Tests indicate that there is causality from Korea and Thailand to Indonesia, but not the other way round.

[13] IMF (1997a) and IMF (1997b) outlined concerns about the soundness of the banking sector just prior to the onset of the crisis.

[14] Hardy and Pazarbasioglu (1998) find a persistent tendency for credit to the private sector to follow a boom and bust pattern in advance of banking crises, with a further decline in credit growth during the crisis. Sachs, Tornell, and Velasco (1996), Radelet and Sachs (1998b) and Corsetti, Pesenti, and Roubini (1998b) also use this variable as a measure of a bank lending boom, arguing that this measure proxies for financial

increase in these ratios signifies growing strain in the banking system.[15] These variables were intended to account for a possible boom and bust lending cycle in the crisis countries. Moreover, financial inflows in previous years had been channeled into the property market, stock market, and the corporate sector with decreasing profitability.[16] We also included variables intended to measure foreign exchange exposure risks in the financial sector. The ratio of foreign liabilities to GDP measures the extent to which the banking system relies on foreign capital to fund its operations; hence, it proxies for the banking system's vulnerability to a sudden reversal of capital inflows. The ratio of foreign assets to M1 measures the degree to which the M1 money supply is backed by foreign assets of the banking system. The interest rate spread is the difference between bank lending and deposit rates. It is an indicator of the profitability of the banking system. A deterioration of the trade balance may indicate an overvalued exchange rate leading to slow export growth and increased import growth. An adverse terms of trade shock may affect the competitiveness of the economy, and lead to deterioration of corporate sector profitability. The political risk index is a measure of investors' confidence in the political stability of the economy. An increase reflects greater confidence, which may encourage capital inflows.

The external fundamentals consist of U.S. and Japanese rates of interest. The U.S. rate of interest is a proxy for the world interest rate. Lower world interest rates reduce pressure on the exchange rate as capital flows out of industrial countries to developing countries in search of relatively higher returns. In addition to the US interest rate, Japanese interest rate is used, since monetary conditions in Japan are believed to have contributed to the Asian crisis.

The sources and construction of all variables are provided in the data appendix.

Table 1 shows the trends in the explanatory variables from 1991-1998 Q1. Although Indonesia had a current account deficit in 1990s, the merchandise trade balance was in surplus. The trade surplus more than doubled in US dollar terms between 1991 and 1994,

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fragility, as the quality of bank loans is likely to deteriorate significantly when bank lending grows at a rapid pace in a relatively short period of time. Kaminsky and Reinhart (1996) find that the growth in domestic credit to GDP accelerates steadily and markedly as the crisis approaches, peaking at the time the crisis erupts.

[15] Domestic credit to GDP consists mainly of claims on the private sector. Net claims on the government are negative, indicating that the government was a net creditor. The inclusion of the central bank may be important in Indonesia's case since the central bank was a source of subsidized credit to the agricultural sector and public enterprises. For some Latin American country studies, net domestic credit of the central bank may be the most useful variable, as it would reflect the financing of government expenditure similar to the first generation speculative attack models. However, it is less relevant for Indonesia since it did not have budget problems in recent years. The total domestic credit from the central bank and deposit money banks gives an overall measure of lending activity of the entire banking system to the domestic economy.

[16] Claessens, Djankov, and Lang (1998) find that while investment rates were high, corporate profitability in most East and Southeast Asian countries declined sharply in the years 1994-1996 while leverage increased. In Indonesia, profitability measured by real Return on Assets (ROA) declined from 12.8 percent in 1990 to 4.9 percent in 1996. This data, while instructive, is unfortunately annual. We are not aware of high frequency data on corporate profitability for Indonesia.

after which it declined in 1995 and 1996. The trade balance increased to 11.7 billion US dollars in 1997, mainly in response to import compression from the massive depreciation in August. The terms of trade index improved over the period 1991-96. However, it deteriorated in 1997, affecting the competitiveness of the economy. Domestic credit to GDP and private claims to GDP rose from around 46 percent to 58 percent between 1991 and 1997. The ratio of foreign assets to GDP increased from 4.5 to 6.5 percent between 1991 and 1994, and further increased to 11.3 and 15 percent in 1997 and 1998 Q1, respectively. The ratio of foreign assets to M1 remained between 30 and 40 in 1991-96, but increased to 68 and 108 percent in 1997 and 1998 Q1, respectively, mainly reflecting the exchange rate effect[17]. The interest rate spread peaked in 1993 at 6 percent. Since then it has fallen to a low of 1.8 and 1.6 percent in 1997 and 1998 Q1, respectively, indicating disintermediation of banks. The political risk index shows an increase from 1989 through early 1997 (Chart 4). According to the definition of political risk, Indonesia moved from a high risk to moderate risk country in 1993. But it again became a high risk country beginning in the latter half of 1997, and the index experienced a sharp decline in 1998 Q1.

To find out which of the above variables best explain the pressures in Indonesian currency, an Ordinary Least Square (OLS) equation is estimated. The MPI for Indonesia is regressed on all the domestic and foreign fundamentals (contemporaneous and lagged). The OLS results are shown in table 2. When the fundamentals are regressed contemporaneously, only five variables are significant (foreign liabilities to GDP, political risk, interest rate spread, trade balance and terms of trade). However, since this equation may suffer from endogeneity problems[18], a similar equation is estimated with lagged fundamentals. This has three significant variables (foreign liabilities to GDP, political risk and private claims to GDP). To arrive at the most important fundamentals, the insignificant variables were dropped from this equation one by one. The final specification has foreign liabilities to GDP, political risk and private claims to GDP. The positive sign on foreign liabilities to GDP means that an increase in this variable makes the banking system more vulnerable to capital outflows, hence putting a pressure on the currency. The negative sign on the political risk variable means that as investors lose confidence in the economy, there is an outflow of funds and hence a pressure on the currency. The sign on private claims to GDP is significant and negative. This unexpected sign prevails despite positive sample correlations between this variable and the MPIIDN on a contemporaneous and lagged basis.[19]

Probit Models:

[17] The domestic currency equivalent of foreign currency denominated assets rises as domestic currency falls.

[18] For example, movements in the explanatory variables may result from valuation effects related to exchange rate changes, or may reflect the economic consequences of a major devaluation.

[19] We are indebted to Charles Engel for pointing out that an increase in private sector claims to GDP may represent a strengthening of the banking sector on the basis that if increased confidence in the banking sector leads to more deposits, there could be correspondingly higher lending activity.

Following the methodology used in the literature (especially Eichengreen, Rose and Wyplosz (ERW) (1996)), we estimate a probit model. The probit model is presented mainly as a benchmark against which to compare the later Markov Switching estimations, which we argue have theoretical advantages over the probit model. The probit model uses a discrete dependent variable, and permits estimation of the probability of a speculative attack. The discrete dependent variable is constructed as follows (using the definition of the crisis or speculative attack that ERW (1996) use):

$DUMMPIx = 1$ if $MPIx > \mu_{MPIx} + 1.5*\sigma_{MPIx}$,

where x denoted IDN, KOR and THA for Indonesia, Korea and Thailand, respectively, μ denotes the mean, and σ denotes the standard deviation. According to this definition, there were only four time periods when Indonesia faced a crisis.

Table 3 shows the results from probit models. The dummy for crisis in Indonesia (DUMMPIIDN) is estimated using contemporaneous (model1) and lagged (model2) domestic fundamentals (foreign liabilities, political risk and private claims to GDP). Only the ratio of foreign liabilities to GDP is significant when the variables are contemporaneous. When the variables are lagged, the ratio of private claims to GDP is also significant but with the wrong sign as in the OLS estimation. Chart 5 shows the actual and fitted probabilities of crises for the model with lagged fundamentals. The fitted value series peaks in early 1998, although with a one period delay compared to the actual. It misses the crisis in 1986 and mid-1997. The model also indicates periods of pressure in 1989-93 (especially in 1991), when there is no actual crisis according to this definition.

Models 3 and 4 are estimated with contemporaneous and lagged probabilities of crises, respectively, in Korea and Thailand and with the domestic fundamentals. No variable is significant in model 3, where all the variables are contemporaneous. In model 4, coefficients on probability of a crisis in Thailand and private claims to GDP are significant. The sign on the latter variable is again incorrect while the sign on the former suggests that pressure in Thailand leads to pressure in Indonesia. Chart 6 shows the actual and fitted probabilities of crises for model 4. The fitted value is a slight improvement compared to model 2, since it peaks simultaneously with the actual data in early 1998 and had a smaller probability of a crisis in 1991.

In order to see if the external fundamentals (probability of crises in Korea and Thailand) are significant in predicting a crisis in Indonesia, a Likelihood Ratio Test was performed. The result is in Table 5. The test indicates the joint significance (at 5 percent level) of the two variables in the probit model. This is an indication of some kind of contagion from the neighboring countries into Indonesia.

Markov Switching Models[20]:

[20] For details about estimating these models, see Kim and Nelson (1998)

Fixed Transitional Probability Model:

Although the probit model results suggested a weak sign of contagion, there are limitations to the use of probit models. The creation of a discrete dependent variable involves an arbitrary cut-off in the underlying MPI in defining a period of crisis. In the Indonesian data, the conversion of the MPI to a discrete measure of crisis for the probit models results in only four cases of crisis. Also, making the probability a discrete variable leads to a loss of information on the magnitude of speculative attack (e.g. the data shows numerous incidents of pressure on the currency of varying degree). The exclusion of incidents of speculative pressure on the exchange rate below the arbitrary threshold value has the further disadvantage of introducing sample bias into the estimation procedure. Flood and Marion (1998) argue that many models of speculative attack indicate that unanticipated devaluations produce the largest jump in the MPI. The size of jumps in the MPI at the time of attack is reduced by the extent to which the attack is anticipated. Thus, selection of only extreme values of the MPI (as in construction of the dependent variable for probit models) may reduce the share of predictable crises in the sample and reduce the number of crises that are likely to be correlated with fundamental economic determinants. We turn to a model that makes the probability of a crisis in Indonesia continuous and endogenous. Estimation of Markov Switching Models (MSMs) permits full use of the continuous dependent variable while endogenously determining the probability of a switch in regime.

The Fixed Transitional Probability (FTP) MSM estimates the switch in mean of the MPI of Indonesia in the two states (high pressure indicating a crisis state and low pressure a non-crisis state). The model filters the data into states of high and low pressures and estimates the probabilities accordingly. The estimated model is the following:

$$MPI_t - \mu_{s_t} = \phi [MPI_{t-1} - \mu_{s_{t-1}}] + e_t$$
$$e_t \sim iidN(0, \sigma^2)$$
$$\mu_{s_t} = (1 - s_t)\mu_0 + s_t \mu_1$$
$$\Pr(s_t = 0 / s_{t-1} = 0) = q$$
$$\Pr(s_t = 1 / s_{t-1} = 1) = p$$

where MPI has two means (μ_0 low pressure and μ_1 high pressure);
MPI follows an AR(1) process
p is the probability of being in a crisis at time t if the country had been in a crisis at time t-1
q is the probability of being in a no-crisis state at time t if the country had been in a no-crisis state at time t-1
s_t is the unobserved state

There are two types of charts shown for the Markov Switching Models. The charts containing the probability of a crisis compare the actual data at time t, $MPIIDN_t$, and the one step ahead probability of a crisis ($\Pr(S_t = 1 / MPIIDN_{t-1})$). The charts containing the

forecasted values compare the actual data, $MPIIDN_t$, and the conditional expectation at time t-1, $(E_{t-1} MPIIDN_t)$. Construction of forecasted values is described in Appendix 2. The forecasted values of MPIIDN have been constructed using the parameters that have been estimated over the entire sample, the predetermined explanatory variables and one step ahead probability of switching to the high state in the next period.

Charts 7 and 8 show the MPI for Indonesia, one-step ahead probability of a crisis in Indonesia, and the forecasted MPI for Indonesia. Chart 7 shows that the dependent variable (Indonesia's MPI) indicates the occurrence of crises in 1997 and early 1998, but does not indicate incidents of significant pressure on the currency in any earlier periods. The spikes in the one step ahead probabilities occur one period after the crisis. Chart 8 shows the forecasted MPI for Indonesia from FTP MSM. The values are concentrated around zero, as the probability of going to a high state (1-q) is very low. Also, the spikes in the forecasted values occur one period after the actual data.

The coefficient estimates are summarized in table 4. The estimate of q is most significant, followed by variance and μ_1. The high value of q depicts a lot of persistence in the no-crisis state.

Time-Varying Transitional Probability Model with regional contagion:

To see if the exchange market pressures in Indonesia could be explained by movements in MPIs of Thailand and Korea, a time varying transitional probability (TVTP) Markov Switching Model[21] is estimated. In this model, the probability of a crisis varies in the high and low states according to one period lags of the MPIs of Thailand and Korea. The estimated model is given by:

$$MPI_{i,t} - \mu_{s_t} = \phi\,(MPI_{i,t-1} - \mu_{s_{t-1}}) + e_t$$

$$e_t \sim iidN(0, \sigma^2)$$

$$\mu_{s_t} = (1 - s_t)\mu_0 + s_t \mu_1$$

$$\Pr(s_t = 1 / s_{t-1} = 1) = p_t = \frac{\exp[p_0 + p_1 MPI_{j,t-1} + p_2 MPI_{k,t-1}]}{(1 + \exp[p_0 + p_1 MPI_{j,t-1} + p_2 MPI_{k,t-1}])}$$

$$\Pr(s_t = 0 / s_{t-1} = 0) = q_t = \frac{\exp[q_0 + q_1 MPI_{j,t-1} + q_2 MPI_{k,t-1}]}{(1 + \exp[q_0 + q_1 MPI_{j,t-1} + q_2 MPI_{k,t-1}])}$$

where $MPI_{j,t-1}$ and $MPI_{k,t-1}$ is the lagged MPI for Thailand and Korea; respectively and p and q are varying over time in response to movements in these MPIs. Chart 9 shows the actual MPI and one-step ahead probability of a crisis in Indonesia when the probability is a function of lagged Thai and Korean MPIs. It is clear from these figures that even small pressures on the currency are indicated when the neighboring countries' market pressure indexes are accounted for. Chart 10 shows the forecasted values from this model. The

[21] These models have been used by Diebold, et al (1994) and Filardo (1994) to examine the business cycles.

forecasted values overestimate the actual data during the earlier "tranquil" periods. This could be attributed to the higher probability of switching to the higher (crisis) state.

Although only q1 is individually significant, a LR test was conducted to test the joint significance of the p's and q's (table 5). The likelihood ratio is significant at the 1 percent level of significance. Hence, there is evidence of contagion of the crisis in Thailand and Korea.

FTP and TVTP Models with domestic and external fundamentals:

The next step is to control for the domestic and external fundamentals. From the earlier OLS results, three variables were found to be significant. So the above two models (FTP and TVTP) are estimated again by putting lagged fundamentals in the measurement equation.[22] The above models would change as follows.

$$MPI_t - \mu_{s_t} = \Phi[MPI_{t-1} - \mu_{s_{t-1}}] + \sum_{i=1}^{3} \beta_i DV_{i,t-1} + e_t$$

where DV_i consist of the predetermined variables political risk, forliabgdp, and pvtclaimgdp.

The third and fourth columns of Table 4 show the parameter estimates from the FTP and TVTP MSMs with domestic variables in the measurement equation. The estimates of q, phi, variance, mu1 and the coefficient on political risk are significant in both models. The coefficient on political risk is negative indicating that decreasing confidence in the political environment is associated with an increase in speculative pressure. The coefficients on forliabgdp and pvtclaimgdp have the correct signs, although they are insignificant. In addition, mu0, q1 and q2 are significant in TVTP MSM. The negative signs on q1 and q2 show that as the pressure on Thai and Korean currency rises, the probability of remaining in a no-crisis state decreases and hence there is increased likelihood of a move to a crisis state in Indonesia. The joint significance of p's and q's again shows a highly significant likelihood ratio, suggesting the importance of Thai and Korean MPIs in predicting a crisis in Indonesia.

Charts 11 and 12 show one step ahead probabilities and forecasted values for the FTP MSM, while charts 13 and 14 show results from the TVTP MSM. It is clear that FTP MSM probabilities again indicate the occurrence of a crisis in 1997, that too after a one-period lag from the actual data. Like the earlier FTP model, forecasted values are close to zero up until 1997, and spikes in the forecasted data occur with a lag. Chart 13 shows that most crises are picked up with much greater accuracy in a TVTP and without delays. The probability of a crisis (pr(crisis)) peaks very close to one at the same time as the actual data in autumn 1997 and again in early 1998. The simultaneous peaking is prediction

[22] As a sensitivity test, we attempted to put the three domestic variables into the transitional probabilities, and separately tried using the entire original set of fundamental variables in the measurement equation, but convergence was not achieved in either case.

because the comparison at each point in time is between the actual data at time t, $MPIIDN_t$, and the one step ahead probability of a crisis ($\Pr(S_t = 1 / MPIIDN_{t-1})$). In fact, there were two other occasions of spikes in the pr(crisis) earlier in 1997. Although the crisis did not happen in those same months, these points could be thought of as early warning. Thus, including both fundamental variables and MPIs from Thailand and Korea, the MSMs can predict periods of crisis in 1997 and 1998. In contrast, analogous probit models had relatively poor results in predicting these crises. On the other hand, the TVTP MSMs have relatively performed poorly in the sense of indicating too many potential crises in earlier years that did not occur. Chart 14 depicts the forecasted values. The overestimation of MPI based on the forecasted values can be seen in earlier "tranquil" periods.

Attention should be drawn to one additional point regarding the MSM results. The MSMs predict state shifts in the mean of the MPI. Although these state dependent means were not specified a priori, they are endogenously estimated by the model. In all of these MSMs, the estimates for the low state mean is slightly below the simple mean of the MPIIDN over the sample, while the estimated value of the high state means are very high, ranging from 8 ½ to 10 ½. The actual data on MPIIDN only attains these high values in 1997, during the time when any reasonable definition would indicate that a crisis occurred. Therefore, the probability of having the high state mean could be reinterpreted as the probability of having mean so high as to be equivalent to "crisis".

Contagion in Stock Market:

The currency crisis in Indonesia was accompanied by a massive drop in the stock market. Chart 15 shows the daily co-movement of the Nominal Effective Exchange Rate (NEER) and stock market index (SMI) in Indonesia. There was a sharp drop in exchange rate and SMI in August 1997 and since then they have moved together. This observation is consistent with a movement out of Indonesian financial and Rupiah-denominated assets. Chart 16 shows the daily movements in SMIs in Indonesia, Korea and Thailand. It is evident that the three stock markets have been moving together since mid-1997. Thailand's SMI has been declining continuously since the beginning of 1996.

To look for contagion in stock market, similar FTP and TVTP models are estimated on SMIs. Charts 17 and 18 show results from FTP models, while charts 19 and 20 show those for TVTP models.

The estimates of p, ϕ, variance and μ_0 are significant in both models, while μ_1 is significant only in TVTP model. Although the p's and q's are individually insignificant, the LR test shows a joint significance of SMIs for Korea and Thailand at 5 percent level. Thus, there is some evidence of contagion in stock market.

VII. CONCLUSIONS

The chief objective of this paper has been to examine the causes of exchange rate crisis in Indonesia. Estimated "equilibrium" level of REER for Indonesia shows that the degree of overvaluation in 1997 was around 27 percent. This suggests that there was scope for exchange rate correction, but does not explain the actual depreciation of more than twice that amount. Additional causes are explored, which fall into three broad categories: (i) domestic factors, including non-financial and financial fundamentals, and political risks; (ii) external shocks common to the Asian countries, and (iii) contagion from crisis in the region. The latter factor is meant to gauge shifts in market sentiment that is unexplained by other macroeconomic fundamentals.

There may be some difficulty in distinguishing pure contagion from unobserved spillovers from neighboring countries or unobserved common global shocks. The two most likely spillovers include either trade linkages or financial linkages. If a neighboring country has a devaluation, the home country's exports may slow due to slackening demand from the neighbor or third countries (due to export competition with the neighbor); likewise, imports from the neighbor may increase owing to the price effect. These trade linkages may lead to deterioration of the home country's trade balance. There could also be direct financial linkages between the countries. Financial institutions in the home country may have a credit exposure or equity stakes in corporations, financial institutions, or real estate in the neighboring country. A crisis in the neighbor could then spillover by causing weakness in the home country's financial sector. While this paper does not control for direct spillovers from Thailand and Korea, it includes variables such as Indonesia's trade balance, and various financial indicators which should respond to linkages with neighbor, among other things. An attempt was also made to control for common global shocks by including international variables such as U.S. and Japanese interest rates.

Results from OLS, Probit, and Markov-Switching models suggest that domestic financial conditions, political risk, and contagion from the region were all instrumental in causing the crisis. In particular, exchange pressure in Thailand and Korea helped predict subsequent exchange pressure in Indonesia.

Appendix 1: Data Source and Construction

Date Sources:

Variable	Description of the Variable	Source
e	Average-period exchange rate	IFS line rf
i	Discount-rate or money market rate	IFS line 60 or 60b
r	Non-gold international reserves	IFS line 1ld
REER	Real Effective Exchange Rate	IMF calculation
gdp	Gross Domestic Product	Indonesian Financial Statistics, BI Publication
forliab	Deposit money banks' gross foreign liabilities	IFS line 26c
pvtcredit	Deposit money banks' credit to private sector	IFS line 22d
domcr	Domestic Credit	IFS line 32
depliab	Real bank deposit liabilities	IFS line 24 + 25
M1	M1 measure of money supply	IFS line 34
forasset	Deposit money banks' gross foreign assets	IFS line 21
rtspread	Difference between lend rate and deposit rate	IFS line 60P minus 60L
polrisk	Political Risk Measure	International Country Risk Guide
exports	Exports	IFS line 70d
imports	Imports	IFS line 71d
xvalue	Unit price of export	IFS line 76 (updated from Indonesian Financial Statistics, BI Publication)
mvalue	Unit Value of import	Indonesian Financial Statistics &Import Statistika
gcon	Government consumption expenditures	Indonesian Financial Statistics
ginv	Government investment expenditures	Indonesian Financial Statistics
jpndisctrt	Japanese discount rate	IFS line 60
jpncpi	Japanese Consumer Price Index	IFS line 60
uscpi	U.S. Consumer price Index	IFS line 64
ustbillrt	U.S. 3-month treasury bill rate	IFS line 60

Data Construction:

11. Market Pressure Index (MPI) for Indonesia, Korea and Thailand was constructed as:

$$MPI_{i,t} = (\%\Delta e_{i,t}) / \sigma_{\Delta e_{i,t}} + (\Delta i_{i,t}) / \sigma_{\Delta i_{i,t}} - (\%\Delta r_{i,t}) / \sigma_{\Delta r_{i,t}}$$

where e is the U.S. dollar exchange rate (domestic currency/US$);

i is the discount rate;

r is the non-gold international reserves;

σ is the standard deviation of the respective series

2. forliabgdp = forliab/gdp

3. pvtclaimgdp = pvtcredit/gdp = private claims to GDP

4. forasset2m1 = fa2m1=forasset/m1

5. domcrgdp = domcr/gdp

6. tradebalance=tb = exports-imports

7. TOT = (xvalue/mvalue)*100

8. usrroi = ustbillrt – usinflation

9. jpnrroi = jpndisctrt - jpninflation

10. OPEN = (export+import)/gdp

11. The measure on political risk (polrisk) was taken from ratings compiled every month by the PRS Group in the International Country Risk Guide. This indicator is weighted by each component as (%):

a. Government Stability (12)
b. Socio-Economic Conditions (12)
c. Investment Profile (12)
d. Internal Conflict (12)
e. External Conflict (12)
f. Corruption (6)
g. Military in Politics (6)
h. Religion in Politics (6)
i. Law and Order (6)
j. Ethnic Tensions (6)
k. Democratic Accountability (6)
l. Bureaucracy Quality (4)

Overall, political risk rating is as follows:
00-49.9% indicates Very High Risk;
50-59.9% indicates High Risk;
60-69.9% indicates Moderate Risk;
70-79.9% indicates Low Risk;
80% or more indicates Very Low Risk.

12. Due to lack of available data on sectoral productivities, a simple time trend is used as a proxy for the differential productivity.

Appendix 2: Construction of "Forecasted Values" for the Markov Switching Models

The measurement equation for the simple Fixed Transitional Probability Model is given by equation (1).

(1) $Y_t = \mu_t + \phi(Y_{t-1} - \mu_{t-1}) + e_t$

where

(2) $Y_t = MPIIDN_t$

(3) $\mu_t = \mu_0 (1- S_t) + \mu_1 S_t$

The expected value of Y_t at time (t-1) can be found by taking the expectation of both sides of (1), conditional on information at (t-1).

(4) $E_{t-1}Y_t = E_{t-1}[\mu_0 - \mu_0 S_t + \mu_1 S_t] + E_{t-1}[\phi Y_{t-1}] - E_{t-1}[\phi\mu_0 - \phi\mu_0 S_{t-1} + \phi\mu_1 S_{t-1}] + E_{t-1}[e_t]$

The parameters μ_0, μ_1 and ϕ are constants. They are, therefore, independent of the state. We have the following conditional expectations:

(5) $E_{t-1}[\mu_i] = \hat{\mu}_i \quad i = 0,1$

(6) $E_{t-1}[\mu_i S_t] = \hat{\mu}_i E_{t-1}[S_t] \quad i = 0,1$

(7) $E_{t-1}[\phi\mu_i] = \hat{\phi}\ \hat{\mu}_i + C\hat{o}v(\phi, \mu_i) \quad i = 0,1$

(8) $E_{t-1}[e_t] = 0$

We can also find the conditional expectations of the state.

(9) $E_{t-1}S_{t-1} = \sum_{0,1} S_{t-1} \Pr(S_{t-1} / Y_{t-1}) = \Pr(S_{t-1} = 1 / Y_{t-1})$

(10) $E_{t-1}S_t = \sum_{0,1} S_t \Pr(S_t / Y_{t-1}) = \Pr(S_t = 1 / Y_{t-1})$

Substituting (5) through (10) into (4), we can get an expression for $E_{t-1}Y_t$ in terms of the parameter estimates μ_0, μ_1 and ϕ, the off-diagonal elements of the parameter covariance matrix Cov(ϕ,μ_0) and Cov(ϕ,μ_1), the conditional probabilities in (9) and (10), and the lagged dependent variable Y_{t-1}.

(11) $E_{t-1}Y_t = \hat{\mu}_0 + (\hat{\mu}_1 - \hat{\mu}_0) * \Pr(S_t = 1 / Y_{t-1}) + \hat{\phi} Y_{t-1} - (\hat{\phi}\ \hat{\mu}_0 + C\hat{o}v(\phi, \mu_0)) +$
$[\hat{\phi}\ \hat{\mu}_0 + C\hat{o}v(\phi, \mu_0) - \hat{\phi}\ \hat{\mu}_1 - C\hat{o}v(\phi, \mu_1)] * \Pr(S_{t-1} = 1 / Y_{t-1})$

Construction of forecasted values for the Time Varying Transitional Probability Markov Switching Model in Chart 10 are similar to above, except that the transitional probabilities are affected by lagged values of MPIs in Thailand and Korea.

To construct forecasted values for Charts 12 and 14, equation (1) must be appended to account for pre-determined fundamental variables in the measurement equation.

$$(12) \qquad Y_t = \mu_t + \phi (Y_{t-1} - \mu_{t-1}) + \sum_{j=1}^{3} \beta_j X_{j,t-1} + e_t$$

Since the explanatory variables are pre-determined, we can find the conditional expectations by using actual values of the lagged explanatory variables.

$$(13) \qquad E_{t-1}[\sum_{j=1}^{3} \beta_j X_{j,t-1}] = \sum_{j=1}^{3} \hat{\beta}_j X_{j,t-1}$$

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Table 1: Trends in Explanatory Variables

	1991	1992	1993	1994	1995	1996	1997	1998, Q1
Trade Balance (millions of US dollars)	3273	6687	8495	8072	4787	6885	11750	6300 1/
Terms of Trade (Index)	128.8	131.6	131.4	135.9	150.5	170.6	145.8	133.7
			(in percent)					
Domestic Credit to GDP	45.6	46.0	47.7	50.6	51.8	54.2	58.1	62.4
Private Claims to GDP	45.8	45.5	48.9	51.9	53.5	55.4	61.1	59.8
Foreign Liabilities to GDP	4.8	5.7	6.2	6.5	5.9	5.6	11.3	14.8
Foreign Assets to M1	41.5	47.3	33.6	31.1	36.3	40.3	68.1	108.1
Interest Rate Spread	2.2	4.4	6.0	5.2	2.1	2.0	1.8	1.6
Japanese Discount Rate	4.5	3.3	1.8	1.8	0.5	0.5	0.5	0.5
US three-monthT-bill rate	5.4	3.5	3.0	4.3	5.5	5.0	5.1	5.1
Political Risk (Index)	56.6	56.9	60.7	62.0	62.7	65.9	65.0	52.0

1/ The figure for 1998 represents quarterly trade balance and is not annualized

Table 2: Results from Ordinary Least Squares

	MPIIDN	MPIIDN(+1)	MPIIDN(+1) Final Specification
Constant	-0.099	0.559	0.170
	-0.486	2.288 **	1.260
AR(1)	-0.017	-0.093	-0.034
	-0.186	-0.870	-0.358
DOMCRGDP	3.545	-7.933	
	0.901	-1.566	
FORLIABGDP	5.511	12.532	12.153
	2.071 **	3.669 **	3.898 **
FA2M1	2.137	-1.198	
	1.467	-0.655	
POLRISK	-0.463	-0.582	-0.351
	-3.623 **	-3.638 **	-2.973 **
PVTCLAIMGDP	13.247	-4.400	-4.893
	0.868	-2.302 **	-2.940 **
RTSPREAD	0.629	0.317	
	2.587 **	1.068	
TB	0.771	-0.341	
	1.910 *	-0.654	
TOT	0.007	0.001	
	1.928 *	0.080	
JPNRROI	-0.127	0.832	
	-0.211	1.108	
USRROI	0.948	0.502	
	1.492	0.651	
R-squared	0.502	0.212	0.157
Sample Period	86:7 to 98:3	86:7 to 98:3	85:1 to 98:3
No. of Observation	141	141	159

Note: The figures below the coefficients are t-statistics. ** and * denote the significance at 5 and 10% level, respectively.

Table 3: Results from the Probit Model
The dependent variable if DUMMPIIDN

	Model1	Model2	Model3	Model4
CONSTANT	-2.717	-2.408	-2.740	-2.613
	-5.696 **	-6.631 **	-5.900 **	-5.915 **
DUMMPIKOR			0.381	
			0.125	
DUMMPITHA			0.993	
			1.165	
DUMMPIKOR(-1)				1.870
				0.638
DUMMPITHA(-1)				1.621
				2.047 **
FORLIABGDP	1.506		1.107	
	1.674 *		1.161	
POLRISK	-0.279		-0.127	
	-0.734		-0.320	
PVTCLAIMGDP	2.130		2.082	
	0.500		0.437	
FORLIABGDP(-1)		1.555		0.935
		3.006 **		1.319
POLRISK(-1)		-0.156		0.004
		-0.943		0.015
PVTCLAIMGDP(-1)		-8.459		-6.543
		-2.992 **		-1.798 *
LOGLIKELIHOOD	-8.333	-11.478	-7.743	-7.938
Obs. With Dep=1	4	4	4	4
Obs. With Dep=0	155	156	155	155

Note: The figures below the coefficients are t-statistics. ** and * denote significance at 5 and 10% respectively

Table 4: Results from Simple Markov Switching & Time Varying Transitional Probability Models

	MPIIDN		MPIIDN		SMIIDN	
	MS	TVTP	MS	TVTP	MS	TVTP
p	0.331	0.003	0.331	0.000	0.951	1.000
	1.228	0.017	1.225	0.000	55.400 **	348.42 **
q	0.987	1.000	0.987	1.000	0.188	0.000
	108.11 **	-- **	107.99 **	11111 **	1.500	0.017
phi	-0.100	-0.101	-0.167	-0.284	0.413	0.247
	-1.257	-1.262	-2.100 **	-2.930 **	5.820 **	3.660 **
variance	1.142	1.142	1.087	1.062	2.267	2.678
	17.660 **	17.620 **	17.660 **	17.510 **	18.280 **	18.460 **
mu0	-0.075	-0.075	-0.104	-0.135	-7.118	-1.406
	-0.890	-0.857	-1.325	-1.920 *	-9.280 **	-2.760 **
mu1	10.425	10.425	9.816	8.515	0.252	0.542
	16.355 **	16.396 **	14.480 **	15.830 **	1.012	1.700 *
mpithap(-1)	-	-9.098	-	-0.740	-	0.019
	-	-0.044	-	-1.057	-	0.196
mpithaq(-1)	-	-0.201	-	-0.195	-	0.344
	-	-1.750 *	-	-1.709 *	-	0.584
mpikorp(-1)	-	4.409	-	0.410	-	0.435
	-	0.101	-	0.727	-	1.255
mpikorq(-1)	-	-0.167	-	-0.148	-	-0.363
	-	-1.294	-	-3.093 **	-	-1.179
fliabgdp(-1)	-	-	11.427	20.227	-	-
	-	-	0.554	1.004	-	-
polrisk(-1)	-	-	-0.184	-0.243	-	-
	-	-	-2.284 **	-3.099 **	-	-
ptclmgdp(-1)	-	-	9.919	8.848	-	-
	-	-	0.882	0.806	-	-
Likfn.Val	254.70	289.47	246.98	280.47	636.63	642.45

Note: The figures below the coefficients are the t-statistics. ** and * denote the significance of the coefficient at the 5 and 10% level of significance, respectively.

Table 5: Likelihood Ratio Tests 1/

Model 2/	Likelihood Value	Critical Values 3/	Likelihood Ratio
Probit models with MPI Idn:			
DVs	-11.48		
DVs and MPIs	-7.94		
		4.6, 6.0, 9.2	7.1 **
Markov Switching Models with MPI Idn:			
FTP	254.70		
TVTP with MPIs	289.47		
		7.8, 9.5, 13.3	69.5 ***
FTP; DVs in measurement eqn.	246.98		
TVTP with MPIs; DVs in measurement eqn.	280.47		
		7.8, 9.5, 13.3	67.0 ***
Markov Switching Models with SMI Idn:			
FTP	636.63		
TVTP with SMIs	642.45		
		7.8, 9.5, 13.3	11.6 **

1/ $2*(LR_{UR} - LR_R) \sim \chi^2_{d.f.}$ where d.f. is the number of restrictions.

2/ DVs denote domestic variables; MPIs denote the MPI for Thailand and Korea; SMI denotes stock market indices; FTP is fixed transition probability model while TVTP indicates a time-varying transition probability model. The residual is from an OLS model which includes lagged domestic variables.

3/ At the 10, 5, and 1 percent levels, respectively.

Note: Significance at the 10, 5, and 1 percent level is denoted by *, **, and ***, respectively.

Chart 1: REER, Sample Mean, Fitted Time Trend and Trend created by Hodrick-Prescott Filter

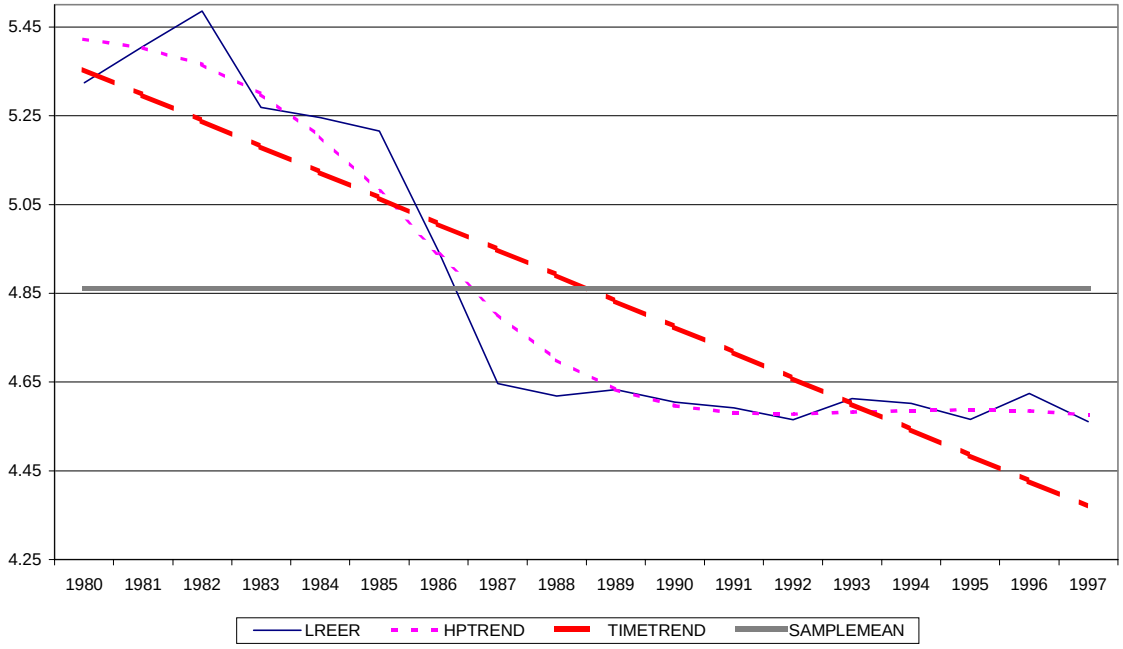

Chart 2: Actual and Fitted Values of LREER from Cointegrating Equation

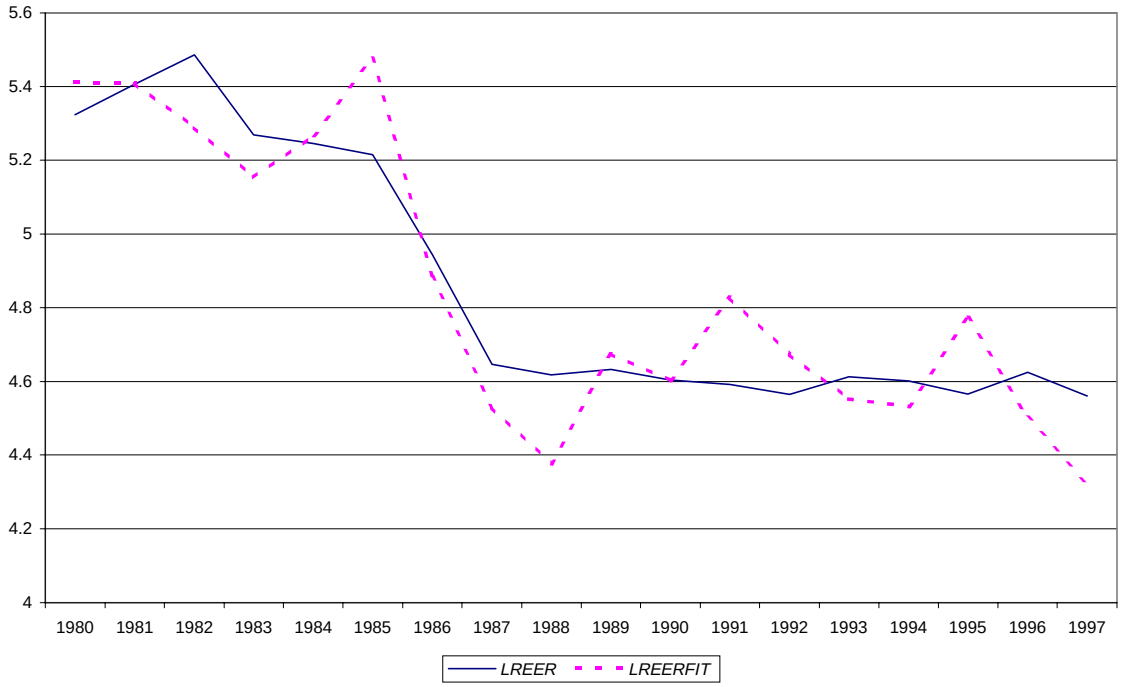

Chart 3: MPI for Indonesia, Korea and Thailand

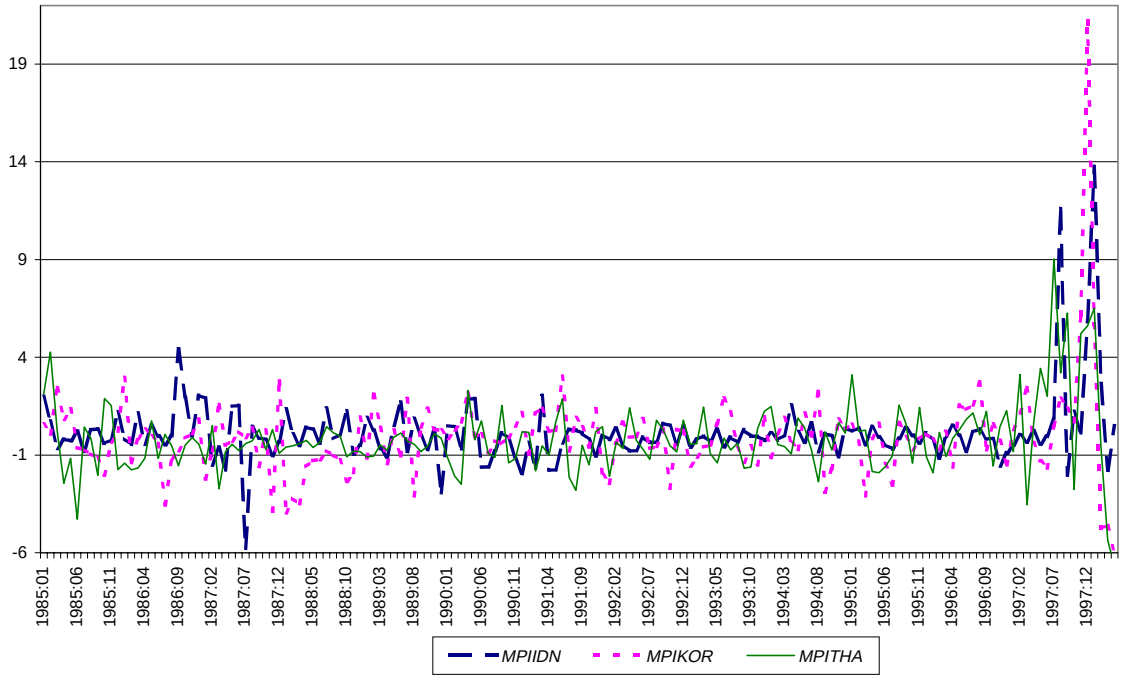

Chart 4: Political Risk Index for Indonesia

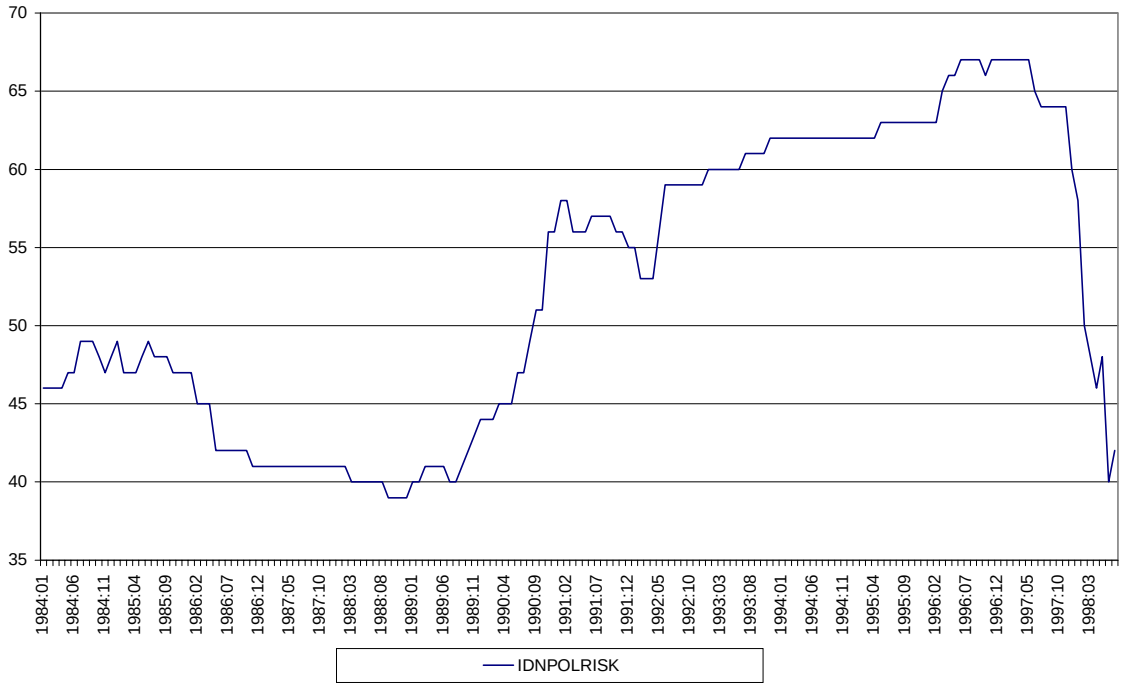

Chart 5: Actual and Fitted Values from Probit Model with Lagged Domestic Variables

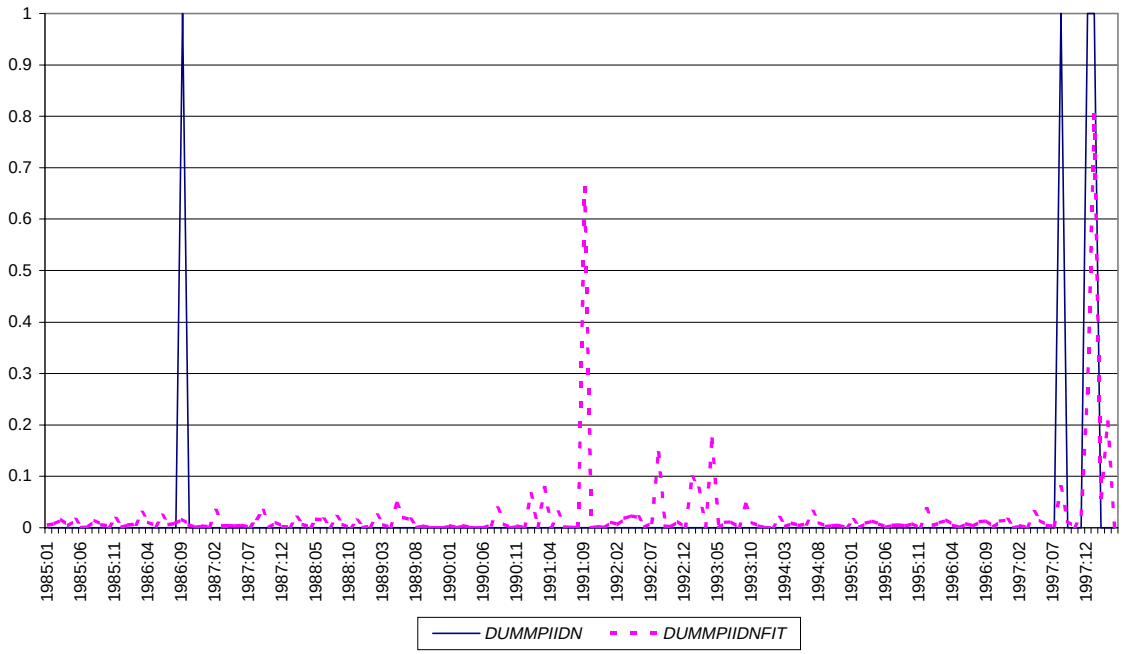

Chart 6: Actual and Fitted Values from Probit Model with Lagged Crisis in Thailand and Korea and Lagged Domestic Variables

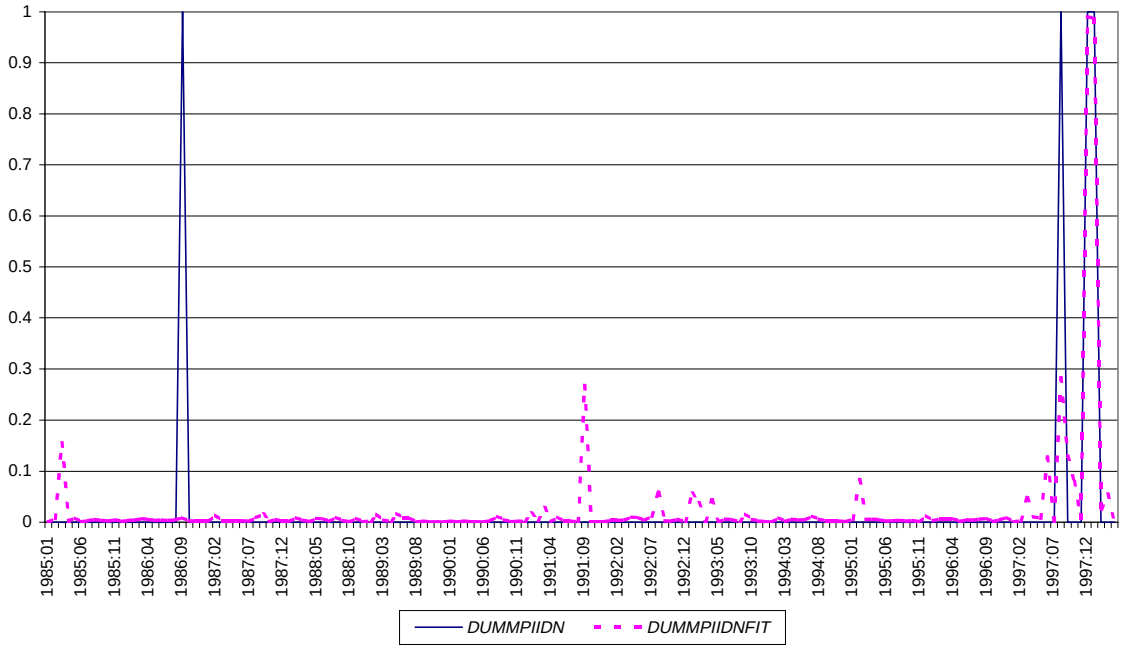

Chart 7: MPI for Indonesia and One-Step Ahead Probability of a crisis using a simple FTP Markov Switching Model

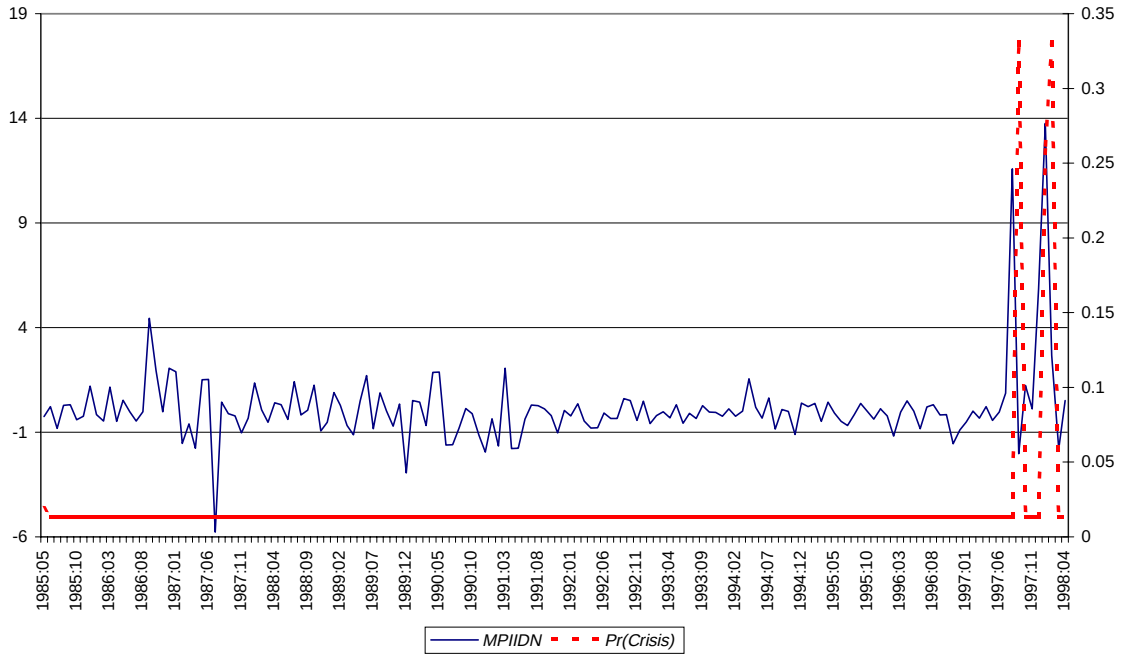

Chart 8: Actual and Forecasted MPI for Indonesia from a simple FTP Markov Switching Model

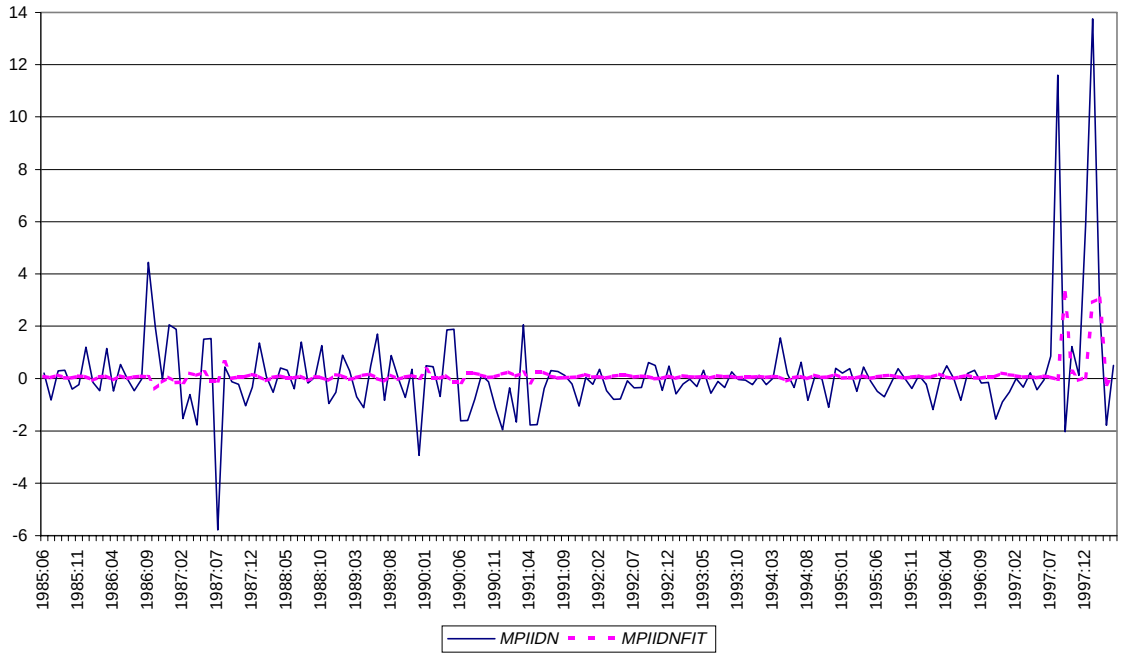

Chart 9: MPI for Indonesia and One-Step Ahead Probability of a Crisis using a TVTP Markov Switching Model with lagged MPI for Thailand and Korea in the Transition Probability

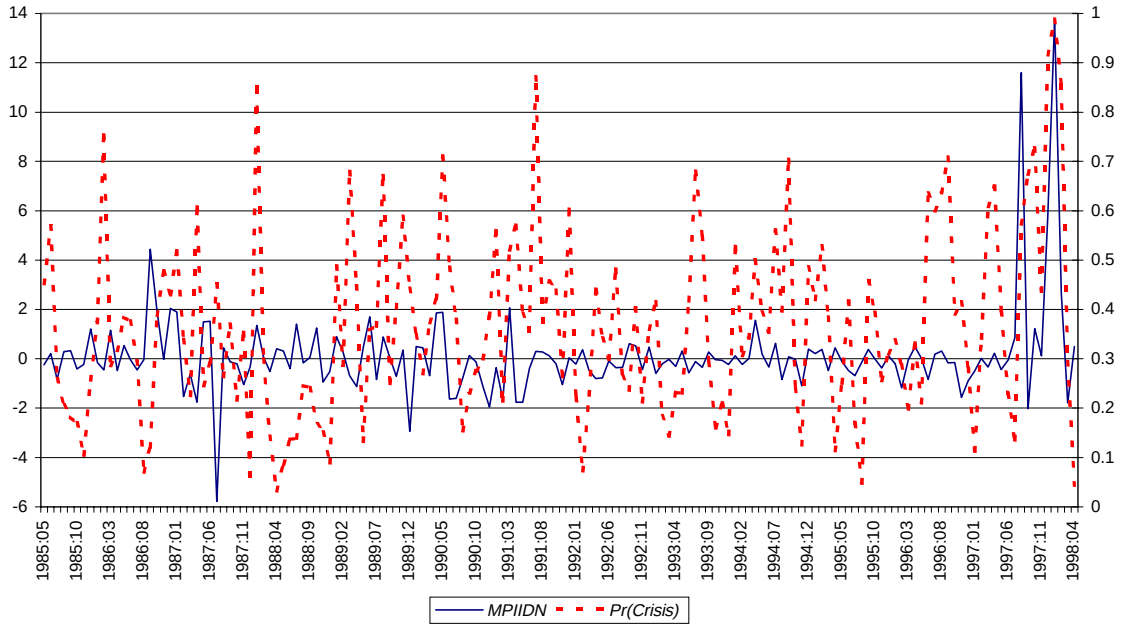

Chart 10: Actual and Forecasted MPI for Indonesia using a TVTP Markov Switching Model with lagged MPI for Thailand and Korea in the Transition Probability

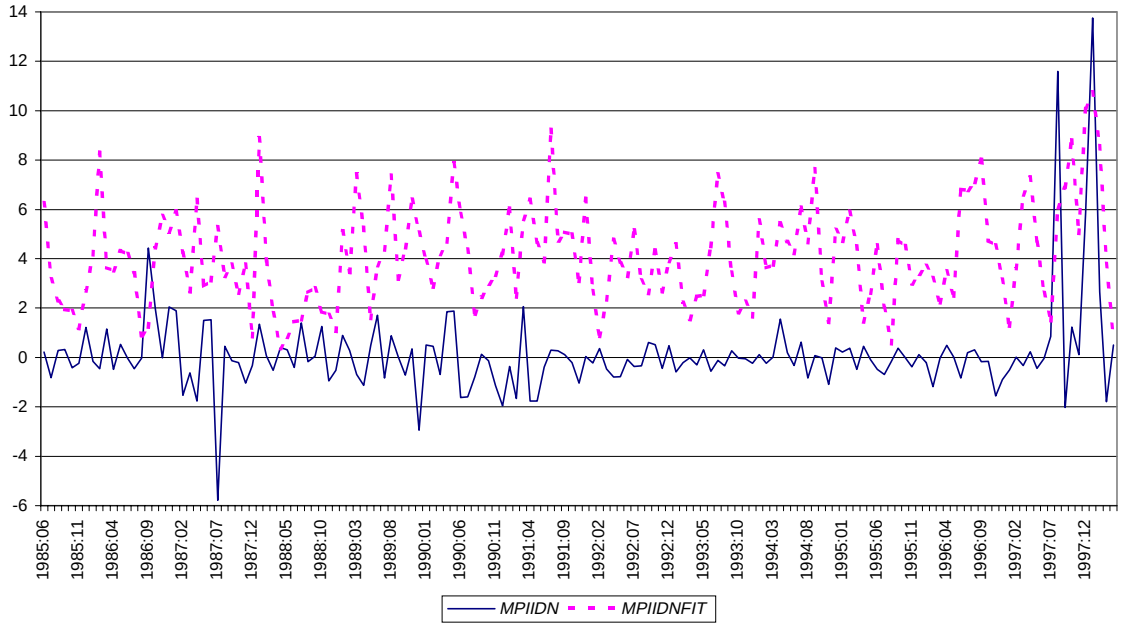

Chart 11: MPI for Indonesia and One-Step Ahead Probability of a Crisis using a simple FTP Markov Switching Model when lagged domestic variables are taken outside of the Transition Probability

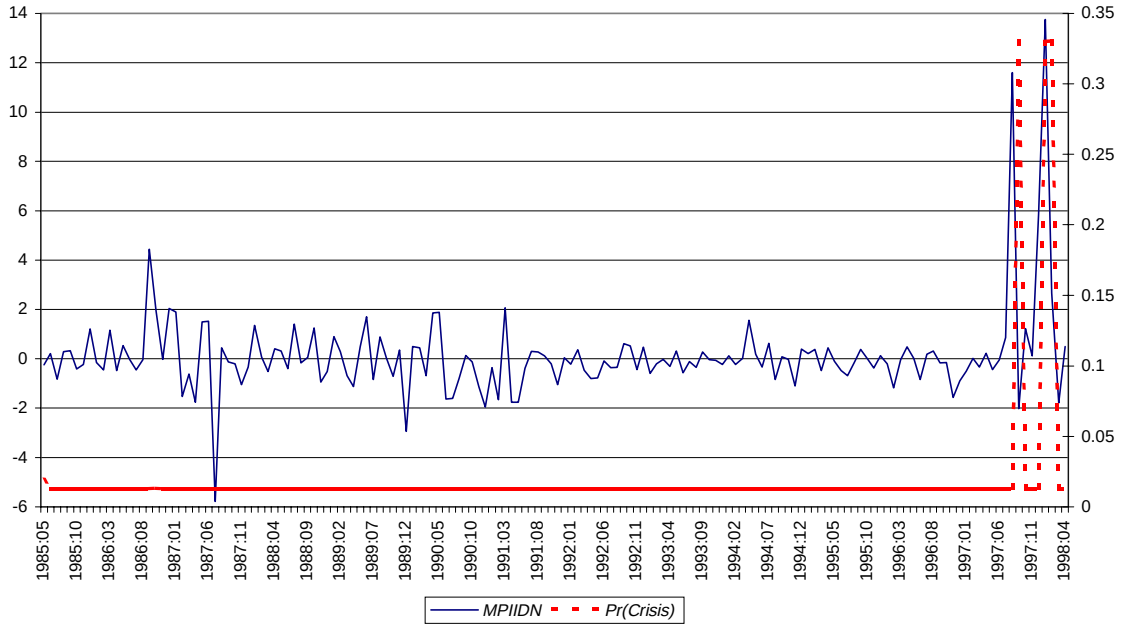

Chart 12: Actual and Forecasted MPI for Indonesia using a simple FTP markov Switching Model when lagged domestic variables are taken outside of the Transition Probability

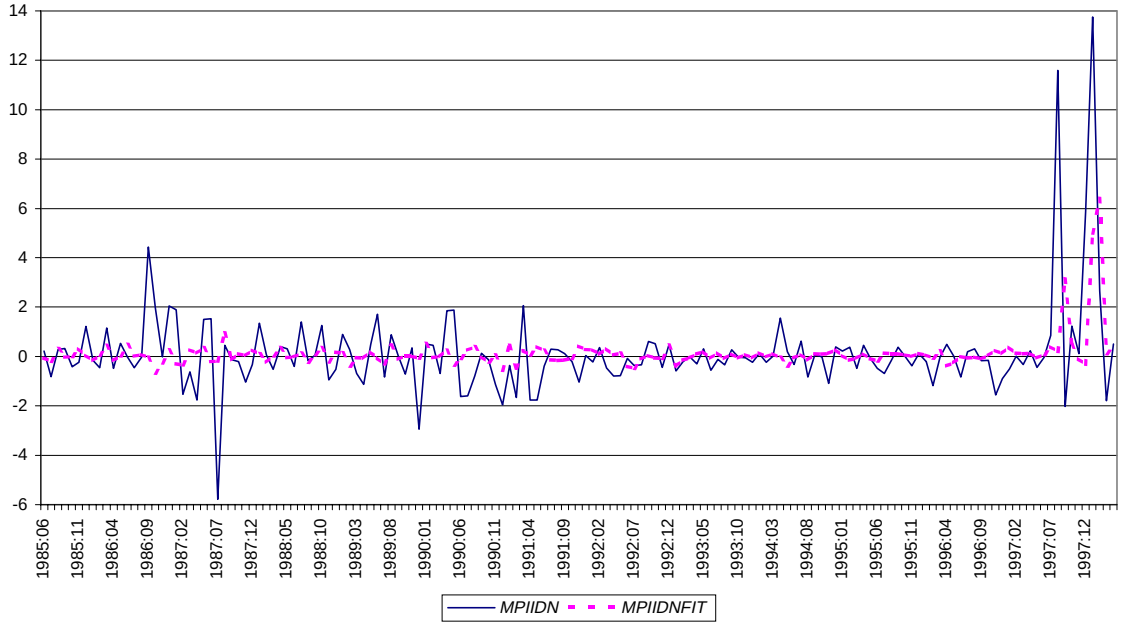

Chart 13: MPI for Indonesia and One-Step Ahead Probability of a Crisis using a TVTP Markov Switching Model when lagged MPI for Thailand and Korea are in the Transition Probability and lagged domestic variables are outside

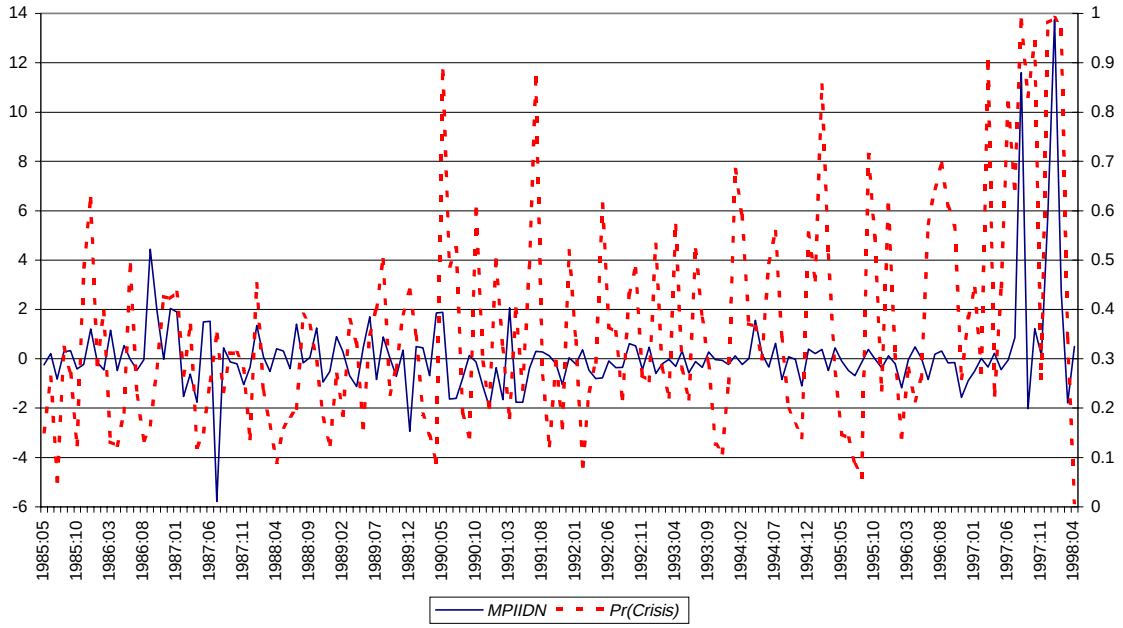

Chart 14: Actual and Forecasted MPI for Indonesia using a TVTP Markov Switching Model when lagged MPI for Thailand and Korea are in the Transition Probability and lagged domestic variables are outside

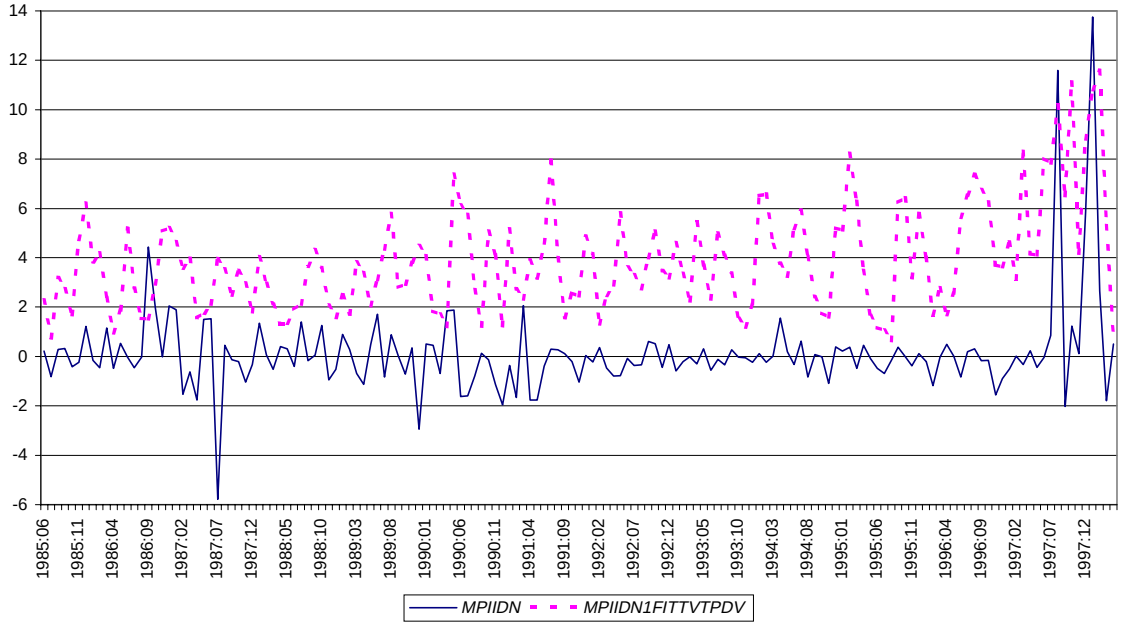

Chart 15: Daily NEER and Stock Market Index for Indonesia, 1/4/94-3/13/98

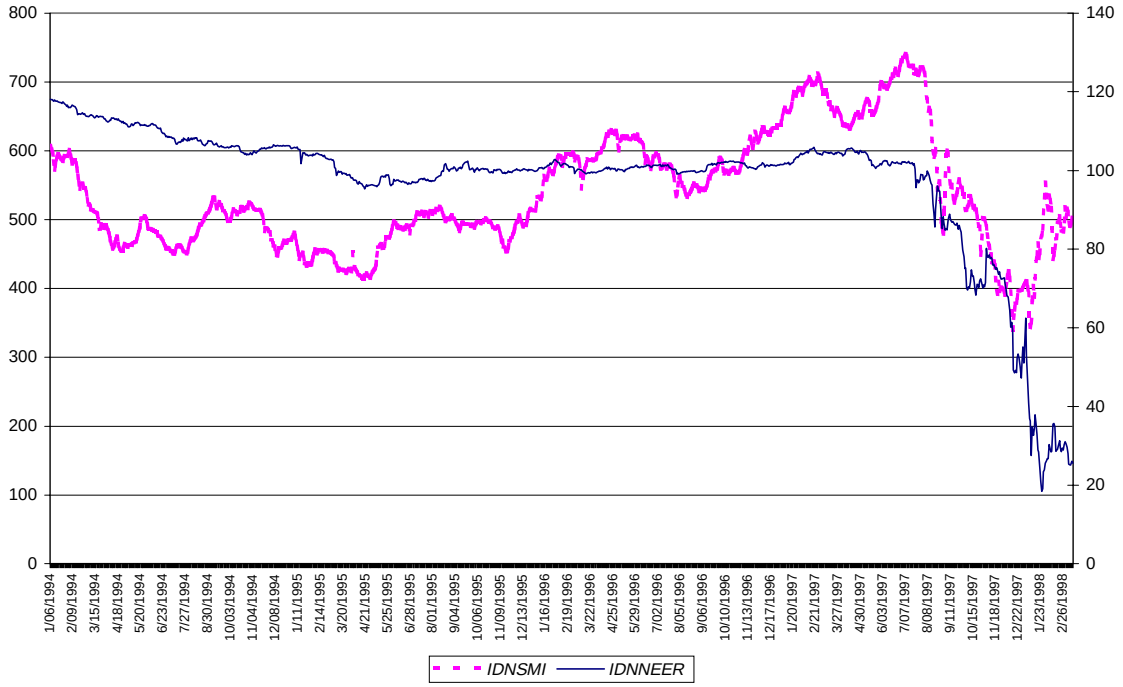

Chart 16: Daily Stock Market Indices for Indonesia, Korea and Thailand, 1/4/94-3/12/98

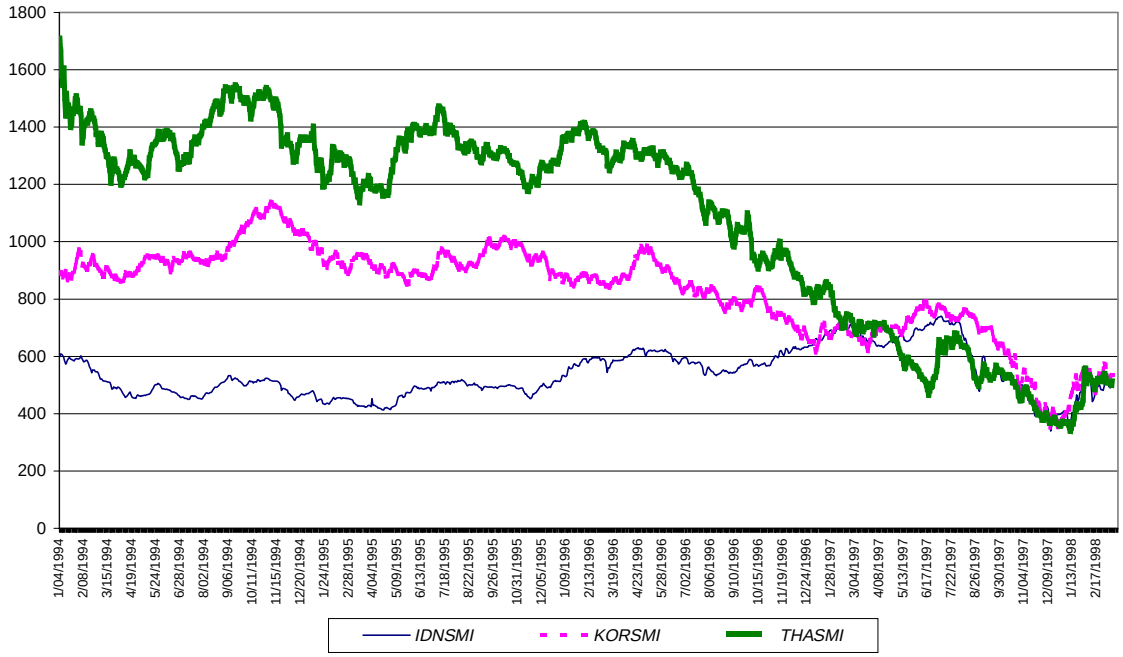

Chart 17: Daily Stock Market Index for Indonesia and Probability of the rise in Stock Market using a simple FTP Markov Switching Model

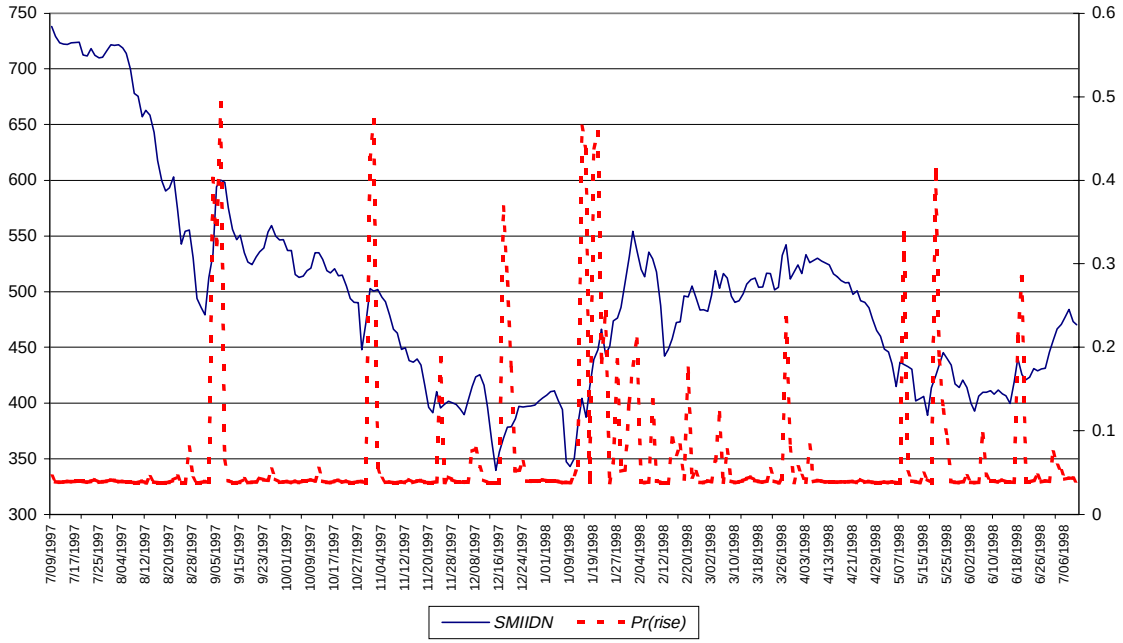

Chart 18: Actual and Forecasted Daily Stock Market Index for Indonesia using a simple FTP Markov Switching Model

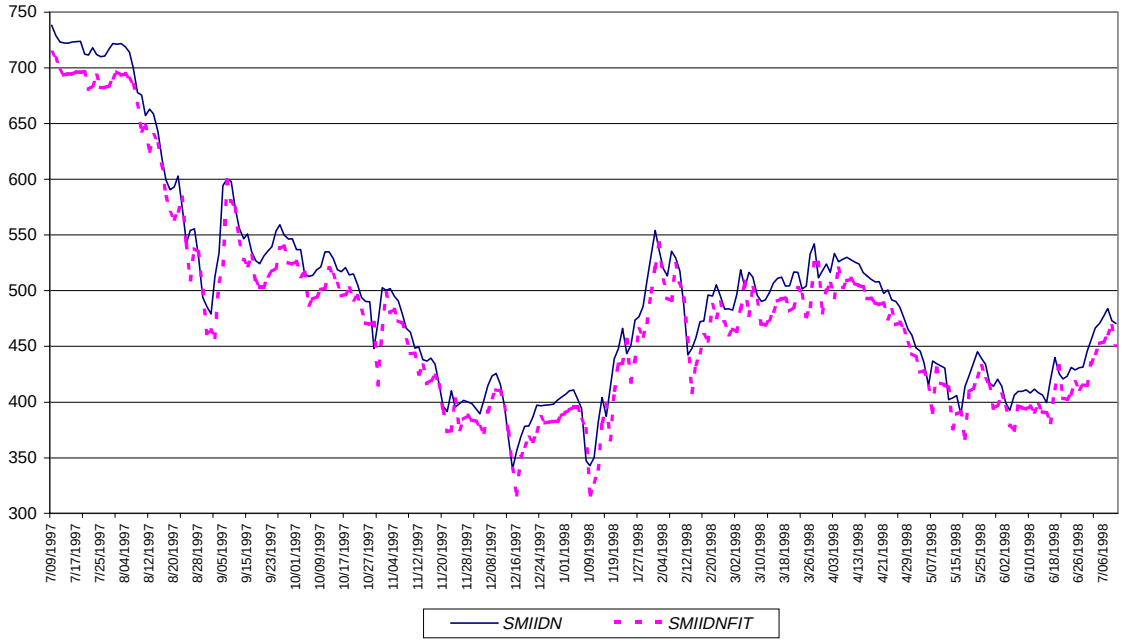

Chart 19: Daily Stock Market Index for Indonesia and the Probability of the rise in Stock Market using a TVTP Markov Switching Model when Lagged Stock Market Indices for Thailand and Korea are in Transition Probability

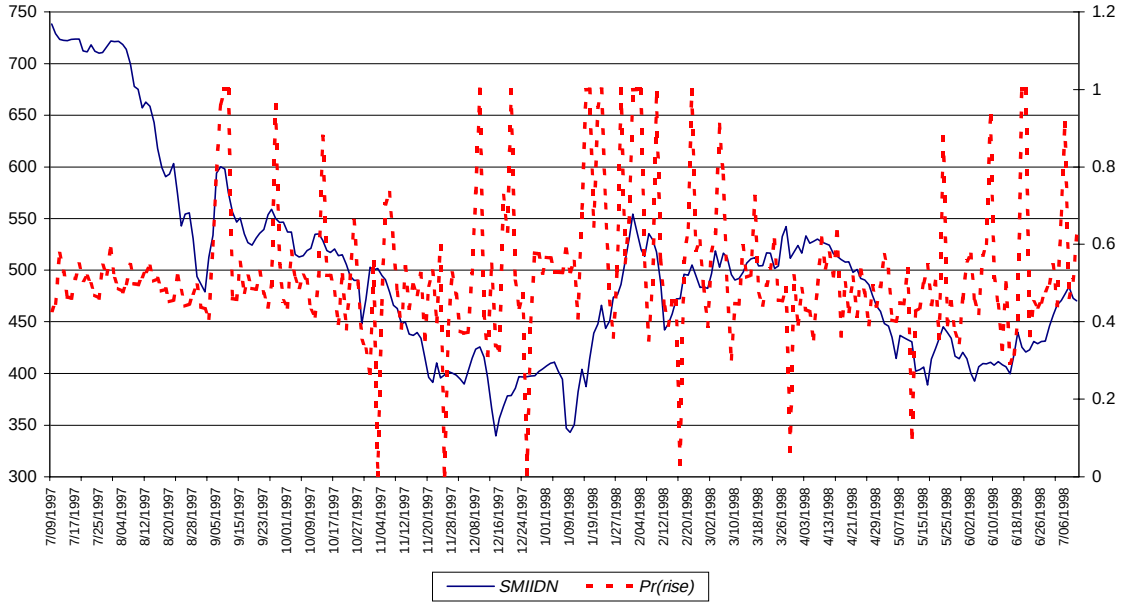

Chart 20: Actual and Forecasted Daily Stock Market Index for Indonesia using a TVTP Markov Switching Model when Lagged Stock Market Indices for Thailand and Korea are in the Transition Probability