# AN EMPIRICAL STUDY OF FINANCIAL CRISES AMONG MIDDLE-INCOME COUNTRIES BETWEEN 1993-2003

## Weiping Liu[1]

*Eastern Connecticut State University, USA.*
*E-mail: liuw@easternct.edu*

**ABSTRACT**

One of the puzzling phenomena in the emerging financial market was that financial crises often took place in middle-income countries rather than in low-income countries. This study empirically studies the financial crises between 1993 and 2003 and finds that the over-reliance on foreign debt, particularly short-term debt and volatility of net income for these countries were the most important factors which caused financial crises in the middle-income countries. Therefore, for the developing countries, prudent policy towards foreign debt, particularly short-term debt, and financial income stability are the two most important preventive measures against financial crises.

**Key words:** financial crises, middle-income countries, foreign debt, volatility of net-income.

**JEL Codes:** F34, F37

## 1. INTRODUCTION

In the last decade (1993-2003), the world financial market has witnessed high frequencies of financial crises for developing countries. Mexico suffered a financial crisis in December 1994. In 1997, Thailand was attacked by an international speculation and the crises quickly spread to Malaysia, Indonesia, Philippines and South Korea. Brazil devalued its currency in 1999, significantly reducing the real value of its domestic liabilities. At the end of 2001, Argentine defaulted $90 billion of its bonded debt plus more than $20 billion in overdue interest payments. This was the largest sovereign debt default in contemporary history.

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1 Author's other contact details: Department of Business Administration, 83 Windham Rd
Willimantic, CT 06226, Tel (860)465 4608, Fax (860)465 4468

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From this, we can see that these financial crises took place not in low-income countries but in middle-income countries[2]. Therefore, the term "financial crises" in fact refers to, as suggested by Roodman (2006), two distinct problems. The first problem was the debt default of low-income nations, such as some of the sub-Saharan African countries. This problem is actually a chronic syndrome rather than crises. Lending to these countries has high but known risks and is often done by aid agencies rather than commercial banks.

The second is a true crisis. The high growth in many middle-income developing countries attracted a large amount of international capital and investment. These funds often serve as double-edge sword. On the one hand, the influx of external fund often creates booms in the borrowing countries. On the other hand, unfortunately, the service of these external debts also becomes a big burden for the borrowing countries and sudden reverse of directions of funds flow causes financial crises. In this study, our attention will be focused on this type of crises.

In the previous studies to address the problem of the sovereign debt service capacity (DSC hereafter) in the emerging markets, attentions were often focused on the study of the models predicting DSC of the developing countries (e.g. Feder et al (1981), Edwards (1984)). Most of the previous models to predict DSC of developing countries were built by using indicators of the likelihood of debt moratoriums of the developing countries as independent variables and these independent variables were equally weighted. When an indicator of a particular country exceeded a preset level, analysts would forecast that this country might have debt service problem. Obviously, this approach does not differentiate the two types of problems mentioned above. For the low-income countries, the change of DSC indicators might be useful in predicting their DSC. However, for the middle-income countries, they usually have very good economic growth rate and healthy macroeconomic fundamentals before they become victims of financial crises. Unfortunately, most of the previous models were built to forecast the DSC of developing countries in general. Very few studies are specific on the study of financial crises in middle-income countries.

This study intends to fill up this gap by empirically studying two groups of victim countries. The first group includes Thailand, Malaysia, Philippines, Indonesia and South Korea, victims of 1997 Asian financial crisis. The second group consists of three Latin American countries: Mexico, Brazil and Argentine. They were the biggest sufferers of financial crises in the last decade.

The fact that financial crises often take place in middle-income countries is a puzzling phenomenon. Middle-income countries, by definition, have higher per capita income than low-income countries and should be more capable in dealing with economic shocks. But in reality, middle-income countries are very

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2 . According the World Bank, countries with $876 to $10,725 GNI (Gross National Income) per capita are defined as middle income countries.

vulnerable to external or internal economic shocks and susceptible to financial crises. What are the reasons that financial crises often take place in middle-income countries? What are the most important determinants of the financial crises for middle-income countries? This study is trying to answer these questions and identify the most important factors which caused financial crises in the middle-income countries in the last decade.

Financial crises in the past decade not only inflicted serious consequences on the countries directly affected but also had very negative effects on the world economy as a whole. The frequent occurrence of these financial crises and great damages inflicted by these crises are causing great concerns among financial administrators and financial researchers alike. Hopefully this study can provide some insights as to how to prevent financial crises and break up the odd circle of "boom-and-bust" in the developing countries.

The rest of the paper is organized as follows: Section 2 studies the effects of short-term debt and volatility of net income on the financial crises which took place in middle-income countries. Section 3 describes the data and methodology used in this study. Section 4 reports the results of the empirical tests. Section 5 contains some remarks of conclusion.

## II. THE EFFECTS OF SHORT-TERM DEBT AND NET-INCOME VOLATILITY ON FINANCIAL CRISES OF MIDDLE-INCOME COUNTRIES

### A. Effects of Short-term Debt

When we study financial crises in the emerging market in the last decade, we can find that the crisis-inflicted countries are similar in one very important aspect: before the crises, they all had surging foreign capital inflows, which played an important role in boosting the economies of the recipient countries. Paradoxically many crisis-inflicted countries were taken as models for other developing countries to emulate.

Before the Asian financial crisis, foreign capital influx to emerging markets soared more than fivefold-from $42 billion in 1990 to $256 billion in 1997. East Asia absorbed nearly 60 percent of all short-term capital flows to the developing countries. These inflows fueled the domestic credit boom in East Asia and the credit boom in turn led to an increase in assets prices, creating an appearance of high returns (World Bank, 1998). Table 1 shows the total debt and short-term debt imported by the victim countries before the 1997 Asian Financial Crisis. Figure 1 shows the trend of the short-term debt of Eastern Asian countries.

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**Table 1**
**Total Debt and Short-term Debt for Victim Countries of 1997 Asian Financial Crisis**
**(Unit of Currency: Millions of US Dollar)**

| Country | Total Debt | | | Short-term Debt | | |
|---|---|---|---|---|---|---|
| | 1993 | 1997 | Annual Growth | 1993 | 1997 | Annual Growth |
| Korea, Rep. | $47,202 | $136,984 | 30.52% | $12,200 | $53,792 | 44.91% |
| Thailand | $52,638 | $109,699 | 20.15% | $22,634 | $37,836 | 13.71% |
| Malaysia | $26,148 | $47,228 | 15.93% | $6,951 | $14,929 | 21.08% |
| Indonesia | $89,172 | $136,161 | 11.16% | $17,987 | $32,865 | 16.26% |
| Philippines | $35,936 | $45,683 | 6.18% | $5,035 | $11,793 | 23.71% |

**Figure 1        Short-term Debt of Eastern Asian Countries**
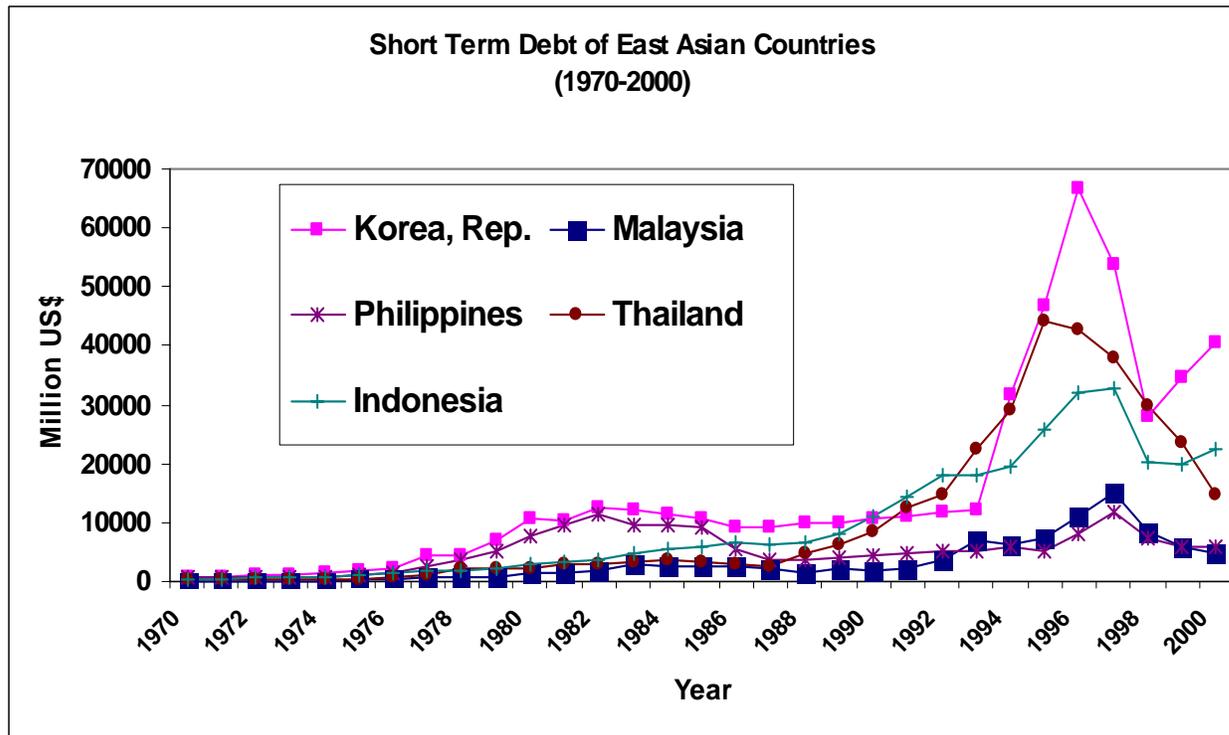


Mexico received considerable capital inflows in the years leading up to the crisis of 1994-95. To a large extent, these capital inflows were attracted by the favorable outlook for the economy after years of macroeconomic stabilization and intensive structural reform. These policies led to economic recovery after nearly a decade of low growth and high inflation. Under these circumstances, unprecedented amounts of capital flew into the country, reaching $104 billion between 1990 and 1994, which was about 20 percent of total capital flows to developing economies during the period. Its short-term debt increased from $590
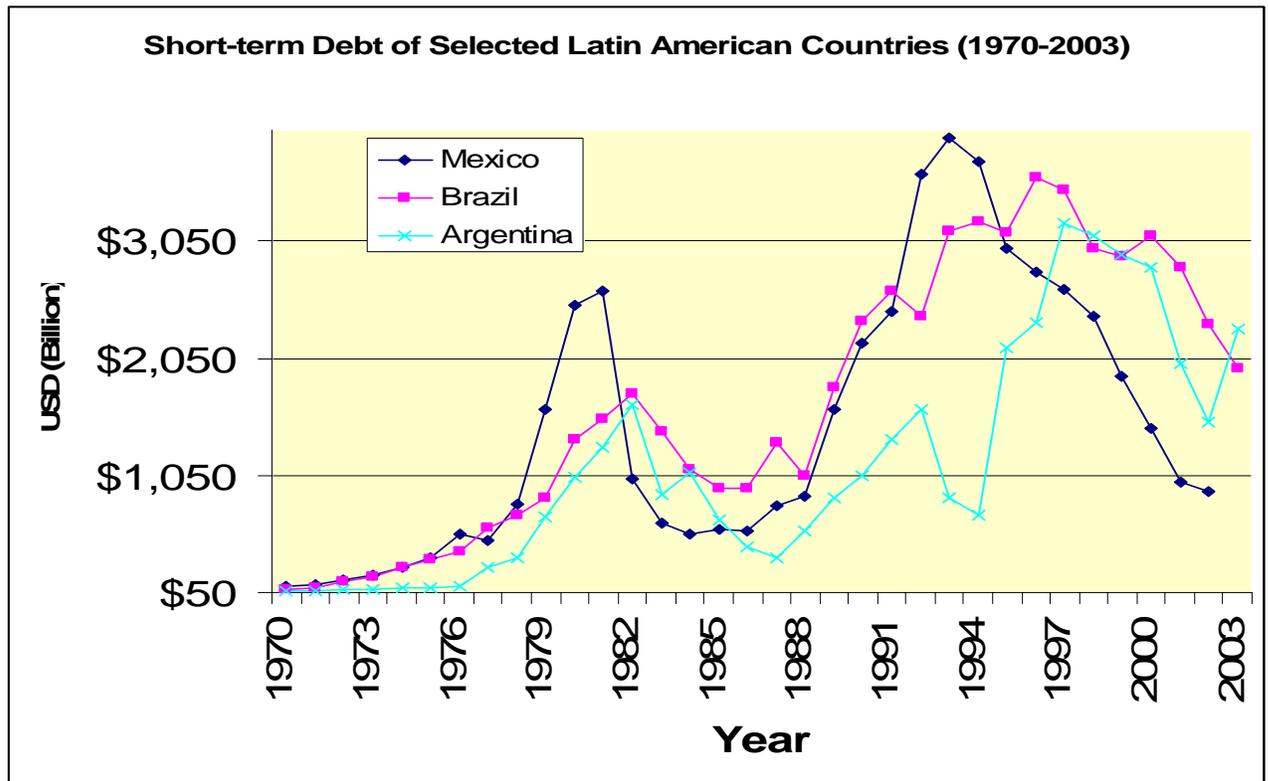
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billion in 1985 to $3,932 billion in 1995 with an annual growth of 26.71%. Before being attacked by financial crises, Brazil and Argentine had similar situations. Brazil's short-term debt increased from $942 billion in 1986 to $3,593 billion in 1996 with an annual growth of 14.32%. Argentine's short-term debt increased from $353 billion in 1987 to $3,199 billion in 1997 with an annual growth of 28.88%. Figure 2 and Table 2 are illustrating the trend of short term debt of these three countries

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**Table 2**
**Short-term Debt for Victim Countries of Financial Crisis in Latin America**
**(Unit of Currency: Billions of US Dollars)**

|  | Ten Years Before the Crisis | The Crisis Year | Annual Growth |
|---|---|---|---|
| Mexico (1985 vs. 1995) | $590 | $3,932 | 26.71% |
| Brazil (1986 vs. 1996) | $942 | $3,593 | 14.32% |
| Argentina(1987 vs. 1997) | $353 | $3,199 | 28.88% |

Source: Global Development Finance, 2005 by World Bank.

Figure 2          Short-term Debts for Selected Latin American
Countries



Short-term Debt of Selected Latin American Countries (1970-2003)

Even though these foreign capitals played an important role in the economic development of the recipient countries, the dramatic increase of foreign capital influx created several major problems. The service of interest and

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principal payment of foreign debt is a big burden of many borrowing countries and greatly weakens the borrowing countries' ability to deal with financial shocks. In the emerging market, we can often observe that many developing countries suffered severe recession after high economic growth. What is the nature of this "boom-and-bust" pattern? Can the developing countries break the odd circle?

It is well known that the development of many social processes is characterized with very fast initial-stage growth which looks like positive exponent and late-stage very slow growth which looks like a negative exponent, approaching some limit value. Obviously, the odd "boom-and-bust" circle is just another example of this process. In mathematics, this process can be expressed with a logistic differential function, which is in the form of the following equation.

$$\frac{d\,X(t)}{dt} = r\,X(t)\,(1 - \frac{X(t)}{K}) \qquad\qquad \textbf{(1)}$$

where X(t) = foreign capital imported for a country at time t,

    r = constant relative growth rate of foreign capital imported,

    t = time period.

    K = the maximum imported capital the country can attain.

This equation is also known as Verhulst Equation[3]. Recently, several efforts have been made to use this model to describe the economic processes, such as capital accumulation in a country (Ferreira, 1998), debt borrowing pattern in Russia (Trofimov, 2000). For our purpose, this model essentially tells us that excessive borrowing of foreign funds, particularly short funds, will result in chaotic results.

In this equation, both r and K are assumed to be constant. K is a critical number in this model and it is also known as carrying capacity. This number gives the logistic differential model an important feature. When X (t) is small comparing with K, $\frac{X(t)}{K}$ is close to 0 and thus $1 - \frac{X(t)}{K}$ is close to 1. So the growth of X (t) is approximately proportional to X (t). Namely, X (t) is growing at a fast rate.

However, as X (t) increases toward K, $\frac{X(t)}{K}$ increases to 1, so that $1 - \frac{X(t)}{K}$ decreases to zero. Then the growth of X (t) would have a slower rate and eventually tends to zero. If X (t) > K, then $1 - \frac{X(t)}{K}$ will be negative, so the growth of X (t) is negative, i.e., decreasing.

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3 . Verhulst (1804-1849) was a Belgian mathematician. In his seminal paper "Notes on the law that the population pursuit" (1838), Verhulst developed this equation to model human population growth.

Therefore, if the curves showing the amount of short-term debt borrowings for the victim countries of financial crises are all consistent with logistic differential curve, then we can conclude that the excess short-term debt borrowing is one of the most important factors leading to financial crises.

## B. Effects of Net-income Volatility

What are the impacts of volatility of a country's net income in causing financial crises? Previous prediction models only used levels of DSC indicators as independent variables. In another word, only the first moments of these indicators were used. The second moments of these indicators, i.e., the volatility of these indicators, are neglected. Probably the study of the volatility of these indicators will shed more lights on the nature of financial crises of middle-income countries.

Does the net-income volatility of a country affect the likelihood that financial crises will take place in that country? This is a controversial topic. One opinion is that the volatility should not affect the DSC of the middle-income countries. The living standards in the middle-income countries are well above the poverty line in the world. In the situation when high volatility of DSC indicators occurs, these countries should be able to adopt an austerity policy, i.e., to reduce demand for imports and free up capacity for exports.

Some researchers, e.g. Froot et al. (1989) and Rowlands (1993), compared the difference between corporate debt and sovereign debt. In corporate DSC analyses, many researchers have reported that firms with stable earnings have a higher DSC. Consequently, in estimating a firm's DSC, pro forma financial statements are often developed to analyze the possible variance of future cash flows of a leveraged firm.

However, private debt and sovereign debt are different in one very important aspect. Lenders to companies, such as bond holders, have seniority in claiming property of a firm when the firm's value is under the face value of the debt. For sovereign debt, only in very rare situations can sovereign lenders seize the assets of the borrowing country or otherwise impose judicial sanctions of defaulting nations in the event of a debt default. In this sense, sovereign nations always have the incentive to repudiate their debt voluntarily. Thus, the key issue in the sovereign lending is how to ensure the enforceability of debt contracts, i.e., how to keep borrowers from incurring debts and then defaulting voluntarily.

The consequence of sovereign debt default will be (1) the debtor will lose its access to international credit markets for a long period of time; (2) the debtor has to repay the old defaulted debt before it can regain the trustworthiness of creditors. Neither situation will allow the debtors to benefit from the default. As a consequence of these negative effects of sovereign debt default, moratoriums are relatively infrequent occurrences.

Grossman and Van Huyck (1988) point out: "A sovereign's decision to validate lender's expectations about the servicing of its debt presumably

depends mainly on the sovereign's concern for its trustworthy reputation for debt servicing. A trustworthy reputation is valuable because it provides continued access to loans."

The other opinion is that the high volatility of DSC indicator does affect a country's DSC. Catao and Sutton (2002) find that countries with historically higher macroeconomic volatility are more prone to default, and particularly so if part of this volatility is policy-induced. When a country is encountered high volatility of DSC indicators, an austerity policy will slow down the growth of the economy and decrease per capita consumption. Attempting to lower people's consumption level will most likely result in discontent. Discontented people will not reelect those members of office that were responsible for the austerity policy. Thus, the administration would rather sacrifice the national reputation to maintain the consumption level. In this case, high volatility does affect the DSC and result in debt crises.

More importantly, high volatility of DSC indicators make a country's economy very vulnerable to the external and internal economic shocks. Pettis (2001) suggests that financial crises occurred not because of the mismanagement of economic policies in the emerging countries but because of the underestimation of the sources and magnitude of volatility in emerging financial markets.

In the last decade's world financial market, another important new trend we can observe is the increasing mobility of funds. The mobility of capital is one of the most important goals of financial markets. It is good for both lenders and borrowers. To the borrowers, increased external financing can enhance economic growth and welfare by financing investment projects. To the lenders, in the last decade, emerging markets offer higher returns than markets in the industrialized countries.

However, too much of a good thing could turn out to be devastating. As more and more funds flew into the emerging markets, many developing nations became increasingly relying on foreign funds. Rapid capital inflows, particularly short-term capitals, created several weaknesses in the economic foundations in the developing countries. Banks in these countries borrowed large amount of foreign currencies and liberally made loans in domestic currencies largely for speculation investments. The banks' short-term borrowings and long-term lending created extraordinary mismatch risks. This debt structure made economies in those emerging countries very vulnerable to sudden reversals. Investors could abruptly change their attitudes, leading to massive outflows of capital. Outflows of capital caused asset value plummeting and crash of stock market. In turn, banks were left with a large volume of non-performing assets. Financial disasters, bank failures created more panic. The virtuous circle previously dominated the market became a vicious circle. Financial crisis can take place as suddenly as a volcano eruption.

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## III. DATA AND METHODOLOGY

### A. Data

The data used in this study are collected from "Global Development Finance" published by World Bank (2006).  Three tests are conducted in this study. The first one is trying to identify the most important factor(s) causing financial crises. The second one is to test the relationship between short-term foreign debt and the occurrence of financial crises. The third one tests the influence of volatility of net-income of a nation on the occurrence of financial crises. Three corresponding sets of data are collected.

For the first data set, as the attention of this study is focused on the middle-income countries, only countries whose per capita GNI is above $875 are selected. The following ten debt service ratios are included in the data set: EDT/XGS (Total external debt to exports of goods and services), (for convenience it will be referred as $X_1$); EDT/GNP (total external debt to gross national product), ($X_2$); TDS/XGS (debt service ratio), which measures the percentage of debt service payments (interests and principals) in export income, ($X_3$); INT/XGS, total interest payments to exports of goods and services, also called the interest service ratio, ($X_4$); INT/GNP, total interest payments to gross national product, ($X_5$); RES/EDT, international reserves to total external debt Ratio, ($X_6$); RES/MGS,  international reserves to imports of goods and services, ($X_7$); Short-term /EDT, short-tern debt to total external debt, ($X_8$); Concessional/EDT,  Concessional debt to total external debt, ($X_9$); and Multilateral/EDT, Multilateral debt to total external debt, ($X_{10}$). These ten ratios are used as independent variables to build a model to predict debt crisis. The dependent variable in this analysis is whether a country has the experience of financial crisis. If a country has the experience, 1 is assigned. Otherwise 0 is assigned.

The data set collected for the second test contains short-term debt of the victim countries (i.e. five Asian countries and three Latin American countries) of financial crises.

The third set of data includes debt service ratios, import costs, export revenues and whether a country has the experience of financial crisis. When the fluctuation of a country's net income is calculated, we should include both the fluctuation of export revenue and the effects of that country's import cost. When the effects of export revenue and import costs fluctuation are considered simultaneously, the difference between export revenue and import cost of a country, i.e. the net external income of the nation, could be either positive or negative.  Thus the regular measurements of volatility, such as standard deviation and coefficient of variation become invalid.

To address this problem, a coefficient, which is labeled as the Standardized Sovereign Debt Volatility Coefficient (SSDVC), is developed to

measure the volatility of consumption smoothness (Liu, 2001). This coefficient is computed as follows:

1. Compute the nation's net income, which is the difference of Import Cost (denoted by MGS in the data source) and Export Revenue (denoted by XGS). Then the mean of the net income of that nation is computed over the period examined.

2. Compute the standard deviation of the net income for that nation over the period examined. The result is $\sigma\{XGS - MGS\}$.

3. Compute the mean of that country's total debt service (TDS), the result is denoted by $\mu_i\{TDS\}$.

4. Divide $\sigma\{XGS - MGS\}$ $\mu_i\{TDS\}$ by, we obtain the Standardized Sovereign Debt Volatility Coefficient.

Thus, SSDVC can be defined as:

$$SSDVC = \frac{\sigma_i\{XGS - MGS\}}{\mu_i\{TDS\}} \tag{2}$$

This coefficient is inversely related to DSC volatility, i.e., when the coefficient decreases, the risk increases. The reason why the reciprocal is not used is because sometimes the standard deviation can be very small or even zero. In those cases, the coefficient obtained could be either very difficult to interpret or, even worse, undefined.

This coefficient has several advantages: First, it reflects the simultaneous effects of export income and import costs. Second, it incorporates the volatility of the differences between export and import. Therefore, it should be a better indicator of a sovereign's consumption smoothness. Third, it is standardized. It is adjusted for the size effect and so it can be applied to compare the risks between countries.

## B. Methodology

To find the most influential determinant(s) of financial crises, we first use logistic regression analysis and correlation test to screen unimportant factors from important factors in financial crises predicting.

(1) Logistic regression analysis. Because the dependant variable is binary, logistic regression analysis is employed here. Logistic regression analysis, like linear regression analysis, is used to describe the nature of the relationship between a dependent variable and one (or more) independent variable(s).

The logistic response functions are of the form:

$$E\{Y\} = \frac{\exp(\alpha + \quad )}{1 + \exp(\alpha + \quad )} \tag{3}$$

Where $E\{Y\}$ is the mean response, i.e., the probability when the dependent variable is one; $\alpha$ is the intercept, $\beta$ is the vector of regression parameters: and **X** is a realization of the vector of predictor variables.

The shape of the response function will frequently be sigmoid but it can easily be linearized. If we denote E{Y} by π and let π'=log$_e$[π/(1-π)], then π'=**b'x** is easily obtained. This transformation is called the logistic transformations of the probability π. The ratio π/(1-π) in the logistic transformation is the odds. The transformed response function is referred to as the logistic response function, and π' is called the logistic mean response.

In logistic regression analyses, the coefficient obtained has a very special meaning. Its exponential is the odds ratio, which is the ratio between the probability that an event will happen and the probability that the event will not happen. This feature often makes logistic regression a very useful tool of analysis.

(2) Logistic Differential Curve Test. By using the logistic differential equation, we can test whether the curve of the short-term debts of a country is a logistic curve. To empirically test if the short-term debt borrowed by the middle-income victim countries is actually a logistic curve, we used the short-term debts of the middle-income countries as data samples.

By using $Y(t) = X(t+1) - X(t)$ to approximate $dX(t)/dt$, Equation (1) can be written as $Y(t) = r\,X(t) - (r/K)X^2(t)$. Thus we consider the following more general equation

$$Y(t) = \beta_1 X(t) + \beta_2 X^2(t) \qquad\qquad\qquad \textbf{(4)}$$

In this equation, $\beta_1$ should be greater than 0 and $\beta_2$ should be equal to or smaller than 0.

To test the hypothesis that the high growth of short-term debt is an important factor causing financial crisis in the middle-income countries, we will consider the econometric form of Equation (4):

$$Y(t) = \alpha + \beta_1 X_t + \beta_2 X_t^2 + \varepsilon \qquad\qquad\qquad \textbf{(5)}$$

where Y(t) is the debt change at different time and $\varepsilon$ is the random error.

The test is a straightforward regression analysis. The independent variables are short-term debts of the middle-income countries before the debt crisis and its squared numbers. The dependent variable is the debt change of a particular year, i.e. $X(t+1) - X(t)$.

# IV. EMPIRICAL RESULTS

## A. Test Results of Finding the Most Influential factors to Cause Financial Crises

As mentioned in the previous section, the first test is trying to identify the most important factor(s) causing financial crises. For this purpose, we conducted the tests in several steps. In the first step, we test the significance of each independent variable by regressing the dependent variable against each independent variable individually. The results are reported in Table 3. From this table, we can see that X2 and X7 are not significant.

**Table 3**
**Results of Logistic Regression Analysis When Dependent Variable is Regressed Against Each Independent Variable Individually**

| Variables | β | S.E. | P-value | Exp(β) |
|-----------|------|------|---------|--------|
| X1 | .005 | .001 | .0001 | 1.005 |
| X2 | .002 | .005 | .648 | 1.002 |
| X3 | 048 | .009 | .0001 | 1.049 |
| X4 | .143 | .024 | 0001 | 1.154 |
| X5 | .230 | .091 | .012 | 1.258 |
| X6 | -.018 | 008 | 028 | 982 |
| X7 | -.011 | 048 | 823 | 989 |
| X8 | 020 | 010 | 040 | 1.020 |
| X9 | -.064 | 016 | 0001 | 938 |
| X10 | -.093 | 020 | 0001 | 911 |

In the second step, we conducted a correlation study between independent variables. The results are reported in Table 4.

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**Table 4**
**Correlation Coefficients between Independent Variables**

|   |   | X1 | X2 | X3 | X4 | X5 | X6 | X7 | X8 | X9 | X10 |
|---|---|----|----|----|----|----|----|----|----|----|-----|
| X1 | Pearson Correlation | 1.00 | 0.60 | 0.63 | 0.73 | 0.36 | -0.26 | 0.09 | -0.09 | -0.16 | -0.23 |
|   | Sig. (2-tailed) |   | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.01 | 0.01 | 0.00 | 0.00 |
| X2 | Pearson Correlation | 0.60 | 1.00 | 0.23 | 0.29 | 0.60 | -0.28 | -0.16 | -0.09 | -0.02 | -0.16 |
|   | Sig. (2-tailed) | 0.00 |   | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.01 | 0.63 | 0.00 |
| X3 | Pearson Correlation | 0.63 | 0.23 | 1.00 | 0.87 | 0.53 | -0.21 | 0.14 | -0.07 | -0.43 | -0.37 |
|   | Sig. (2-tailed) | 0.00 | 0.00 |   | 0.00 | 0.00 | 0.00 | 0.00 | 0.04 | 0.00 | 0.00 |
| X4 | Pearson Correlation | 0.73 | 0.29 | 0.87 | 1.00 | 0.64 | -0.21 | 0.19 | -0.07 | -0.40 | -0.36 |
|   | Sig. (2-tailed) | 0.00 | 0.00 | 0.00 |   | 0.00 | 0.00 | 0.00 | 0.05 | 0.00 | 0.00 |
| X5 | Pearson Correlation | 0.36 | 0.60 | 0.53 | 0.64 | 1.00 | -0.23 | -0.03 | -0.07 | -0.38 | -0.38 |
|   | Sig. (2-tailed) | 0.00 | 0.00 | 0.00 | 0.00 |   | 0.00 | 0.45 | 0.04 | 0.00 | 0.00 |
| X6 | Pearson Correlation | -0.26 | -0.28 | -0.21 | -0.21 | -0.23 | 1.00 | 0.71 | -0.05 | 0.13 | 0.27 |
|   | Sig. (2-tailed) | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |   | 0.00 | 0.12 | 0.00 | 0.00 |
| X7 | Pearson Correlation | 0.09 | -0.16 | 0.14 | 0.19 | -0.03 | 0.71 | 1.00 | 0.00 | -0.05 | 0.03 |
|   | Sig. (2-tailed) | 0.01 | 0.00 | 0.00 | 0.00 | 0.45 | 0.00 |   | 0.90 | 0.16 | 0.39 |
| X8 | Pearson Correlation | -0.09 | -0.09 | -0.07 | -0.07 | -0.07 | -0.05 | 0.00 | 1.00 | -0.39 | -0.43 |
|   | Sig. (2-tailed) | 0.01 | 0.01 | 0.04 | 0.05 | 0.04 | 0.12 | 0.90 |   | 0.00 | 0.00 |
| X9 | Pearson Correlation | -0.16 | -0.02 | -0.43 | -0.40 | -0.38 | 0.13 | -0.05 | -0.39 | 1.00 | 0.79 |
|   | Sig. (2-tailed) | 0.00 | 0.63 | 0.00 | 0.00 | 0.00 | 0.00 | 0.16 | 0.00 |   | 0.00 |
| X10 | Pearson Correlation | -0.23 | -0.16 | -0.37 | -0.36 | -0.38 | 0.27 | 0.03 | -0.43 | 0.79 | 1.00 |
|   | Sig. (2-tailed) | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.39 | 0.00 | 0.00 |   |

From this analysis, we can see X4 and X3, X10 and X9 are highly correlated with each other. To avoid the so-called multicollineality problem, in addition to X2 and X7, we drop X4 and X10. Therefore, in the third step, the

dependent variable is regressed against all other independent variables simultaneously. The results are reported in Table 5.

**Table 5**
**Results of Logistic Regression Analysis When Dependent Variable is Regressed Against Selected Independent Variables Simultaneously**

|          | B       | S.E.   | Wald    | df     | Sig.   | Exp(B) |
|----------|---------|--------|---------|--------|--------|--------|
| X1       | 0.0024  | 0.0019 | 1.6262  | 1.0000 | 0.2022 | 1.0024 |
| X3       | 0.0255  | 0.0120 | 4.4961  | 1.0000 | 0.0340 | 1.0258 |
| X5       | 0.0034  | 0.1302 | 0.0007  | 1.0000 | 0.9791 | 1.0034 |
| X6       | -0.0097 | 0.0081 | 1.4402  | 1.0000 | 0.2301 | 0.9903 |
| X8       | 0.0227  | 0.0138 | 2.7050  | 1.0000 | 0.0900 | 1.0229 |
| X9       | -0.0460 | 0.0165 | 7.7281  | 1.0000 | 0.0054 | 0.9551 |
| Constant | -3.4690 | 0.7535 | 21.1960 | 1.0000 | 0.0000 | 0.0311 |

From Table 5, we have several important findings. The first is that in addition to X2 and X7, X1, X5 and X6 become insignificant now. This shows that the model built is of limited use in predicting financial crises. This result is consistent with our observation that the victim countries of financial crises had good economic growth rate and healthy macroeconomic fundamentals before the financial crises.

The second is that three variables, i.e. X3, X8 and X9 are still significant in predicting financial crises. The importance of X9 (the ratio between concessional debt to total external debt) in predicting financial crises is intuitively understandable. Obviously, the more
concessional debt the country has, the less likely that it will suffer from financial crises. The reason why the other two variables are significant in predicting financial crises help us to gain an insight of the causes of financial crises. X3 is called the debt service ratio (the ratio between total interest and principal payments to exports of goods and services) and X8 is the ratio between the short-term debts to total external debts. The significance of these two variables suggests that volatility of income of a country and improper use of short-term debts by a country could be very important in predicting the likelihood of financial crisis of that country.

**B. Test Results of Logistic Differential Curve Test**
Table 6 reports the results of Logistic Differential Curve Test. From this table, we can see that $\beta_1$ are all positive and $\beta_2$ are all negative. This confirms that these short-term debts curves of the victim countries are logistic differential curves and thus provides evidence that overuse of short-term debt might be one of the most important reasons why financial crises often take place in middle-income countries.

*Weiping Liu*

**Table 6**
**Test Results of Logistic Differential Equation**

| Country | $B_1$ | $B_2$ |
|---|---|---|
| Argentina | 3.221 | -2.98 |
| Brazil | 1.22 | -1.193 |
| Mexico | 2.202 | -1.551 |
| Korea | 2.512 | -1.632 |
| Malaysia | 0.79 | -0.014 |
| Indonesia | 1.228 | -0.809 |
| Thailand | 1.908 | -1.182 |
| Philippines | 2.156 | -4.36 |

C. Test Results of Finding Whether High Volatility Affects DSC of Middle-Income Countries

In this test, we also use logistic regression analysis. The results are reported in Table 7.

**Table 7**
**Test Results of Logistic regression Analysis by Using SSDVC as Independent Variable**

| Independent Variable | B | S.E. | Wald | df | Sig. | Exp(B) |
|---|---|---|---|---|---|---|
| SSDVC | -1.7838 | 0.9924 | 3.2308 | 1.0000 | 0.0723 | 0.1680 |

From this test, we can see that the beta coefficient obtained is negative and significant. The coefficient is negative because SSDVC is negatively related to volatility. The significance of this coefficient implies that the volatility of net-income of a middle-income country is a factor which causes financial crises. The exponential of beta is 0.1680, which means that when independent variable, SSDVC decreases (i.e. the volatility of net-income of a middle income country increases), DSC of the country will decrease. Obviously, this test provides strong evidence that volatility of net income for the middle-income developing countries has significant impact on their DSC.

**V. DISCUSSIONS**

This study empirically studies the financial crises between 1993 and 2003. This study found that even though before financial crises, the victim countries usually have very good economic growth and healthy macroeconomic fundamentals, they were not immune from internal and external economic shocks. On the contrarily, they were very susceptible to financial crises attacks. We found that two factors are very important to cause financial crises. The first

one was the over-reliance on foreign debt, particularly short-term debt. The second was the volatility of net-income of these countries. High volatility of net-income could significantly reduce the ability of these countries to deal with attacks of financial crises. What are the implications of these findings?

First, foreign investment and foreign debt provide a good leverage to the economic development of the recipient countries. Nonetheless, foreign capital, particularly short-term fund, also weakens a nation's ability to deal with economic shocks. Many researchers and practitioners have come to realize that the international short-term fund (the so-called "hot money") is one of the most important factors that cause the instability in the international financial market. Consequently, as some experts pointed out, the magnitude of external capital, especially short-term capital, must be controlled within the rational limits of an economy's absorptive capacity (Guitian, 1998). This opinion is consistent with the empirical findings of this study.

Second, since short-term debt is one of the most important destabilizing factors for the middle-income countries. To maintain the healthy economic growth, an efficient and effective macroeconomic monitoring system, particularly the system to monitor the short-term debt and short-term investment, should be developed. Developing countries can benefit from foreign investment and debt only in the transparent, robust and well-regulated financial markets. Liberalization of market must be accompanied by sensible regulation of financial institutions and financial markets.

Third, one of consequences of over-reliance on foreign funds is that the middle-income developing countries become vulnerable to external shocks. Therefore, from the long-term point of view, the developing middle-income countries should develop domestic bond market to meet its long-term development objective. If developing countries can take advantage of the high saving rate of their peoples and significantly improve the financial markets and system, substituting foreign capital funds with internally generated funds is not only feasible but also beneficial. Internally generated funds are generally more stable and can serve as a buffer when financial shocks take place. To most international investors, it is also safer to invest in a country that has a high percentage of internally generated funds.

Fourth, one of the consequences for the massive increase in capital flows associated with high-tech international financial system is that the global financial markets do not always achieve an appropriate equilibrium. This implies that the hotbed for the financial crises still exists. The abruptness, severity and duration of the previous financial crises serve as a warning that similar crises might happen again. Historical experiences also show us that once financial crises start, it is very difficult to stop it. Moreover, crises could be very contagious and spread to other countries rapidly. After the crises, it takes a lot of efforts to recover. Consequently, it is very important to forecast the possible

occurrence of the crisis and take preventive measures. Unfortunately, lack of sufficient competent financial management personnel is still one of the critical weaknesses in most of the developing countries. If this problem is not addressed effectively and promptly, the danger of being attacked by another financial crisis is not a question of likelihood but a question of time and severity.

Fifth, this study also finds that a middle-income country exposed to higher net-income volatility does have a higher propensity to be attacked by a financial crisis. Why does this counterintuitive phenomenon take place? There might be two possible explanations. The first is the mismanagement when high volatility takes place. When a middle-income country has a high volatility of net external income, the policy-makers of those nations would be more reluctant to pursue an austerity policy before it is too late. The second one could be the economic structures of the victim countries are not well constructed and cannot stand the attacks of financial crises. Therefore, it is important to set up an independent monetary policy agency which can be freed from the political influence and competent to monitor the national economic structure.

To summarize, for the developing countries, particularly for those with high economic growth rate, prudent policy towards foreign debt, particularly short-term debt, and maintaining financial income stability are the two most important preventive measures against financial crises.

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