

IMPACT OF PROBABILITY OF CRISIS ON THE ECONOMY

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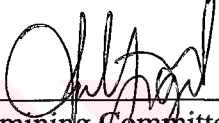
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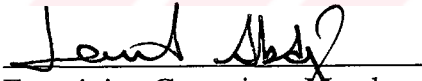
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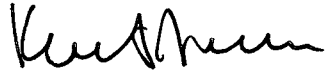
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ABSTRACT

IMPACT OF PROBABILITY OF CRISIS ON THE ECONOMY

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The increased frequency of financial crises in the last two decades led to a surge of interest in search for common elements of those crises and to the creation of early warning systems as instruments to avoid currency crises by predicting the timing of the crises. Along with the early warning systems, observation of increased frequency of crisis called forth deeper research of costs of crisis. This study combines both areas of research in it by employing a new econometric approach in assessing costs of crises. The study utilizes an early warning system in order to measure the impact of the predicted probability of crisis on the economy. Later on, the predicted probabilities of crises obtained are employed in a country-specific VAR system so as to come up with measures of consequences of currency crises. The study predicts crises for a sample of 15 emerging market economies over the period of 1980-2000. The costs of crises analysis for Latin American countries reveals that crises experienced during 1980-2000 caused significant amount of reduction in growth rates of output of those countries. Furthermore, the results

suggest that the slowdown in economic activity lasts no more than two years and then the economy recovers.

Keywords: Predicting Crises, Costs of Crises, Probit, VAR.



ÖZET

KRİZ OLASILIĞININ EKONOMİ ÜZERİNDEKİ ETKİSİ

Ersal, Eylem

Yüksek Lisans, İktisat Bölümü

Tez Danışmanı: Doç. Dr. Kıvılcım Metin Özcan

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Son yirmi yılda artan finansal krizler, bu krizlerin ortak elementlerinin araştırılmasına ve de krizleri engellemek adına krizlerin zamanlarının tahmin edilmesi için erken uyarı sistemlerinin geliştirilmesine yol açmıştır. Bu sistemlerin yanı sıra, artan krizler, kriz maliyeti konusunda daha derin araştırmalara çağrı olmuştur. Bu çalışma, bu iki araştırma alanını kriz maliyetini ölçmede kullandığı yeni ekonometrik yaklaşımla birleştirmiştir. Çalışmada, tahmin edilen kriz olasılığının ekonomi üzerindeki etkisini ölçmek için bir erken uyarı sisteminden faydalanılmıştır. Sonrasında, para krizlerinin sonuçlarını ölçmek için elde edilen olasılık değerleri her ülke için kurulan VAR sistemlerinde kullanılmıştır. Kriz olasılıkları, 1980-2000 dönemi ve 15 gelişmekte olan ülke için hesaplanmıştır. Yalnızca Latin Amerika ülkeleri için yapılan kriz maliyeti analizi, krizlerin büyüme hızlarında önemli miktarlarda düşüşe sebep olduğunu göstermiştir. Buna ek olarak, sonuçlar ekonomik aktivitedeki yavaşlamanın iki yıldan fazla sürmediğini ve sonrasında ekonominin toparlandığını göstermiştir.

Anahtar Kelimeler: Kriz Tahmini, Kriz Maliyeti, Probit, VAR.

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CHAPTER 1

Introduction

Crisis as a prominent problem is one of the dominant macroeconomic phenomenon of our age. The recent crises of 2000 and 2001 and previously the Asian crises were the latest in a series of currency crises that at various times in the post-Bretton Woods period have engulfed emerging market economies and industrial countries alike. The increased frequency of crises channeled the academic research into a surge of explicating the common elements of those crises and creating early warning systems as instruments to avoid currency crises by predicting the timing of the crises. Although it is difficult to fit the characteristics of crises into a single mold, some common features nonetheless stand out from the analysis of the behavior of various macroeconomic and financial variables. Typically, overvalued exchange rate, growing current account deficit and domestic credit expansion are observed prior to a crisis. Previously, the literature was shallow in its empirical side since the dataset and time period employed were narrow so as to come up with robust results in predicting the crises of in-sample and out-sample countries. However, recent usage of monthly data for more countries and longer periods and improved econometric techniques reinvigorated the literature on early warning systems and gave rise to the construction of new models with high predictive power.

Along with the early warning systems, observation of increased frequency of crises necessitated deeper research for costs of crises. Magnitudes of

contraction/expansion of economies following crises for short and long-term are still being questioned. Currency crises can be very costly in terms of fiscal and quasi-fiscal costs of restructuring the financial sector and more broadly in terms of the effects on economic activity of the inability of financial markets to function effectively. The output effects of a currency crisis may depend on a large number of factors: conditions prevailing in the real, external, financial sectors; fiscal and monetary policies implemented during the period; and structural characteristics of the economy. Debt overhangs and capital reversals are two of the fundamental causes of significant distortions experienced in the period of crisis. The reversal of capital inflows can increase the incidence of non-performing loans and cutting the credit underlying the longer-mature projects can reduce the productive activity (See Calvo (1998) and Calvo and Reinhart (1999)).

So far, it has often been mentioned that a country should set up a prudent infrastructure before opening its capital account. Strengthening of banking sector is one of the most important issues under that title. The weakness of the banking sector during the crisis period can magnify the disrupting effect of devaluation on the balance sheets of productive firms by giving rise to a “credit crunch”.

Another issue to be taken into account is surely the effects of crises on trade. In the trade-growth literature it is often emphasized that growth in export could serve as an engine of output growth. Since crises profoundly alter the trade flow with abrupt changes in exchange rate (commonly a devaluation), it may impinge on the ongoing course of growth severely. In theory, a real devaluation is expected to increase the competitiveness of exports of the country (see, e.g. Glick and Rose (1999)). However, if the competitors of the country undertake a similar devaluation, the expected expansion would not be realized. The so-called “beggar-thy-neighbor”

effect will prevent the economy from expanding its exports and will cause a contraction.

It is known that when the country experiences a speculative attack, government needs to make a tradeoff between output and inflation. When capital starts to flee from the country, government needs to choose between a contraction in real demand and depreciation. Generating a recession and reducing absorption would pull down output and letting the exchange rate to depreciate would inflict loss on international investors and reduce the magnitude of required transfer of resources. Therefore, costs of inflation during crisis episodes depend on the actions undertaken by the government. A bigger magnitude of change in growth of output during crisis increases the likelihood of a rise in inflation.

The goal of this thesis is to utilize an early warning system in order to measure the impact of the predicted probability of crisis on the economy. It is not an attempt to formulate or test specific theories, but rather to measure the effect of probability of crisis on a proxy to the level of the economic activity. The study looks at a sample of emerging market economies over the period of 1980-2000.¹ Chronology of crises for each country is presented in the appendix Table 2.1. The attempt of this text is to deduce generalized hypotheses on costs of probability of a crisis on financially open developing countries by merging early warning systems methodology and cost of crises analysis. The motivation of combining early warning systems methodology and cost of crises analysis lies in its evaluation of patterns of selected variables in tranquil, crisis and recovery periods. Using probability of crises instead of dates of crises enables one to capture the effects of vulnerability of the economy at each observation of the time interval analyzed.

¹ Argentina, Bolivia, Brazil, Chile, Colombia, Indonesia, Israel, Malaysia, Mexico, Peru, Philippines, Thailand, Turkey, Uruguay, Venezuela.

The paper contributes to literature in various ways. First, it is apparent that those two concepts, early warning systems and costs of crises, are examined separately in most of the works done. In this study, however, they will be combined and elaborated together in assessing the effects of crises on the economy. Although the main theme is to consider the effects of crises on the economy, new values of probability of crises are developed touching upon many cornerstone studies in this area. Until now, costs of crises are examined by using dates of crises as a binary variable in regressions or by setting event analysis frameworks. Unlike the previous cost of crises literature, this study evaluates the effects of crises for any period using the probability values between 1 and 0 that indicate the susceptibility (or proneness/hotness) of the economy to crises by constructing and attributing probability values for each period. Thus, the paper contributes to methodological issues by employing the probability of crisis estimated by a multivariate panel probit model in a vector autoregression system built for each economy.

The text will follow a route as the second chapter covering the literature on the early warning systems methodology through various applications and empirical studies. Chapter 3 explains the variables employed and the data structure. Chapter 4 then narrates the attainment of predicted probabilities and issues related to estimation of probabilities. The next chapter handles cost of crises literature. Chapter 6 goes on with construction of VAR systems for the economies of concern, and ends with the analysis of the results. Chapter 7 concludes.

CHAPTER 2

Anticipating Currency Crisis

2.1 Introduction

Before 90s, currency crises were thought to have a significant predictable component, as was captured in a series of first-generation models which assert that a fixed exchange rate policy combined with excessively expansionary pre-crisis fundamentals push the economy into crisis, with the private sector trying to profit from dismantling the inconsistent policies (Salant and Henderson (1978); Krugman (1979)). In these models unsustainable money-financed fiscal deficits lead to a persistent loss of international reserves leaving the exchange rate regime exposed to speculative attacks. The experiences of 1970s and 1980s support the predictions of first-generation models (Flood and Marion (1999)). However, the currency crises experienced in Europe (EMS collapses) in spite of the sound macroeconomic fundamentals challenged this view. New models focus on government officials' concern on unemployment. Expectations about the breakdown of the fixed exchange rate regime that led to higher domestic interest rates forced the governments to abandon the regime. Governments can keep the regime and thus continue the disinflation targets at the cost of loss of competitiveness and recession. However, devaluation may restore competitiveness and help in the elimination of unemployment. Particularly in economies with fragile banking systems, highly indebted firms and volatile financial markets, maintenance of fixed exchange rate became very costly. Thus, second generation models are designed to capture the

features of speculative attacks that are formed in spite of sound economic fundamentals.

More recently, the literature on capital inflows and capital inflow problems has suggested another potential source of instability (see, e.g. Montiel and Reinhart (1997) for a comprehensive review of the literature). Sudden reversals of capital flows may cause liquidity crises as happened in debt crises of 1982, the Mexican crisis in 1994 and the Asian crises in 1997-98. Thus, the liberalization of capital account transactions by allowing this type of short-term capital flows may contribute to the instability of the flow of reserves and inability of the country to peg the domestic currency.

Recent work on currency crises has focused in a broader set of indicators (see, e.g. Kaminsky (1999); Aziz et al. (2000); and many other studies that will be introduced in the subsequent section.). Especially after the currency crises of 1990s, which resulted in devastating economic, social and political effects, economists have had a renewed interest in understanding underlying elements. Especially, the contagion aspect of financial crises alarmed international organizations and private sector institutions and led them to spend intensive effort to develop models detecting the possibility of crises, namely, Early Warning Systems, which will be discussed in the proceeding part. Those models focus primarily on currency crises. Even though the ultimate causes of currency crises cannot be the same for each individual country and hence can be revealed best by country-specific analyses, it might be possible to identify a common pattern in the development of crises and delineate common symptoms and leading indicators of numerous crises experienced. In addition to inferring common indicators of crises, the aforementioned authors also try to construct methods that could assist in predicting the exact timing of currency crises

or a specific time horizon that a country becomes highly vulnerable and exposed to attacks.

Up to now, there has been several models built such as Kaminsky, Lizando and Reinhart's (1998) (KLR) leading indicators approach (IMF), Frankel and Rose's (1996) (FR) probit regression model, Sachs, Tornell and Velasco's (1996a) (STV) weak fundamentals approach, the Developing Country Studies Division (DCSD) model of Berg, Borensztein, Milesi-Ferretti and Pattillo (1999) (IMF), Policy Development and Review (PDR) model of Mulder, Perrelli and Rocha (2001) (IMF) and the model of Bussiere and Fratzscher (2002) (European Central Bank). In addition to those there are other private sector models as Goldman Sachs' GS-WATCH, Credit Suisse First Boston's Emerging Markets Risk Indicator and Deutsche Bank Alarm Clock. These models will be briefly reviewed together with critics addressed later on. Some specification issues of several selected models are presented in Table 2.2 in appendix.

2.2 Early Warning Systems

2.2.1 The leading indicators approach: Kaminsky-Lizando-Reinhart (KLR) Model

The leading indicators approach of KLR is based on monitoring the evolution of a large number of macroeconomic and financial variables exhibiting a deviant behavior in periods preceding a crisis. When an indicator variable exceeds a formerly designed indicator-specific threshold value, a warning signal about an upcoming crisis in the following months is issued. After consolidating the large group of indicators that are gathered from previous works, over 60 variables of ten categories

are picked.² A currency crisis is defined to occur when a weighted average of monthly percentage depreciations in the exchange rate and monthly percentage declines in reserves exceeds its mean by more than three standard deviations. The approach is applied on a dataset of 20 countries, including 15 emerging and 5 industrialized countries, over the sample period of 1970-1995. Indicators that have proven to be particularly useful in anticipating crises include the behavior of international reserves, the real exchange rate, domestic credit, credit to the public sector and domestic inflation.

Later in 2000, Goldstein, Kaminsky and Reinhart update the KLR model by adding new variables and find that on a monthly basis real exchange rate appreciation, banking crisis, equity prices, exports, ratio of broad money to reserves and a recession have high predictive power whereas on an annual basis current account deficit relative to both GDP and investment performs revealing.

Bussiere and Fratzscher (2002) criticize that threshold approach is not reasonable in the sense that it causes loss of information since above the threshold any level would provide the same information although it is not. Moreover, they state that it is difficult to rank situations in terms of vulnerability, because at each time different variables would be in the critical zone. Berg and Pattillo (1999) state that KLR approach produces predictions, which are better than guesses, and has a successful out-of-sample performance. However, they also point out that overall explanatory power is fairly low and weighted-sum based probabilities have lower predictive power compared to ones gathered by probit estimation.

² Categories are: 1) capital account; 2) debt profile 3) current account 4) international variables; 5) financial liberalization; 6) other financial variables; 7) real sector; 8) fiscal variables; 9) institutional/structural factors; 10) political variables.

2.2.2 Probit Regression Model: Frankel-Rose (FR) Model

In Frankel-Rose model, a panel of annual data for over 100 countries is examined in the sample period of 1971-1992. They define a currency crash as a nominal exchange rate depreciation of at least 25 percent that also exceeds the previous year's change in the exchange rate by at least 10 percent. This definition omits unsuccessful speculative attacks. They use a multivariate model where all variables are employed simultaneously and estimate probit models pooling all the available data across both countries and time.³ FR tests the hypothesis that certain characteristics of capital inflows are positively associated with the occurrence of currency crashes. The results show that the probability of a crisis increases when output growth is low, domestic credit growth is high, reserves as a share of M2 are low, the real exchange rate is overvalued, the fiscal and current account deficits are high, external concessional debt and FDI is small, the economy is more closed and foreign interest rates are high. Additionally, neither current account nor government budget deficits appear to play an important role in a typical crash.

Berg and Pattillo (1999) remark that although the use of annual data may restrict applicability of the approach as an early warning system, it allows the analysis of variables such as the composition of external debt for which higher frequency data is rarely available. Furthermore, they state that the model fails to provide useful guidance on probability of crises in out-of-sample predictions.

³ Variables are: 1) commercial bank debt; 2) concessional debt; 3) variable-rate debt; 4) short-term debt; 5) FDI; 6) public sector debt; 7) multilateral debt; 8) the ratio of international reserves to monthly percentage of imports; 9) the current account as a percentage of GDP; 10) external debt as a percentage of GNP; 11) real exchange rate divergence; 12) government budget as a percentage of GDP; 13) percentage growth rate of domestic credit; 14) percentage growth rate of real output per capita; 15) foreign interest rate; 16) northern growth rate.

2.2.3 Weak Fundamentals Approach: Sachs-Tornell-Velasco (STV) Model

In this study, financial events following the devaluation of the Mexican peso are examined to uncover lessons about the nature of financial crises. In STV model, occurrence of crises is analyzed according to three variables, real exchange rate overvaluation, increase in commercial bank lending and level of international reserves. Countries with overvalued exchange rates and weak banking systems (weak fundamentals) are likely to suffer from severe crisis only if they have low reserves relative to monetary liabilities. A country with low reserves could not accommodate capital outflows, and weak fundamentals avoid the country from fighting the attack with high interest rates. Consequently, the economy succumbs and the attack is successful. For the sample of 23 countries, the crisis index is regressed on linear and nonlinear interactive combinations of three variables for the turmoil period of mid-90s.⁴ In their reproduction of STV model Berg and Pattillo mention that none of the forecasts of this model performs well. Later on, Tornell (1998) updates this model by stacking observations from 1995 and 1997 crises and finds that this new model fits fairly well and produces good predictions.

2.2.4 Multinomial Probit Technique: Developing Country Studies Division (DCSD) Model of Berg, Borensztein, Milesi-Ferretti and Pattillo

The DCSD model of Berg and Pattillo also employs a panel-probit model. In the paper, besides reproducing the KLR results, the authors modify the dataset and

⁴ The crisis index is a weighted average of percent change in reserves and the devaluation rate with respect to U.S. dollar.

examine it within a multivariate probit framework.⁵ The model is obtained using the same crisis definition and 45 KLR variables plus three additional variables, then simplifying by dropping insignificant variables. The additional variables are the level of M2/reserves, the current account to GDP ratio and the ratio of short-term debt to reserves. The results indicate that the most significant variables are real exchange rate relative to trend, current account deficit, reserves growth, export growth and the ratio of short-term debt to reserves.

2.2.5 Policy Development and Review (PDR) model of Mulder, Perrelli and Rocha

The third model produced by IMF staff is PDR model, which incorporates balance sheet variables into the DCSD model. They find that leveraged financing and a high ratio of short-term debt to working capital at the corporate level, balance sheet indicators of bank and corporate debt to foreign banks as a share of exports, and a legal regime variable as a proxy to shareholders' rights have significant explanatory power.

2.2.6 Multinomial Logit Technique: European Central Bank Model of Bussiere and Fratzscher

This new model uses multinomial logit technique to predict crisis probability within a specific time horizon. They use a monthly data set for 32 emerging market economies for the years 1993 to 2001 considering the period of integrated capital markets. They criticize existing models by developing a new concept as post-crisis

⁵ They omit the five European countries of KLR country sample and add other emerging market economies. Also they estimate only through April 1995.

bias. They put forward that separating time into three states as pre-crisis periods, post-crisis periods and tranquil periods help out to get rid of this bias. The logic behind this new division is the significantly different patterns of variables in tranquil and recovery (post-crisis) periods. They also employ contagion indicators. They find that using multinomial logit reduces number of false signals and missed crisis.

2.2.7 Private Sector Models

Following the Asian crises, most major banks and financial institutions developed their in-house early warning systems. Those models attempted to assess values and risks in emerging market economies and to set foreign currency trading strategies. Although most of those models are abandoned, the increased volatility in emerging markets in 2000 and 2001 brought out new private models.

i) Goldman Sachs's GS-WATCH

They use a logit regression to illustrate the likelihood of a crisis occurring within three months. The predictor variables include credit booms, real exchange rate misalignment, export growth, reserve growth, external financing requirements, changes in stock prices, political risk, contagion, and global liquidity.

ii) Credit Suisse First Boston's emerging Markets Risk Indicator (CSFB)

They also use a logit model employing real exchange rate deviations from trend, the ratio of debt to exports, growth in credit to the private sector, output changes, reserves to imports, changes in stock prices, oil prices, and a regional contagion dummy.

iii) Deutsche Bank Alarm Clock (DBAC)

They define separate exchange rate and interest rate "events" as depreciations and jointly estimate the probability of these two events allowing bi-directional

influence within each other. Exchange rate event is regressed on changes in stock prices, domestic credit, industrial production, real exchange rate deviations and a contagion variable. They also calculate an “action trigger” to identify cut-off probability levels at which investors should change their positions by maximizing the profits of the investor at the time.



CHAPTER 3

Data and Empirical Analysis

3.1 Data and Variables

The information provided in recent research discussed in previous section and numerous varied experiences with currency crisis reveal that some variables are quite significant in their contribution to the prediction of crises. Main indicators that will be employed in prediction of probability of crises, classified by category, are as follows:

External sector variables

Capital account problems of a country may be an important component of the underlying reasons of crisis. Those problems may become more severe when the country's foreign debt is large and capital flight increases.

Amount of international reserves held, as mentioned in STV model, is crucial before or during a crisis. A stock of strong reserves helps the policymakers to fight with speculative attacks. Also consistently decreasing reserves is an accurate signal of market pressure and a possible subsequent crisis. The data for international reserves is taken from International Financial Statistics of IMF and is calculated as 12-month percent change in reserves.

The differential between foreign and domestic real interest rate may anticipate currency crises as high world interest rates, which is US real interest rates in this study, may lead to capital outflows. One should also note that world interest

rate acts as a channel that transmits external shocks to the economy. Both are employed in the analysis the differential and world interest rates.

Current account is the other foot of external sector, and deterioration in current account is a part of a currency crisis. Growth rates of exports and imports, trade balance, terms of trade and current account to GDP ratio are measures of current account employed in the analysis. Large negative shocks to exports, terms of trade and positive shocks to imports are interpreted as symptoms of financial crises. Required data is taken from IFS CD-ROM.

Real exchange rate is important in its interaction with volumes of export, import, since it is a good measure of trade competitiveness of the economy. Moreover, it also affects capital account movements. Because the financial investors try to avoid short-term capital losses, they flee from countries in which they expect that large nominal exchange rate depreciation will soon take place. A real exchange rate appreciation during the capital inflow period, relative to past average values, indicates a greater risk of currency depreciation. Also, lack of confidence in the program or policymakers increases the pressure on the exchange rate, which after the crisis makes a huge upward jump. Furthermore, real exchange rate overvaluations and a weak external sector contribute to the vulnerability of the economy. The real exchange rate is derived from a nominal exchange rate index, which is adjusted for relative consumer prices. The measure is defined as the relative price of foreign goods (in domestic currency) to the price of domestic goods. The nominal exchange rate index is a weighted average of the 19 OECD countries. The deviations are calculated by regressing the exchange rate index on a time trend. The specification of the trend (log, linear or exponential) is selected on a country-by-country basis to capture the best fit.

Financial sector variables

Currency crises have been linked to rapid growth in credit experienced in the pre-crisis period. Loose monetary policy can fuel a currency crisis (see Krugman 1979). Domestic credit and money multiplier are employed in the analysis to assess this effect. Domestic credit is obtained both by calculating the growth rate of domestic credit and domestic credit-GDP ratio in real terms. Money multiplier is calculated as the 12-month percent change in the ratio of broad money to base money.

To calculate the difference between money demand and money supply a variable called “Excess” real M1 balance is defined as in Kaminsky and Reinhart (1999). It is the percentage difference between actual M1 in real terms and an estimated demand for money; the latter is assumed to be a function of real GDP, domestic inflation and a time trend.

Another important variable is M2 over reserves ratio. M2 includes the potential amount of liquid monetary assets that agents can convert into foreign exchange. If this ratio is high, a self-fulfilling panic among investors is more likely to occur. The data is taken from IFS and the variable is utilized both in level and as growth rate.

An increase in lending-deposit interest rate spread in the domestic economy can capture a decline in loan quality. High real domestic interest rates could also be a sign of liquidity crunch leading to a slowdown and banking fragility. Change in bank deposits could also be the sign of vulnerability in the sense that bank runs precede most banking and currency crises (see Dornbusch et al. (1995)).

Real sector

Industrial production growth and real GDP growth are employed interchangeably to assess the effects of recessions and the decline in real sector of the economy on the whole economic situation. Industrial production is taken from IFS of IMF and GDP is gathered from World Economic Outlook by interpolation of quarterly (and when not available annual) data. Growth rate of unemployed population is also included in the empirical analysis. Source of the data is either IFS or ILO statistical reports compiled due to each one of the data set being rudimentary.

In addition to recessions, stock prices are also used as a variable for the real sector, since burst of asset bubbles precede financial crises (see Calomiris and Gorton (1991)). As for growth rate of unemployed population data, source of the data is either IFS or International Finance Corporation (IFC) depending on availability of data for the specific country.

Fiscal Sector

Government budget surplus/deficit is used as a proxy to fiscal deficits and public debt, which may sometimes be the sole (as in debt crises) or part of the problems underlying the crises. The data is taken from IFS CD-ROM. When available, it is used in monthly basis, and when not, it is interpolated from quarterly data.

Banking Crises

Since the mid-1980s, banking crises have come to the forefront of international economics. If the banking sector is not sound and or is already experiencing a crisis around the time of the currency crisis, the supply of domestic credit to domestic firm is likely to get disrupted. With devaluation adversely

affecting the balance sheets of their clients and a rise in non-performing loans, banks may roll back their lending activities or go bankrupt.

Although the concrete direction of causality between banking and currency crises could not be verified unambiguously, it is possible to state inferentially that they are related. For instance, in the “Twin Crises” Kaminsky et al. suggest that banking crises do not lead to currency crises, however if the banking system is vulnerable at the time of crises it collapses during crises and deepens the impacts of crises.

For all these variables (with the exception of deviation of the real exchange rate from trend, the “excess” of real M1 balances), the variable on a given month is defined as the percentage change in the level of the variable with respect to its level a year earlier. Filtering the data by using the 12-month percentage change ensures that the units are comparable across countries and that the transformed variables are stationary with well-defined moments, and free from seasonal effects. Additionally, a table of variables with expected signs and explanations of their effects is included in appendix (see Table 3.1).

The data set used is largely taken from International Financial Statistics database of IMF. Despite the breadth of the database, it should be noted that the data availability of a variable could differ substantially across countries and within the time interval for a specific country.

In this study instead of creating market pressure indexes using changes in international reserves, interest rates and exchange rates, dates of crises are used for the creation of the probability of crises that are taken from the Kaminsky & Reinhart, 1999 and updates. The reason is that, the analysis in this thesis does not claim a success in predicting the exact timing of crises. Free from the time of the crisis, the

main endeavor here is to present a new approach in assessing the cost of crises, which utilizes the newly developed early warning system procedures.

3.2 Methodology

Data sets that combine time series and cross sections are common in tracking the explanatory power of various indicators employed to assess timing of crises. Modeling in this setting, however, requires complex specifications. The fixed effects model is a reasonable approach when it is for sure that the differences between units can be viewed as parametric shifts of the regression function, that the sample employed is the population. When the population appears to be the sample, then there will be fixed parameters across cross-sectional units. However, in the setting of this study only 15 of all developing countries are analyzed, which means that individual specific constant terms are randomly distributed across cross-sectional units. This specification is denoted as,

$$Y_{it} = \alpha + \beta x_{it} + \varepsilon_{it}$$

where $\varepsilon_{it} = u_i + m_{it}$ and u_i characterizes each cross-sectional unit and constant over time.

Since in probit model the conditional probability approaches one or zero with higher rate, it might yield better estimation results than the logit model when studying financial crises. The probit analysis model, called Goldberger (1964), assumes that there is an underlying response variable y^*_{it} , which is unobservable, defined by the regression relationship,

$$y^*_{it} = \beta x_{it} + u_i$$

y^*_{it} is defined such that

$y=1$ if there is a crisis in the period

$$y=0 \text{ otherwise}$$

Then the probability of crisis is derived from the cumulative distribution function $\Phi(\beta x_{it})$ after estimating

$$\text{Prob}(y_{it}=1 | \mathbf{x}_{it}) = G(\beta x_{it})$$

In this study a multivariate model is estimated where all the variables are employed simultaneously. Monthly data for 15 countries over the period 1980-2000 is employed. To avoid simultaneity bias that may occur, the dependent variable “crisis” is regressed on one month lagged variables.



CHAPTER 4

Estimation and Results

Finding the predicted probability values for crises, different empirical specifications are estimated in order to obtain the best fit. As explained above, there are two alternatives in measuring the effect of the variables domestic credit expansion, growth rate of output, M2-reserves ratio and M2 multiplier. The best of each pair is selected based on the amount of explanatory power created by different combinations, after controlling for econometric issues.

To obtain the most information from the wide set of variables mentioned above and to cope with multicollinearity problems, instead of dropping variables principal components are constructed for each category defined in the previous section. We skipped fiscal sector since the data available for this category is very limited.

Table 4.1 Random Effects Panel Probit Model

Random-effects probit	Number of obs	=	2597	
Group variable (i) : id	Number of groups	=	15	
Random effects u_i ~ Gaussian	Obs per group: min	=	82	
	avg	=	173.1	
	max	=	243	
Wald chi2(3)	=	48.73		
Log likelihood	= -164.06622	Prob > chi2	= 0.0000	
crisis	coefficient	Std. Err.	z	P> z
real sector**	0.167305	0.073231	2.28	0.022
external sector*	-0.36511	0.063877	-5.72	0
financial sector*	-0.25173	0.06374	-3.95	0

Panel probit estimation of crisis model for twelve countries over 1980-2000. Monthly data.

* denotes that the variable is significant at the 99% confidence level. ** denotes that the variable is significant at the 95% confidence level.

The large value of the Wald test statistic points at the total significance of the variables in explaining the dependent variable. Since the coefficients gathered by probit are hard to interpret and computing marginal effects for vectors obtained by principal components is meaningless, they will not be analyzed. Moreover, evaluating signaling power of the variables employed is beyond the scope of this study. The predicted probability values of crises for Latin American countries are in the appendix (Figure 1).⁶



⁶ We depicted the probabilities only for Latin American countries since they will be investigated in the cost of crisis framework as a case study.

CHAPTER 5

Costs of Crises

5.1 Introduction

Currency crises are not neutral and have effects on various sectors of an economy both in short and long-run. In this section, the predicted probabilities of crises obtained in the previous section will be employed so as to come up with measures of consequences of currency crises. Different than the previous work, instead of using trends of several variables or crisis dates to acquire necessary information for drawing inferential statements about costs of crises, this study employs predicted probabilities and reveals the pattern followed by the examined variable before during and after the crises in a structural VAR system for each economy. Thus, this approach is valuable not only in assessing the outcomes of crises, but also in assessing the explanatory power of various variables in signaling currency crises. As opposed to many studies held, this study is not limited to any single crisis episode due to the broad time horizon included in the research. Although it is possible to implement this methodology for a wide set of countries, only the Latin American case will be elaborated in this study for tractability reasons.

5.2 Theoretical and Empirical Literature on Costs of Crises

Financial crises can be very costly, both in terms of fiscal and quasi-fiscal costs of restructuring the financial sector and more broadly in terms of the effect on economic activity due to the inability of financial markets to function effectively.

The effects of a currency crisis on the economy may depend on a large number of factors: conditions prevailing in the real, external, and financial sectors; fiscal and monetary policies implemented during the period; and the structural characteristics of the economy. Debt overhangs during crisis can conduce to hinder aggregate investment and economic activity and since most of the developing countries' external debt is denominated in foreign currencies, they are particularly vulnerable to this effect, which may be one of the reasons of observing the negative effect of an increase in probability of crisis on output in the sample (see Calvo (1998) and Mishkin (1999)). Capital reversal is one of the fundamental causes of significant distortions experienced in the period of crisis. The reversal of capital inflows can increase the incidence of non-performing loans and cutting the credit underlying the longer-mature projects can reduce the productive activity (see Calvo (1998) and Calvo and Reinhart (1999)). Moreover, Rodrik and Velasco (1999) has highlighted that the capital flow reversal that creates difficulties in rolling over short-term debt can also shrink the level of economic activity by squeezing the liquidity available within the economy.

So far, it has often been mentioned that a country should construct an infrastructure of prudence before opening its capital account. Strengthening of banking sector is one of the most important issues under this title. The weakness of the banking sector during the crisis period can magnify the disrupting effect of devaluation on the balance sheets of productive firms by giving rise to a "credit crunch". Mishkin (1999) claims that such a contraction in credit brought about by banking sector problems aggravates the crisis in emerging markets and the reduction in economic activity. It is also argued that the liberalization of the external capital account without taking regulatory and strengthening actions becomes a source of

external vulnerability and thus a severe cause of a reduction in the growth of the economy (see Furman and Stiglitz (1999) and the World Bank's Global Economic Prospects (1997/98)).

Another issue to be taken into account is surely the effects of crises on trade. In the trade-growth literature it is often emphasized that growth in export could serve as an engine of output growth. Since crises profoundly alter the trade flow with abrupt changes in exchange rate (commonly a devaluation), it may impinge on the ongoing course of growth severely. In theory, a real devaluation is expected to increase the competitiveness of exports of the country (see, e.g. Glick and Rose (1999)). However, if the competitors of the country undertake a similar devaluation, the expected expansion would not be realized. The so-called "beggar-thy-neighbor" effect will prevent the economy from expanding its exports and will cause a contraction.

It is known that when the country experiences a speculative attack, government needs to make a tradeoff between output and inflation. When capital starts to flee from the country, government needs to choose between a contraction in real demand and depreciation. Generating a recession and reducing absorption would pull down output and letting the exchange rate depreciate would inflict loss on international investors and reduce the magnitude of required transfer of resources. Therefore, costs of inflation during crisis episodes depend on the actions undertaken by the government. Another study claims that prices respond positively to any deviation of real output from trend (Christiana Romer (1996)). Therefore a bigger magnitude of change in growth of output during crisis increases the likelihood of a rise in inflation.

As the theoretical literature differs in its explanations of costs of crises, there are two opposing views on the effects of a currency crisis in empirical literature. The traditional view is that, with price and wage rigidities, a sharp nominal devaluation would produce a real depreciation in the short-run, increase exports and stimulate employment and output. By contrast, an alternative view is that sharp devaluation could have contractionary effect, working through such channels as a wealth effect on aggregate demand, higher production costs, disruption in credit markets, or a sudden cessation in capital inflows limiting imported capital goods (as in Moreno (1999)). In addition to the discussion about the sign of the effect, views about the persistency of the effects of currency crises, in other words factors that cause the difference in sign or persistency of the effects of currency crises also vary. Furthermore, the empirical literature differs in the samples used (such as studies that focus on single crisis episodes such as Mexican crisis or Asian crisis-e.g. Calvo and Mendoza (1996); Lane and Phillips (1999); Calvo and Reinhart (1999)- and studies that analyze output developments in a broader sample of countries- e.g. Milesi-Ferretti and Razin (1998 and 1999), Aziz et al. (2000), Bordo et al. (2001), Barro (2001), Gupta et al. (2000), Hutchison (2001) and Hutchison and Neuberger (2001a, b)). In the proceeding part several different studies and views will be overviewed and assessed.

Cerra and Saxena (2003) examine whether a recession following a crisis permanently lowers the level of output. They investigate the extent to which output has recovered in the aftermath of the Asian crisis. A regime-switching approach that introduces two state variables is used to decompose recessions in a set of six Asian countries into permanent and transitory components. It is found out that while growth

recovered fairly quickly after the crisis, there is evidence of permanent losses in the levels of output in all of the countries studied.

However, Barro (2001) does not detect a persistent adverse influence of currency and banking crises on long-run economic growth. A panel analysis for a group of five East Asian economies shows that in 1997-98, crisis reduced economic growth over a five-year period by 3% per year. Analysis for a broader set of countries revealed that over the same horizon, crises reduce economic growth by 2% and no evidence is found supporting the persistent adverse effects of crises on economic growth. Park and Lee (2002) find that a V-shaped pattern of growth is associated with crises.

Alternatively, using a panel data set over the 1975-97 period and covering 24 emerging-market economies in their study, Hutchison and Neuberger (2001) find out that currency and balance of payments crises reduce output by about 5-8 percent over a two-three year period. This adverse effect is two to four times larger than the average output loss in a developing economy. Typically, growth tends to return to trend by the third year following the crisis. The large output costs are likely related to their dependence on private capital markets and abrupt reversals in capital inflows that in turn force substantial real-side adjustment.

Greene (2002) examines whether capital outflows may have contributed to output declines during the Asian crises by reducing the financing available for domestic investment. Panel data regressions built suggest a positive, short-term relationship between net capital inflows and investment during the period before 1997 in five Asian countries once real net capital flows are netted out from real flows of private bank credit.⁷ In addition, net real private inflows and real private

⁷ Indonesia, Korea, Malaysia, Philippines, Thailand.

investment appear to have been cointegrated in at least three of these countries, suggesting a long-term relationship as well.

Aziz et al. (2000), comparing GDP growth after a crisis with trend GDP growth, assert that, for approximately 40 percent of crises output growth returned to trend in a little more than 1.5 years time. It is also estimated that the average recovery time is shorter in emerging market countries than in industrial countries, although the cumulative output loss on average is larger. The authors suggest that this difference in recovery time and cumulative output losses may be due to the higher mean and variance of output growth in emerging market economies compared to industrial economies.

Gupta et al. (2001) discuss whether currency crises are necessarily contractionary. They find that more than 40 percent of the 195 crisis episodes across 91 countries have been expansionary and reject the notion that output severity of crises has risen over time. However, they do not find that large and more developed countries are often more subject to contraction during crises than small economies. In addition, this paper identifies factors that contribute to such diverse growth effects. The authors find that crises that are preceded by large capital inflows occur at the peak of an economic boom, under a relatively free capital mobility regime, and in countries that trade less with the rest of the world, are more likely to be contractionary in the short-run. The growth effects get further exacerbated in the short-run if trade competitors devalue, crude oil price rise, and post-crisis period is marked by tight monetary policy. However, large private capital flows, which could be detrimental to growth in a crisis environment, are found to be beneficial to growth in the long-run, posing an important “short-versus-long-run” policy trade-off for developing countries.

Ranciere et al. (2003) discusses that growth and welfare can be higher in crisis prone economies. They show that there is a robust empirical link between per-capita GDP growth and negative skewness of credit growth across countries with active financial markets. That is, countries that have experienced occasional crises have grown on average faster than countries with smooth credit conditions.



CHAPTER 6

Data and Empirical Analysis

6.1 Methodology

After obtaining the predicted probability values, the next step is to assess the effects of those values on the economy. In order to evaluate those effects, we constructed an unrestricted VAR equations system in which the effect of probability of crisis on growth rate of output is sought. The systems incorporate probability of crisis, inflation real exchange rate and growth rate of GDP as variables. For each country, the optimal lag length is selected according to Akaike, Schwarz and Hannan-Quinn information criteria, final prediction error and sequential modified likelihood ratio test. For tractability reasons, the VAR framework is constructed for the Latin American countries only.⁸ In the following section, the results driven from the estimation of the model are analyzed.

6.2 Estimation and Results

The output of the estimation of the model gave the impulse responses that enable us to interpret the sign and significance of relations within exogenous variables and endogenous variables. It is important to mention that the band in the graphs shows a significant response of the variable of concern whenever the line zero is not included in the band. The horizontal axis demonstrates the number of months

⁸ Argentina, Bolivia, Brazil, Chile, Colombia, Mexico, Peru, Venezuela

at which the effect of the shock is examined. The graphs are in the appendix (Figure 2).

As seen in the graphs, an increase in the probability of crisis, for most of the economies, causes a reduction in the growth rate of output. In Argentina, growth rate of output significantly falls down and keeps decreasing until the 11th month. For Bolivia, the impact of probability of crisis seems insignificant, although the two-standard deviations band is falling below zero. The pattern of growth of output is different for Brazil because the detrimental effect of crisis is significantly seen after a year the shock is given. The contractionary period for Brazil lasts for almost a year. The Chilean economy is also adversely affected by the probability of crisis, however output recovers faster than the Argentina case, approximately in six months. Furthermore, the country experiences an almost significant jump in the growth rate of output after the contraction, which soothes after the 32nd month. Colombia is one of the cases in which output slowdown is clearly seen and it lasts more than two years (26 months). The impulse response of Mexican economy is quite similar to that of Colombia except that the contraction lasts for 24 months. In Peru, the economy is significantly affected by the probability of crisis and the effect of shock persists for 2 years as in Mexico. Venezuela, like Brazil, experiences a late reduction in its growth rate of output, which lasts approximately four months.

The magnitudes of reductions are changing and they are more restricted for Bolivia. Analyzing the probability values graphed in the appendix for the previous chapter reveals that the predicted probabilities for Bolivia has big gaps and the behavior of output in this case can be attributed to the significant amount of missing data. Except Bolivia, the probability of crisis negatively affects the growth rate of

output. Especially, in Argentina, Mexico, Colombia and Peru, currency crisis significantly wards off output growth.

In developing countries, any crack in the confidence of investors reverses the direction of flow of capital. Due to capital outflows, developing countries undergo a shortfall of credit during crisis episodes, which is the main reason of slowdown observed in every sector. In this perspective, it is reasonable that output growth rates of most of the countries examined undergo a fall behind trend.

The evidence drawn from the estimation output realizes the theoretical explanations summarizing the contractionary effects of crises as in Moreno (1999). The increase in exports due to devaluation is suppressed by the decline in aggregate demand, which in turn reduces the economic activity in the country. In each country, a positive change in the probability of crisis adversely affects growth rate of output in the wake and aftermath of crisis. Although, it would be a fallacy to classify them as sole underlying reasons of contraction during crisis episodes, it is clear that none of the country experiences in our sample reveals an expansionary effect in contrast to the theory of Gupta, Mishra and Sahay (2003).

One other discussion in the literature of output cost of crises is about the persistency of the effect of crises. Although, we did not measure the effect of crisis on output level, based on our findings we can state that all of the countries in our sample that experiences a significant fall in their rates of growth of output enter into a recovery period after approximately 20 months (Argentina, Mexico and Colombia). This result is similar to findings of Aziz et al. (2000).

Inevitably, the severity of crises and many other prevailing conditions of the time covered here affect the results, but it is obvious that in the Latin American case,

as a part of developing country context, currency crises are expected to reduce growth rate of output for a period of approximately and at most two years.



CHAPTER 7

CONCLUSION

The increased frequency of crises in the last two decades aroused interest in investigating various aspects of crises. The costly experience of currency crises invigorated empirical studies that are developed to find variables with high signaling power. Under the leadership of international institutions like IMF, private international financial institutions and central banks of many countries early warning system models are created as instruments to avoid currency crises by predicting the timing of the crises. In addition to these recent improvements in this research area, investigating the costs of a crisis has also gained importance. Since financial crises can be very costly, both in terms of fiscal and quasi-fiscal costs of restructuring the financial sector and more broadly in terms of the effect on the economic activity due to the inability of financial markets to function effectively, different methodologies developed and results are still ambiguous.

In line with these practices, we constructed a model that predicts probability of crises molding three variables as real sector, external sector and financial sector combining the explanatory power of various variables using principal components. The main ambition in this study is to utilize the early warning system procedure to come up with consequences regarding the cost of crises.

The predicted probabilities attained from a multivariate panel probit framework are employed in an unrestricted VAR system constructed for each economy. We restricted the sample to Latin American countries in the analysis of

impulse response of growth rate of output to a positive change in the probability of crises. The results indicate that six of the nine countries examined experiences a slowdown in their rates of growth of output. Although the time required for recovery changes for each country, in the countries that we observed the most severe reduction, economic activity takes off after the 20th month on average. Therefore, we can state that, change in growth rate of output caused by detrimental effects of currency crises is not permanent. Although the methodology we used is brand-new in the literature and should be improved and extended, our results make a consistent inference for the contractionary effects of currency crises for developing countries.



SELECT BIBLIOGRAPHY

- Adelman, I. and E. Yeldan. 2000. "The Minimal Conditions for a Financial Crisis: A Multiregional Intertemporal CGE Model of the Asian Crisis", *World Development* 28 (6), 1087-1100.
- Altomonte, C. and C. Guagliano. 2001. "Competing Locations? Market Potential and FDI in Central and Eastern Europe vs the Mediterranean", *Licos Discussion Paper*
- Aziz, J., F. Caramazza, and R. Salgado. 2000. "Currency Crises: In Search of Common Elements", *IMF Working Paper* 00/67.
- Barro, R. 2001. "Economic Growth in East Asia Before and After the Financial Crisis", *NBER Working Paper*, No. 8330.
- Beckmann, D. and L. Menkhoff. 2004. "Early Warning Systems: Lessons from New Approaches", In: Michael Frenkel, Alexander Karmann and Bert Scholtens (Eds.), *Sovereign Risk, Financial Crises and Stability*.
- Berg, A. 1999. "The Asia Crisis: Causes, Policy Responses, and Outcomes", *IMF Working Paper* 99/138.
- Berg, A. and C. Pattillo. 1999. "Are Currency Crises Predictable? A Test", *IMF Staff Papers* 46 (2).
- Berg, A. and C. Pattillo. 1999. "Predicting Currency Crises: The Indicators Approach and an Alternative", *Journal of International Money and Finance* 18:561-586.
- Berg, A. and C. Pattillo. 2000. *The Challenge of Predicting Economic Crises*. International Monetary Fund, Washington, DC.
- Berg, A., E. Borensztein and C. Pattillo. 2004. "Assessing Early Warning Systems: How Have They Worked in Practice?", *IMF Working Paper* 04/52.
- Bordo, M., B. Eichengreen, D. Klingbiel and M. S. Martinez-Peria. 2001. "Financial Crises", *Economic Policy*, April.
- Burnside, C., M. Eichenbaum, and J. D. M. Fisher. 2003. "Fiscal Shocks and Their Consequences", *NBER Working Paper*, No.9777.

- Burnside, C., M. Eichenbaum, and S. Rebelo. 2000. "Understanding the Korean and Thai Currency Crises", *Economic Perspectives* (Q III):45-60.
- Bussiere, M. and M. Fratzscher. 2002. "Towards a New Early Warning System of Financial Crises" *European Central Bank Working Paper Series*, No. 145.
- Calomiris, C. and Gary Gorton. 1991. "The Origins Banking Panics: Models, Facts and Bank Regulation, in Hubbard, G. (eds.) *Financial Markets and Financial Crises*, University of Chicago Press, Chicago, III.
- Calvo, Guillermo A. 1998. "Capital Flows and Capital-Market Crises: The Simple Economics of Sudden Stops", *Journal of Applied Economics*, v. 1, iss. 1, pp. 35-54
- Calvo, Guillermo, A., 1998, "Capital Flows and Capital Market Crises: The Simple Economics of Sudden Stops," *Journal of Applied Economics*, Vol. 1 (November), pp. 35-54.
- Calvo, G. and Enrique Mendoza. 1996. "Mexico's Balance of Payments Crises. A Chronicle of a Death Foretold", *Journal of International Economics*, 41, 235-264.
- Calvo, Guillermo, A., and Carmen M. Reinhart, 1999, "When Capital Inflows Come to a Sudden Stop: Consequences and Policy Options" (unpublished; Maryland: University of Maryland).
- Caprio, G. and D. Klingbiel. 2003. "Episodes of Systemic and Borderline Financial Crises", *World Bank Research Data Set*.
- Cerra, V. and S. C. Saxena. 2003. "Did Output Recover from the Asian Crisis?", *IMF Working Paper* 03/48.
- Dooley, M. P. 2000. "Can Output Losses Following International Financial Crises Be Avoided?", *NBER Working Paper*, No. 7531.
- Dornbusch, R., I. Goldfajn, and R. O. Valdes. 1995. "Currency Crises and Collapses", *Brookings Papers on Economic Activity* (2).
- Edwards, S. 2004. "Financial Openness, Sudden Stops and Current Account Reversals", *NBER Working Paper*, No. 10277.
- Eichengreen, B. and M. D. Bordo. 2002. "Crises Now and Then: What Lessons from the Last Era of Financial Globalization?", *NBER Working Paper*, No. 8716.
- Feldstein, M. 2002. "Economic and Financial Crises in Emerging Market Economies: Overview of Prevention and Management", *NBER Working Paper*, No. 8837.

- Flood, R. and N. Marion. 1999. "Perspectives on the Recent Currency Crisis Literature", *International Journal of Finance and Economics* 4:1-26.
- Frankel, J. A. and A. K. Rose. 1996. "Currency Crashes in Emerging Markets: An Empirical Treatment", *Journal of International Economics* 41: 351-366.
- Furman, Jason and Joseph Stiglitz, 1999, "Economic Crises: Evidence and Insights from East Asia", *Brookings Papers On Economic Activity* (1998:2), pp1-135.
- Glick, Reuven and Andrew Rose, 1998, "Contagion and Trade: Why are currency Crises Regional", *NBER Working Paper* No. 6806.
- Goldberger, A. S. (1964), *Econometric Theory*, New York: John Wiley & Sons, Inc
- Goldstein Morris, Graciela .L. Kaminsky and Carmen M. Reinhart, 1999. "Assessing Financial Vulnerability: An Early Warning System for Emerging Markets.", Washington, DC: Institute for International Economics.
- Greene, J. E. 2002. "The Output Decline in Asian Crisis Countries: Investment Aspects", *IMF Working Paper* 02/25.
- Greene, W.H. 1993. *Econometric Analysis*, MacMillan Publishing Company.
- Gupta, P. 2000. "Aftermath of Banking Crises: Effects on Real and Monetary Variables", *IMF Working Paper* 00/96.
- Gupta, P., D. Mishra, and R. Sahay. 2001. "Output Response to Currency Crises", *IMF Working Papers* 03/229.
- Hutchison, M. M. 2001. "A Cure Worse Than the Disease? Currency Crises and the Output Costs of IMF-Supported Stabilization Programs", *NBER Working Paper*, No. 8305.
- Hutchison, M. and I. Neuberger. 2001. "Output Costs of Currency and Balance of Payments Crises in Emerging Markets", *University of California Santa Cruz Working Paper Series*.
- Hutchison, M. M., and I. Noy. 2002. "Output Costs of Currency and Balance of Payments Crises in Emerging Markets", *Comparative Economic Studies* 44 (2/3): 27-45.
- Kaminsky, G. 1999. "Currency and Banking Crises: The Early Warnings of Distress", *IMF Working Paper* 99/178.
- Kaminsky, G., S. Lizondo and C. Reinhart. 1998. "Leading Indicators of Currency Crises", *IMF Staff Papers* 5 (1), 1-48.

- Kaminsky, G. and C.M. Reinhart. 1999. "The Twin Crises: The Causes of Banking and Balance-of-Payments Problems", *The American Economic Review* 89 (3), 473-500.
- Komulainen, T. and J. Lukkarila. 2003. "What Drives Financial Crises in Emerging Markets?", *BOFIT Discussion Papers* (5).
- Krugman, Paul. 1979. "A Model of Balance of Payments Crises", *Journal of Money, Credit and Banking*, 11, 311-25.
- Lane, Timothy and Steven Phillips. 1999. "Macroeconomic Environment", in Lane Timothy et al. (eds.), *IMF-Supported Programs in Indonesia, Korea and Thailand: A Preliminary Assessment*, IMF Occasional Paper 178.
- Milesi-Ferretti, G.M. and A. Razin. 1998. "Sharp Reductions in Current Account Deficits: An Empirical Analysis", *European Economic Review* 42, 897-908.
- Milesi-Ferretti, G.M. and A. Razin. 1999. "Current Account Reversals and Currency Crises: Empirical Regularities" Paper presented at NBER Conference on Currency Crises, Cambridge, Mass. 2/6/98.
- Mishkin, Frederic S., 1999, "Global Financial Instability: Framework, Events, Issues," *Journal of Economic Perspective*, Vol. 13, No. 4, pp. 3-20.
- Montiel, P., and C.M. Reinhart, "The Dynamics of Capital Movements to Emerging Economies During the 1990s," forthcoming in *Short-term Capital Movements and Balance of Payments Crises*, Griffith-Jones, Montes (eds.), (Helsinki: UNU/WIDER, 1997).
- Moreno, R. 1999. "Depreciation and Recessions in East Asia", *Federal Reserve Bank of San Francisco Economic Review*, 3, 27-40.
- Mulder, Christian; Perrelli, Roberto; Rocha, Manuel, March 2002. "The Role of Corporate, Legal and Macroeconomic Balance Sheet Indicators in Crisis Detection and Prevention", *International Monetary Fund Policy Working Paper*: WP/02/59, pp. 26.
- Park, Y.C. and J.W. Lee 2002. "Recovery and Sustainability in East Asia," in M. Dooley and J. Frankel, *Managing Currency Crises in Emerging Markets*, The University of Chicago Press.
- Ranciere, R., A. Tornell, and F. Westermann. 2003. "Crises and Growth: A Re-evaluation", *NBER Working Paper*, No. 10073.
- Rodrik, Dani and Andres Velasco, 1999, "Short-Term Capital Flows," *NBER Working Paper*, W7364 (Cambridge, Mass.: National Bureau of Economic Research).

Romer, Christiana, 1996, "Inflation and the Growth Rate of Output", *NBER Working Paper*, W5575.

Sachs, J., A. Tornell, and A. Velasco. 1996. "Financial Crises in Emerging Markets: The Lessons from 1995", *Brookings Papers on Economic Activity* (1).

Salant S., D. Henderson. 1978. Market anticipation of government policy an the price of gold, *Journal of Political Economy* 86, s. 627-648.

Stone, M. R. and M. Weeks. 2001. "Balance Sheets, Model Uncertainty, and Systemic Financial Crises", *IMF Working Paper*.

The World Bank's Global Economic Prospects (1997/98)

Tornell, A. (April 1998). "Reform from Within." *NBER Working Paper*, No. 6497.





Table 2.1 Chronology of Crises

Country	Currency Crisis	Country	Currency Crisis	Country	Currency Crisis
Argentina	Feb-81	Colombia	Mar-83	Philippines	Oct-83
	Jul-82		Feb-85		Jun-84
	Sep-86		Sep-97		Feb-86
	Apr-89		Sep-98		Jul-97
	Feb-90		Aug-99	Thailand	Jul-81
Bolivia	Nov-82	Indonesia	Apr-83		Nov-84
	Nov-83		Sep-86		Jul-97
	Sep-85		Dec-97		Jan-98
Brazil	Feb-83		Jan-98		Sep-99
	Nov-86	Israel	Oct-83		Jul-00
	Jul-89		Jul-84	Turkey	Jan-80
	Nov-90	Malaysia	Aug-97		Mar-94
	Oct-91		Jan-98	Uruguay	Oct-82
Chile	Jan-99	Mexico	Feb-82	Venezuela	Feb-84
	Aug-82		Dec-82		Dec-86
	Sep-84		Dec-94		Mar-89
		Peru	Oct-87		May-94
					Dec-95

Table 2.2 Specification of Selected Early Warning Models

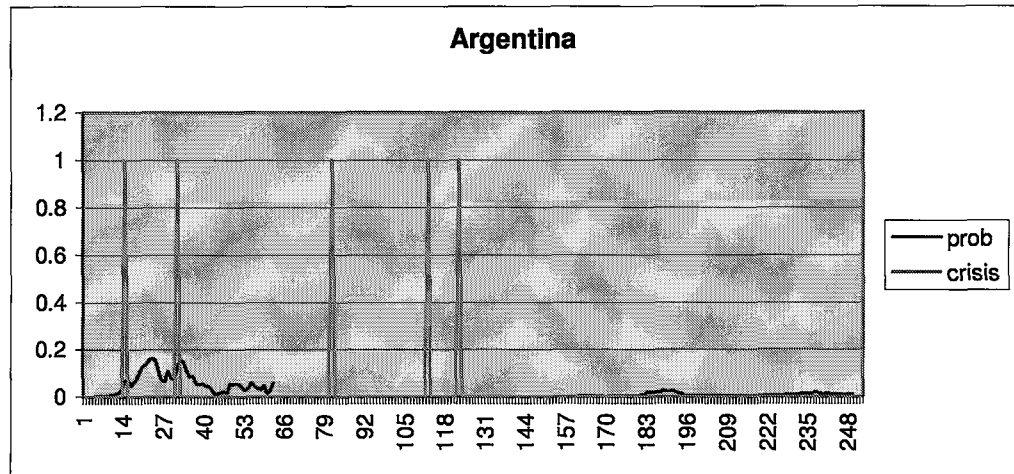
	DCSD(Berg, Borensztein, Milesi- Ferretti, and Pattillo)	KLR (Kaminsky, Lizando and Reinhart)	GS-Watch (Goldman Sachs)	EMRI (Credit Suisse First Boston)	DB Alarm Clock (Deutsche Bank)
Crisis Definition	Weighted average of one-month changes in exchange rate and reserves more than 3 (country-specific) standard deviations above country average	Same as DCSD	Weighted average of three-month changes in exchange rate and Reserves above country-specific threshold	Depreciation > 5% and at least Double of preceding month's	Various "trigger points" Depreciation > 10% and Interest rate increase > 25% typical
Horizon	2 years	2 years	3 months	1 month	1 month
Method	Probit regression with rhs Variables measured in (country-Specific) percentile terms	Weighted (by frequency of correct predictions) average of indicators. Variables measured as 0/1 indicators according to threshold chosen to minimize noise/signal ratio.	Logit regression with (most) rhs variables measured as 0/1 Indicators based on thresholds Found in autoregression with Dummy (SETAR)	Logit regression with rhs Variables measured in logs, then deviation from mean and standardized	Logit two-equation simultaneous systems on exchange rate and interest rate "events" of different magnitude
Variables	Overvaluation Current account Reserve losses Export growth ST Debt/Reserves	Overvaluation Reserve losses Export growth Reserves/M2 (level) Reserves/M2 (growth) Domestic credit growth Money multiplier change Real interest rate Excess M1 balances	Overvaluation Export growth Reserves/M2 (level) Financing requirement Stock market Political event Global liquidity Contagion	Overvaluation Debt/Exports Growth of credit to private sector Reserves/Imports (level) Oil prices Stock price growth GDP growth Regional contagion	Overvaluation Industrial production Domestic credit growth Stock market Devaluation contagion Market pressure contagion Regional dummies Interest rate "event"

Table 3.1 Table of Indicators

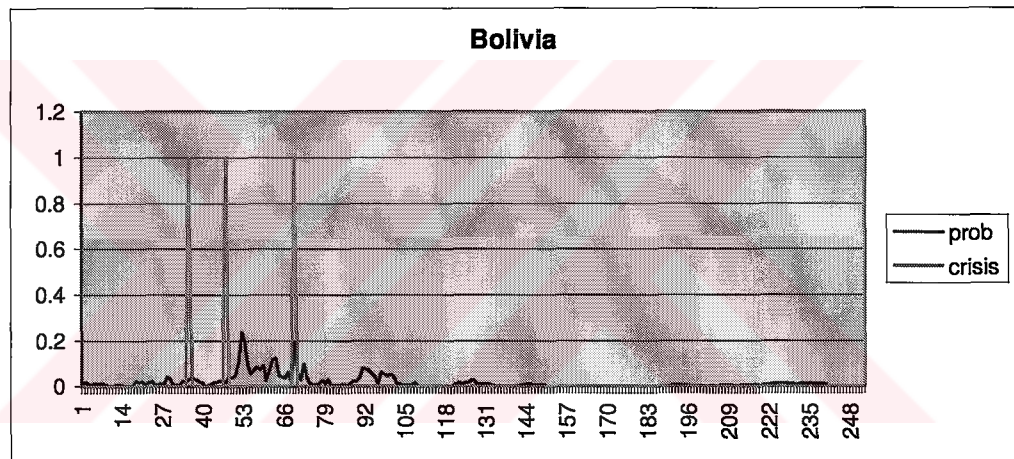
		Expected	
	Indicators	sign	Explanation
Fiscal Sector	Budget Balance / GDP	-	Insolvency expectations / credit creation
External Sec.			
<i>capital acc.</i>	International reserves	-	Decreasing reserves signal market pressure
	Interest rate differential	+	Signals devaluation expectation
		-	Attracts capital inflows
<i>current acc.</i>	Current account / GDP	-	Surplus creates demand for domestic currency
	Exports	-	Exports create demand for domestic currency
	Imports	+	Imports decrease demand for domestic currency
	Overvaluation of RER	-	Harms competitiveness
	Terms of Trade	+	Expensive exports
		-	Expensive imports
	US interest rate	+	High rates induce capital outflows
Financial Sec.	Excess real M1 balances	+	Loose monetary policy may fuel crisis
	M2 multiplier	+	Rapid credit growth fueled by liberalization induces risk
	Domestic credit expansion	+	Lowers demand for domestic currency
	Bank deposits	-	A bank run induces capital outflows
	Lending rate / Deposit rate	-	Low ratio signals unprofitable banks
		+	Banks increase lending rates in crisis; poor loan quality
	M2 / Reserves	+	High ratio creates vulnerability
	Domestic real interest rate	+	High rates cause liquidity crunch, non-performing loans
	Banking crisis dummy	+	Induces capital outflows
	M2 / M1	+	Rapid credit growth fueled by liberalization induces risk
Real Sec.	Industrial production	-	Recessions often accompany crisis
	Stock prices	-	Burst of asset bubbles precede financial crisis
	Unemployment	+	Creates incentives to devalue
	Inflation	+	Lowers demand for domestic currency

Figure 1 Predicted Probabilities

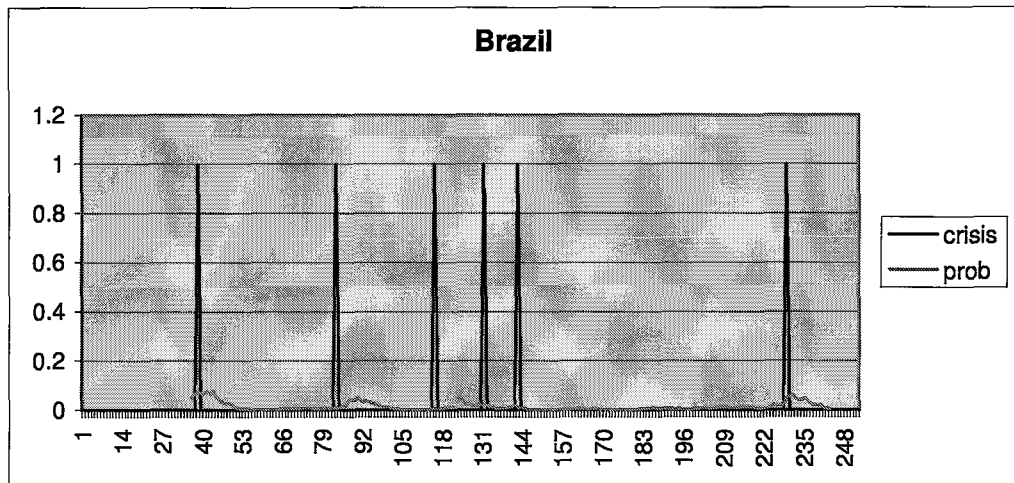
a.



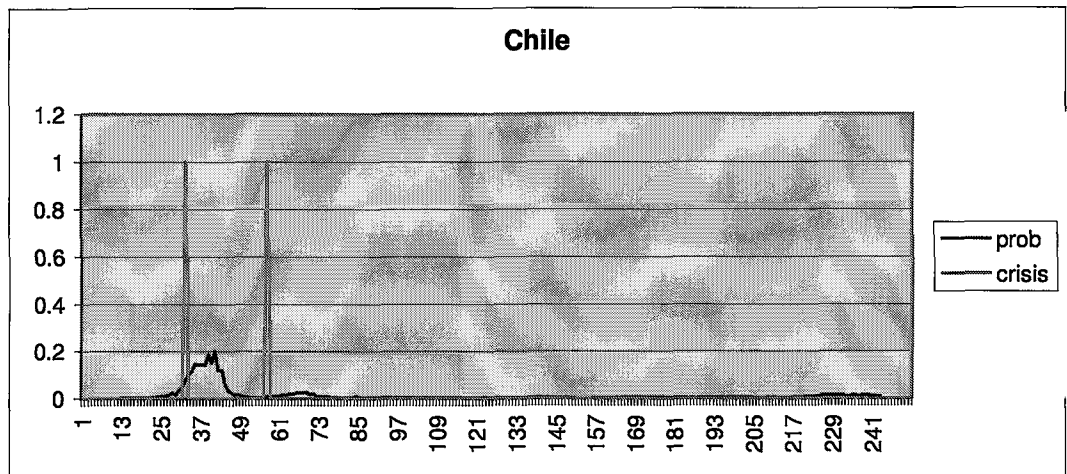
b.



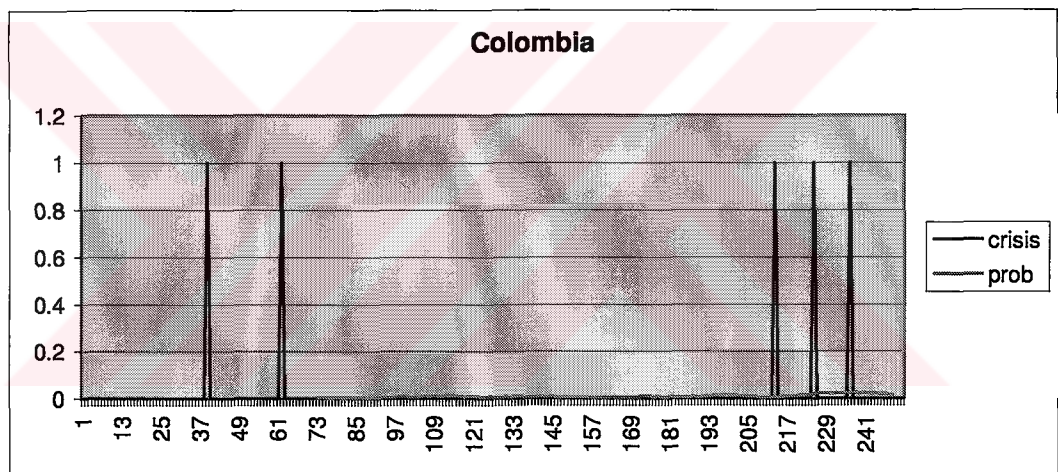
c.



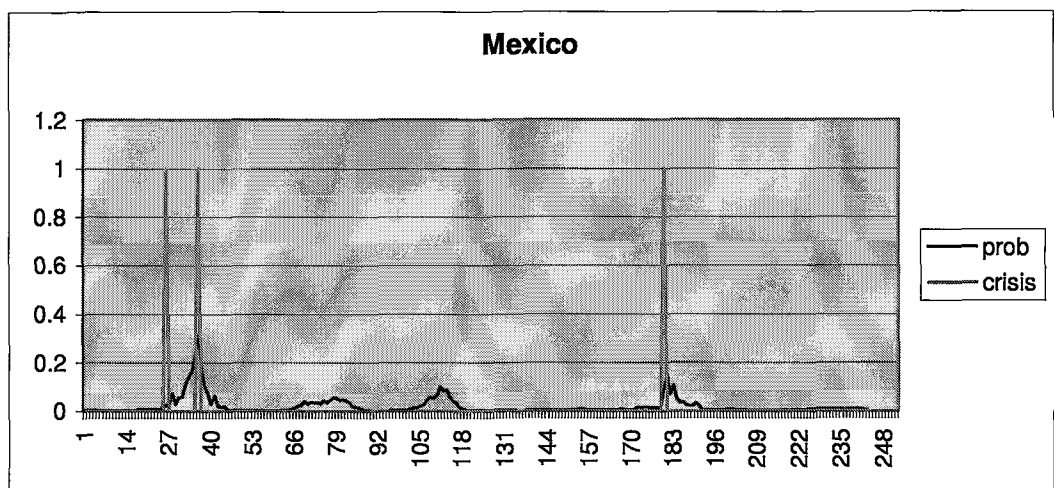
d.



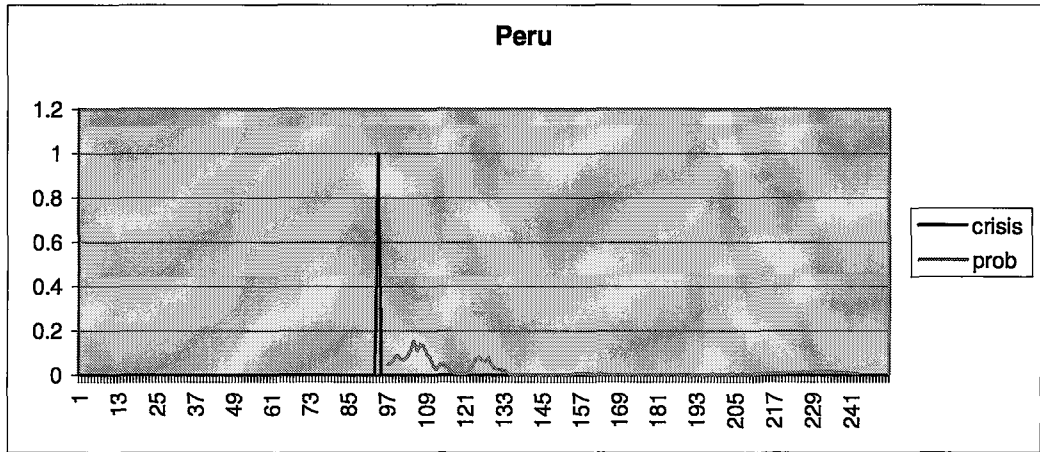
e.



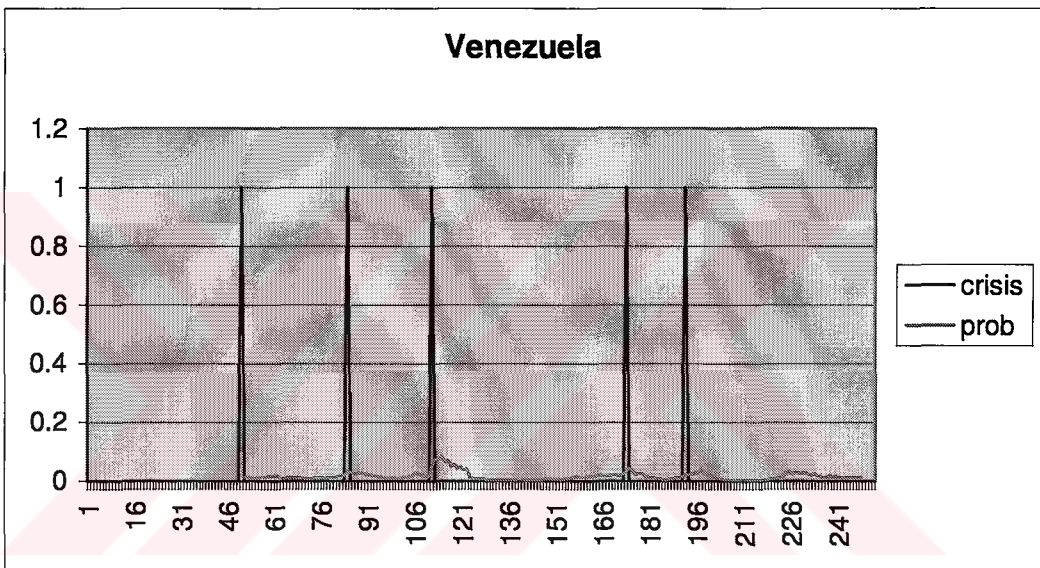
f.



g.



h.



i.

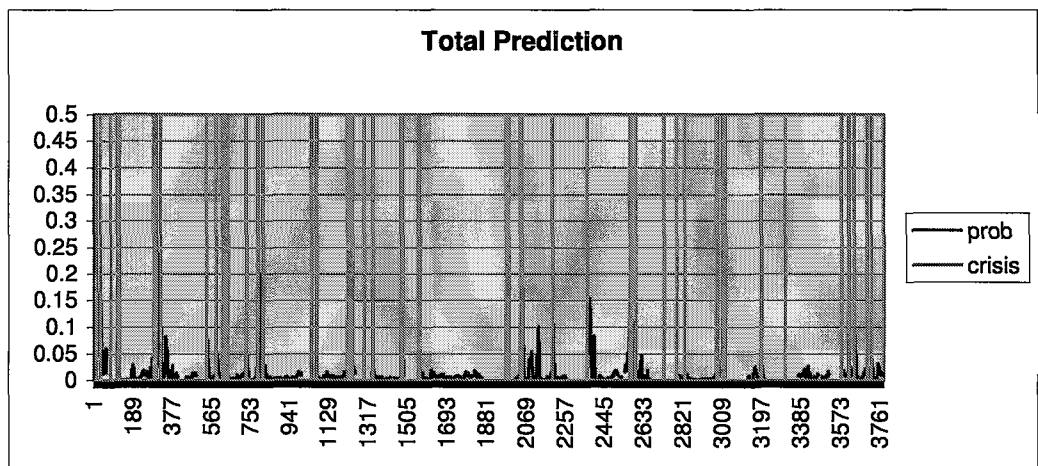
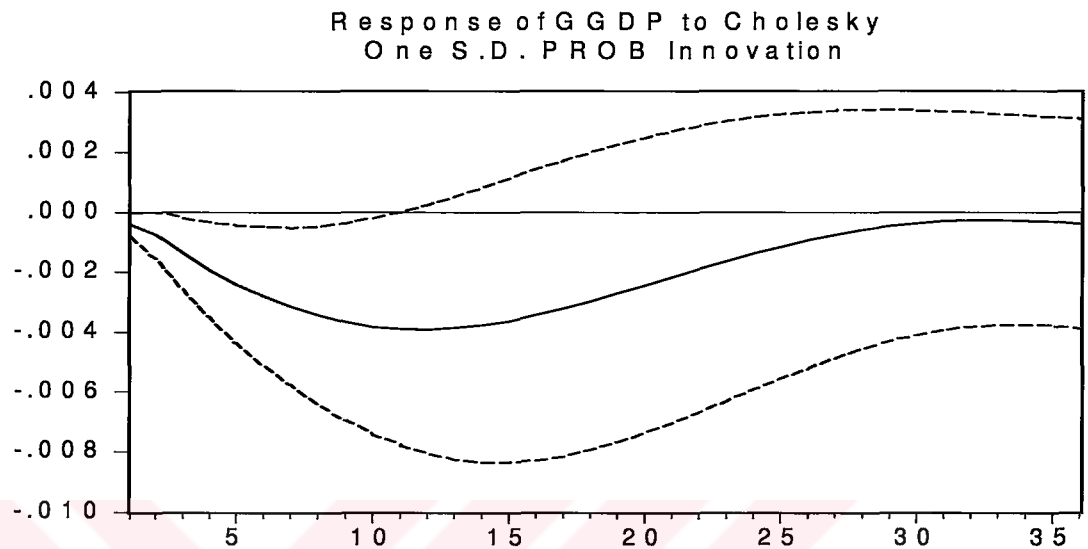
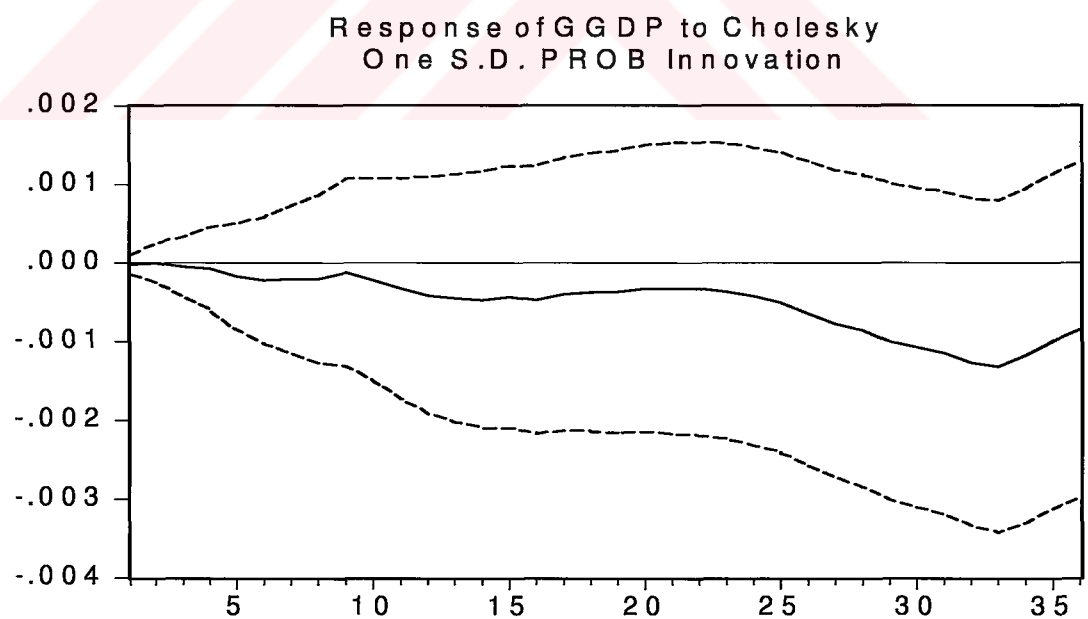


Figure 2 Impulse Response of Growth Rate of GDP to a Shock of Probability of Crisis

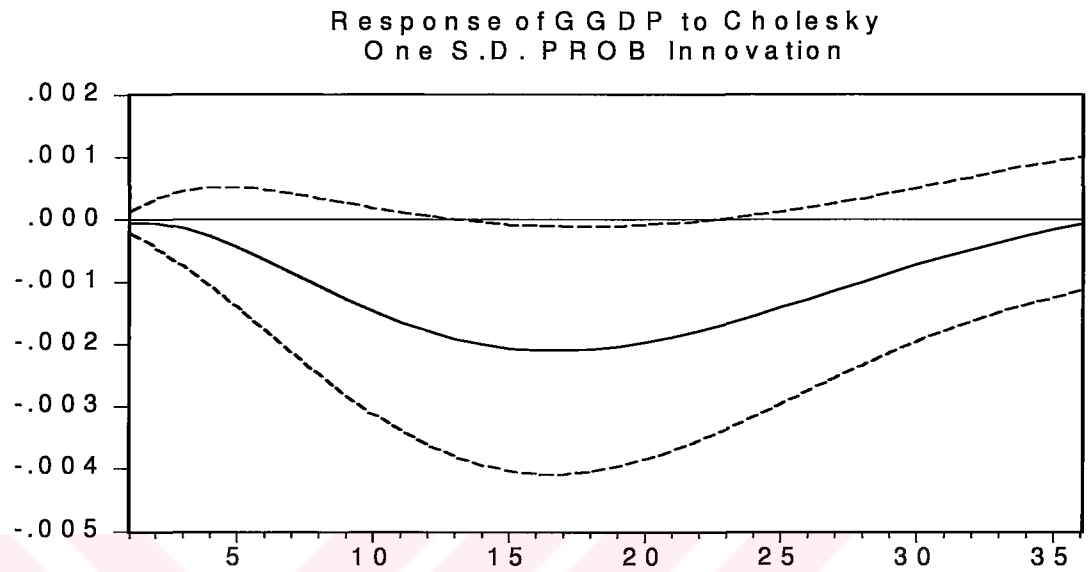
a)
Argentina
Lag length: 3



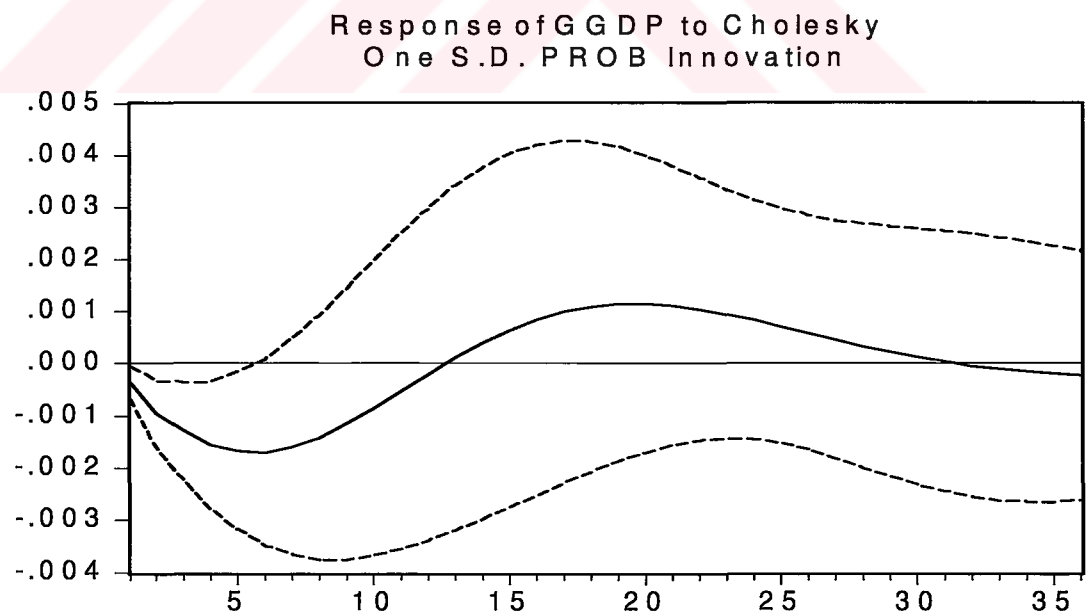
b)
Bolivia
Lag length: 17



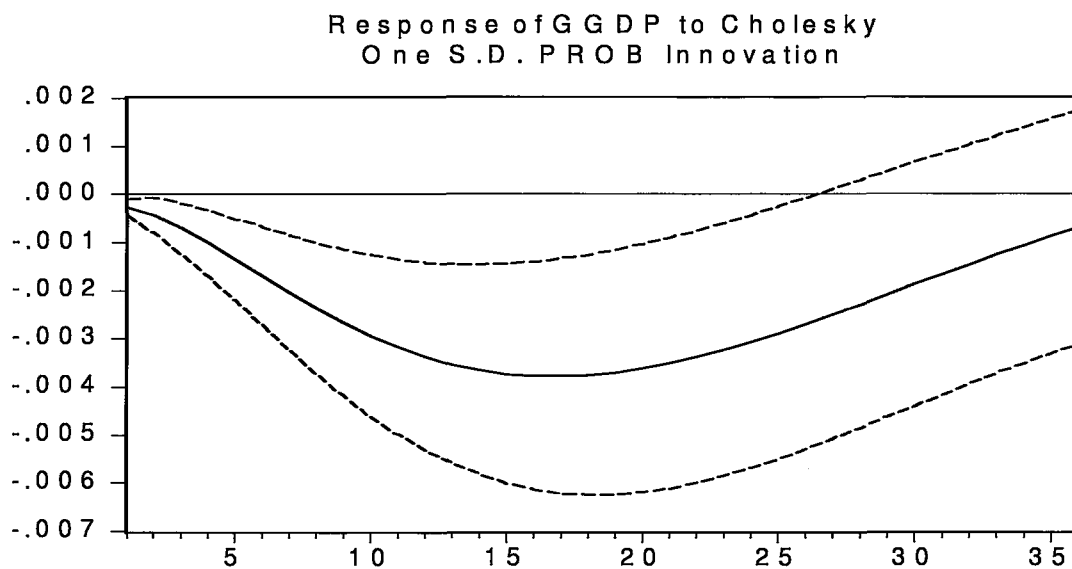
c)
Brazil
Lag length: 2



d)
Chile
Lag length: 4



e)
Colombia
Lag length: 2



f)
Mexico
Lag length: 2

