

Revisiting the Asian Financial Crisis : Were Capital Markets Caught by Surprise ?

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Abstract

We use standard options pricing techniques and the Clark (1991) macroeconomic estimation methods to analyse the Asian crisis for three countries - Indonesia, Malaysia and the Philippines. We then use the observed risk premiums given by the market to compute the implied volatilities of each country's economy and their evolution from 1993 to 1997. We find that implied volatilities were high and generally increasing over the period. By 1996 implied volatilities were at levels comparable to those at the height of the Mexican peso crisis at the end of 1994. We observe the macro-economic and financial situation for the three countries under observation during the period, particularly, the resort to external short-term borrowing. We conclude that the market was sensitive to the three countries' growing economic, financial and political problems and was able to judiciously discriminate among them. In this context, the "crisis" looks more like a rational portfolio rebalancing due to the evolving economic situation in each of the three countries rather than a mindless, indiscriminate panic.

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1. INTRODUCTION

On July 2, 1997 the Thai baht was ignominiously devalued by 20% despite weeks of desperate moves to prop up the currency, including central bank intervention of 8.7 billion on the spot market and \$23 billion in forward contracts, interest rate increases from 12% to 18% and restrictions on foreign speculators. By the end of the year the baht crisis had spread around the world. The median devaluation of the five East Asian tigers hardest hit by the crisis - Indonesia, Korea, Malaysia, the Philippines and Thailand - was 80%. The International Finance Corporation's (IFC) emerging stock market index dropped by 20% between June and December and its Asian index fell by 53%. By the end of the year the baht had depreciated by 93%, the Hong Kong dollar, the Korean won and the Taiwan dollar were under attack and their stock markets were nosediving, currencies and equity prices in Eastern Europe and Latin America were falling and in November, Korea, the world's eleventh largest economy, became the recipient of the world's largest ever rescue package.

What happened? Conventional wisdom has it that in spite of a benign international background with high rates of growth in world trade and declining spreads on international borrowing, international investors suddenly awoke to the reality of structural weaknesses in the private financial sector including resource misallocation and maturity and currency mismatches as well as public sector economic mismanagement regarding the exchange rate, financial regulation and implicit or explicit government guarantees. The rude awakening caused a crisis of confidence that the three countries, vulnerable because of the build-up of private sector, short term, unhedged debt, were unable to overcome. Nevertheless, it is generally agreed that when the reckoning did come, the countries' underlying economic and financial situation did not warrant the humiliating treatment inflicted on it by the international financial markets. It is noted that public borrowing was subdued, most of the countries were running a fiscal surplus, inflation was low relative to most other developing countries and savings rates were high. With this in mind, conventional wisdom has it that the Asian crisis was a mindless overreaction by international investors.

There are several shortcomings to this attractive conventional view, which seems to fit the facts in general. First of all, it fails to explain how otherwise sophisticated international investors could have remained oblivious so long to events that were known and had been developing over an extended period. It also fails to explain what caused them to overreact when they finally did get wise. Finally, it fails to explain what caused a crisis that was uniquely Asian in nature to spread to the other emerging markets in general, including those as far afield and economically different as Latin American and Eastern Europe.

In this paper we address these questions. We give evidence for the conventional conclusion that the region's underlying economic and financial situation did not warrant the humiliating treatment inflicted on it by the international financial markets. Although the region's economic and financial situation definitely did warrant a substantial readjustment of its importance in international investors' portfolios, it did not warrant the spectacular readjustment that actually occurred. The spectacular scale of the readjustment, however, was not a mindless overreaction to suddenly perceived changes in the countries' political fragility. On the contrary, we show that the countries' evolving economic, financial and political fragility was recognized and compensated for as far back as 1994.

The paper is organized as follows. In section 2, we give a brief overview of the institutional response to the spill-over effect in the aftermath of the Asian Financial crisis. In Section 3, we look at the three countries' economic, financial and political situation, with particular emphasis on international short-term borrowing. This analysis generally confirms the conventional consensus of overall well being with significant but manageable problems. In section 4 we use option pricing theory to analyse how the situation was perceived by the market. More specifically, we ask what was the perceived level of risk and was the level rising or falling. Contrary to the conventional view, we find that international investors perceived Indonesia and Malaysia as very risky and that the perceived risk was growing. The perceived risk for the Philippines was high but falling. Section 6 presents our concluding remarks.

II. Financial crises, herd instinct and spill-over effect.

Today, buoyant world economic growth has already put the 1997 Asian financial crisis back in economic history books. The dust has settled on the international rescue packages. In mid-August 2000, the Philippines came back to the Samurai market with a Y35 billion five-year deal, the first benchmark yen bond issue since December 1996, and Malaysia asked lenders to shave 70bp off a past loan's margin. Amnesia is a key feature of international capital markets probably more so than the well-known « herd instinct ». The two concepts are closely related, however. It seems indeed that, after focusing on the same group of borrowers, capital markets quickly forget that creditors' behavior is at the root of past financial turmoil. Investor overreaction is well illustrated by George Soros's diagnosis in January of 1998 that "the international financial system was suffering a systemic breakdown" with an immediate risk of "worldwide deflation".³ Investors are prompt to loose temper once they lose financial assets.

³ Avoiding a Breakdown, George Soros, Financial Times, January 1, 1998.

The crisis in Asia seemed like a containable regional problem in July of 1997, when Thailand abruptly devalued its currency by 20%. It then led to the biggest confidence crisis since the Mexico peso shock at the end of 1994. Sharp liquidity downturns around the world made investors wary of countries that rely heavily on foreign capital inflows. Spillover from Asia's crisis clouded a number of welcome developments in Latin America when investor anxiety hit this region as well as other emerging market groups. Rating agencies severely downgraded sovereign and corporate debt, and investors feared the real prospect of defaults and moratoriums in countries such as Korea and Indonesia. All in all, Asian stock market US\$ indices dropped by 58% during 1997, with cuts of 78% in Thailand, 75% in Indonesia, 74% in Malaysia, and 62% in Indonesia.⁴ Consequently, yield spreads on many Asian bonds hit record levels at end-1997, with issues from countries such as Korea widening out to more than 1,000 basis points over Treasuries.

The crisis in Asia has raised several important issues regarding the so-called international financial architecture, as well as the role of the IMF and the need for "early warning signals". The Fund was at the center of a storm of criticism. It did not see the crisis coming and acted too late to stem it. It is known that the Fund's 1997 Annual Report praised "Korea's continued impressive macroeconomic performance and the authorities enviable fiscal record". Moreover, when the Fund acted, its traditional belt-tightening policy measures, including a sharp increase in interest rates, led to a deflationary spill-over effect in the region and elsewhere. The IMF tightened domestic credit in economies already at risk from slumping demand, currencies in free fall, and reserves close to exhaustion. Finally, the main focus of criticism was moral hazard, i.e., that by its interventions the IMF allows borrowers and lenders to escape the full consequences of their recklessness, thereby encouraging other agents to follow the same course in the future. The Fund under fire argues that available data were unreliable: thus, the South Korean government actively misled capital markets about the liquidity of their reserves and the leverage of the banking system. In addition, 30 years of dynamic growth had given Asian policymakers a sense of impregnability, illustrated for instance by the unrealistic peg of the Thai currency to the US\$.⁵ The IMF could point out that, just before the crisis erupted, Institutional Investor's Country Risk rating still showed positive assessment of the Asian countries with South Korea and Malaysia standing ahead of Chile and Hongkong, Thailand ahead of China, Greece and Israel, and Indonesia ahead of Poland, Hungary and Tunisia.⁶ And S&Ps as well as Moody's maintained their credit rating for most Asian countries till mid-1997.

The purpose of the paper is not to revisit the question of "what went wrong" in Asia. Research literature from the IFIs, commercial banks and the academic community provides ample room for analysis of the macro and micro roots of the crisis, notably large current account deficits and deep-seated structural weaknesses in domestic financial markets.⁷ One key policy mistake, indeed, was to allow banks and corporations to borrow extensively abroad without prudential controls on foreign exchange exposure. The paper's aim is to assess capital markets behavior and to observe whether investors were caught by surprise by the abrupt financial crisis. There is a broad consensus that international investors did not anticipate any

⁴ IFC Emerging Markets Index, Financial Times, December 8, 1997.

⁵ "Defending the Fund", Interview of Michel Camdessus, Financial Times, February 9, 1998.

⁶ Institutional Investor, September 1997, p. 118.

⁷ See among many others: Krugman, Sachs.

Mathieson, Richards & Shara: "Crises financières des Marchés Emergents", in Finance & Development, December 1998, pp. 28-31.

Bijan Aghevli: "La Crise Asiatique: Causes et Remèdes", in Finance & Development, June 1999, pp. 28-31.

of the three crises that erupted in the 1980s, in Latin America, the Mexico crisis of 1994-95, and nor the Asia crisis of 1997-98.⁸ According to many authors, surprise is one of the key factors behind ramification and spill-over effects. They argue that despite rising investor sophistication, there is a tendency to treat emerging markets as a single asset class in times of uncertainty.

Our analysis differs from mainstream research conclusions. We looked at two key variables of capital markets, namely risk premium and implied volatility to assess whether private investors discriminate among sovereign borrowers. The paper leads to clear-cut conclusions in at least three countries (Indonesia, Philippines and Malaysia) and it will be expanded shortly to include Korea and Thailand. First, a sharp rise in risk premium and implied volatility can be observed for those countries that (i) exemplified strong macro-economic imbalances throughout the 1990s (thus, well before the inception of the 1997 crisis), and (ii) exemplified protracted inertia to adjust macroeconomic policies to get rid of structural weaknesses and restore private sector confidence. This is particularly the case of Indonesia. Second, risk premium and implied volatility remain stable for those countries that either embark on robust IMF-supported adjustment programs (i.e., the Philippines) or adopt ad-hoc and heterodox but successful adjustment measures (i.e., Malaysia).

⁸ See for instance Mathieson, Richards and Sharma, *op. cit.*

3. The Economic and Financial Situation: a brief overview

Each of the eight main Asian countries (China, Hongkong, Singapore, Indonesia, Malaysia, Philippines, Korea and Thailand) exemplified very different macro-economic situation when the crisis erupted in the second half of 1997. China, for instance, witnessed dynamic growth rates close to 10% a year throughout the period 1993-99 and the yuan's exchange rate resisted speculative attacks thanks to some US\$149 billion official reserves, equivalent to 9 months of import coverage.

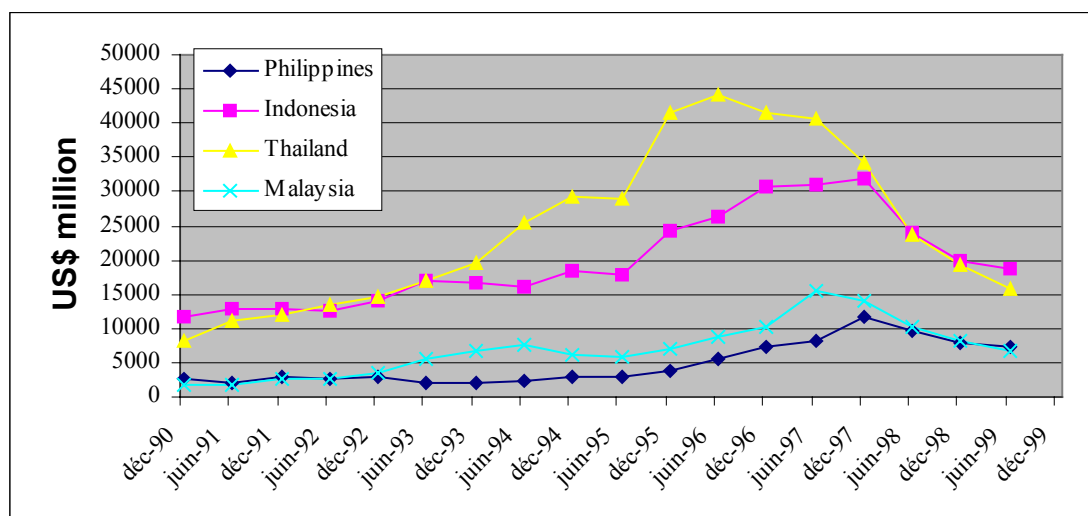
The contrast is striking regarding the three countries under observation in this paper. The case of **Indonesia** stands out as an intricate and often opaque combination of financial fragility, structural and institutional weaknesses on one hand, and deeply-rooted macroeconomic distortions on the other. One can distinguish four main problems.

- First, Indonesia's current account deficit averaged 3% of GDP in the years 1990-97, with a peak of 3.8%, equivalent to more than US\$8.6 billion, in the year 1996 before the crisis eruption. This large and rising deficit is entirely attributable to mounting interest payments on foreign debt, given that the country enjoyed trade surpluses despite one of the lowest trade openness ratios in the region.⁹
- Second, change in GDP deflator averaged 10% during the same period, a very high rate for the region. Inflation stemmed from large increases in domestic demand.
- Third, Indonesia's financial system suffered from weak supervision, a highly indebted corporate sector, and market distortions that translated into large portfolios of non-performing assets as well as undercapitalization. The government has been reluctant to take stern measures against recalcitrant debtors and to speed up privatization. Indonesia's large conglomerates provide case studies for inefficient investment and crony capitalism. Bold restructuring measures were announced only in mid-2000 under strong pressures from the IFIs, paving the way for the release of a US\$400 million IMF loan.
- Last but not least, Indonesia suffered from a typical external debt overhang, coupled with a deep maturity mismatch. The country's debt to exports ratio was the highest in the region, averaging 230% in the period, culminating at 256% in 1997. Moreover, Indonesia relied heavily on short-term borrowing from international banks. One can observe a drastic rise in "original" short-term bank liabilities from less than US\$12 billion at end-1990 to nearly US\$32 billion at end-1997, to drop sharply to US\$20 billion in the following year of credit crunch¹⁰. Moreover, Indonesia's ratio of short-term debt to total bank debt remained consistently above 50% throughout this period.

⁹ Indonesia's openness to trade ratio reached 20% in 1996 compared with 29% for Korea, 79% for Malaysia, 31% in the Philippines, and 35% in Thailand, according to the BIS 68th Annual Report, dated June 1998.

¹⁰ Short-term bank claims are adjusted to obtain original short-term debt by eliminating residual short-term debt that incorporates current debt service payments to banks. Data come from BIS sources. US banks alone cut their overall lending to Philippines by one-third during the December 1996-March 1999 period, according to FFIEC data.

Graph 1 "Original" short-term bank liabilities



Regarding **the Philippines**, a large current account deficit was rooted in a substantial trade deficit that reached US\$11 billion in 1997. With a healthy fiscal surplus, the annual current account deficit stemmed from buoyant domestic demand. The Philippines' imbalances were quickly tackled by the government, contrary to Indonesia.

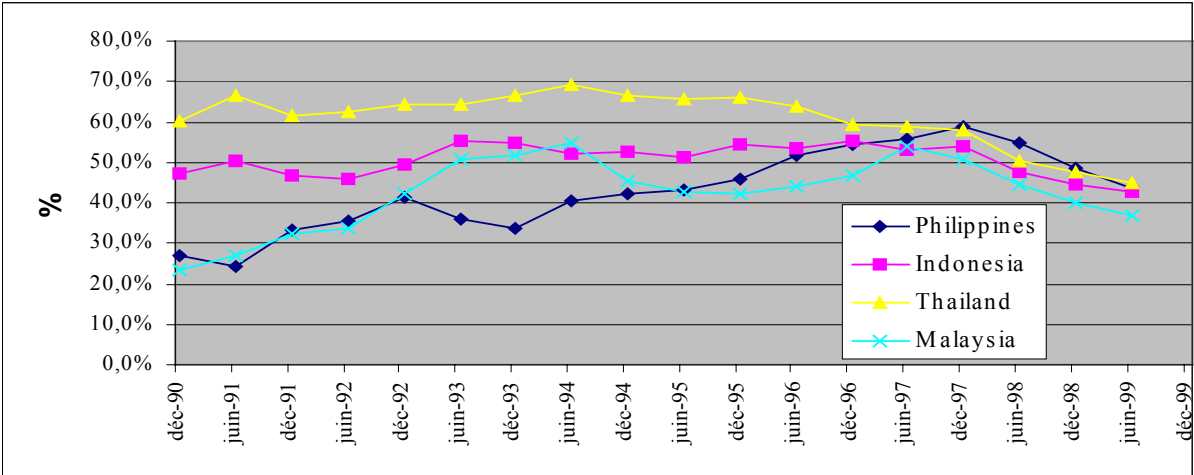
- First, Philippines's SDRs1 billion IMF stand-by arrangement was approved by the IMF's Board as early as March 1998, following the expiration of the previous extended facility by the end-1997. In addition, the World Bank provided a large financial sector adjustment loan. One can also observe that OECD's export credit agencies provided massive support for the Philippines' exports by increasing officially-guaranteed or insured trade-related bank claims by 88% between end-1996 and end-1998. Thanks to international support, the Philippines managed to turn current account deficits that averaged close to 5% of GDP each year in the 1994-97 period to a 2% surplus in 1998. With export growth boosted by gains in competitiveness, domestic economic expansion slackened only little and indeed became the strongest in the region.
- Second, Philippines' financial sector was under World Bank's scrutiny since late 1988. The financial fragility of the central bank had grown over the years to the point that it became bankrupt in 1993 and it had to be recapitalized and fully restructured. The crisis, however, did not spread to the entire financial system as in Thailand, Indonesia or even Korea.
- Third, the Philippines had benefited from a US\$4.5 billion Brady-type London Club debt restructuring in 1989, with substantial debt relief. Hence, the country's debt/exports ratio dropped from close to 200% in 1993 to "only" 106% in 1997. Moreover, our analysis shows that adjusted short-term debt remained steady throughout the 1990-96 period at less than US\$5 billion even though the ratio of short-term to total debt rose due to a drop in the denominator (i.e., total debt).

As for **Malaysia**, in the face of sizeable capital outflows, in particular of equity capital, the authorities opted for currency depreciation as the main line of defense, accompanied by administrative measures to control capital flows and cushion equity prices. Monetary tightening was moderate. More importantly, preemptive banking reform measures mean that the country has been able to forestall a real crisis without radical surgery of its

financial system. Its unique approach reflected a desire to avoid the systemic dislocation and social upheaval that have beset other Asian countries. Moreover, Malaysia's reluctance to rely on short-term debt meant its banks never experienced the same degree of turmoil as those elsewhere in the region.¹¹ Malaysia's ratio of short-term debt decreased during the mid-1994/end-1996 period at levels well below those of neighbouring countries.

All in all, Malaysia's macroeconomic management was relatively sound in the aftermath of the regional crisis, despite the IMF's criticism for the country's unorthodox policy measures and resistance to the Fund's shock therapy. Malaysia's policymakers intend to be rewarded for having tackled the country's problems boldly. In mid-August 2000, the country asked international lenders to cut the margin on a US\$1.35 billion dual currency loan due to mature in 2003 to shave almost 70bp off the initial loan margin, currently 120bp over US\$ Libor.

Graph 2 Ratio of Short-term bank debt to Total bank debt



4. THE EMPIRICAL STUDY

4.1. The data

Since our methodology is based on a market value approach, it is necessary to dispose of marked to market data in order to conduct an empirical study. Unfortunately, as noted by Kamin and Von Klein (1999), no readily available alternative to Brady bond-based measures of average emerging market country spreads exists. Consequently, because the only Asian country with Brady bonds is the Philippines, we had to build a specific index to evaluate the market assessment of their external debt.

For that, we used the International Securities Market Association (ISMA) database. ISMA provides weekly market prices for all world-wide issued eurobonds. For each country, we compute the issued amount weighted average of the yield to maturity of every US\$ bond listed in the ISMA Weekly Eurobond Guide, at the end of each year. We then take this rate as

¹¹ Only two banks, Sime and Bank Bumiputra, the situation was critical. The first was absorbed into RHB Bank and the second merged with Bank of Commerce. Overall, a rising stock market helped to boost the collateral value of bank loans.

a proxy for the average yield to maturity of a whole country's external debt. The period runs from 1993, corresponding to one year before the Mexican crisis, until the end of 1997, six months after the beginning of the Asian crisis.¹²

We wish to study the five main countries directly concerned by the Asian crisis, namely Indonesia, Korea, Malaysia, the Philippines and Thailand. But in a first step, due to lack of reliable data, we can only focus on Indonesia, Malaysia and the Philippines. Macroeconomic data are missing for Korea in 1995 and 1996, when this country was excluded from World Bank database, being considered as a developed country because its GDP per inhabitant in US\$ reached the threshold of \$10,000. For Thailand, ISMA market data are missing from 1993 through 1995.

4.2. Observed market risk premium on Asian external debt from 1993 to 1997

We compute the observed risk premium at the end of each year, by subtracting the US T-bond yield with the nearest maturity to the country's debt duration from the average yield to maturity computed from ISMA data.

Graph 3

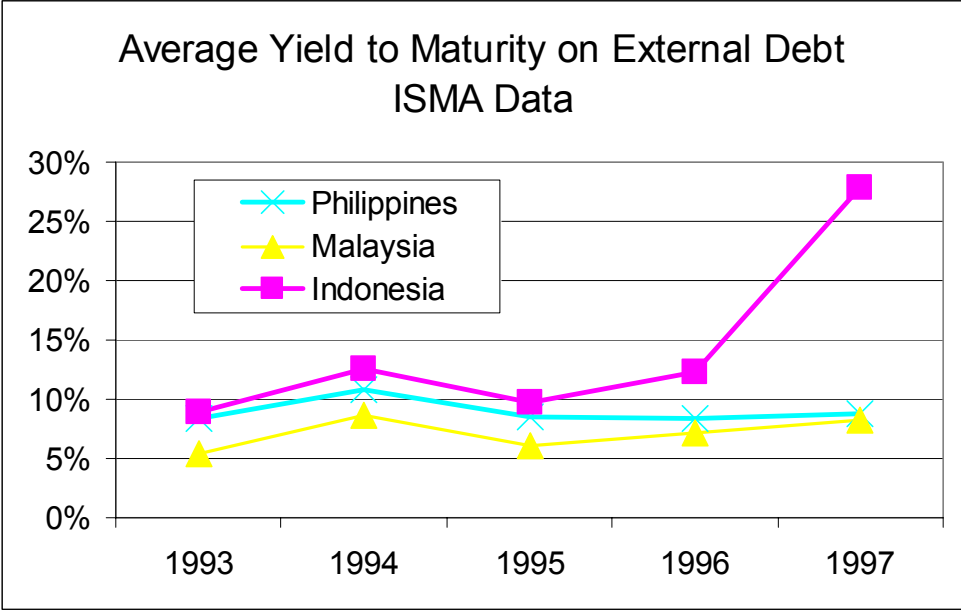


Table 1 Average Yield to Maturity on External Debt

	1993	1994	1995	1996	1997
Indonesia	8,90%	12,52%	9,72%	12,32%	27,88%
Malaysia	5,44%	8,70%	6,08%	7,19%	8,18%
Philippines	8,35%	10,80%	8,52%	8,43%	8,79%

Source: ISMA Weekly Eurobond Guide 1993-1997

¹² We intend to extend the period of study up to 1998 as soon as macroeconomic data becomes available.

Table 2 Relevant US T-bond Yields According each Country's Duration¹³

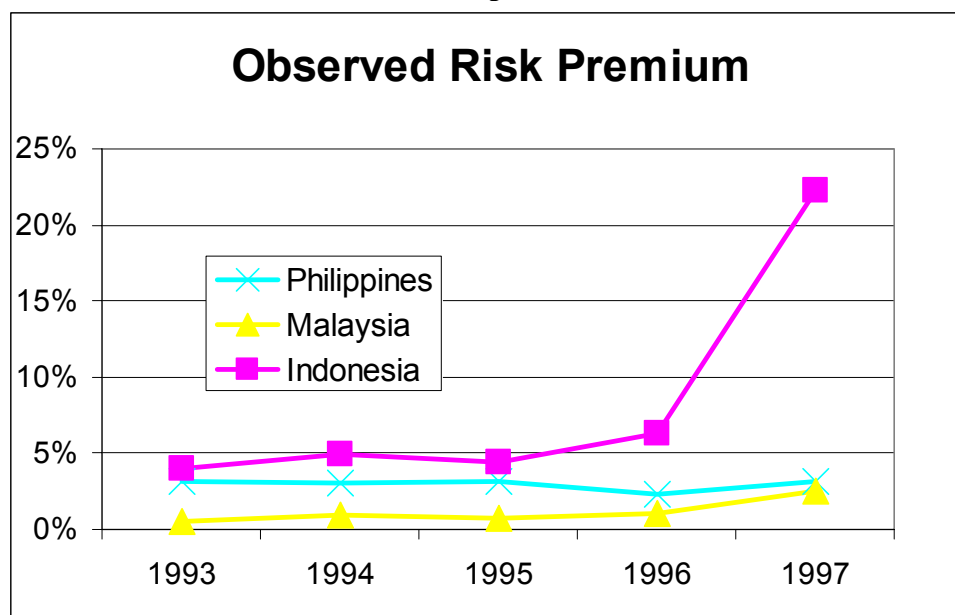
	1993	1994	1995	1996	1997
Indonesia	4,88%	7,61%	5,36%	5,99%	5,65%
Malaysia	4,88%	7,72%	5,39%	6,10%	5,69%
Philippines	5,20%	7,72%	5,36%	6,10%	5,69%

Source: Bloomberg

Table 3 Observed Market Risk Premium

	1993	1994	1995	1996	1997
Indonesia	4,02%	4,91%	4,36%	6,33%	22,23%
Malaysia	0,56%	0,98%	0,69%	1,09%	2,49%
Philippines	3,15%	3,08%	3,16%	2,33%	3,10%

Graph 4



Based on the observed risk premium, it seems that, by the end of 1996, the markets had begun to anticipate some problems for Indonesia and Malaysia. Indonesia experienced an increase of its risk premium from 436 to 633 basis points between 1995 and 1996 and Malaysia's rose by 58% over the same period to a higher level than 1994 in the wake of the Mexican peso crisis. The Philippines' risk premium, however, was falling. At the end of 1997, the risk premium was obviously strongly impacted by the events of mid-1997, although the Philippines seems to have been less exposed than its neighbours and better able to manage the crisis. In any case, all three countries suffered a dramatic rise in their premium. In this sense, we could conclude as did the World Bank (1998) that: "Rating agencies and international institutions failed to adequately assess the region's economic vulnerabilities... Markets and market observers failed to anticipate the scope and severity of the crisis". In the following section we use the concept of implied volatility to test whether or not this statement was, in fact, true.

¹³ In order to get the risk premium, we compute the duration of each country's debt for each year, and we take the US T-bond yield with the nearest maturity to each country's external debt duration. We then subtract the average yield to maturity from the relevant US T-bond yield.

4.3. Implied volatility on Asian external debt from 1993 to 1997

Clark (1991) derived a method for measuring the market value of a national economy and showed how it can be applied for estimating and managing many types of international risk. We use the Clark (1991) macroeconomic estimation method and the Black-Scholes (1973) option pricing formula¹⁴ to compute the implied volatility of the three economies in question, in order to get an instantaneous measure of risk at different times.¹⁵ This instantaneous measure of risk represents the market's perception of the riskiness of each economy at each point in time.

The procedure goes as follows.

1. We apply the Clark estimation method using data from International Financial Statistics to calculate the market value of the three economies for each year over the period 1993 to 1997. This variable represents the underlying asset in the Black-Scholes formula.
2. We use data from the World Bank Debt Tables to calculate the Macaulay (1938) duration of each economy's outstanding foreign debt at the end of each year. The strike price for each year is estimated as the present value of projected external debt service¹⁶ and the risk free rate is the US T-bond with the maturity the nearest to the duration of the external debt.
3. We use the observed yield to maturity (ISMA rate) to estimate the market value of the debt in the formula: Market value of the debt \approx Face value of debt $\times e^{-\text{duration} \times \text{YTM}}$.
4. We use the market value of the debt to calculate the value of the call in the formula: Market Value of the Call = Market Value of the Economy – Market Value of the Debt.

¹⁴ The formulas are $C_0 = V_0 N(d_1) - E e^{-rt} N(d_2)$, $d_1 = \frac{\ln(V_0 / E) + (r + \sigma^2 / 2)t}{\sigma \sqrt{t}}$,

$d_2 = \frac{\ln(V_0 / E) + (r - \sigma^2 / 2)t}{\sigma \sqrt{t}}$, where C_0 is the market value of the bond, V_0 is the present value of the

underlying security, E is the exercise price, and $N(d)$ is the value of the standardized normal cumulative distribution evaluated at d , r is the continuously compounded riskless rate of interest, σ is the standard deviation of the underlying security's continuously compounded annual rate of return, and t is the time to maturity or the duration of the call.

¹⁵ In the Appendix we outline the Clark (1991) macroeconomic estimation method

¹⁶ To be more accurate, we should have considered a successive chain of options at each payment date with their own strike price. Nevertheless, this approach would have made much more difficult, if not impossible, the practical computation of these options.

5. We calculate the economy's implied volatility by running the option pricing formula backwards with the call price as given and volatility as the unknown.¹⁷

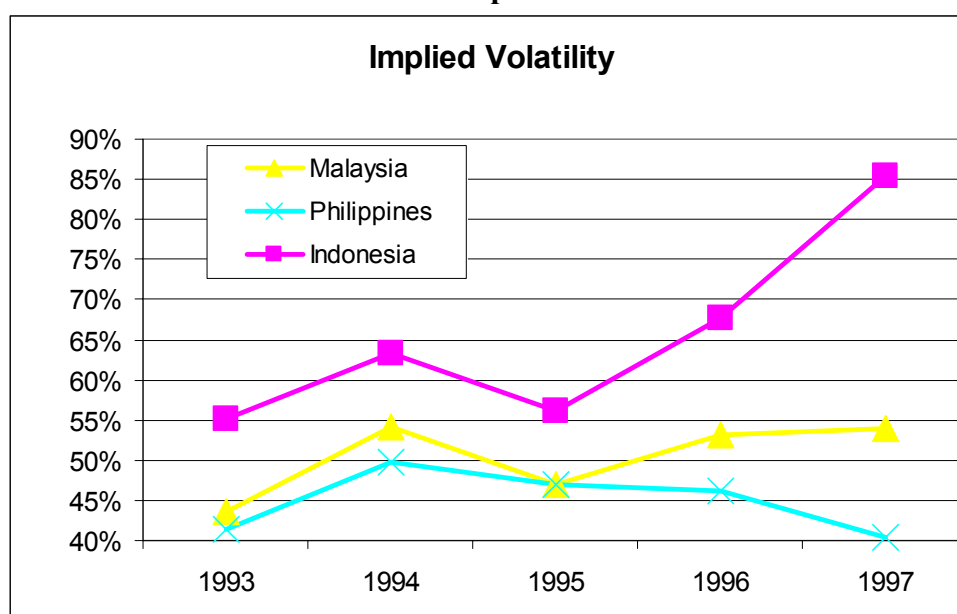
¹⁷ For more details on implied volatility, see Cox and Rubenstein (1985, pp; 278-279).

The results given below represent the market's perception of the riskiness of each economy at the end of each year.

Table 4 Implied Volatility

Year	1993	1994	1995	1996	1997
Indonesia	55,0%	63,3%	56,2%	67,8%	85,4%
Malaysia	43,6%	54,1%	47,0%	53,2%	54,0%
Philippines	41,4%	49,8%	46,9%	46,2%	40,3%

Graph 5



From these results, we can observe that the market considered these countries as extremely risky as far back as 1993 with implied volatility ranging from 41% to 68% between 1993 and 1996. Furthermore, by 1996 implied volatility for Indonesia and Malaysia was at the levels reached at the height of the Mexican peso crisis in 1994. This suggests that the market anticipated as early as 1996 the potential difficulties that would eventually materialize in 1997. Only the Philippines has a decreasing implied volatility over the period and it is the Philippines that was least affected when the crisis did hit.

These outcomes are consistent with the economic performance of the three countries during the crisis. It could seem surprising to rate the Philippines as the lowest risk before 1997 but in light of the actual 1997 events, this was, on the contrary, a very shrewd assessment. Indeed, as evidenced by *a posteriori* results, even though the Philippines had not been able to achieve its neighbours' economic performance over the last decade, it did not suffer their specific weaknesses to the same extent. One of the main causes of the Asian problems arose from its financial sector's vulnerability. In fact, if we look at the financial ratios in Table 5, the Philippines resembles the Latin American countries more than the Asian countries. This could explain why its implied volatility actually decreased in 1997 as the Asian crisis unfolded.

Table 5 Ratios of short-term debt to total debt and to reserves in East Asia and Latin America, mid-1997 (percent)

Country	Short-term debt / total debt	Short-term debt / reserves
Indonesia	24	160
Korea, Rep. of	67	300
Malaysia	39	55
Philippines	19	66
Thailand	46	107
Argentina	23	108
Brazil	23	69
Chile	25	44
Colombia	19	57
Mexico	16	126

Source: Bank for International Settlements data; IMF International Financial Statistics; and World Bank data, from Global Development Finance 1999.

Therefore, contrary to most previous statements on this topic, we conclude that the market was sensitive to the five countries' growing economic and political problems. Furthermore, it was able to discriminate between each country's specific features as well. Thus, we conclude that while the rating agencies and international institutions failed to adequately assess the region's economic vulnerabilities, the markets themselves were able to accurately assess the situation for the region in general and for individual countries in particular.

4. CONCLUSIONS

In this paper we use standard options pricing techniques and the Clark (1991) macroeconomic estimation methods to analyse investors' anticipations concerning three countries - Indonesia, Malaysia and the Philippines - before, during and after the Asian crisis of 1997. We find that implied volatilities were generally high for all three countries over the whole period. By 1996, just before the crisis, implied volatilities were at levels comparable to those at the height of the Mexican peso crisis at the end of 1994. However, the market did seem to discriminate shrewdly among the three countries. Indonesia had the highest implied volatility and was the hardest hit by the crisis. Malaysia was hit second hardest and had the second highest implied volatility. The Philippines, which was only marginally affected by the crisis, had the lowest implied volatility and it was falling before, during and after the crisis. We conclude that the market was sensitive to the three countries' growing economic, financial and political problems and was able to judiciously discriminate among them. In this context, the "crisis" looks more like a rational portfolio rebalancing due to the evolving economic situation in each of the three countries rather than a mindless, indiscriminate panic.

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APPENDIX 1 - ESTIMATING MACROECONOMIC MARKET VALUE

The methodology for measuring a national economy's market value was first developed in Clark (1991). It involves presenting economic activity as a series of expected cash flows in a convertible currency such as dollars. Start with the following definitions:

b_t = the dollar value of income from the sale of the economy's output of final goods and services for period t .

a_t = the dollar value of the economy's expenditure on final goods and services for period t .

X_t = the dollar value of exports including all goods and services, other income, and unrequited transfers for period t .

M_t = the dollar value of imports including all goods and services except dividends and interest paid abroad, other income, and unrequited transfers for period t .

D_t = the dollar value of dividends and interest paid abroad in period t .

F_t = the net inflow (outflow) of foreign capital including operations by the monetary authority.

V_t = the dollar value of the economy at the beginning of period t .

r = the economy's internal rate of return.

$R = 1+r$.

E is the expectations operator.

Macroeconomic accounting discipline is imposed through the transactions involving the external sector by the balance of payments identity:

$$(A1) \quad X_t - M_t + D_t + F_t = 0$$

Define b_t and a_t as:

$$(A2) \quad b_t = X_t + (C_t - M_{ct})$$

and

$$(A3) \quad a_t = M_t + (C_t - M_{ct})$$

where C is the dollar value of domestic consumption and M_c represents the dollar value of imports of consumption goods. From (A2) and (A3) it is clear that $(b_t - a_t)$ will always be equal to $(X_t - M_t)$, which, as can be seen from (A1), is an expression of balance of payments accounting discipline.

Suppose that all transactions take place on the first day of each period and that the capital markets are in equilibrium so that the economy's cost of capital is equal to its internal rate of return, r . The value of the economy measured in dollars at the beginning of time T is:

$$(A4) \quad V_T = E[(b_T - a_T) + (b_{T+1} - a_{T+1})R^{-1} + \dots + (b_n - a_n)R^{-(n-T)}]$$

Equation (A4) is the expression for the economy's net present value measured in units of foreign exchange. It is market oriented in so far as it is cast in terms of expected values of future cash flows. It also reflects international criteria for resource allocation. The reason is straightforward. Remember that $(b_t - a_t)$ will always be equal to $(X_t - M_t)$, the difference between exports and imports. The prices of exports and imports are generally derived in the international marketplace. Thus, V_T , the discounted value of the $X_t - M_t$, reflects these prices.

It is important to see the relationship between (A4) and the traditional national accounting equation. Taking the formula for V_{t+1} gives:

$$(A5) \quad V_{T+1} = E[(b_{T+1} - a_{T+1}) + (b_{T+2} - a_{T+2})R^{-1} + \dots + (b_n - a_n)R^{-(n-(T+1))}]$$

Substituting (A5) into (A4) gives:

$$(A6) \quad V_T = (b_T - a_T) + V_{T+1}R^{-1}$$

Since b_T and a_T are known because they take place on the first day of the period, the expectation operator before $(b_T - a_T)$ disappears.

Multiplying (A6) by $1+r$ to obtain the value of the economy at the end of period T and rearranging, yields the national accounting equation for period T :

$$(A7) \quad r(V_T + a_T - b_T) + a_T = b_T + (V_{T+1} - V_T)$$

where $r(V_T + a_T - b_T)$ represents profits before interest and dividends paid abroad, a_T represents cost, b_T represents income and $(V_{T+1} - V_T)$ represents net investment. Equation (A7) says that profits plus cost (on the LHS of the equation) are equal to income plus investment (on the RHS of the equation). It can be more easily recognized if we substitute (A2) and (A3) into (A7) and rearrange:

$$(A8) \quad r(V_T + M_T - X_T) + C_T = X_T - M_T + C_T + (V_{T+1} - V_T)$$

The right hand side of (A8) is immediately recognized as a derivative presentation of net national product: exports minus imports plus consumption plus net investment. The difference between this presentation and the traditional format is that interest and dividends paid abroad are not included and net investment is an expected value since it depends on V_{T+1} . The left hand side of the equation shows the economy's earnings before interest and dividends paid abroad plus consumption. Consumption, then, appears directly as a cost. However, it does not represent the total cost. Total cost would include expenditure on imports of investment goods.

The individual V_t 's in the foregoing accounting format cannot be observed directly for two reasons. First of all, we are dealing with expected future flows and, secondly, a country's national accounts are presented in domestic currency rather than foreign currency. The market information does, however, exist so that they can be estimated. The estimation procedure involves using the exchange rate to link the V_t 's to the domestic currency statistics presented in the national accounts.

The domestic currency equivalent of (A4) is:

$$(A9) \quad V'_T = E[(b'_T - a'_T) + (b'_{T+1} - a'_{T+1})R'^{-1} + \dots + (b'_n - a'_n)R'^{-(n-T)}]$$

where the primes denote domestic currency values and $R' = 1+r'$. r' is the economy's internal rate of return in domestic currency. Since $b-a$ equals $X-M$, equation (A9) can be rewritten using the exchange rate. Let

$$X'_t = S_t X_t$$

and

$$M'_t = S_t M_t$$

where S_t is the spot exchange rate at time t expressed as the number of units of domestic currency for one unit of foreign currency. Then

$$(A10) \quad V'_T = E[S_T(X_T - M_T) + S_{T+1}(X_{T+1} - M_{T+1})R'^{-1} + \dots + S_n(X_n - M_n)R'^{-(n-T)}]$$

Using interest rate and forward rate parity and assuming linear independence, it is easy to show that:

$$(A11) \quad V_T = \frac{V'_T}{S_T}$$

and at the end of the period

$$(A12) \quad V_{T+1} = \frac{V'_{T+1}}{S_{T+1}}$$

Equations (A11) and (A12) mean that the economy's NPV measured in units of foreign currency is equal to the NPV in domestic currency divided by the exchange rate. It is important to note that the effects of expectations on future cash flows are captured in the exchange rate through the mechanisms of interest rate and forward rate parity.

Now write V'_T and V'_{T+1} using historical values showing what has been invested in the economy from time 0 to time $T-1$

$$(A13) \quad V'_T = -(b'_o - a'_o)R^T - (b'_1 - a'_1)R^{T-1} - \dots - (b'_{T-1} - a'_{T-1})R$$

$$(A14) \quad V'_{T+1} = -(b'_o - a'_o)R^{T+1} - (b'_1 - a'_1)R^T - \dots - (b'_T - a'_T)R$$

Historical and expected measures of V'_T and V'_{T+1} will be equivalent if all discounting and compounding is done at the economy's internal rate of return. Making this assumption means that V'_T can be estimated directly from readily available statistical data. It is simply the sum, from period 0 to the end of period T-1, of the domestic currency value of net investment at market prices, which itself is a component of the traditional presentation of the national accounts (or it can be estimated from gross fixed capital formation). This can be written:

$$(A15) \quad V'_T = \sum_{t=0}^{T-1} (V'_{t+1} - V'_t)$$

and at the end of period T it is:

$$(A16) \quad V'_{T+1} = \sum_{t=0}^T (V'_{t+1} - V'_t)$$

Applying (A11), (A12), (A15), and (A16) gives the macroeconomic market value.