Predicting Financial Debt Crises: A Case Study of India

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Abstract

The following paper develops a qualitative and quantitative model for predicting financial debt crises. The qualitative model breaks down the balance sheet of emerging market countries to identify weaknesses in the country's assets and liabilities. The values of the items on a country's balances sheet are then compared to the pre-crisis conditions of the East Asian and South American crises that occurred in the late 1990's and early 2000's. The quantitative model consists of a logistic function that uses economic variables to determine the probability that a country will face a financial crisis the following year. The logistic function is developed using a comprehensive set of data which consists of forty different variables from forty-three countries over the past ten years.

The logistic model developed in the paper is further analyzed to identify the economic variables that have the greatest impact on a country having a financial crisis. The marginal effect each of the variables is identified by increasing each of the variables by one standard deviation while keeping the other variables constant. The variables with the greatest marginal effect have the largest impact on a financial crisis and policy reform is recommended based on keeping these variables at sustainable levels.

The paper concludes with a case study that applies the models to India. Using the balance sheet analysis and the logistic model, India's strengths and weaknesses are identified. The paper concludes that India is not in danger of a financial debt crisis but there are still many areas where the economy can improve.

I. Introduction

Financial debt crises in emerging markets have caused widespread turmoil in the world economy over the past several decades. In recent years, countries have become more globalized and international investments have increased dramatically. Average businesses have begun to outsource jobs and import goods from emerging markets to keep up with competition. Global trade has become a vital part of succeeding in the modern business world. As globalization becomes more prevalent in the world economy, a greater number of countries are at risk to the adverse effects of a financial debt crisis.

During the 1990's, East Asian countries experienced extraordinary levels of growth. Almost half of the investments in emerging markets were directed towards countries in this region. Many of the East Asian countries used inefficient policies for structuring their debt. Eventually the financial systems of these countries collapsed and they faced financial debt crises. Given the unexpected nature of the East Asian crises, it is important to be vigilant of high growth emerging markets.

The goal of this paper is to develop a model for predicting financial debt crises. The paper seeks to answer the questions: What economic factors are the most important indicators of a future crisis? What economic policy can be used to prevent a country from having a debt crisis? How can we evaluate a country's risk of a having a crisis? By analyzing economic data from a variety of emerging market countries over the past ten years, this paper will address all of these questions.

Predicting a financial debt crisis is one of the steps necessary to prevent a crisis from occurring. This paper will use historical research and information to develop a strategy for identifying countries that are vulnerable to a crisis. The first section of the paper will discuss

the different types of debt crises that have occurred over time. The following section will review the different methodologies that economists have used to predict debt crises. Different qualitative and quantitative studies on predicting crises will be examined. Once these strategies have been evaluated, the best methods will be chosen and developed for the rest of the study. The accuracy and predictive power of these methods will be assessed using empirical data. The models will then be broken down to interpret the importance of the individual economic factors. General policy reforms for vulnerable countries will be recommended based on the impact that specific variables play in a crisis.

The final section will use the analyses developed in the paper to evaluate India's vulnerability to a financial debt crisis. India is an emerging market country that has faced high growth from capital inflows over the past few years. The case study of India will serve as an example of how to analyze an emerging market's financial risk. Based on the results of the study, India's economic status will be determined and policy reforms will be recommended.

II. Literature Review

Types of Crises

Economists have developed three generations of models to explain the fundamental causes of financial debt crises. A country is defined as being in a debt crisis if it is classified as being in default by Standard & Poor's, or it if it has access to nonconcessional IMF financing in excess of 100 percent of quota.[1] The first generation financial crisis model was developed by Paul Krugman (1979). Early financial crises occurred in countries that pegged their exchange rate. In order to defend a pegged rate, countries with developed markets utilize open market operations, currency forwards, and foreign assets. Less developed

[1] Definition comes from Manasse, Roubini, and Schimmelpfennig (2000)

countries, without these resources, are forced to use poor economic policies where the central bank lends money to the government to finance its fiscal deficit. This policy leads to a gradual loss of foreign reserves. Once foreign reserves reach a critical level, the currency is likely to experience a speculative attack that will deplete the rest of the currency stock. Eventually, the government is no longer able to defend the fixed rate and the peg is abandoned. Speculators threaten the balance of payments by disinvesting in domestic capital. Additionally, the devaluation of currency multiplies the value of foreign debt.

The second generation crisis model, created by Obstfeld (1994), is when the government is conflicted between maintaining a fixed exchange rate regime and using expansionary monetary policy to assist the economy. When the government of a fixed exchange rate economy prioritizes expansionary monetary policy, changing interest rates force the government to abandon the pegged exchange rate. The second generation crisis is based on "self-fulfilling" expectations where private agents believe that the currency is overvalued. Accordingly, interest rates increase to the point where the government finds it too costly to defend the exchange rate. If the country pushes interest rates too high, growth rates suffer and unemployment rises. Consequently, governments choose to abandon the fixed rate in favor of economic expansion.

The third generation financial crisis model was developed by Dornbusch (2001) in response to the 1997-98 Asian financial crises. These crises are best explained by mismatches in the private and banking sectors. Many of the East Asian countries had high levels of short-term debt that was exposed during liquidity runs. When companies and banks could no longer refinance their debt, they were forced to restructure or default. Other countries had currency mismatches on their debt that led to capital erosion when domestic

currency depreciated. Both instances of debt collapse were followed by high levels of default and output losses. The accumulation of private failures often forced countries into devaluating their currencies.

After identifying the causes of the three generations of crises, many economists developed strategies for warning against potential crises. Each of the strategies was developed by observing quantitative and qualitative information from countries that faced financial crises. The information that was consistent among these countries in the years leading up to the crisis was identified as potential indicators of a financial crisis. The information that was identified was evaluated in the context of the three generations of financial crises. All of the information that was consistent with the models of financial crises were identified as indicators that warn against potential financial crises.

Balance Sheet Analysis

Roubini and Setser (2004) develop an effective method of evaluating emerging markets' risk of experiencing a debt crisis through analyzing the countries' financial balance sheets. Traditional economic analyses observe variables such as the current account and fiscal deficit. Balance sheet analyses look into the mismatches between a country's debts and assets. This analysis identifies why two countries with equivalent debt-to-GDP ratios do not necessarily run the same risk of having a financial crisis. Varying debt structures play a large role in determining a country's vulnerability. The three main balance sheet factors that evaluate a country's risk on debt are maturity mismatches, currency mismatches, and capital structure mismatches.

Maturity mismatches between short-term debt and liquid assets accentuate the vulnerability of a country's balance sheet. There are a number of risks a country runs when it

has a high level of short-term debt. When a country's debt has a short maturity, it constantly needs to refinance existing debt. During financial distress, these countries are forced to quickly increase interest rates on debt. Additionally, investors can quickly make a run if they begin to lose confidence in the market. In a country where there is a high level of short-term debt, there needs to be a large amount of liquid assets available to finance the debt. If short-term debt is larger than the level of liquid assets, the liable government, bank, or firm is vulnerable of being unable to pay its debt during a run and it will be forced to restructure its capital or default. Many emerging market countries issue short-term debt because investors do not have long-term confidence in their economy (Roubini and Setser 2004).

A currency mismatch is when a country issues debt in a currency that they do not own assets or earn revenue in. The most common form of currency mismatch is when a government borrows in foreign currencies while earning revenue in its domestic currency. This situation restrains countries that depend on currency depreciation to stimulate their economy. Typically, currency depreciation stabilizes the current account by boosting a country's exports and decreasing its imports; but when debt is issued in a foreign currency, depreciation increases the cost of liabilities. Accordingly, countries that have a currency mismatch cannot use deprecation as an expansionary policy because the positive effects are countered by an increase in the cost of debt. Emerging markets often take on debt in foreign currencies because investors do not trust the stability of local money (Roubini and Setser 2004).

The way a country structures its capital can increase or decrease its level of downside risk. In raising capital, a government, bank, or firm can issue debt or equity. If the government issues debt, it assumes all of the downside risk because debt payments are fixed.

On the contrary, dividends on equity can be reduced during economic recessions. Equity essentially acts as a buffer against economic shocks, while debt is unable to curb the effects of a negative shock. Countries run the largest risk when their capital structure relies on debt rather than foreign direct investment to finance their current account deficit (Roubini and Setser 2004).

Early Warning System

In Kaminsky, Lizondo, and Reinhart (1998), the International Monetary Fund created an Early Warning System (EWS) to serve as an indicator that a currency crisis might take place within the next 24 months. A currency crisis is defined as a situation where an attack on a currency leads to a sharp depreciation of the currency.[2] The model includes a set of variables which indicate a currency crisis is likely to occur when its value surpasses a threshold number. The threshold values were determined by finding a balance between sending an excess of false alarms and missing the crisis altogether. The authors found that the best performing variables for signaling a currency crisis include: real exchange rate, banking crises, exports, stock prices, M2/international reserves, output, international reserves, M2 multiplier, domestic credit/GDP, real interest rate, terms of trade, real interest differential, imports, bank deposits, and lending/deposit rate. The authors highlight the link that Krugman drew between a currency crisis and the deterioration of the trade balance which often leads to a balance of payments crisis. Since there is such a strong connection between currency crises and debt crises, many of IMF's EWS variables will be taken into account in developing a model for predicting financial debt crises.

[2] Definition comes from Kaminsky, Lizondo, and Reinhart (1998)

III. Empirical Analyses

Binary Econometric Analyses

Qualitative measurements, such as the balance sheet analysis, can be useful in getting a general picture as to where a country stands with respect to a possible financial crisis. Quantitative econometric analyses can be helpful in specifically determining a country's status towards a financial crisis. The focus of this study is to evaluate the probability of having a financial debt crisis given the economic conditions of the previous year. Using an econometric analysis, this probability can be determined based on the economic data from previous crises. Once a function is obtained, variables from countries in 2006 can be used to determine their current vulnerability to experiencing a financial crisis. The model resulting from the econometric analysis will serve as a key component for the rest of this study.

There are various econometric analyses that have been used to evaluate a country's probability of going into a financial crisis. The most relevant assessments are binary dependant variable regressions. This type of regression has a dependent variable (Y) that can only take on one of two possible values: zero or one. Since the regression in this analysis assesses the probability of a financial crisis occurring the following year, the binary dependent variable can only take on a value of "no crisis next year" (0) or "crisis next year" (1).

One type of binary regression that has been used to predict financial crises is the Binary Recursive Tree. Paolo Manasse, Nouriel Roubini, and Axel Schimmelpfennig (2000) used this type of analysis in their paper *Predicting Sovereign Debt Crises*. This method employs a sequence of rules that predict a binary outcome of crisis or non-crisis. The binary tree analysis uses a stepwise process that has a number of interrelated rules which classify

each country by the values of its economic variables. Each classification directly corresponds to the probability that a country faces of experiencing a financial crisis. While the authors accurately predicted 89% of crises using this method, 19% of the cases incorrectly predicted there would be a crisis when one did not occur. Despite its high rate of success, the binary tree model was limited to 9 variables and each of the stepwise rules was set at arbitrary thresholds. For these reasons, this type of analysis is not the most efficient method.

Another binary analysis that could be used is the linear probability model. This analysis uses a linear regression where the dependant variable only takes on binary values. The linear probability model is a good initial indicator of which variables have the most weight in determining the probability of a binary outcome. Despite the usefulness of this evaluation, it encounters a number of flaws: the linear distribution of the function does not correspond to the outcomes of the financial model which is being evaluating and the function allows for the dependant variable to take on values greater than one and less than zero.

Logistic Analysis

The most efficient binary regression for this analysis is a logistic regression. A logistic regression is a nonlinear regression model for a binary dependent variable in which the population regression function is modeled using the cumulative logistic distribution function.[3] This type of regression best fits this analysis because the distribution of the function accurately matches the financial model which is being evaluating and the dependent variable will always take a value between zero and one. While a probit regression is very similar to a logistic regression, the probit model does not accurately fit the data because it uses a cumulative normal distribution and financial crises are not normally distributed. Manasse, Roubini, and Schimmelpfennig (2000) use a logistic regression in their paper to

[3] Definition comes from Stock and Watson (2003)

predict if the countries in their sample would enter a financial debt crisis the following year. In their study, the logistic function accurately predicted 74% of the crises-entry situations and only incorrectly predicted there would be a crisis when one did not occur in 6% of the cases. This type of function is advantageous because it allows an unlimited number of independent variables to be used. For these reasons, a logistic regression will be run in this study using multiple economic variables to predict whether a country will experience a crisis the following year.

A logistic regression takes the form:

$$\Pr(Y=1 \mid X_1, X_2, \ldots, X_k) = F(\beta_0 + \beta_1 X_1 + \beta_2 X_2 + \ldots + \beta_k X_k)$$

$$= \frac{1}{1 + e^{-(\beta_0 + \beta_1 X_1 + \beta_2 X_2 + \ldots + \beta_k X_k)}}$$

Where F is the logistic distribution function, Y is the dependent binary variable, X's are the independent variables, and β's are the logistic regressors.

In running a logistic regression, the most efficient values of the regressors β_0 through β_k will be identified. Each of these values will indicate how strong of an effect the independent variables have on the probability of a financial debt crisis. The independent variables X_1 through X_k will represent economic variables. The economic variables will fall under one of the following categories: external debt variables, public debt variables, IMF's EWS variables, macroeconomic variables, and fiscal variables. A measure of fit, called the pseudo R^2, will be used to indicate how well the model predicts the sample values. Additionally, the significance of each of the logistic regressors will be evaluated by its P-value.

IV. Data

The data used to develop the logistic model for predicting financial debt crises comes from a vast number of economic variables in a large sample of countries. The major source of data comes from Moody's Statistical Handbook on Country Credit which was published in May 2007. Moody's is an international credit rating agency that uses a wide variety of economic data to evaluate the credit worthiness of different countries' national debt. Moody's Statistical Handbook is a reliable data source that is cited in both *Predicting Sovereign Debt Crises* and *A Balance Sheet Crisis in India?* The data from Moody's Statistical Handbook is drawn from a number of international sources including the International Monetary Fund (IMF), the Organization for Economic Cooperation and Development (OECD), Eurostat, the World Bank, and the Bank for International Settlements (BIS).

The sample data used in the economic analysis includes both countries that have and have not experienced financial crises. Data from non-crisis countries were included as control variables so the final regression is not biased by an overrepresentation of crisis situations. Similar to the study done by Manasse, Roubini, and Schimmelpfennig (2000), the dataset includes 43 emerging market countries. These countries were chosen because they represent economies that are at a similar level of development as the East Asian and South American countries that experienced crises in the late 1990's and early 2000's. A list of the countries and their crisis years is included in Table A.

Given the nature of the study, it is important that the data used in the analysis is comprehensive, internally consistent, and relevant to the situations being evaluated. Moody's Statistical Handbook includes 40 different variables from all 43 countries over the years 1997

Table A
Country List*

Country	Number of Crises	Years in Crisis	Crisis Episodes
Algeria	1	1	1997
Argentina	1	6	2001-
Bolivia	0	…	
Brazil	2	9	1998-00, 2001-
Chile	0	…	
China	0	…	
Colombia	0	…	
Costa Rica	0	…	
Czech Republic	0	…	
Dominican Republic	1	10	1997-
Ecuador	1	3	1999-2001
El Salvador	1	1	1997
Estonia	0	…	
Guatemala	0	…	
Hungary	0	…	
India	0	…	
Indonesia	2	10	1997-2001, 2002-
Israel	0	…	
Jamaica	0	…	
Kazakhstan	0	…	
Korea	1	3	1997-99
Latvia	0	…	
Lithuania	0	…	
Malaysia	0	…	
Mexico	0	…	
Morocco	0	…	
Oman	0	…	
Pakistan	1	3	1998-2000
Panama	1	1	1997
Peru	1	2	1997-1998
Philippines	0	…	
Poland	0	…	
Romania	0	…	
Russia	1	4	1998-2001
Slovak Republic	0	…	
South Africa	0	…	
Thailand	1	2	1997-1998
Trinidad and Tobago	0	…	
Tunisia	0	…	
Turkey	1	3	2000-2002
Ukraine	1	4	1998-2001
Uruguay	1	1	2001
Venezuela	1	2	1997-1998

*Source: Manasse and Roubini (2005) – IMF; Standard & Poor's; World Bank

to 2006. The dataset includes estimated values for each of the variables in the years 2007 and 2008 which can be used to forecast the economic status of countries during subsequent years. The 10 years of information included in the dataset should serve as a comprehensive sample that is representative of the crisis situations that occurred during the late 1990's and early 2000's. The crisis information from this period should be a good basis of comparison for the years following 2006. As mentioned earlier in the paper, there have been three different generations of financial crises. Each type of crisis was very different in nature and the factors that led to their arrival differed in each generation. The most recent generation of crises (Third Generation) primarily occurred during the years 1997-2002. All of the Third Generation crises, except the Mexican Peso Crisis of 1994, are included in this dataset. If this study included crises from earlier generations, the resulting function might factor in less relevant crisis situations leading to less accurate results.

Each country in the dataset was separated by country and year and each of the country-year combination has values for each particular variable. For example, Argentina in 2000 has external debt of $155 billion USD and a domestic credit/GDP ratio of 33.7. Once all of the data was collected, the variables were ordered chronologically by country. Then each of the variables was classified as being in a crisis or not being in a crisis. The country-year combinations that were in a crisis were given a value of "one" for the "crisis variable" and a value of "zero" if it was not in a crisis. Since Argentina was not in a crisis in 2000, it took on a value of zero for the crisis variable. After determining which country-year combinations experienced crises, another variable was created that lagged the crisis by one period (one year). Countries that experienced a crisis the following year were given a value of one for the "year before a crisis" variable and a value of zero if it did not experience a

crisis during the following year. The final logistic equations were derived using the lagged variables because the function determines the probability of a crisis during the following year. If the crisis variable weren't lagged, the regression would only identify if a country were currently in a crisis. Since Argentina experienced a crisis in 2001, the year before a crisis variable for Argentina in 2000 took on a value of one. In economic terms, independent variables from year *t – 1* were used to "predict" a crisis in year *t*. The dependent variable Y, the crisis variable, was regressed on the independent variables X_i's from the year *t – 1*.

$$Y_t = \frac{1}{1 + e^{-(\beta_0 + \beta_1 X_{1(t-1)} + \beta_2 X_{2(t-1)} + \ldots + \beta_k X_{k(t-1)})}}$$

Since there was such a large set of variables, they were divided into five categories to make it easier to analyze which types of variables were most important in predicting a financial crisis. These classifications were also used later in the analysis in one of the methodologies for arriving at the final logistic equation. This process will be described in greater detail later in the paper. Using the guidance of Manasse, Roubini, and Schimmelpfennig, the five different variables categories include: external debt variables, public debt variables, variables from IMF's EWS, other macroeconomic variables, and fiscal variables. Each of the groups were composed as follows:

External Debt Variables – external debt in US billion dollars, short-term external debt to total external debt, external debt to GDP, external debt to current account receipts, interest paid on debt in US billion dollars, amortization paid on debt in US billion dollars, total external debt to official foreign reserves, debt servicing ratio, external vulnerability indicator, liquidity ratio

Public Debt Variables – general government debt in US billion dollars, general government debt to GDP, general government debt to general government revenue, general government interest payments to general government revenue, general government foreign currency debt to general government debt, domestic credit annual percent change, domestic credit to GDP

IMF's EWS Variables – current account balance in US billion dollars, current account balance to GDP, M2 to foreign exchange reserves, official foreign exchange reserves,

Macroeconomic Variables – nominal GDP in US billion dollars, GDP per capita in US billion dollars, nominal GDP annual percent change, real GDP annual percent change, inflation annual percent change, gross investment to GDP, gross domestic savings to GDP, nominal exports of goods and services annual percent change based on US dollars, nominal imports of goods and services annual percent change based on US dollars, openness, net foreign assets of domestic banks in US billion dollars, M2 annual percent change, short-term nominal interest rate in percent per annum, net foreign direct investment to GDP, total liabilities of BIS banks to total assets of BIS banks

Fiscal Variables – general government revenue to GDP, general government expenditure to GDP, general government financial balance to GDP, general government primary balance to GDP

The five categories were developed to identify which types of variables are most prominently represented in the final logistic equation. These classifications are useful in determining the areas where reform would be the most effective. To put the variables into perspective, Table B shows the average value for each of the variables in years where there is a crisis, years where there is a crisis the next year, years where there is no crisis, and years where there is no crisis the next year.

For the purpose of comparison, nominal variables have been converted into US dollars using the exchange rates from the year when Moody's Statistical Handbook was published. Since exchange rates change from year to year between the dollar, domestic currencies, and the currencies of the trading partners of the 43 countries, the values of these variables are highly dependent on the timing of the conversion. The variability of these conversions should be taken into account when interpreting the results.

Even though the dataset is highly comprehensive, there are a number of missing variables that could have an effect on the final equation. For some of the years, the values of the independent variables were missing from the dataset. The country-year combinations that

Table B
Variable Averages*

Crisis Situation	Total Average	Crisis Year	Crisis Next Year	Non-crisis	No Crisis Next Year
External Debt (US$ Bil.)	54.68	99.01	106.04	46.79	46.36
Short-term External Debt/Total External Debt	19.15	17.16	17.16	19.50	19.47
External Debt/GDP	47.43	56.68	55.65	45.78	46.09
External Debt/CA Receipts	126.04	186.45	196.32	115.29	114.65
Interest Paid on External Debt (US$ Bil.)	2.91	5.48	5.90	2.46	2.43
Amortization Paid on External Debt (US$ Bil.)	6.61	13.52	14.22	5.38	5.38
Total External Debt/Official Forex Reserves	463.50	868.60	920.16	391.36	389.44
Debt Service Ratio	21.38	35.21	37.61	18.91	18.74
External Vulnerability Indicator	148.57	251.94	266.13	130.11	129.45
Liquidity Ratio	68.69	79.82	84.70	66.71	66.10
Gen. Gov. Debt (US$ Bil.)	67.58	123.75	137.51	57.68	56.37
Gen. Gov. Debt/GDP	44.29	55.14	55.57	42.38	42.48
Gen. Gov. Debt/Gen. Gov. Revenue	192.50	269.73	273.24	179.06	179.99
Gen. Gov. Int. Pymt/Gen. Gov. Revenue	14.07	18.38	18.89	13.33	13.35
Gen. Gov. FC & FC-indexed Debt/GG Debt	53.87	65.00	65.04	51.88	52.10
Domestic Credit (% change Dec/Dec)	17.01	22.54	23.90	16.03	15.90
Domestic Credit/GDP	52.60	50.30	48.19	53.01	53.32
Current Account Balance (US$ Bil.)	2.24	2.55	0.85	2.18	2.46
Current Account Balance/GDP	-0.75	1.36	0.76	-1.13	-1.00
M2/Official Forex Reserves (X)	4.23	6.08	6.40	3.90	3.88
Official Forex Reserves (US$ Bil.)	28.15	18.77	18.96	29.82	29.64
Nominal GDP (US$ Bil.)	165.80	205.34	229.68	158.76	155.44
GDP per capita (US$)	4194.27	2716.43	2769.45	4457.45	4425.32
Nominal GDP (% change, local currency)	13.56	17.60	17.58	12.84	12.91
Real GDP (% change)	4.31	2.90	2.49	4.57	4.61
Inflation (CPI, % change Dec/Dec)	8.51	16.84	18.60	7.03	6.87
Gross Investment/GDP	22.29	20.53	20.15	22.60	22.63
Gross Domestic Saving/GDP	22.04	22.37	21.58	21.98	22.12
Nominal Exports of G & S (% change, US$ basis)	11.43	5.74	5.95	12.41	12.31
Nominal Imports of G & S (% change, US$ basis)	10.67	3.39	2.42	11.93	11.99
Openness of the Economy	79.10	61.56	59.49	82.22	82.28
Net Foreign Assets of Domestic Banks (US$ Bil.)	-2.00	-4.30	-5.52	-1.58	-1.41
M2 (% change Dec/Dec)	17.76	22.28	23.20	16.96	16.88
Short-term Nominal Interest Rate (% per annum, Dec 31)	10.43	17.45	19.39	9.18	8.98
Net Foreign Direct Investment/GDP	3.28	2.28	2.02	3.46	3.49
Total Liab. due BIS Banks/Total Assets Held in BIS Banks	138.54	173.69	181.34	132.28	131.60
Gen. Gov. Revenue/GDP	26.17	22.46	22.75	26.82	26.69
Gen. Gov. Expenditures/GDP	28.47	24.81	25.50	29.12	28.93
Gen. Gov. Financial Balance/GDP	-2.30	-2.28	-2.66	-2.31	-2.25
Gen. Gov. Primary Balance/GDP	1.13	1.83	1.56	1.01	1.06

*Source: Moody's Statistical Handbook, Country Credit, May 2007

had missing data were omitted from the analysis. This procedure has led to omitted variable bias. In logistic functions, the omission of variables can depress the remaining regressors towards zero. The final logistic equations that are developed in this paper include some level of omitted variable bias and this should be taken into account when interpreting the results.

V. Methodology

The logistic model was developed using a variety of economic factors to predict the probability of a country facing a financial crisis during the following year. The dataset used to derive the logistic equation includes 40 economic variables that could potentially indicate a financial crisis. In order to achieve the most efficient logistic equation, six different models were derived using three methodologies and two sets of data. The six logistic equations include the most significant and highest predictive variables. Significance was determined by the P-value of the individual regressors. For the purpose of this study, 90% significance was used as a benchmark for indicating a sufficient level of significance. Predictability was determined by the value of the pseudo R^2. Pseudo R^2 is a measurement of best fit used in logistic and probit functions. The pseudo R^2 takes on a value between zero and one; the closer the value is to one, the stronger the fit.

Before running multi-variable logistic regressions, individual logistic regressions were run between of each of the independent variables and the "year before a crisis" variable. By running logistic regressions for each of the 40 variables, the most significant variables were identified in equations where all of the other variables were kept constant. In the single-variable regressions, the most significant variables tended to be the most highly predictive when they were measured individually against the "year before a crisis" variable. Once these regressions were completed, the signs (positive or negative) of the regressors were observed

to determine whether the relationships made economic sense. Since the variables were being regressed individually, there should be economic explanations for all of the results because there is no covariance to bias the results.

The initial method for deriving the logistic equation was executed using the following procedure. Using the results of the single-variable logistic equations, a list was compiled of all of the variables which were significant at the 90% level. All of the significant variables were combined into one large multi-variable logistic equation. The resulting equation had a pseudo R^2 of .637 and 14 of the 31 variables were significant at the 90% level.[4] While the pseudo R^2 had a high value, this equation cannot accurately be used and interpreted because it has so many insignificant variables. In order to improve the efficiency of the equation, a strategy was developed to find an equation where all of the remaining variables were significant. Using the results of the initial multi-variable equation, a second regression was run where the least significant variable from the previous equation was eliminated. This procedure was repeated again using the results of the second equation. This methodology was continued until all of the remaining variables were statistically significant at the 90% level. The strategy of eliminating the least significant variables will be referred to as the "step-wise procedure." The resulting equation has 16 different variables and a pseudo R^2 of .611. The equation can be found under Method 1 in Table C.

The second method used to derive the logistic equation involved breaking down the variables into the five different data categories (external debt variables, public debt variables, variables from IMF's EWS, other macroeconomic variables, and fiscal variables). After each of the variables was separated into its respective category, a series of multi-variable regressions were run where each of the regressions included only variables from the specific

[4] The results of this equation can be found in Appendix 1

category. Using the step-wise procedure of eliminating the least significant variables, five different equations were derived with the most significant variables from each of the categories. In the next step, the remaining variables from the five categories were combined into a comprehensive multi-variable regression. The resulting equation had a pseudo R^2 of .569 where 13 of the 24 variables were significant.[5] Once again, the step-wise procedure of removing the least significant variables was utilized until an equation was derived where all of the variables were significant. The resulting equation includes 14 variables and has a pseudo R^2 of .529. The equation can be found in Table C under Method 2. This method was employed as a way to find the most predictive variables from each category. The variables within each of the five categories are likely to have covariance because they measure similar information. If two variables in the same category have high covariance, the degree and magnitude of their regressors can be largely affected. This can lead to complications in explaining the individual effects that each variable plays in the equation. The strategy employed in Method 2 was used as a means of minimizing covariance by identifying the strongest variables from each of the categories.

The third and final method for deriving the logistic equation began by using all of the available data. The first logistic regression was run with all 40 variables in the dataset. The resulting equation had a pseudo R^2 of .771 where 13 of the 40 variables were significant.[6] Once this equation was obtained, the step-wise procedure of eliminating the least significant variables was used until a final equation was derived where all of the variables were significant. The final equation obtained in this regression has 22 variables and a pseudo R^2 of

[5] The results of this equation can be found in Appendix 2
[6] The results of this equation can be found in Appendix 3

.726, which is substantially higher than the ones obtained in the previous two strategies. The resulting equation can be observed in Table C under Method 3.

Before making any conclusions about the results of the three logistic equations, the variables being used in the models need to be further analyzed. Eight of the 40 different variables are in absolute terms, where they are typically are measured in US billion dollars. These variables do not adjust for the relative sizes of the economies. Accordingly, three more logistic functions were derived using a dataset that only included the 32 variables that adjust for the size of the economies.[7] Methods 1, 2, and 3 were used to derive these equations. The final logistic equation developed from Method 1 has 14 variables and a pseudo R^2 of .455. The equation derived from Method 2 has 14 variables and a pseudo R^2 of .423. The final equation developed by Method 3 has 24 variables and a pseudo R^2 of .635. The results of all three of these equations are in Table D.

VI. Results

After observing the results from the six different logistic equations, it is clear that Method 3 consistently has the strongest fit. Method 3 produced the highest pseudo R^2 for both the full and reduced sets of variables. Additionally, the Method 3 equations resulted in the two highest overall pseudo R^2 values. Before making a final decision on how well these two equations can predict future crises, they must be tested to determine how well the functions work in practice. The best way to test the strength of the equations is to test how well they predict financial crises within the sample dataset. Certain parameters need to be defined before the equations can be tested. Logistic functions produce a value between zero and one. The dependent variable can be interpreted as the probability that a binary event will

[7] The results of these equations can be found in Appendix 4, 5, and 6 respectively.

Table C

Regression Results - Full Set of Variables						
	Method 1	Pseudo R^2 = 0.611	**Method 2**	Pseudo R^2 = 0.529	**Method 3**	Pseudo R^2 = 0.726
	Logit Coef.	P-value	Logit Coef.	P-value	Logit Coef.	P-value
External Debt (US$ Bil.)	0.035	0.001	0.027	0.001	0.134	0.000
External Debt/GDP					-0.112	0.006
External Debt/CA Receipts					0.018	0.045
Interest Paid on External Debt (US$ Bil.)					-0.749	0.012
Amortization Paid on External Debt (US$ Bil.)	0.162	0.005			0.268	0.011
Total External Debt/Official Forex Reserves			0.002	0.000		
Gen. Gov. Debt (US$ Bil.)	0.020	0.004	0.018	0.000	0.038	0.016
Gen. Gov. Int. Pymt/Gen. Gov. Revenue	-0.141	0.000			-0.398	0.000
Gen. Gov. FC & FC-indexed Debt/GG Debt	0.067	0.000	0.040	0.004		
Domestic Credit (% change Dec/Dec)					0.042	0.019
Domestic Credit/GDP					-0.054	0.005
Current Account Balance (US$ Bil.)					0.157	0.020
Current Account Balance/GDP			0.142	0.004		
M2/Official Forex Reserves	0.368	0.000			0.355	0.005
Official Forex Reserves (US$ Bil.)					-0.307	0.002
Nominal GDP (US$ Bil.)	-0.017	0.010	-0.011	0.013	-0.024	0.040
GDP per capita (US$)	0.000	0.008				
Nominal GDP (% change, local currency)	-0.072	0.004	-0.060	0.030	-0.138	0.000
Real GDP (% change)	0.284	0.010	0.245	0.024	0.257	0.051
Inflation (CPI, % change Dec/Dec)	0.066	0.002			0.142	0.000
Nominal Imports of G & S (% change, US$ basis)	-0.083	0.009	-0.045	0.066	-0.100	0.006
Openness of the Economy	0.021	0.056			0.081	0.000
Short-term Nominal Interest Rate (% per annum, Dec 31)	0.105	0.001	0.148	0.000		
Net Foreign Direct Investment/GDP	-0.498	0.001			-0.340	0.043
Total Liab. due BIS Banks/Total Assets Held in BIS Banks			0.006	0.056		
Gen. Gov. Revenue/GDP	-0.076	0.072	0.302	0.011	-1.761	0.000
Gen. Gov. Expenditures/GDP			-0.361	0.001	1.350	0.001
Gen. Gov. Primary Balance/GDP			-0.238	0.045	1.238	0.002
Constant	-6.593	0.002	-6.797	0.000	4.338	0.024

Table D

Regression Results - Relative Variables Only						
	Method 1	Pseudo R^2 = 0.455	**Method 2**	Pseudo R^2 = 0.423	**Method 3**	Pseudo R^2 = 0.635
	Logit Coef.	P-value	Logit Coef.	P-value	Logit Coef.	P-value
Short-term External Debt/Total External Debt					0.114	0.010
External Debt/GDP			-0.052	0.001	-0.171	0.000
Total External Debt/Official Forex Reserves			0.001	0.004	0.004	0.003
Debt Service Ratio	0.045	0.000	0.043	0.000	0.099	0.000
External Vulnerability Indicator					-0.007	0.021
Liquidity Ratio					-0.030	0.028
Gen. Gov. Debt/GDP	0.083	0.008			0.131	0.000
Gen. Gov. Debt/Gen. Gov. Revenue	-0.011	0.068	0.004	0.041		
Gen. Gov. Int. Pymt/Gen. Gov. Revenue	-0.080	0.011			-0.401	0.000
Gen. Gov. FC & FC-indexed Debt/GG Debt	0.024	0.012	0.024	0.022	0.067	0.002
Domestic Credit/GDP					-0.041	0.012
Current Account Balance/GDP	0.091	0.038	0.162	0.000		
M2/Official Forex Reserves	0.226	0.000				
GDP per capita (US$)	0.000	0.035	0.000	0.014	0.000	0.029
Nominal GDP (% change, local currency)			-0.048	0.034	-0.091	0.004
Real GDP (% change)	0.160	0.055	0.175	0.035	0.219	0.057
Inflation (CPI, % change Dec/Dec)					0.047	0.056
Gross Investment/GDP					-0.157	0.075
Gross Domestic Saving/GDP					0.194	0.003
Nominal Imports of G & S (% change, US$ basis)	-0.044	0.049	-0.034	0.099	-0.062	0.051
Openness of the Economy					0.028	0.020
M2 (% change Dec/Dec)						
Short-term Nominal Interest Rate (% per annum, Dec 31)	0.092	0.000	0.111	0.000	0.165	0.000
Net Foreign Direct Investment/GDP	-0.349	0.002			-0.369	0.030
Total Liab. due BIS Banks/Total Assets Held in BIS Banks	0.010	0.000	0.013	0.000	0.037	0.000
Gen. Gov. Revenue/GDP			0.195	0.010	-1.292	0.001
Gen. Gov. Expenditures/GDP	-0.127	0.022	-0.177	0.016	1.017	0.003
Gen. Gov. Primary Balance/GDP					1.267	0.000
Constant	-3.566	0.032	-5.728	0.000	-4.321	0.161

occur; in this case, the binary event is a crisis the next year or no crisis the next year. Since the resulting value will not equal exactly zero or one, it is necessary to define a threshold value that determines when a future crisis is being predicted and when a future crisis is not being predicted. While it seems logical to choose 50% as the threshold, this is not always the most predictive value. In the paper *Predicting Sovereign Debt Crises*, the authors use 20.5% as the threshold because 20.5% of the cases were crisis situations. The authors address the fact that this value does not have a strong justification and can be seen as arbitrary. The objective of the study conducted in this paper is to obtain the most robust and predictive model. Accordingly, tests were performed to obtain the most accurately predictive threshold value.

The most effective way to evaluate the predictive power of the resulting equations is to run data on each of these regressions and analyze the results. The data points associated with a country and year that accurately predicted a crisis will be referred to as a "hit." The data points where a crisis should be predicted but it isn't will be referred to as a "miss." Lastly, the data points where no crisis occurs, but the model predicts that one will occur will be referred to as a "false alarm." The threshold value used in this model will be determined by the value that produces the most hits with the least amount of misses and false alarms. The following tables break down the hits, misses, and false alarms for all thresholds between 30% and 70% at 5% intervals. The results are shown in absolute values on the left side of Table E and the results are shown in percent values on the right side of Table E. Hit and miss percentages are taken out of the total number of years before a crisis and false alarms are taken out of the total number of years not before a crisis.

Table E

Method 3 Full Set of Variables

Threshold	Hits	Misses	False Alarms
30%	47	9	10
35%	47	9	8
40%	46	10	4
45%	46	10	3
50%	45	11	3
55%	44	12	2
60%	43	13	2
65%	43	13	1
70%	41	15	0

421 Total Observations
Note: 9 missing data points, 4 of which are pre-crisis

Threshold	Hits	Misses	False Alarms
30%	83.9%	16.1%	2.7%
35%	83.9%	16.1%	2.2%
40%	82.1%	17.9%	1.1%
45%	82.1%	17.9%	0.8%
50%	80.4%	19.6%	0.8%
55%	78.6%	21.4%	0.5%
60%	76.8%	23.2%	0.5%
65%	76.8%	23.2%	0.3%
70%	73.2%	26.8%	0.0%

421 Total Observations
Note: 9 missing data points, 4 of which are pre-crisis

Method 3 Reduced Set of Variables

Threshold	Hits	Misses	False Alarms
30%	45	9	15
35%	45	9	14
40%	44	10	11
45%	43	11	9
50%	41	13	5
55%	39	15	3
60%	36	18	2
65%	36	18	1
70%	35	19	0

402 Total Observations
Note: 28 missing data points, 6 of which are pre-crisis

Threshold	Hits	Misses	False Alarms
30%	83.3%	16.7%	4.4%
35%	83.3%	16.7%	4.1%
40%	81.5%	18.5%	3.2%
45%	79.6%	20.4%	2.6%
50%	75.9%	24.1%	1.4%
55%	72.2%	27.8%	0.8%
60%	66.7%	33.3%	0.5%
65%	66.7%	33.3%	0.3%
70%	64.8%	35.2%	0.0%

402 Total Observations
Note: 28 missing data points, 6 of which are pre-crisis

While different thresholds result in varying qualities of results, both models seem to hold up strongly for the entire range. At lower thresholds, there are a larger percentage of hits accompanied by a larger percentage of false alarms. Higher thresholds result in a lower percentage of hits but have a lower percentage of false alarms. After observing the trade-offs

in both models, it appears that 50% serves as a sufficient threshold value that produces strong results.

The logistic equation derived from Method 3 that includes the full set of variables has 45 hits, 11 misses, and 3 false alarms using a 50% threshold. Due to missing data, there are 9 data points excluded from the evaluation, 4 of which are pre-crisis years. These results indicate that 80.4% of the "year before a crisis" data points are accurately predicted while sending only 0.8% false alarms. To put these results into perspective, the logistic model developed in Manasse, Roubini, and Schimmelpfennig (2000) accurately predicted 74% of crisis entries while sending 6% false alarms. Note that the logistic function developed in that article was more specific since it only predicted whether the following year was a crisis entry year (the first year of a crisis) as opposed to this model which predicts if a country will be in a crisis the next year, even if it is currently in a crisis. Still, the results of the logistic function in Manasse, Roubini, and Schimmelpfennig (2000) are supportive evidence of the strength of the model in this paper.

The logistic equation derived from Method 3 that includes the reduced set of variables has 41 hits, 13 misses, and 5 false alarms using a 50% threshold. Due to missing data, there are 28 data points excluded from the evaluation, 6 of which are pre-crisis years. These results indicate that 75.9% of the available year before a crisis data points are accurately predicted while sending only 1.4% false alarms. Even though these results are not as strong as the ones developed in the model that includes the full set of variables, the equation might be a more valid indicator since it accounts for the relative size of the economies. The results must be taken with caution because there is a larger amount of omitted variable bias than in the previous equation.

Breaking Down the Models

Now that two different models have been developed, the variables and regressors can be broken down to interpret how each of the variables relates to a future financial debt crisis. This section of the paper will examine the signs (positive or negative) of the regressors in the two logistic equations to make conclusions about the effects of all the variables. The method using the full set of variables will be examined first. This model has five external debt variables, four public debt variables, three variables from IMF's EWS, seven macroeconomic variables, and three fiscal variables.

The five external debt variables that are present in the logistic regression are external debt ($US billion), external debt/GDP, external debt/current account receipts, interest paid on external debt ($US billion), and amortization paid on external debt ($US billion). The logistic coefficients indicate that the risk of a crisis increases as the following variables increase: external debt ($US billion), external debt/current account receipts, and amortization paid on external debt ($US billion). The effects of these variables align with economic expectations because increasing levels of debt and amortization add to the liabilities of a country and intensify their risk of a financial debt crisis. The equation also indicates that the risk of a crisis decreases as external debt/GDP and interest paid on external debt ($US billion) increase. Unlike the previous three variables, the relationships of these two variables conflict with economic reasoning. Additionally, the regressors of these variables have a different relationship from when they were measured individually against the year before a crisis variable. In many studies, these variables would immediately be thrown out. Yet, when these variables are omitted from the regression equation, the pseudo R^2 drops to a much lower level and many of the remaining regressors are no longer significant. Further tests were taken

to understand the reasons why the regressors take incorrect signs. Both of these variables have high correlations and covariance with other variables in the equation. The intricate relationships that the two variables have with the other independent variables seem to have reversed how they interact with the dependent variable. While the details of the reversing relationship remains unexplained, it is evident that the variables still have a significant impact on the efficiency of the equation. For this reason, the variables will remain in the final model. This situation arises a number of times in the two logistic models. The variables where this reversal occurs will be noted throughout this section of the paper.

The four public debt variables that are in the logistic equation with the full set of variables are general government debt ($US billion), general government interest payments/general government revenues, domestic credit (annual percent change), and domestic credit to GDP. General government debt ($US billion) and domestic credit (annual percent change) have positive relationships with the likelihood of a future financial debt crisis while the remaining two variables have negative relationships. The only variable that takes on a relationship different from its single variable equation is the general government interest payments/general government revenues variable. The three variables from IMF's EWS in the equation are current account balance ($US billion), M2/foreign exchange reserves, and official foreign exchange reserves ($US billion). As the current account balance ($US billion) and M2/foreign exchange reserves increase, so does the probability of a crisis the following year. Foreign reserves serve as a buffer against a currency devaluation because central banks can decrease money supply by exchanging foreign currency for domestic money. Countries with high foreign reserves face the least risk to a financial debt crisis.

The macroeconomic variables included in the logistic equation are nominal GDP ($US billion), nominal GDP change (annual percent change in local currency), real GDP change, inflation (CPI annual percent change), nominal imports of goods and services (annual percent change in $US), openness of the economy, and net foreign direct investment/GDP. As nominal GDP increases, the likelihood of a future crisis decreases. This relationship occurs because an increase in the level of output is good for the economy and the country will be able to pay off its debts. Inflation increases the chances that a country will face a debt crisis because it weakens the value of local currency and increases the value of debt denominated in foreign currencies. The greater the change in nominal imports, the stronger the economy is against a crisis. There are a number of competing forces in this relationship, but it is consistent with the single variable regression. One possible explanation is that increased imports lower costs for emerging markets and allow them to specialize. High levels of foreign direct investment/GDP decrease a country's risk against a debt crisis. FDI is a great way for emerging markets to increase investments without taking on high levels of debt. Foreign equity investments help a country avoid capital mismatches similar to the ones that occurred during the East Asian crises. The regressors of the openness variable and real GDP percent change are inconsistent with the single logistic regressions. This relationship might have changed because the variables have a high covariance with FDI, imports, and nominal GDP.

The public debt variables in the logistic equation are general government revenue/GDP, general government expenditure/GDP, and general government primary balance/GDP. Increasing government revenue/GDP reduces a country's risk to a debt crisis and increasing government expenditures/GDP magnifies a country's risk. Maintaining a

fiscal balance is a major responsibility of emerging markets that is often neglected. Countries that have high levels of government spending and low levels of government revenue are vulnerable to being unable to pay their debts. Government primary balance has a positive relationship with the likelihood of a crisis.

The logistic model with the reduced set of variables has six external debt variables, four public debt variables, no variables from IMF's EWS, eleven macroeconomic variables, and three fiscal variables. From the combined results of the two equations, it appears that external debt variables and macroeconomic variables have the strongest impact on predicting financial debt crises. The implications of these findings will be discussed in the section on policy reform. The regressors in the equation with the reduced set of variables have similar signs and magnitudes as the ones in the other equation. While these results are not discussed directly, the key variables will be addressed in the following section.

VII. Policy Reform

The logistic model can be used as more than a resource that evaluates a country's probability of experiencing a financial debt crisis. By breaking down the logistic function and determining the magnitude and directional effects of the individual regressors, the most important variables can be identified. Once these variables are identified, policy reform can be recommended to all countries that are in danger of a debt crisis.

A test was run on each of the variables' regressors in the logistic function to determine their marginal effects. The marginal effect of a variable will be defined as the change in probability of facing a future debt crisis when a variable is increased by one standard deviation. To measure the marginal effect of a variable, the sample average of all the variables were plugged into the logistic functions to arrive at average values for the

dependent variable. Each of the variables was then increased by one standard deviation while holding the remaining variables constant. The difference between the result of the new logistic function and the one calculated for the sample mean was identified as the marginal effect of the variable. Even though all of the variables in the logistic equations are statistically significant, they are not all economically significant. The marginal effect of a variable indicates how much a change a single variable has on influencing a financial crisis. By identifying the variables that have the strongest marginal effects, policy reform can be directed towards containing these variables. For the sake of this analysis, a regressor with a marginal effect greater than the absolute value of 10% will be considered economically significant. Table F displays the marginal effects of all the regressors.

The equation with the full set of variables only has two variables that are economically significant at the sample mean: external debt (US $Billion) and government expenditures/GDP. External debt has a marginal effect of 29.6%. This percentage means that at the sample average, the probability of a country having a crisis the following year increases by 29.6% if external debt is increased by one standard deviation. Given that 50% is the threshold value for a country experiencing a financial crisis, an increase of 29.6% is a very significant value. Government expenditures/GDP has a marginal effect of 98.2% at the sample mean. This value shows that an increase in government expenditures/GDP has an extremely strong effect on a country facing a financial debt crisis. Since these two variables have a large impact on financial crises, countries that are vulnerable to a debt crisis should implement economic policy that prevents these variables from reaching unsustainable levels. Some ways to curb high levels of external debt are decreasing domestic interest rates, giving

Table F
Marginal Effects

Regression Results	**Method 3 Full Set of Variables**			**Method 3 Reduced Set of Variables**		
	Logit Coef.	P-value	Marginal Effect	Logit Coef.	P-value	Marginal Effect
External Debt (US$ Bil.)	0.134	0.000	0.296			
Short-term External Debt/Total External Debt				0.114	0.010	0.021
External Debt/GDP	-0.112	0.006	0.000	-0.171	0.000	-0.007
External Debt/CA Receipts	0.018	0.045	0.000			
Interest Paid on External Debt (US$ Bil.)	-0.749	0.012	0.000			
Amortization Paid on External Debt (US$ Bil.)	0.268	0.011	0.001			
Total External Debt/Official Forex Reserves				0.004	0.003	0.030
Debt Service Ratio				0.099	0.000	0.035
External Vulnerability Indicator				-0.007	0.021	-0.005
Liquidity Ratio				-0.030	0.028	-0.006
Gen. Gov. Debt (US$ Bil.)	0.038	0.016	0.007			
Gen. Gov. Debt/GDP				0.131	0.000	0.210
Gen. Gov. Int. Pymt/Gen. Gov. Revenue	-0.398	0.000	0.000	-0.401	0.000	-0.008
Gen. Gov. FC & FC-indexed Debt/GG Debt				0.067	0.002	0.037
Domestic Credit (% change Dec/Dec)	0.042	0.019	0.000			
Domestic Credit/GDP	-0.054	0.005	0.000	-0.041	0.012	-0.006
Current Account Balance (US$ Bil.)	0.157	0.020	0.001			
M2/Official Forex Reserves	0.355	0.005	0.000			
Official Forex Reserves (US$ Bil.)	-0.307	0.002	0.000			
Nominal GDP (US$ Bil.)	-0.024	0.040	0.000			
GDP per capita (US$)				0.000	0.029	-0.005
Nominal GDP (% change, local currency)	-0.138	0.000	0.000	-0.091	0.004	-0.005
Real GDP (% change)	0.257	0.051	0.000	0.219	0.057	0.010
Inflation (CPI, % change Dec/Dec)	0.142	0.000	0.001	0.047	0.056	0.007
Gross Investment/GDP				-0.157	0.075	-0.004
Gross Domestic Saving/GDP				0.194	0.003	0.030
Nominal Imports of G & S (% change, US$ basis)	-0.100	0.006	0.000	-0.062	0.051	-0.005
Openness of the Economy	0.081	0.000	0.002	0.028	0.020	0.014
Short-term Nominal Interest Rate (% per annum, Dec 31)				0.165	0.000	0.035
Net Foreign Direct Investment/GDP	-0.340	0.043	0.000	-0.369	0.030	-0.005
Total Liab. due BIS Banks/Total Assets Held in BIS Banks				0.037	0.000	0.274
Gen. Gov. Revenue/GDP	-1.761	0.000	0.000	-1.292	0.001	-0.008
Gen. Gov. Expenditures/GDP	1.350	0.001	0.982	1.017	0.003	0.987
Gen. Gov. Primary Balance/GDP	1.238	0.002	0.006	1.267	0.000	0.354
Constant	4.338	0.024	-	-4.321	0.161	-

tax breaks to companies that borrow internally, implementing tariffs on external borrowing, and placing restrictions on companies that prevent them from borrowing high levels of external debt. The best way for a country to lower government expenditures/GDP is for the government to increase fiscal discipline. Governments need to identify areas of wasteful spending and cut back these expenditures. Corruption is one of the most common ways that government expenditures increase unproductively. Other areas that should be further examined are defense spending and subsidies. Socialist countries need to guarantee that high levels of government spending are productive and accompanied by high government revenues.

The second equation has four variables that are economically significant at the sample mean: government debt/GDP, total BIS bank liabilities/total BIS bank assets, government expenditures/GDP, and government primary balance/GDP. Government debt/GDP has a marginal effect of 21.0%, total BIS bank liabilities/total BIS bank assets has a marginal effect of 27.4%, government expenditures/GDP has a marginal effect of 98.7%, and primary balance/GDP has a marginal effect of 35.4%. Governments should minimize each of these variables to avoid a financial debt crisis. High levels of government debt/GDP can be avoided by lowering government expenditures, increasing government revenues, and regulating levels of government borrowing. Keeping a balanced budget and avoiding fiscal deficits are the keys to maintaining reasonable levels of government debt. Monetary agencies should try to limit the number of Bank of International Settlements (BIS) liabilities in comparison to their BIS assets. BIS liabilities can be decreased by paying off debts and regulating borrowing by central banks. BIS assets can increase when central banks increase their foreign reserves. Government expenditures/GDP is still an important variable in this

equation and all types of reforms that were described earlier should also be attributed to this model. In order for a government to maintain a stable primary balance/GDP, it needs to keep a moderate ratio of lending to borrowing. Conservative lending and productive borrowing needs to take place to keep a low primary balance.

VIII. India Case Study

Introduction

The first half of the paper developed a strategy for analyzing a country's risk to a financial debt crisis. The rest of the paper is a case study that applies the results of the previous sections to examine an individual country: India. The reason why India was chosen for the case study is because it is an emerging market country that is growing at a very rapid rate. India's economy is very similar to the ones of the East Asian countries that experienced crises in the late 1990's and early 2000's. India is at a similar level of development as many of the countries that were used for logistic model. Even though the analysis will not give a definitive forecast about India, it will give valuable insight about the country's economic status. Utilizing the tools developed earlier in the paper, India's vulnerability to a crisis will be estimated and accompanied by recommendations for policy reform.

In January 2004, Nouriel Roubini and Richard Hemming published the paper *A Balance Sheet Crisis in India?* that analyzed India's risk of having a financial crisis by comparing the country's economic state in 2003 to the pre-crises conditions of emerging markets that faced recessions during the late 1990's and early 2000's. Roubini and Hemming used balance sheets to evaluate the financeability and sustainability of India's debt by observing the country's capital structures, liquidity/rollover risk, mismatched currency of liabilities, and solvency risk. The authors conclude that India has many protections against

debt default, but it also has numerous variables that resemble crisis countries. The authors believe that India faces an increasing risk to a financial debt crisis given the size of the country's debt ratio, deficit, and primary gap. Roubini and Hemming believe that fiscal adjustment is necessary to decrease the primary gap and stabilize the debt ratio to reduce India's vulnerability to having a financial crisis.

Roubini and Hemming evaluate the stability of India at the end of 2003, but it is important that the vulnerability of India's economy is continually monitored. India is one of the world's fastest growing economies and it has been attracting an increasing number of foreign investors. Kronstadt (2004) points out that India has faced a number of economic and political changes since 2003, the year Roubini and Hemming conducted their study. When India held its parliamentary elections in 2004, the center-right coalition headed by the Bharatiya Janata Party was defeated by the center-left coalition headed by the Indian National Congress who was able to obtain the Lok Sabha majority. Manmohan Singh, the former Finance Minister, was appointed the new Prime Minister of the Indian government. Singh, who was one of the main architects of India's economic liberalization during the early 1990's, has worked to implement a number of economic reforms. In order to obtain parliamentary majority, the Indian National Congress formed a coalition with the Communist Party. Initially investors were afraid that communist involvement in the coalition would slow down economic liberalization. Large drops in the stock market occurred shortly after the election. These fears were eventually deterred when leaders from the Congress Party declared that they would promote growth, savings, and investment. Singh's administration has focused on reducing the fiscal deficit, providing debt-relief to poor farmers, extending social programs, and advancing pro-industry tax policies.

In 2004, India's government approved a new foreign trade policy that adopts numerous reforms to improve India's global economic relations. Some of the reforms include reducing government intervention in private businesses, decreasing duties on imports, generating additional employment in rural areas, upgrading technology infrastructure, and liberalizing the economy to fit regional free trade agreements.[8] India's economy has experienced extremely high levels of growth since the year 2000. The country, which only saw 3.5% annual growth rates during the three decades prior to 1980, has steadily increased its annual growth rates to an average of around 6% during the 1980's and 1990's. From the years 2003-2007, India has had an average annual growth rate higher than 8% (The Economist "India on Fire" 2007). India's government has a Five-Year Plan until 2012 that targets 10% average annual growth.[9] Due to the volatile nature of emerging markets, it is valuable to constantly examine the risk of rapidly growing countries. All of the changes that India has incurred since the Roubini and Hemming study indicate that it is necessary to reevaluate the status of India's financial stability.

In the case study, India's economic stability will be evaluated using recent emerging market debt crises as comparative indicators. Similar to the Roubini and Hemming paper, India's balance sheet will be broken down by its economic and debt variables to expose the country's financial vulnerabilities. The case study includes an updated analysis with data as recent as 2006. The logistic models that were developed earlier in the paper will be applied to India to indicate the probability of the country facing a financial debt crisis. India's current and future status will be evaluated based on how well it performs in the logistic equation in

[8] Source: Foreign Trade Policy, Government of India, Ministry of Commerce and Industry 2004
[9] Source: Report of the Working Group on Centre's Financial Resources for the Eleventh Plan (2007-2012)

addition to a series of qualitative measures. Finally, India's vulnerabilities will be identified and accompanied by recommendations for policy reform.

Background on India's Economy

Prior to the early 1980's, India was a relatively closed economy that practiced restrictive macroeconomic policies. Central government revenues exceeded expenditures and surpluses were used to finance the capital account deficit. During the early 1980's, India's cautious fiscal policy was abandoned in favor of expansionary programs. These policy reforms transformed government surpluses into deficits, which forced the government to borrow from home and abroad. From 1981 to 1991, India's external debt increased from $18.3 billion to $71.1 billion. In 1991, India's short-term debt was four times the size of foreign reserves and the fiscal deficit was 7.7% of GDP (Srinivasan 2002). Foreign reserves were only large enough to cover two weeks of imports while most governments recommend that it covers up to six months. India's liberalizing policies of the 1980's expanded the capital account deficit and pushed the country to unsustainable levels of debt. All of these factors eventually led to India's balance of payments crisis in 1991.

The 1991 balance of payments crisis was responded by a devaluation of the Indian currency and an increase in interest rates. Fiscal adjustments, structural reform, and financial assistance from the International Monetary Fund helped pull the country out of its economic recession. Further reforms were made during the 1990's to stabilize the economy. Large sums of foreign reserves were accumulated and the economy became more open to foreign trade and investments.

Although significant reforms have been made to recover from and prevent another balance of payments crisis, many variables on India's economic balance sheet indicate that it

is still vulnerable to potential difficulties. In 2003, government debt was equal to 93.7% of GDP and the overall fiscal deficit was 9.1% of GDP.[10] Inflation has risen to 6-7% in 2006 and credit is rising at an annual rate of 30%. The Reserves Bank of India has not taken action to curb excess demand. Interest rates have not even kept up with consumer-price inflation from the beginning of 2005 until February 2007 (The Economist "India Overheats" 2007).

India's government debt is largely due to inefficient fiscal policies. Many of India's states are increasing subsidies on government goods and services without making any effort to raise revenues. Many of these government expenditures come from large industries including: electricity, irrigation, water, transportation, education, and health. Developmental capital expenditures by the government have been decreasing while allocations toward non-developmental activities have been steadily increasing. In order to reduce India's high fiscal deficit and overall debt, the government needs to increase revenues and reform its spending policies.

Meanwhile, it is unfair to claim that all economic indicators point to a potential debt crisis in India. There are a number of factors that strongly support that India is financially stable and can handle high levels of debt. In 2003, the maturity of government external debt was mostly long-term with an average maturity of around 9 years. India has a strong backing of $301 billion of foreign-exchange reserves as of February 2008.[11] The majority of India's government debt is in domestic currency, preventing any potential currency mismatches if local money depreciates. Most government debt is held by domestic residents and only 5.4% of India's government debt was in foreign currencies in 2006.

[10] Source: Moody's Statistical Handbook, Country Credit, May 2007
[11] Source: IMF's Data on Current Foreign Exchange Reserves of Reporting Countries

The rupee, India's monetary unit, is currently under a pegged exchange rate regime. It is important to understand the nature of a country's currency when examining financial debt crises because currency and debt crises typically occur at the same time. In a study on debt crises, Reinhart (2002) found that about 85% of the cases in her sample were preceded by a currency crisis. While the Reserves Bank of India does not release details about the exchange rate regime, studies, such as *India's Policy Stance on Reserves and the Currency* by Patnaik (2003), describe the Indian rupee as a de facto crawling peg of the US dollar. A crawling peg is a fixed exchange rate where the currency value can vary within a range of rates. India has accumulated foreign reserves at an increasing rate since the 1991 currency crisis. Due to the nature of this growth, it is believed that the increase in reserves has not occurred as a goal of India's currency policy, but rather as a side effect. If this evaluation is valid, India is less likely to experience currency problems because its policy is not constrained by foreign reserves. Although the rupee is not a floating exchange rate, it appears that the Reserves Bank of India does not face stringent financial restrictions due to the currency peg.

India's Balance Sheet

The next step in evaluating India's economic stability is breaking down its financial balance sheet. At the end of 2006, India had an external debt to GDP ratio of 16.3% and 9.1% of the country's external debt was short-term. These factors are positive indicators about the future of India's debt sustainability. The external debt to GDP ratio is at a reasonable level which means that foreign lenders do not have a strong hold on India's economy if they decide to pull money out of the country. Since the majority of external debt is long-term, India is not threatened by the possibility of a liquidity run. India's debt is not highly exposed to currency mismatches and does not face potential difficulties from

depreciation. The majority of government debt is held by domestic residents which reduces the country's risk to foreign shocks. India's risk to foreign investors is further offset by its high level of foreign currency reserves.

Although India's balance sheet has many positive factors, the government debt to GDP ratio is very alarming. In 2006, India's government debt to GDP ratio was 89.5%. The country has a high fiscal deficit, high public debt to revenue ratio, and low revenue to GDP ratio. India's debt ratio is higher than all but one of the countries that experienced financial crises in the late 1990's. This problem doesn't appear to be improving since India's fiscal deficit is also worse than many of the countries that had financial crises. The primary gap is an indicator of the long-term sustainability of a country's debt. It is calculated by finding the difference between the debt ratio minus the growth-interest differential and the actual primary balance. When this indicator is positive, debt levels are increasing and reform is necessary because the debt to GDP ratio cannot rise without limit. Since India already has a high debt to GDP ratio, its growth-interest differential must stay positive for India's debt to be sustainable. Unless India maintains a high level of growth or slows down borrowing, the country is at risk to a financial debt crisis. Table G compares India's balance sheet in 2006 to the pre-crisis conditions of 14 countries from the late 1990's and early 2000's.

What type of crisis is India in danger of?

India appears to have learned from past mistakes of emerging economies. The government does not finance its debt with monies from the central bank. India's currency does not face strong overvaluation where changing interest rates for economic expansion will threaten the pegged exchange rate. Lastly, India has avoided maturity and currency

Table G: Balance Sheet Comparisons*

Country	Mexico	Korea	Thailand	Indonesia	Malaysia	Russia	Brazil	Ecuador	Pakistan	Ukraine	Turkey	Argentina	Uruguay	Brazil	Avg	**India**
Year	1994	1997	1997	1997	1997	1997	1998	1998	1998	1998	2000	2001	2001	2002		**2006**
Liquidity/Rollover Risk																
M2/reserves	-	18.9	11.1	4.7	4.5	6.2	7.7	3.3	31.1	7.8	3.8	5	3.3	5.2	8.7	**3.5**
Inflation	-	4.4	7.6	10.3	2.9	11	1.7	43.4	6.5	20	39	-1.5	3.6	-	12.4	**7.3**
Country Solvency Risk																
External Debt/GDP	-	33.7	72.4	63.1	43.8	31.1	30.7	64.6	48.1	44.9	59.9	61.8	48.2	49.6	50.1	**16.3**
Short-term External Debt/ Total External Debt	-	36.6	35	23.2	25.3	24.6	10.9	10.8	15.1	24.7	23.7	12.6	30.2	10.3	21.8	**9.1**
Sovereign Solvency Risk																
Government Debt/GDP	35	6.9	6.9	25	31.9	46.9	51.8	56.3	75.3	28	52	53.7	39	76.7	41.8	**89.5**
Government Debt/Revenue	155	55.3	38.7	221	136.8	124.2	165	406.1	566.2	109.3	192	286.2	138.9	221.4	201.2	**436**
Currency Mismatch Risk																
Foreign currency gov. debt/ total gov. debt	53	17.7	90.3	100	14.4	52.4	NA	81.4	49	67.2	48.4	96.8	75.1	34.6	60.0	**5.4**
Dollarization Vulnerability indicator	NA	NA	6	91.2	5	55.3	0	High	289.6	64.1	92.7	213.2	135.6	0	86.6	**7.1**
Capital Structure Equity-FDI/Foreign Liabilities	Medium	Low	Medium	Medium	High	Low	High	Medium	Medium	Medium	Low	Low	Low	Medium		**Medium**
FDI/GDP		-0.3	2.2	2.1	5.1	0.4	3.3	3.7	0.8	1.8	0.1	0.7	1.6	3.1	1.9	**1.2**
Current account deficit/GDP	-7.1	-1.6	-2.1	-2.3	-5.9	0	-4.2	-8.6	-2.3	-3.1	-4.9	-1.4	-2.7	-1.7	-3.4	**-2.9**
Fiscal Balance/GDP	-0.2	0	-1.8	-0.4	2.4	-8	-5.9	-4.1	-6.3	-2.8	-10.3	-3.2	-5.7	-5.3	-3.7	**-6.8**
Primary Balance/GDP	2.1	0.6	-1.4	1.4	4.6	-3	0.3	-0.1	-0.1	-0.5	6.1	0.5	-3.2	2.3	0.7	**-1.2**
Gen. Gov. int payments/ Gen. Gov. Revenue		NA	1.8	15.5	9.8	12.9	19.6	29.2	47.1	9.1	60.6	20.2	8.8	21.8	21.4	**26.9**
Fixed Exchange Rate	Soft Peg	Soft Peg	Soft Peg	Soft Peg	Soft Peg	Peg	Peg	Managed Float	Heavily Managed	Heavily Managed	Quasi Cur Board	Currency Board	Peg	Managed Float		**Managed Float**
Liquidity Ratio rel to BIS Banks		140.5	406.9	291.8	109.9	218.8	76.3	69.4	50.3	58	127.4	119.1	34.8	57.2	135.4	**53.2**

*Source: Roubini and Hemming (2004); Moody's Statistical Handbook, Country Credit, May 2007

mismatches in its debt so that it is not vulnerable to liquidity runs or the threat of depreciation.

Despite the success India has had in steering clear of the first, second, and third generation models of financial crises, the country has still overextended itself in high levels of debt. The balance sheet seems to indicate that India's debt is financeable in the short term but this level of debt will not be sustainable in the long-run without strong reforms. If India does not sustain its high level of growth, there is a potential that the country will be unable to pay its high levels of long-term debt. The resulting problems can range from credit loss to devaluation of the pegged exchange rate. Fortunately, liquidity runs are constrained by the long-term maturity of the country's debt. This gives India enough time to make adjustments that can prevent a fourth generation of financial crises from evolving.

Results of India Data in the Logistic Equations

After comparing the balance sheet of India to the balance sheets of countries that experienced financial crises during the 1990's and early 2000's, India's risk of a financial crisis is put in the perspective of other economies. While this analysis is useful in making initial assessments about India's stability, there is no clear indication of India's overall vulnerability. Rather than making objective evaluations, it will be more valuable to use econometric analyses to assess India's vulnerability to a financial crisis.

The logistic models that were developed earlier in the paper are valuable in numerically assessing India's vulnerability to a financial debt crisis. India's most recent data was input into the two equations to evaluate the country's current economic status. The value of the dependent variable gives a good indication of where India currently stands in its risk to a financial debt crisis. India's data from 1997-2006 was used to find how vulnerable the

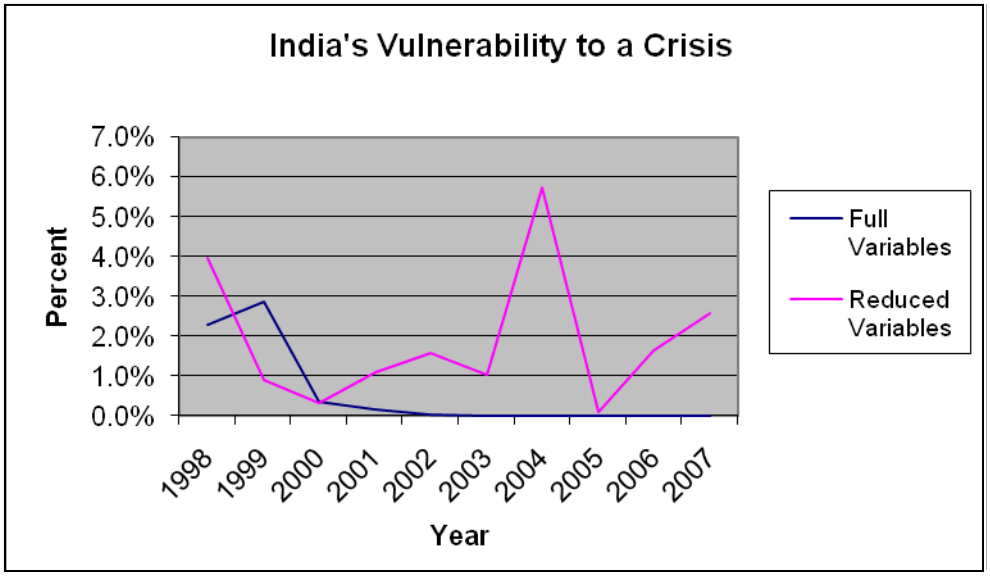
country was to a financial debt crisis in the years 1998-2007. The output values of the logistic model were plotted on a graph so that trends can easily be observed. Since India did not experience a financial crisis during this period, it was not anticipated that Y values would be greater than 50% at any of the points. The results of these tests are as follows:

Table H

India's Logistic Results

Country	Year	Full Variables	Reduced Variables
India	1998	0.023	0.039
India	1999	0.029	0.009
India	2000	0.004	0.003
India	2001	0.002	0.011
India	2002	0.000	0.016
India	2003	0.000	0.010
India	2004	0.000	0.057
India	2005	0.000	0.001
India	2006	0.000	0.016
India	2007	0.000	0.026

Table I



Since the threshold value for predicting a financial debt crisis is 50%, the results show that it is highly unlikely that India will face a crisis by the end of 2007. The two equations produce results with slightly different trends. The equation with the full set of variables steadily decreases from 1998 to 2007. The equation with the reduced set of variables decreases from 1998 to 2000 and then increases to a peak during 2004. The probability then decreases to a value of 2.6% in 2007.

Forecasting

The results from the logistic model show that India has a decreasing probability of experiencing a financial crisis in recent years. Despite these trends, it is important to look into the future to see if India will continue to protect itself against a crisis. Using resources on India's economy, forecasted variables for the years 2007 and 2008 were applied to predict India's vulnerability to a financial debt crisis in 2008 and 2009. Moody's Statistical Handbook published forecasted values for many of the pertinent variables for the years 2007 and 2008. The remaining variables were estimated using linear regression models based on the previous 10 years of data. All of the functions developed reasonable estimates for the 2007 and 2008 values of the variables. When the forecasted values of the variables were applied to the logistic functions, the results predicted that India would continue to become less at risk to a financial crisis. The resulting probabilities of these equations serve as reliable indicators of India's vulnerability in the years 2008 and 2009. The results of the forecasting tests are as follows:

Table J

Forecasted Values for India

Country	Year	Full Variables	Reduced Variables
India	2008	0.000	0.020
India	2009	0.000	0.014

It is important to note that the probabilities being calculated after 2007 are extrapolated values. Extrapolated data does not necessarily fit the same distribution as the original data. As values further from the original dataset are tested, the accuracy of the results diminishes.

Another resource that was used to estimate future values of economic and political variables is the Indian Government's Five Year Plan. Every five years, the Indian Government writes a five year plan of its economic goals which the country plans to achieve during that period. India's five year plans include: macroeconomic targets, employment perspectives, disaster management, policy initiatives, sector outlooks, and social development. India recently published its Eleventh Five Year Plan which covers the years 2007-2012. The economic targets and policy initiatives from the Five Year Plan serve as a reliable resource for evaluating India's financial stability.

The Eleventh Five Year Plan predicts that India will continue to improve its economic situation and further protect itself from facing a financial debt crisis. By the year 2012, the government anticipates that India will experience 10% annual growth in GDP. Government expenditures and revenues will increase at high rates, but revenues will grow at a faster pace than expenditures. Tax revenues will increase from 11.4% of GDP to 13.9% of GDP.[12] Foreign exchange reserves increased dramatically during the Tenth Five Year Plan and these increases are anticipated to continue throughout the Eleventh Five Year Plan. Increasing government revenues and growth in GDP should keep the fiscal deficit low and stabilize government debt. Even though the predictions of the Eleventh Five Year Plan

[12] Source: Report of the Working Group on Centre's Financial Resources for the Eleventh Plan (2007-2012)

cannot be applied directly to the logistic models, the positive projections appear to show that India will further protect itself against a financial debt crisis over the next five years.

Policy Reform

Although the logistic equations indicate that India is not vulnerable to a financial debt crisis, the results of the analysis can be used to determine the country's weaknesses. Similar to the policy reform section used for the entire sample, marginal effects were determined for each of India's variables. In the case of India, the marginal effect of a variable will be defined as the change in probability of facing a future debt crisis when the 2006 values for India are increased by one standard deviation of the India-specific data. The model with the full set of variables has no variables with significant marginal effects. The model with the reduced set of variables did not have any variables with a marginal effect greater than 10%, but it did have five variables where the marginal effect was greater than 5%. The following variables had the largest marginal effects: government debt/GDP, government interest payments/government revenues, government revenues/GDP, government expenditures/GDP, and government primary balance/GDP.[13]

All of India's vulnerable variables are related to government borrowing, spending, and lending policies. The best way for India to protect itself against a financial crisis is to maintain sustainable levels of government debt by enforcing fiscal discipline. Increases in government expenditures need to be accompanied by increases in government revenues. Government spending needs to be efficient and productive. The government should try to keep a balanced budget and avoid fiscal deficits. Government surpluses should be used to pay off the country's national debt. Currently these variables are at sustainable levels, but it is important that the Indian government makes sure they do not get any worse. Policy reform

[13] The marginal effects of all the variables for India can be found in Appendix 7.

will help protect India against any unwarranted shocks, but as of now, the government can still borrow at high levels if the economy continues to grow.

Why do these results differ from Roubini and Hemming?

Roubini and Hemming's paper *A Balance Sheet Crisis in India* indicates that India has a number of vulnerabilities that could lead to a financial debt crisis in the near future. The authors argue that India's situation is getting worse through increases in the fiscal and primary deficits, public debt, and primary gap. On the other hand, the authors identify many areas where India is improving: India has modest liquidity/rollover risk, few currency mismatches, small current account balances, and low external debt. Still, the authors find strong reasons to be cautious because of the severity of India's weaknesses. Roubini and Hemming recommend that public officials in India act immediately to prevent their situation from getting worse.

The results found in the Roubini and Hemming paper are quite different from the ones that were reached in the study being conducted in this paper. The results of this study find that India's situation is getting progressively better. There are many possible explanations why the two studies reached different conclusions. Roubini and Hemming perform their study in 2003, which happens to be a year where India was in one of its worst economic conditions. During this time, India was about to face political transition and many economic policy changes were in their early phases. Most of the other differences stem from the fact that Roubini and Hemming used a qualitative comparison while this paper's study used both qualitative and quantitative analyses. The authors primarily focused on India's negative variables that stood out against the debt crisis countries. No weights were attached to the variables so it was hard to determine if a positive variable could outweigh a negative

variable. Lastly, there were no control variables in their study because all of the countries being compared in the sample were crisis countries. In the study being conducted in this paper, India's economic variables are being compared quantitatively through the logistic function. The logistic model gives different weights to each of the variables based on how well they indicate risk to a financial debt crisis. The logistic model was developed using data from both crisis and non-crisis countries to include control values and avoid biasing results.

Roubini and Hemming probably find India at a greater risk to a financial debt crisis because their study emphasizes the variables that are performing poorly and they do not take positive factors as strongly into account. There is still great value to the paper *A Balance Sheet Crisis in India*. The paper points out the areas where India is weak and needs to improve its economic policy. Even if India is not threatened by a financial crisis, it should not continue to run fiscal deficits and build on its national debt. Poor economic policy can deteriorate India's financial system. Still, the necessity for reform should not be overestimated because contractionary policy can also deplete long run growth. Roubini and Hemming raised awareness of India as a volatile, high growth emerging market that continually needs to be monitored. It is important that the stability of emerging markets continue to be analyzed so that investors don't make the same mistakes that they did during the East Asian crises.

IX. Conclusion

Financial debt crises have occurred in waves over the past several decades. The majority of crises happened in emerging market countries with overextended levels of debt. Unexpected shocks often resulted in currency devaluations which forced the countries to default. Domestic and international investors were hurt severely and the countries took years

to recover. Most financial debt crises are the result of poor economic policy. If countries can identify weaknesses in their markets and foresee potential problems, many crises can be avoided or deterred.

Three generations of financial debt crises have been observed during the last 50 years. Emerging market countries have been the most common victim of these crises. The most recent generation of crises that occurred in East Asia happened very quickly and unexpectedly. Prior to these crises, the East Asian countries focused on achieving high levels of growth and neglected to use cautious economic policy. Most of the countries over-borrowed and their debt was in foreign currencies with a short payback period. The governments of these countries did not properly monitor their markets and debt crises resulted. Emerging market countries must be vigilant of their economic vulnerabilities to avoid having similar crises occur in the future.

The balance sheet analysis and logistic models developed in the paper serve as valuable assessments of countries' economic vulnerability to a financial debt crisis. The balance sheet analysis helps pin-point the disparity between a country's assets and liabilities. Debt maturity mismatches, foreign currency reserves, money supply, and many other economic variables can identify the areas where a country is most vulnerable. The logistic models use a comprehensive set of variables to assess a country's risk to a crisis. The models take economic data from 43 countries over the past ten years to evaluate where countries currently stand. This analysis has a strong empirical foundation that uses variables from past defaults as indicators of future crises.

India, a high growth emerging market country, was used as a case study for applying the empirical and qualitative analyses developed in the paper. Results showed that India is

economically stable and not vulnerable to a financial crisis. India's weakest areas, government borrowing and spending, were identified and accompanied by policy recommendations. While the results showed positive prospects for India, it is important that India and similar countries continue to be monitored. High growth markets with large levels of debt are always running the risk of defaulting.

As economies around the world continue to globalize, foreign debt crises become more pertinent to the average investor. Many businesses have increased imports and outsourced jobs to emerging markets as a means of cutting costs. International business has become an integral part of succeeding in modern day economies. Increased globalization puts more countries at risk to the adverse effects of a financial debt crisis. Analyses similar to the one conducted in this paper need to be performed to identify vulnerable countries and help prevent future defaults from occurring.

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Appendix 1
Method 1 Full Variables

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. logit  crisisnextyear externaldebtusbil externaldebtcareceipts4 interestpaidon
> externaldebtusbil amortizationpaidonexternaldebtus totalexternaldebtofficialfo
> rexre debtserviceratio5 externalvulnerabilityindicator6 gengovdebtusbil3 gengo
> vdebtgdp3 gengovdebtgengovrevenue3 gengovintpymtgengovrevenue gengovfcfcindexe
> ddebtggdebt3 domesticcreditchangedecdec  currentaccountbalancegdp m2officialfo
> rexreservesx nominalgdpusbil gdppercapitaus nominalgdpchangelocalcurrency real
> gdpchange inflationcpichangedecdec grossinvestmentgdp nominalexportsofgschange
> usbasis nominalimportsofgschangeusbasis opennessoftheeconomy1  netforeignasset
> sofdomesticbanksu m2changedecdec shorttermnominalinterestratepera netforeigndi
> rectinvestmentgdp totalliabduebisbankstotalassetsh gengovrevenuegdp gengovexpe
> ndituresgdp

Iteration 0:   log likelihood = -154.85754
Iteration 1:   log likelihood = -82.585787
Iteration 2:   log likelihood = -64.424312
Iteration 3:   log likelihood = -58.697528
Iteration 4:   log likelihood = -56.658685
Iteration 5:   log likelihood = -56.256039
Iteration 6:   log likelihood = -56.235635
Iteration 7:   log likelihood = -56.235567

Logit estimates                                   Number of obs   =        389
                                                  LR chi2(31)     =     197.24
                                                  Prob > chi2     =     0.0000
Log likelihood = -56.235567                       Pseudo R2       =     0.6369

------------------------------------------------------------------------------
crisisnext~r |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
externalde~l |   .0336035   .0177337     1.89   0.058     -.001154     .068361
externalde~4 |  -.0020184   .0074776    -0.27   0.787    -.0166742    .0126374
interestpa~l |   .1374583   .2695747     0.51   0.610    -.3908984     .665815
amortizati~s |    .177636   .0761465     2.33   0.020     .0283915    .3268804
totalexter~e |   .0019091   .0017292     1.10   0.270    -.0014802    .0052983
debtservic~5 |  -.0041368   .0322091    -0.13   0.898    -.0672654    .0589918
externalvu~6 |  -.0013363   .0041771    -0.32   0.749    -.0095232    .0068506
gengovdeb~l3 |    .028752   .0094964     3.03   0.002     .0101393    .0473646
gengovdeb~p3 |  -.0214292   .0516183    -0.42   0.678    -.1225992    .0797409
gengovdeb~e3 |  -.0042666   .0104451    -0.41   0.683    -.0247386    .0162054
gengovintp~e |  -.1269033   .0472687    -2.68   0.007    -.2195483   -.0342584
gengovfcfc~3 |   .0667663   .0221536     3.01   0.003     .0233461    .1101866
domesticcr~c |   .0162527   .0228763     0.71   0.477     -.028584    .0610893
currentacc~p |   .0561321   .0785915     0.71   0.475    -.0979044    .2101686
m2official~x |   .2930693   .1494825     1.96   0.050     .0000889    .5860496
nominalgdp~l |   -.023691   .0090546    -2.62   0.009    -.0414377   -.0059442
gdppercapi~s |  -.0004958   .0002769    -1.79   0.073    -.0010386    .0000469
nominalgdp~y |  -.0770349   .0343355    -2.24   0.025    -.1443313   -.0097385
realgdpcha~e |   .3459628    .139331     2.48   0.013     .0728789    .6190466
inflationc~c |   .0778392   .0307614     2.53   0.011     .0175479    .1381305
grossinves~p |    .055332   .1027624     0.54   0.590    -.1460786    .2567426
nominalexp~s |    .015291   .0353673     0.43   0.665    -.0540278    .0846097
nominalimp~s |  -.0918295   .0377721    -2.43   0.015    -.1658615   -.0177975
opennessof~1 |   .0091029   .0179496     0.51   0.612    -.0260776    .0442834
netforeign~u |   .0559069   .0573115     0.98   0.329    -.0564216    .1682353
m2changede~c |  -.0338633   .0256995    -1.32   0.188    -.0842333    .0165067
shorttermn~a |   .1071441   .0496386     2.16   0.031     .0098543     .204434
netforeign~p |  -.4998964    .204011    -2.45   0.014    -.8997507   -.1000421
totalliabd~h |   .0039722   .0045931     0.86   0.387    -.0050301    .0129744
gengovreve~p |   -.101404   .1778793    -0.57   0.569     -.450041    .2472329
gengovexpe~p |   .0258325   .1693111     0.15   0.879    -.3060111    .3576762
       _cons |  -6.210586   4.297987    -1.44   0.148    -14.63449    2.213315
------------------------------------------------------------------------------
```

Appendix 2
Method 2 Full Variables

```
. logit  crisisnextyear externaldebtusbil totalexternaldebtofficialforexre debts
> erviceratio5 liquidityratio7 gengovdebtusbil3 gengovdebtgengovrevenue3  gengov
> fcfcindexeddebtggdebt3 domesticcreditchangedecdec currentaccountbalancegdp m2o
> fficialforexreservesx nominalgdpusbil gdppercapitaus nominalgdpchangelocalcurr
> ency realgdpchange inflationcpichangedecdec grossinvestmentgdp grossdomesticsa
> vinggdp nominalimportsofgschangeusbasis opennessoftheeconomy1 shorttermnominal
> interestratepera totalliabduebisbankstotalassetsh gengovrevenuegdp gengovexpen
> dituresgdp gengovprimarybalancegdp

Iteration 0:   log likelihood =  -155.4402
Iteration 1:   log likelihood = -87.593754
Iteration 2:   log likelihood = -71.285442
Iteration 3:   log likelihood = -67.681695
Iteration 4:   log likelihood = -67.102237
Iteration 5:   log likelihood = -67.074717
Iteration 6:   log likelihood = -67.074613

Logit estimates                                   Number of obs   =        393
                                                  LR chi2(24)     =     176.73
                                                  Prob > chi2     =     0.0000
Log likelihood = -67.074613                       Pseudo R2       =     0.5685

------------------------------------------------------------------------------
crisisnext~r |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
externalde~l |   .0372001   .0113253     3.28   0.001      .015003    .0593972
totalexter~e |   .0009133   .0006758     1.35   0.177    -.0004113     .002238
debtservic~5 |   .0109067   .0164343     0.66   0.507    -.0213039    .0431173
liquidityr~7 |  -.0036886   .0096431    -0.38   0.702    -.0225888    .0152115
gengovdeb~l3 |   .0201685    .006354     3.17   0.002     .0077148    .0326222
gengovdeb~e3 |  -.0032398   .0033987    -0.95   0.340    -.0099011    .0034216
gengovfcfc~3 |   .0401547   .0167102     2.40   0.016     .0074033    .0729061
domesticcr~c |   .0083504   .0162047     0.52   0.606    -.0234101    .0401109
currentacc~p |   .2312849   .1018207     2.27   0.023       .03172    .4308498
m2official~x |   .1777013   .1249648     1.42   0.155    -.0672252    .4226278
nominalgdp~l |  -.0134604   .0061435    -2.19   0.028    -.0255014   -.0014193
gdppercapi~s |  -.0002317   .0001514    -1.53   0.126    -.0005284     .000065
nominalgdp~y |  -.0638477    .029498    -2.16   0.030    -.1216626   -.0060327
realgdpcha~e |   .2562291   .1141799     2.24   0.025     .0324406    .4800176
inflationc~c |   .0394553   .0278715     1.42   0.157    -.0151717    .0940824
grossinves~p |    .067759   .1171449     0.58   0.563    -.1618408    .2973588
grossdomes~p |  -.1565495   .0997455    -1.57   0.117    -.3520471     .038948
nominalimp~s |  -.0462419   .0264235    -1.75   0.080    -.0980309    .0055472
opennessof~1 |   .0096684   .0133658     0.72   0.469    -.0165281    .0358648
shorttermn~a |   .0926066   .0450245     2.06   0.040     .0043601    .1808531
totalliabd~h |   .0085663   .0068001     1.26   0.208    -.0047616    .0218942
gengovreve~p |   .3573767    .163314     2.19   0.029     .0372872    .6774663
gengovexpe~p |  -.4077259   .1408297    -2.90   0.004    -.6837471   -.1317047
gengovprim~p |   -.273349   .1524628    -1.79   0.073    -.5721705    .0254726
       _cons |  -5.249582   3.183355    -1.65   0.099    -11.48884      .98968
------------------------------------------------------------------------------
```

Appendix 3
Method 3 Full Variables

```
. logit  crisisnextyear externaldebtusbil shorttermexternaldebttotalextern exter
> naldebtgdp externaldebtcareceipts4 interestpaidonexternaldebtusbil amortizatio
> npaidonexternaldebtus totalexternaldebtofficialforexre debtserviceratio5 exter
> nalvulnerabilityindicator6 liquidityratio7 gengovdebtusbil3 gengovdebtgdp3 gen
> govdebtgengovrevenue3 gengovintpymtgengovrevenue gengovfcfcindexeddebtggdebt3
> domesticcreditchangedecdec domesticcreditgdp currentaccountbalanceusbil curren
> taccountbalancegdp m2officialforexreservesx officialforexreservesusbil nominal
> gdpusbil gdppercapitaus nominalgdpchangelocalcurrency realgdpchange inflationc
> pichangedecdec grossinvestmentgdp grossdomesticsavinggdp nominalexportsofgscha
> ngeusbasis nominalimportsofgschangeusbasis opennessoftheeconomy1 netforeignass
> etsofdomesticbanksu m2changedecdec shorttermnominalinterestratepera netforeign
> directinvestmentgdp totalliabduebisbankstotalassetsh gengovrevenuegdp gengovex
> pendituresgdp gengovfinancialbalancegdp gengovprimarybalancegdp

Iteration 0:   log likelihood = -154.56379
Iteration 1:   log likelihood = -69.834244
Iteration 2:   log likelihood = -49.253512
Iteration 3:   log likelihood = -41.849173
Iteration 4:   log likelihood = -37.855164
Iteration 5:   log likelihood = -36.059008
Iteration 6:   log likelihood = -35.519525
Iteration 7:   log likelihood = -35.454607
Iteration 8:   log likelihood = -35.453156
Iteration 9:   log likelihood = -35.453155

Logit estimates                                   Number of obs   =        387
                                                  LR chi2(40)     =     238.22
                                                  Prob > chi2     =     0.0000
Log likelihood = -35.453155                       Pseudo R2       =     0.7706

------------------------------------------------------------------------------
crisisnext~r |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
externalde~l |   .1118131    .046942     2.38   0.017     .0198083    .2038178
shortterme~n |   .1267609   .1137758     1.11   0.265    -.0962356    .3497574
externalde~p |  -.2631181   .1012627    -2.60   0.009    -.4615893   -.0646468
externalde~4 |   .0262686   .0167127     1.57   0.116    -.0064877     .059025
interestpa~l |  -.4672547   .5511619    -0.85   0.397    -1.547512    .6130028
amortizati~s |   .4732432   .1908616     2.48   0.013     .0991614    .8473251
totalexter~e |   .0005493    .002787     0.20   0.844    -.0049132    .0060117
debtservic~5 |  -.0222739   .0678189    -0.33   0.743    -.1551964    .1106487
externalvu~6 |   .0039486   .0074695     0.53   0.597    -.0106913    .0185885
liquidityr~7 |   .0117591   .0212512     0.55   0.580    -.0298925    .0534106
gengovdeb~l3 |   .0245477   .0222501     1.10   0.270    -.0190616     .068157
gengovdeb~p3 |  -.0776368   .1450546    -0.54   0.592    -.3619387     .206665
gengovdeb~e3 |   .0313184   .0273783     1.14   0.253    -.0223421    .0849789
gengovintp~e |  -.6285107   .2271887    -2.77   0.006    -1.073792   -.1832289
gengovfcfc~3 |   .0702996   .0470621     1.49   0.135    -.0219405    .1625397
domesticcr~c |   .0452589   .0348737     1.30   0.194    -.0230923    .1136101
domesticcr~p |  -.0440918   .0424033    -1.04   0.298    -.1272007    .0390171
currentacc~l |   .1625192   .0946704     1.72   0.086    -.0230313    .3480696
currentacc~p |   .1192342   .2523864     0.47   0.637    -.3754341    .6139025
m2official~x |   .1840212   .2629596     0.70   0.484    -.3313702    .6994125
officialfo~l |   -.236819   .1076484    -2.20   0.028     -.447806   -.0258321
nominalgdp~l |  -.0334203    .019762    -1.69   0.091     -.072153    .0053125
gdppercapi~s |   -.000323   .0004223    -0.76   0.444    -.0011506    .0005046
nominalgdp~y |  -.1775398   .0561125    -3.16   0.002    -.2875182   -.0675613
realgdpcha~e |    .322089   .1726967     1.87   0.062    -.0163902    .6605682
inflationc~c |   .1828089   .0548973     3.33   0.001     .0752123    .2904056
grossinves~p |   .0877828   .2360897     0.37   0.710    -.3749446    .5505102
```

Appendix 3 (continued)

grossdomes~p	.1028311	.2367139	0.43	0.664	-.3611196	.5667818
nominalexp~s	.0023723	.0466203	0.05	0.959	-.0890018	.0937463
nominalimp~s	-.1001811	.0551572	-1.82	0.069	-.2082873	.007925
opennessof~1	.083161	.0385945	2.15	0.031	.0075172	.1588048
netforeign~u	-.0563195	.1331857	-0.42	0.672	-.3173587	.2047197
m2changede~c	-.0426355	.0389544	-1.09	0.274	-.1189848	.0337137
shorttermn~a	.0637632	.0756764	0.84	0.399	-.0845598	.2120862
netforeign~p	-.4738945	.301737	-1.57	0.116	-1.065288	.1174991
totalliabd~h	.0030887	.016887	0.18	0.855	-.0300093	.0361867
gengovreve~p	-9.958431	6.049745	-1.65	0.100	-21.81571	1.898851
gengovexpe~p	9.693162	6.040174	1.60	0.109	-2.145361	21.53168
gengovfina~p	7.477798	5.636476	1.33	0.185	-3.569491	18.52509
gengovprim~p	2.158441	.8937141	2.42	0.016	.4067938	3.910089
_cons	-7.418897	6.904318	-1.07	0.283	-20.95111	6.113318

Appendix 4
Method 1 Relative Variables

```
. logit crisisnextyear externaldebtcareceipts4 totalexternaldebtofficialforexre d
> ebtserviceratio5 externalvulnerabilityindicator6 gengovdebtgdp3 gengovdebtgengo
> vrevenue3 gengovintpymtgengovrevenue gengovfcfcindexeddebtggdebt3 domesticcredi
> tchangedecdec currentaccountbalancegdp m2officialforexreservesx gdppercapitaus
> nominalgdpchangelocalcurrency realgdpchange inflationcpichangedecdec grossinves
> tmentgdp nominalexportsofgschangeusbasis nominalimportsofgschangeusbasis openne
> ssoftheeconomy1 m2changedecdec shorttermnominalinterestratepera netforeigndirec
> tinvestmentgdp totalliabduebisbankstotalassetsh gengovrevenuegdp  gengovexpendi
> turesgdp

Iteration 0:   log likelihood = -158.88987
Iteration 1:   log likelihood = -98.830057
Iteration 2:   log likelihood = -85.576144
Iteration 3:   log likelihood = -81.348987
Iteration 4:   log likelihood = -80.979151
Iteration 5:   log likelihood = -80.971128
Iteration 6:   log likelihood = -80.971122

Logit estimates                                   Number of obs   =        404
                                                  LR chi2(25)     =     155.84
                                                  Prob > chi2     =     0.0000
Log likelihood = -80.971122                       Pseudo R2       =     0.4904

------------------------------------------------------------------------------
crisisnext~r |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
externalde~4 |  -.0068843    .005287    -1.30   0.193    -.0172467    .0034781
totalexter~e |   .0027629   .0012799     2.16   0.031     .0002543    .0052714
debtservic~5 |   .0566863   .0213841     2.65   0.008     .0147743    .0985983
externalvu~6 |  -.0051053   .0032059    -1.59   0.111    -.0113888    .0011783
gengovdeb~p3 |   .1061502   .0363331     2.92   0.003     .0349386    .1773618
gengovdeb~e3 |  -.0164058    .007632    -2.15   0.032    -.0313643   -.0014474
gengovintp~e |  -.0848612   .0355572    -2.39   0.017    -.1545519   -.0151704
gengovfcfc~3 |   .0183632   .0118137     1.55   0.120    -.0047913    .0415177
domesticcr~c |    .010008   .0168322     0.59   0.552    -.0229826    .0429986
currentacc~p |   .1080011   .0541307     2.00   0.046     .0019068    .2140953
m2official~x |   .0968324   .0935994     1.03   0.301    -.0866191    .2802839
gdppercapi~s |  -.0002196   .0001139    -1.93   0.054    -.0004427    3.63e-06
nominalgdp~y |   -.045611   .0316984    -1.44   0.150    -.1077387    .0165167
realgdpcha~e |   .2256419   .1036738     2.18   0.030      .022445    .4288388
inflationc~c |   .0098488   .0218698     0.45   0.652    -.0330151    .0527127
grossinves~p |  -.0130146   .0570124    -0.23   0.819    -.1247569    .0987277
nominalexp~s |   .0038406   .0242705     0.16   0.874    -.0437286    .0514099
nominalimp~s |  -.0381856   .0267773    -1.43   0.154    -.0906681    .0142969
opennessof~1 |  -.0094528   .0115948    -0.82   0.415    -.0321783    .0132726
m2changede~c |  -.0119762    .022187    -0.54   0.589    -.0554619    .0315096
shorttermn~a |   .1347663   .0456735     2.95   0.003     .0452479    .2242847
netforeign~p |   -.308262   .1342137    -2.30   0.022    -.5713161    -.045208
totalliabd~h |   .0113888   .0028011     4.07   0.000     .0058986    .0168789
gengovreve~p |   .0531098   .1057772     0.50   0.616    -.1542098    .2604293
gengovexpe~p |  -.2030416   .1107858    -1.83   0.067    -.4201776    .0140945
       _cons |  -1.557562   2.786135    -0.56   0.576    -7.018287    3.903162
------------------------------------------------------------------------------
```

Appendix 5
Method 2 Relative Variables

```
. logit  crisisnextyear externaldebtgdp totalexternaldebtofficialforexre debtserv
> iceratio5 externalvulnerabilityindicator6 liquidityratio7 gengovdebtgengovreven
> ue3  gengovfcfcindexeddebtggdebt3 domesticcreditchangedecdec currentaccountbala
> ncegdp m2officialforexreservesx gdppercapitaus nominalgdpchangelocalcurrency re
> algdpchange inflationcpichangedecdec grossinvestmentgdp grossdomesticsavinggdp
> nominalimportsofgschangeusbasis opennessoftheeconomy1 shorttermnominalinterestr
> atepera totalliabduebisbankstotalassetsh gengovrevenuegdp gengovexpendituresgdp
>  gengovprimarybalancegdp

Iteration 0:   log likelihood = -158.88987
Iteration 1:   log likelihood = -102.79256
Iteration 2:   log likelihood = -89.618576
Iteration 3:   log likelihood = -85.736305
Iteration 4:   log likelihood =  -85.39217
Iteration 5:   log likelihood = -85.386745
Iteration 6:   log likelihood = -85.386743

Logit estimates                                   Number of obs   =        404
                                                  LR chi2(23)     =     147.01
                                                  Prob > chi2     =     0.0000
Log likelihood = -85.386743                       Pseudo R2       =     0.4626

------------------------------------------------------------------------------
crisisnext~r |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
externalde~p |  -.0584776   .0204909    -2.85   0.004     -.098639   -.0183162
totalexter~e |   .0018835   .0011188     1.68   0.092    -.0003093    .0040763
debtservic~5 |   .0659693   .0187566     3.52   0.000      .029207    .1027316
externalvu~6 |  -.0035042   .0028478    -1.23   0.219    -.0090857    .0020774
liquidityr~7 |  -.0131181   .0085227    -1.54   0.124    -.0298222     .003586
gengovdeb~e3 |   .0044145   .0029792     1.48   0.138    -.0014247    .0102536
gengovfcfc~3 |   .0334359   .0137371     2.43   0.015     .0065118    .0603601
domesticcr~c |    .011118     .01293     0.86   0.390    -.0142244    .0364603
currentacc~p |   .2448396   .0714834     3.43   0.001     .1047348    .3849444
m2official~x |   .0292387   .0966794     0.30   0.762    -.1602495    .2187268
gdppercapi~s |  -.0003754   .0001238    -3.03   0.002    -.0006181   -.0001327
nominalgdp~y |  -.0558275   .0249186    -2.24   0.025    -.1046671   -.0069879
realgdpcha~e |   .1895102   .0908081     2.09   0.037     .0115295    .3674909
inflationc~c |   -.001129   .0211418    -0.05   0.957    -.0425663    .0403082
grossinves~p |   .0382131   .0788679     0.48   0.628    -.1163652    .1927914
grossdomes~p |  -.0745182   .0655878    -1.14   0.256    -.2030679    .0540315
nominalimp~s |  -.0267957   .0223788    -1.20   0.231    -.0706573    .0170658
opennessof~1 |    .003948   .0103476     0.38   0.703    -.0163329    .0242289
shorttermn~a |   .1144223   .0399485     2.86   0.004     .0361246      .19272
totalliabd~h |   .0211518   .0056119     3.77   0.000     .0101527     .032151
gengovreve~p |    .318804   .1360396     2.34   0.019     .0521713    .5854367
gengovexpe~p |  -.2725153   .1186685    -2.30   0.022    -.5051012   -.0399293
gengovprim~p |  -.1167446    .124098    -0.94   0.347    -.3599722    .1264831
       _cons |  -6.340266   2.546645    -2.49   0.013     -11.3316   -1.348933
------------------------------------------------------------------------------
```

Appendix 6
Mehtod 3 Relative Variables

```
. logit  crisisnextyear shorttermexternaldebttotalextern externaldebtgdp external
> debtcareceipts4 totalexternaldebtofficialforexre debtserviceratio5 externalvuln
> erabilityindicator6 liquidityratio7 gengovdebtgdp3 gengovdebtgengovrevenue3 gen
> govintpymtgengovrevenue gengovfcfcindexeddebtggdebt3 domesticcreditchangedecdec
>  domesticcreditgdp currentaccountbalancegdp m2officialforexreservesx gdppercapi
> taus nominalgdpchangelocalcurrency realgdpchange inflationcpichangedecdec gross
> investmentgdp grossdomesticsavinggdp nominalexportsofgschangeusbasis nominalimp
> ortsofgschangeusbasis opennessoftheeconomy1 m2changedecdec shorttermnominalinte
> restratepera netforeigndirectinvestmentgdp totalliabduebisbankstotalassetsh gen
> govrevenuegdp gengovexpendituresgdp gengovfinancialbalancegdp gengovprimarybala
> ncegdp

Iteration 0:   log likelihood = -158.60214
Iteration 1:   log likelihood = -86.910995
Iteration 2:   log likelihood = -66.538201
Iteration 3:   log likelihood = -58.383937
Iteration 4:   log likelihood = -55.951122
Iteration 5:   log likelihood =  -55.57905
Iteration 6:   log likelihood = -55.565149
Iteration 7:   log likelihood = -55.565123

Logit estimates                                   Number of obs   =        402
                                                  LR chi2(32)     =     206.07
                                                  Prob > chi2     =     0.0000
Log likelihood = -55.565123                       Pseudo R2       =     0.6497

------------------------------------------------------------------------------
crisisnext~r |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
shortterme~n |   .1096302   .0514586     2.13   0.033     .0087731    .2104872
externalde~p |  -.1632609   .0417776    -3.91   0.000    -.2451434   -.0813783
externalde~4 |   .0041036   .0081557     0.50   0.615    -.0118813    .0200885
totalexter~e |   .0031183   .0017172     1.82   0.069    -.0002474     .006484
debtservic~5 |   .1023877   .0331805     3.09   0.002     .0373552    .1674202
externalvu~6 |  -.0076033   .0042179    -1.80   0.071    -.0158703    .0006637
liquidityr~7 |   -.033686    .015723    -2.14   0.032    -.0645025   -.0028694
gengovdeb~p3 |   .2001595    .066904     2.99   0.003     .0690302    .3312888
gengovdeb~e3 |  -.0175274   .0127501    -1.37   0.169    -.0425171    .0074624
gengovintp~e |  -.3319588    .112275    -2.96   0.003    -.5520137   -.1119039
gengovfcfc~3 |   .0609841   .0239237     2.55   0.011     .0140946    .1078736
domesticcr~c |   .0242475   .0214617     1.13   0.259    -.0178167    .0663118
domesticcr~p |  -.0523405   .0222551    -2.35   0.019    -.0959596   -.0087213
currentacc~p |   .0983692   .1702772     0.58   0.563     -.235368    .4321064
m2official~x |   .1489775   .1595594     0.93   0.350    -.1637532    .4617081
gdppercapi~s |  -.0004287   .0001845    -2.32   0.020    -.0007903    -.000067
nominalgdp~y |  -.0878757   .0358178    -2.45   0.014    -.1580774   -.0176741
realgdpcha~e |   .2007754    .120281     1.67   0.095    -.0349711    .4365219
inflationc~c |    .051031   .0291935     1.75   0.080    -.0061872    .1082491
grossinves~p |  -.1187868   .1531741    -0.78   0.438    -.4190026     .181429
grossdomes~p |   .1381016   .1532293     0.90   0.367    -.1622222    .4384255
nominalexp~s |  -.0033889   .0298797    -0.11   0.910     -.061952    .0551741
nominalimp~s |  -.0567211   .0350039    -1.62   0.105    -.1253273    .0118852
opennessof~1 |   .0346042   .0152702     2.27   0.023     .0046752    .0645332
m2changede~c |  -.0087695   .0257222    -0.34   0.733    -.0591841    .0416451
shorttermn~a |   .1265819    .054016     2.34   0.019     .0207124    .2324513
netforeign~p |  -.3684701   .1950548    -1.89   0.059    -.7507705    .0138303
totalliabd~h |   .0412467   .0097999     4.21   0.000     .0220392    .0604542
gengovreve~p |  -1.401249   2.789082    -0.50   0.615     -6.86775    4.065252
gengovexpe~p |   1.010814   2.774265     0.36   0.716    -4.426646    6.448273
gengovfina~p |   .2550265   2.730328     0.09   0.926    -5.096318    5.606371
gengovprim~p |   1.064031    .481992     2.21   0.027     .1193441    2.008718
       _cons |  -1.765115   4.008679    -0.44   0.660    -9.621982    6.091753
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Appendix 7 Marginal Effects of India

Regression Results	**Method 3 Full Set of Variables**	**Method 3 Reduced of Variables**
	Marginal Effect	Marginal Effect
External Debt (US$ Bil.)	0.000	0.014
Short-term External Debt/Total External Debt	0.000	0.020
External Debt/GDP	0.000	0.028
External Debt/CA Receipts	0.000	0.014
Interest Paid on External Debt (US$ Bil.)	0.000	0.014
Amortization Paid on External Debt (US$ Bil.)	0.000	0.014
Total External Debt/Official Forex Reserves	0.000	0.026
Debt Service Ratio	0.000	0.030
External Vulnerability Indicator	0.000	0.018
Liquidity Ratio	0.000	0.023
Gen. Gov. Debt (US$ Bil.)	0.000	0.014
Gen. Gov. Debt/GDP	0.000	0.076
Gen. Gov. Debt/Gen. Gov. Revenue	0.000	0.014
Gen. Gov. Int. Pymt/Gen. Gov. Revenue	0.000	0.058
Gen. Gov. FC & FC-indexed Debt/GG Debt	0.000	0.022
Domestic Credit (% change Dec/Dec)	0.000	0.014
Domestic Credit/GDP	0.000	0.023
Current Account Balance (US$ Bil.)	0.000	0.014
Current Account Balance/GDP	0.000	0.014
M2/Official Forex Reserves	0.000	0.014
Official Forex Reserves (US$ Bil.)	0.000	0.014
Nominal GDP (US$ Bil.)	0.000	0.014
GDP per capita (US$)	0.000	0.016
Nominal GDP (% change, local currency)	0.000	0.022
Real GDP (% change)	0.000	0.027
Inflation (CPI, % change Dec/Dec)	0.000	0.016
Gross Investment/GDP	0.000	0.036
Gross Domestic Saving/GDP	0.000	0.035
Nominal Exports of G & S (% change, US$ basis)	0.000	0.014
Nominal Imports of G & S (% change, US$ basis)	0.000	0.050
Openness of the Economy	0.000	0.021
Net Foreign Assets of Domestic Banks (US$ Bil.)	0.000	0.014
M2 (% change Dec/Dec)	0.000	0.014
Short-term Nominal Interest Rate (% per annum, Dec 31)	0.000	0.020
Net Foreign Direct Investment/GDP	0.000	0.017
Total Liab. due BIS Banks/Total Assets Held in BIS Banks	0.000	0.023
Gen. Gov. Revenue/GDP	0.000	0.097
Gen. Gov. Expenditures/GDP	0.000	0.053
Gen. Gov. Financial Balance/GDP	0.000	0.014
Gen. Gov. Primary Balance/GDP	0.000	0.071

Note: The marginal effect of a variable is defined as the change in probability of facing a future debt crisis when the 2006 values for India are increased by one standard deviation of the India-specific data