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Predictability of Currency Crises in Emerging-Country

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Abstract

The purpose of this article is to develop an early warning system that can anticipate currency crises in emerging countries. Based on the teachings of the theoretical and empirical literature, this work aims at constructing an alert system to determine the main triggers of the latest currency crises through a multivariate logit model. Our study covers 16 emerging countries on monthly data between January 1980 and December 2012.

Key words: currency crises, emergent economies, early warning system, logit model
Jel classification: C25; F31; G01

1. Introduction

Since the collapse of the Bretton Woods system, the international financial system has experienced many episodes of financial crises. This financial turmoil affected both emerging and developed countries simultaneously. Indeed, an IMF study, covering a period between 1975 and 1997, identified 158 currency crises in developed and emerging countries. Financial crises can manifest as currency crises, banking crises, stock market crises or sovereign debt crises (Jeanne 2003). These various crises, and especially those of foreign exchange, generally provoke a massive outflow of capital and heavy losses in terms of economic growth.

We note that during these last years, the episodes of the currency crises of the emerging countries are multipling. However, the Mexican currency crises, which began in the end of 1994 and early 1995, opened a new cycle. Two years later, and exactly in July 1997, the Thai crisis spreading across much of Asia in 1997 and 1998 began, affecting the Philippines, Malaysia and Indonesia. This scourge did not stop there, in August 1998, comes the turn of Russia, which shakes Brazil in late 1998 and early 1999. The following years marks the entry into crisis of the following countries, to Turkey, Argentina and Brazil, respectively, during the years 2000, 2001 and 2002. In a context of globalization of economies, the rationalization of the reactions of the various markets, while favoring greater transparency and better information at the macroeconomic and prudential levels, are the main concern of decision makers before the outbreak of crises to take the necessary measures to avoid them.

This observation is at the origin of the renewed interest given by the theoretical and empirical literature to the factors triggering a currency crisis. Many economists, the main objective is to predict, in order to better curb them, the macroeconomic or financial configurations like to provoke a speculative attack on the part of the international investors (Steinberg, David A (2017)). To do this, the definition of warning system seems appropriate and covers several types of questions regarding the triggering of currency crises. It is within this framework that our research focus is focused primarily on the development of a reliable and early warning system likely to warn the governments of emerging countries of possible crises.

2. Literature Review

Theoretical development in the literature on currency crises lead us to distinguish three types of models. The first generation models developed following the work of Krugman (1979) and Flood and Garber (1984) developed following the currency crises that affected the countries of Latin America in the early eighties. Crises are explained by a combination of fiscal imbalances and a limited stock of foreign exchange reserves. From the moment, the investors judge that the authorities can no longer hold the fixed parity; they withdraw to minimize losses, which causes a currency crisis.

In the second-generation models, the currency crises started with the work of Obstfeld (1994). The crisis is the result of a problem of trust between decision-makers in a country and private agents, without the appearance of a particular imbalance. Investors incorporate in their anticipations the fact that the policy of the authorities is not linear, but it responds to the economic situation in a broad sense. It is in this sense that the change in expectations of investors leads to a currency crisis, validating the expectations of agents.

It was the Asian crisis of 1997 that gave birth to the third generation of currency crisis models following the work of Chang and Velasco (1998), Pesenti Tille (2000) and Krugman (2001). These models explain the currency crises by the fragility of the banking system and the imperfection of the financial markets. Taking the Asian crisis as a field of application. The models developed underline the role of banking crises in triggering currency crises. The notion of "twin crises" shows the shift of analysis towards the banking sphere, while emphasizing the role of capital movements in the course of crises. Third-generation models post a dynamic of financial instability on the basis of liquidity and imperfections in information. Nakatani. R. (2016) constructs a twin currency and banking crisis model by introducing the banking sector into the currency crisis model and examining the case in which the exchange rate risk is located in the banking system. The model shows that an unanticipated shock caused by the shift of investors' expectations and/or a negative productivity shock can trigger a twin banking and currency crisis.

If there is a discrepancy between the different approaches, it is because different crisis scenarios are retained in each of them. We musn't conclude that there is a superiority of one approach over another that the currency crises are just consequences to a degradation of the fundamentals or just to the expectations of the agents or only the contagion effect. Obstfeld (1996) pointed out: "The interesting question is not whether or not the crisis is justified by fundamentals, as everyone agrees that fundamentals play a role. but whether, yes or no, the fundamentals are such that they make the crisis the unique and inevitable outcome. This point of view emphasizes an essential point on which the approach followed in this article which consolidated by Burnside. C., Eichenbaum. M. and Rebelo S. (2016) . The outbreak of a currency crisis is not linked to the state of economic fundamentals alone. However, the deterioration of fundamentals does not mean that the country will experience a crisis. And subsequently, the development of an early warning system for currency crises requires taking into consideration all the sources of tension that can lead to a currency crisis without taking into account the superiority of a model over a period of time.

3. The Crisis Index

Assessing the relevance of vulnerability indicators to a currency crisis requires the adoption of an operational definition of the latter, and thus identifying crisis periods throughout the sample. There are different methods for identifying warning indicators empirically; several definitions of currency crises appear in empirical studies.

Generally, a currency crisis is a situation for which an attack of the currency leads to a depreciation of the same currency. Frankel and Rose (1996) defined a currency crisis in the case of a nominal depreciation of the bilateral exchange rate towards the US dollar, of at least 25% in a year.

Simply taking into account devaluation episodes eliminates the situations in which the speculative attack took place but failed, this is the case where the authorities were able to defend their currencies by an increase in the interest rate or by a decrease in foreign exchange reserves. Some

authors use a composite index of speculative stress incorporating changes in the exchange rate and reserve losses and / or significant movements in the interest rate.

Sachs, Tornell and Velasco 1996; Kaminsky, Lizondo and Reinhart 1998 construct a crisis index equal to the weighted average of changes in nominal exchange rates and changes in foreign exchange reserves. The weights correspond to the inverse of their respective standard deviations, so that both components of the index have identical conditional volatility. Eichengreen, Rose and Wyplosz (1995) include in their index, other changes in the nominal exchange rate and foreign exchange reserves, changes in the interest rate.

In general, a currency crisis is identified when the crisis index reaches important values. An increase in the crisis index reflects strong pressure on the foreign exchange market resulting in the sale of the national currency. More concretely, a currency crisis is a period during which the index is, generally, two or three times greater than the standard deviation of its average. The crisis index thus makes it possible to empirically identify the vast majority of crises identified in the literature (Kaminsky and Reinhart 2000).

We have chosen to use a Crisis Index rated (CRISE) that incorporates the composition of Sachs, Tornell and Velasco (1996) incorporating observed changes in exchange rates and reserves. This index is defined as the weighted average of changes in the real exchange rate and the official foreign exchange reserves, relative to their respective standard deviations.

$$\text{CRISE}_{i,t} = \left[\frac{\log\left(TCR_{i,t} / TCR_{i,t-1} \right)}{\sigma_{DTCR}} \right] - \left[\frac{\log\left(RES_{i,t} / RES_{i,t-1} \right)}{\sigma_{DRES}} \right]$$

TCR: real exchange rate against US dollar (an increase corresponds to a real depreciation of the domestic currency)

$$\text{TCR} = \left(\frac{TCN \times IPC^{US}}{IPC} \right)$$

TCN : nominal exchange rate

IPC^{US} US consumer price index

IPC : Consumer price index of the domestic country

RES : International reserves in US dollars

DTCR : $\log(TCR_t/TCR_{t-1})$

DRES : $\log(RES_t/RES_{t-1})$

σ_{DTCR} : standard deviation of DTCR

σ_{RES} : standard deviation of DRES

The crisis index (CRISE) is even higher than the standardized rate of real depreciation of the currency is important and / or the standardized rate of the decline in foreign exchange reserves is high. This index therefore makes it possible to identify the periods during which a country is subject to a speculative attack, which is then identified by extreme values of the index, more than twice the standard deviation above of his average.

The crisis index also makes it possible to define a binary exchange rate index, denoted CC. We consider that there is an exchange rate crisis if this index is greater than its average increased by twice its standard deviation; in this case, the latter takes the value of 1 and 0 otherwise.

$$CC_{i,t} = \begin{cases} 1 \text{ si } \text{CRISE}_{i,t} > \text{moyenne } (\text{CRISE}_t) + 2\sigma(CRISE_t) \\ 0 \text{ sinon} \end{cases}$$

With : $\text{CRISE}_{i,t}$:crsis index at time t

$\sigma(CRISE_t)$: the standard deviation of crisis

It should be noted that we tried preliminary tests for the calculation of the crisis index, when the average crisis exceeds three times its standard deviation and when the average crisis exceeds one time its standard deviation, which showed that the choice we made (the crisis index takes the value 1 when the average crisis exceeds twice its standard deviation) is optimal to maximize the variability of the crisis index without increasing the errors of type I it is to say, do not predict a crisis that exists.

The graphs presented in the appendix show the results obtained for the crisis index for 16 countries selected in our sample from January 1, 1980 to December 31, 2012.

From these graphs our crisis index was able to identify all the exchange rate crises identified in the literature and, therefore, to satisfy our first objective which is the empirical characterization of the currency crises of our sample.

4. Data Description

The choice of variables is made from theoretical models and empirical work. This choice is also consolidated by a small comparison with the variables retained by the international operators in their expectations and in their assessment of their confidence that they gave the macroeconomic situation of a country. The variables used in our study, considered as potential determinants of currency crises, are:

- The real exchange rate (TCR): an increase in the exchange rate distortion towards the dollar implies an increase in the crisis index. A country is vulnerable to a currency crisis when its currency is overvalued.
- Current Account to GDP (CC): If a country has a current account deficit, large capital inflows are needed to close the deficit, these assets are highly volatile and can lead to a currency crisis. An increase in the current account deficit can be perceived as a sign of fragility in the eyes of market participants and contribute to an increase in the crisis index.
- The supply of money in relation to foreign exchange reserves (M2 / reserves): this ratio makes it possible to measure the capacity of a central bank to cope with a situation of falling foreign exchange reserves in the event of a sudden outflow of capital foreigners. A country is more vulnerable to a currency crisis when the supply of money relative to reserves is high.
- Domestic Credits Versus GDP (CD / GDP): a permanent growth of domestic credits above economic growth is interpreted as a sign of lax monetary policy, which can induce an acceleration of inflation or a speculative bubble. The country is more vulnerable to a currency crisis when the ratio is higher.
- Foreign interest rate (TIE): An increase in the reference international interest rate, in real terms, increases the interest burden on the external debt and therefore the current account deficit. A country will be more vulnerable to a currency crisis following a rise in the US interest rate, because of the interest rate differential that investors may wish to enjoy by reallocating their portfolios. This can lead to net outflows of capital.
- Domestic interest rate (TID): the increase in the real domestic interest rate may be a response by the monetary authorities to a speculative attack, and this to prevent a sudden outflow of capital. The currency crisis index should react to a rise in the real domestic interest rate.
- Bank Deposit (DB): A speculative attack on the currency of a country can result in a massive withdrawal of bank deposits. These withdrawals can result in bank failures, and lead to a currency crisis.
- Gross domestic product (GDP): the decline in economic activity is a sign of the fragility of economic fundamentals, a downward trend is therefore observed before the crisis.
- Exports (X): The appreciation of the national currency before the crisis penalizes exports. The goods of a country become more expensive abroad and afterwards any appreciation of the currency of a country leads to a decrease in exports.
- Imports (M): the appreciation of the national currency is accompanied by an increase in imports and the widening of the trade deficit.

To have a predictive model in the reporting of currency crises, the data frequency must be sufficiently short. Our work is based on monthly data because the annual data do not provide sufficiently operational results, so the idea of an early warning system for currency crises is based on the principle of advanced reporting of crises so that the monetary authorities have the time to act before the onset of crises, and thereafter the shorter the data frequency, the more the alert system will be efficient.

We have data mainly from the IMF's international financial statistics database. In addition, since the aim of the warning indicator system was to identify indicators common to currency crises, they must take into account a large amount of data. This was why we used a logit model that covers 16 countries for a period from 01 January 1980 to 31 December 2012.

5. Estimation and Predictive Performance

In our study, we have 16 emerging countries from two different regions, including seven Asian countries and nine Latin American countries. This choice is explained by the search for common characteristics of crises between regions and over time. Our objective now is to determine the impact of the various indicators, retained in our study and already presented, on the crisis index for the 16 country of our sample. The impact of the warning indicators on the currency crisis index are expressed by the following equation

$$CRISE_{i,t} = \alpha_1 TCR_{i,t} + \alpha_2 (CC/GDP)_{i,t} + \alpha_3 (M2/RES)_{i,t} + \alpha_4 (CD/GDP)_{i,t} + \alpha_5 (X)_{i,t}$$
$$+\alpha_6 (M)_{i,t} + \alpha_7 (TID)_{i,t} + \alpha_8 (DB)_{i,t} + \alpha_9 (TIE)_{i,t} + \alpha_{10} (GDP)_{i,t}$$

With:
CRISE: currency crisis index
TCR: real exchange rate
GDP: gross domestic product
X: exports
M: imports
CC / GDP: Current Account to GDP
M2 / RES: the money supply in the sense of M2 in relation to foreign exchange reserves
CD / GDP: domestic credits in relation to GDP
TID: domestic real interest rates
TIE: foreign real interest rate
DB: bank deposits

The stationarity study of the explanatory variables by unit root tests showed the stationarity of the indicators retained in first level or difference. From the correlation matrix of the explanatory variables we have found a correlation between GDP and exports and between GDP and imports, in order to counter the problem of multicollinearity we choose not to introduce the variables GDP, exports and imports into the same equation[1].

The results of the logit model estimation in panel data for all Asian and Latin American countries are given in the following table:

[1] The stationarity and correlation tests as well as the descriptive statistics of the explanatory variables are presented in detail in the appendix

Table 1: Logit estimate for the entire sample

Variables explicatives	Coefficients	P-Value.
Real exchange rate	-0.745701*	0.0000
D[2]Exports	3.21E-11	0.9085
DImports	-1.13E-09**	0.0452
Current account to GDP	2.45E-11**	0.0040
Real domestic interest rate	-0.041566	0.2434
M2/reserves	1.30E-19*	0.0000
Dbank deposit	-0.000846***	0.0695
Foreign real interest rate	-22.04774*	0.0000
Domestic credit (% of GDP)	6.83E-07	0.6687

* Significant at 1%, ** Significant at 5% and *** Significant at 10%

The regression results shows that export variables, real domestic interest rate, and domestic credit to GDP are insignificant while all other variables are statistically significant.

The overvaluation of the real exchange rate is negative sign (witch expected sign) and statistically significant at the 1% threshold, this overvaluation of the real exchange rate is explained by the massive inflows of capital to these countries during the periods before crises. This result is consolidated by the majority of empirical work. Kamainsky and Reinhart (1998); Edison (2003) and Ari and Dagtekin 2007, 2008; with others confirmed the overvaluation of the exchange rate before any episodes of crisis.

As a result of the overvaluation of the real exchange rate, we notes a deterioration in the current account, which we find to be statistically significant. Likewise, the real foreign interest rate have the expected sign, which shows the evidence of the contagion effect in the spread of emerging-country currency crises.

The ratio M2 / foreign exchange reserves and bank deposits are also significant, these results confirm the orientations of several economists that the fragility of the banking system and the macroeconomic imbalance are behind the currency crises of emerging countries.

Table 2, obtained from the logit estimate already presented, shows the average value of the indicators in case of crisis and in case of no crisis. This is useful for identifying specific behavior of warning indicators in times of crisis with reference to quiet or normal periods. Crisis and non-crisis spreads are important for the variables real exchange rate, GDP, current account balance and domestic credit.

However, these averages can be considered as thresholds for each variable, if an indicator reaches its average value in a crisis period this is considered an alert to the government of the variable degradation in question and thereafter take the necessary steps to avoid that it turns into a currency crisis.

Table 2: Average value of the indicators in crisis and non-crisis situations for the entire sample

Variable	Average of the indicator in the absence of a currency crisis	Average of the indicator in a currency crisis period
Real exchange rate	3.293814	3.120925
Exports	1.66E+08	1.87E+08
Imports	93161027	1.15E+08
GDP	1.34E+19	1.01E+19
Current account (%of GDP)	0.222009	-0.014490
Domestic real interest rate	1.03E+09	1.14E+09
M2/reserves	7.05E+17	3.36E+17
Bank Deposit	2453.982	2318.913
Foreign real interest rate	0.080468	0.100790
Domestic Credit (%of GDP)	4986.280	1650.365

[2] D in front of the explanatory variable to indicate that it is in first difference.

To test the ability of the selected indicators to signal emerging-country currency crises sufficiently in advance, we estimate logit models with delayed warning indicators of three and six months (forecast horizon) in order to test the predictive ability of our system of early warning indicators. In the literature of predictability of currency crises, the forecast horizon varies from one to twenty-four months depending on the frequency of data and the beneficiaries of advanced crisis reporting. Public authorities prefers a long horizon to take the necessary measures sufficiently in advance and to avoid a possible crisis, the international investors prefer a short horizon to adjust their portfolio as much as possible.

Table 3: Logit estimation for the entire sample: variables one month late

Variables explicatives	Coefficients	P-Value
Real exchange rate	-0.165056*	0.0000
D[3]Exports	-7.39E-11	0.7719
DImports	-1.85E-09*	0.0007
Current account to GDP	-2.79E-11**	0.0418
Real domestic interest rate	0.001352	0.9755
M2/reserves	-1.16E-19*	0.0004
Dbank deposit	-0.001380*	0.0000
Foreign real interest rate	-5.121050*	0.0000
Domestic credit (% of GDP)	-1.17E-05	0.2056

* Significant at 1%, ** Significant at 5% and *** Significant at 10%

Table 4: Logit estimation for the entire sample: variables three months late

Variables explicatives	Coefficients	P-Value
Real exchange rate	-0.215972*	0.0000
D[4]Exports	-3.78E-10	0.1297
DImports	-5.99E-10	0.2329
Current account to GDP	-2.17E-11	0.0334
Real domestic interest rate	0.002388	0.9431
M2/reserves	-1.48E-19*	0.0000
Dbank deposit	-0.006939*	0.0000
Foreign real interest rate	-5.139435*	0.0000
Domestic credit (% of GDP)	-1.35E-05	0.2215

* Significant at 1%, ** Significant at 5% and *** Significant at 10%

Table 5: Logit estimation for the entire sample: variables six months late

Variables explicatives	Coefficients	P-Value
Real exchange rate	-0.630280*	0.0000
D[5]Exports	-1.91E-11	0.9380
DImports	-4.54E-10	0.3672
Current account to GDP	-1.74E-11	0.0611
Real domestic interest rate	0.016717	0.3857
M2/reserves	2.92E-20	0.4313
Dbank deposit	2.78E-05	0.9193
Foreign real interest rate	-5.165908*	0.0000
Domestic credit (% of GDP)	-4.33E-06	0.1893
Real exchange rate	-0.630280*	0.0000

* Significant at 1%, ** Significant at 5% and *** Significant at 10%

The estimation results presented in the previous tables (Tables 3, 4 and 5) shows that certain variables have the expected effect and are statistically significant regardless of the forecast horizon: the

[3] D in front of the explanatory variable to indicate that it is in first difference.
[4] D in front of the explanatory variable to indicate that it is in first difference.
[5] D in front of the explanatory variable to indicate that it is in first difference.

real exchange rate and bank deposits . We note that these two indicators reported seizures before six months and these signals persisted (these variables signal seizures one and three months late). The current account variables, M2 / foreign exchange reserves and the real foreign interest rate only report crises before three months and continue to one month of crises.

Then, we proceed, in a first step, a division of our sample into two groups according to the regional belonging of the countries, the first group contains 7 Asian countries and the second group comprises 9 Latin American countries. The purpose of the sample division is to investigate whether currency crises have a regional feature and subsequently there are variables that explain the currency crises in the South East Asia region and do not for Latin American countries. As a result, we try to find out whether currency crises are changing, and we are dividing the study period into three: the crises of the 1980s, the crises of the 1990s and the crises of the 2000s.

It is important to specify, before making the estimation, we have renewed the stationarity test of the different explanatory variables of our model according to the sub-sample retained. The enhanced Dickey-Fuller test (ADF) is presented in the appendix of the chapter. We also note the lack of correlation between the explanatory variables, which allows us to integrate them all into the same model.

Tables 6 and 7 present logit model estimation results for Asian and Latin American countries for monthly data for a period between 1980 and 2012.

Table 6: Logit estimation of Asian countries

Variables	Coefficients	P-Value.
Real exchange rate	6.908155*	0.0000
Exports	2.56E-07	0.9635
Imports	-7.20E-06	0.4212
GDP	3.04E-22	0.8732
Current account to GDP	4721237.	0.4119
Taux d'intérêt réel domestique	-0.712301*	0.0009
M2/réserves de change	-1.25E-19*	0.0000
Dépôts bancaires	-0.001016	0.1251
Taux d'intérêt réel étranger	-5.690299*	0.0000
Crédits domestiques par rapport au PIB	-73725015*	0.0000

* Significant at 1%, ** Significant at 5% and *** Significant at 10%

Table 7: logit estimation of Latin American countries

Variables	Coefficients	P-Value.
Real exchange rate	-1.366307*	0.0000
Exports	1.61E-11	0.9503
Imports	-1.12E-09**	0.0348
GDP	1.26E-19*	0.0000
Current account to GDP	-0.007387	0.7884
Domestic real interest rate	-6.55E-12	0.4445
M2/reserves	9.61E-19	0.2861
Bank deposit	-0.001897*	0.0004
Foreign real interest rate	-5.697837*	0.0000
Domestic credit (%of GDP)	-3.61E-06	0.2513

* Significant at 1%, ** Significant at 5% and *** Significant at 10%

For the South-East Asian countries, the export and import variables are not significant, showing that Asian countries do not have trade balance problems before the onset of crises. Indicators associated with current account and GDP also are not significant. This result confirms the conclusions of several authors such as Ostray (1997), according to which current account deficits do not appear unsustainable since the savings rate and the growth rate are high in these countries. We find, the bank deposit variable is significant and thereafter, we can find the overall trend of the majority of empirical

work that sought to determine the causes of the Asian crisis, that the crises of Asian countries are due to a fragility of the system banking.

For Latin American countries, the current account variables in relation to GDP, the money supply relative to foreign exchange reserves and the domestic credit variable in relation to GDP, exports and the real interest rate are not significant, showing that the crises in these countries do not seem to be the cause of external imbalance as the current account variable does not measure up to an expansion of domestic credit as the first model claims. generation of the currency crisis.

On the other hand, in the two zones studied, the variables of the real exchange rate, the real foreign interest rate and the bank deposits are significant at the 1% threshold for the two sets of countries. It is important to note that international shocks are often a vulnerability factor for emerging countries. However, the increase in the US interest rate causes a significant rise in the crisis index and makes the country more exposed to a currency crisis.

The aim of which is to investigate whether there are changes in the structure of exchange rate crises, we are now trying to break down the study period of our sample into three sub-periods: the 1980s (from January 1980 to December 1989), the 1990s (from January 1990 to December 1999) and the 2000s (from January 2000 to December 2012).

Tables 8 and 9 present the results of our panel logit estimation for the Latin American and Southeast Asian region, and for different study periods, namely the 1980s, 1990s, and 1990s. 2000s.

Table 8: Estimation results for Latin American countries by period

	The 80s 80M2—89M12	**The 90s 90M2—99M12**	**The 2000s 2000M2—2012M12**
Variable		**Coefficients**	
Real exchange rate	13.99123* (0.0000)	-0.139596* (0.0001)	4.340044* (0.0094)
Exports	-9.97E-10 (0.7994)	1.02E-09 (0.3559)	1.81E-11 (0.9506)
Imports	-7.15E-09 (0.3314)	-1.45E-09 (0.3508)	-3.33E-10 (0.5547)
Current account to GDP	0.081386* (0.0006)	0.176069 (0.9793)	1.746083 (0.9422)
GDP	-2.19E-17* (0.0000)	-1.31E-20 (0.8728)	-1.10E-19* (0.0000)
M2/reserves	-6.05E-12 (0.7688)	2.11E-12** (0.0017)	-1.79E-19 (0.8138)
Foreign real interest rate	51.85695* (0.0000)	-17.06767* (0.0000)	-22.47213* (0.0000)
Domestic real interest rate	-6.51E-11* (0.0000)	-1.38E-07 (0.8038)	-1.724926* (0.0013)
Domestic Credit (% of GDP)	-4.07E-05* (0.0005)	1243.414 (0.2240)	3.81E+08 (0.3119)
Bank Deposit	-0.000162 (0.7699)	-0.001903** (0.0046)	-0.000645*** (0.0694)

* Significant at 1%, ** Significant at 5% and *** Significant at 10%; P-value in parentheses

Table 9: Estimation results for Asian countryby period

	The 80s 80M1—89M12	**The 90s 90M1—99M12**	**The 2000s 2000M1—2012M12**
Variable		**Coefficients**	
Real exchange rate	-0.213554* (0.0000)	7.907901** (0.0016)	4.357593* (0.0000)
Exports	-8.93E-07 (0.8789)	5.71E-07 (0.9457)	-1.68E-06 (0.8648)

	The 80s 80M1—89M12	**The 90s 90M1—99M12**	**The 2000s 2000M1—2012M12**
Variable		**Coefficients**	
Imports	-8.76E-07 (0.9278)	-1.24E-05 (0.6918)	-1.41E-06 (0.8956)
Current account to GDP	-5476947 (0.3386)	-2995384 (0.8001)	-13003084 (0.4858)
GDP	9.34E-23 (0.9649)	-5.49E-20* (0.0000)	-2.36E-20* (0.0000)
M2/reserves	-5.61E-20** (0.0017)	9.41E-20 (0.0113)	-3.41E-21 (0.9173)
Foreign real interest rate	-2.619907* (0.0009)	-18.58558* (0.0000)	-12.84358** (0.0012)
Domestic real interest rate	0.529140 (0.0191)	7.326783 (0.2403)	-9.525240*** (0.0019)
Domesti Credit (% of GDP)	-93678758* (0.0000)	33428189 (0.9543)	-80275317** (0.0049)
Bank deposit	0.000442 (0.3778)	-0.000807 (0.5555)	-0.000234 (0.8265)

* Significant at 1%, ** Significant at 5% and *** Significant at 10%;P-value in parentheses

For both zones and for all periods, the indicator of the real exchange rate is statistically significant, before any crisis an overvaluation of the exchange rate is observed which confirms the previous studies on the subject.

For the Latin American countries, during the 1980s, we notice that the deterioration of the current account is significant, in fact, current account deficits reached 2.1% in Argentina in 1980 and between 4% and 12% for Colombia, Brazil, Mexico and Chile in 1981. This suggests that the crises of the 1980s appear to be partly justified by external imbalances. The foreign interest rate variable is also significant and thereafter, the rise in the US real interest rate leads to a significant increase in the crisis index, evidence of the existence of the contagion effect during episodes of the same time, the real domestic interest rate is also significant, the rise in the real interest rate may be a response from the authorities to a speculative attack, and this to fight against a massive outflow of capital.

The GDP variable is also significant, which means that the decline in economic activity in the countries of Latin America is also a cause of the currency crises experienced by these countries. These countries also seem to have problems in their banking systems since the bank deposits variable is also significant.

During the 1990s, the regression indicates that Latin American countries are significantly vulnerable to a currency crisis if the ratio of M2 / reserves is high, which is confirmed by several empirical studies.

What marks the 2000s is the domestic credit variable towards to GDP, which becomes significant. We find the lessons of models of currency crisis of first generation, also the problems of the banking system since the variable bank deposits is also significant.

For South East Asia, the indicator associated with domestic credit is significant for the three periods of study, showing that in these countries the expansion of domestic credit is a source of vulnerability. Domestic credit expansion relative to GDP can lead to speculative bubbles.

During the 1980s, the variables of the real foreign interest rate and the ratio M2 / foreign exchange reserves are also significant, which implies that a misbehavior of the monetary policies in addition to the external shocks like the rise of the interest rate American are behind the turbulence that these countries experienced during the 1980s.

Regarding the crises of the 1990s, the ratio M2 / reserves is statistically significant, which implies a loss of confidence of investors in the banking system and the central banks of Asian countries could not avoid losses of foreign exchange reserves before crises. Similarly, the GDP variable has a negative effect on the crisis index, this variable is also significant during this period.

During the 2000s, in addition to the real exchange rate, the variables GDP, domestic credit and bank deposits are also significant, which shows that the expansion of domestic credit and the loss of investor confidence in the banking system are sources of vulnerability. in these countries.

We note that in the 2000s the domestic credit variables, GDP and bank deposits are significant in the two study areas, which suggests first a change in the structure of the currency crises since we can not explain these episodes crisis by referring to a single theoretical model, it is a combination of internal and external imbalance that is behind the crises of the 2000s, this result is proved by Nicolas A, Müller-Plantenberg (2017). On the other hand, the loss of investor confidence in the system banking seems to be a source of vulnerability for emerging countries. The notion of twin crises is developed after the Asian crisis of the 1990s, in the sense that banking crises explain the currency crises, which confirms the results obtained. Finally, the fragility of economic fundamentals is still a source of vulnerability for emerging countries, the GDP variables are significant for both zones.

5. Conclusion

The analysis of the predictive capacity of a set of warning indicators supposed to be at the origin of the exchange crises of Asian and Latin American countries, was measured on a sample of 16 emerging countries over a period of 33 years. Our choice to work on monthly data is based on a conviction, proven by various empirical studies, that monthly data better capture the sudden and brutal nature of the currency crises of recent years.

In our study, we first tried to calculate a currency crisis index. The results found allowed us to identify the vast majority of crises and the crises detected coincide with the actual facts, which shows that we have made a good choice of the crisis index.

The choice of the variables supposed to be responsible for triggering the currency crises is dictated by theoretical and empirical work dealing with the subject, also the availability of data, especially since we chose to work on monthly data for a belief that a system alert is only effective when the signaling horizon is short enough for the authorities to have the time to act and to avoid impending currency crises. We chose to measure contagion by the foreign interest rate in the face of the difficulty of identifying a pure contagion indicators.

As a first step, we tried to measure the predictive capacity of a set of indicators. For the entire sample and over the entire period of study between 1980 and 2012, we note that the crises of the emerging countries of Southeast Asia and Latin America were driven by economic and financial imbalances, consolidated results by the fact that the variables real exchange rate, export, import, gross domestic product, M2 / foreign exchange reserves, bank deposits and foreign real interest rate are significant.

In order to test the persistence of the signals emitted by our warning system we estimated our logit model with variables of three and six months delay. The estimation results showed that the variables: real exchange rate, gross domestic product, bank deposits and foreign interest rates reported the crises before six months and the signals persisted, the variables of the exports, the imports, the rate of Domestic interest and M2 / reserves only reported seizures before three months. However, other variables showed no economic and statistical significance.

The decomposition of the sample, in two, Asian and Latin American countries, allowed us to identify that the variables of real exchange rate, domestic and foreign real interest rates are significant in both zones. Then, the decomposition over time of our sample, we find that domestic credit variables, GDP and bank deposits are significant for Asian and Latin American countries. Our analysis shows that the fragility of the banking system occupies an increasingly important place as triggering factor for currency crises.

Finally, it is important to note that for all countries in any zone and any period of study the real exchange rate is still significant and it is the better warning indicator.

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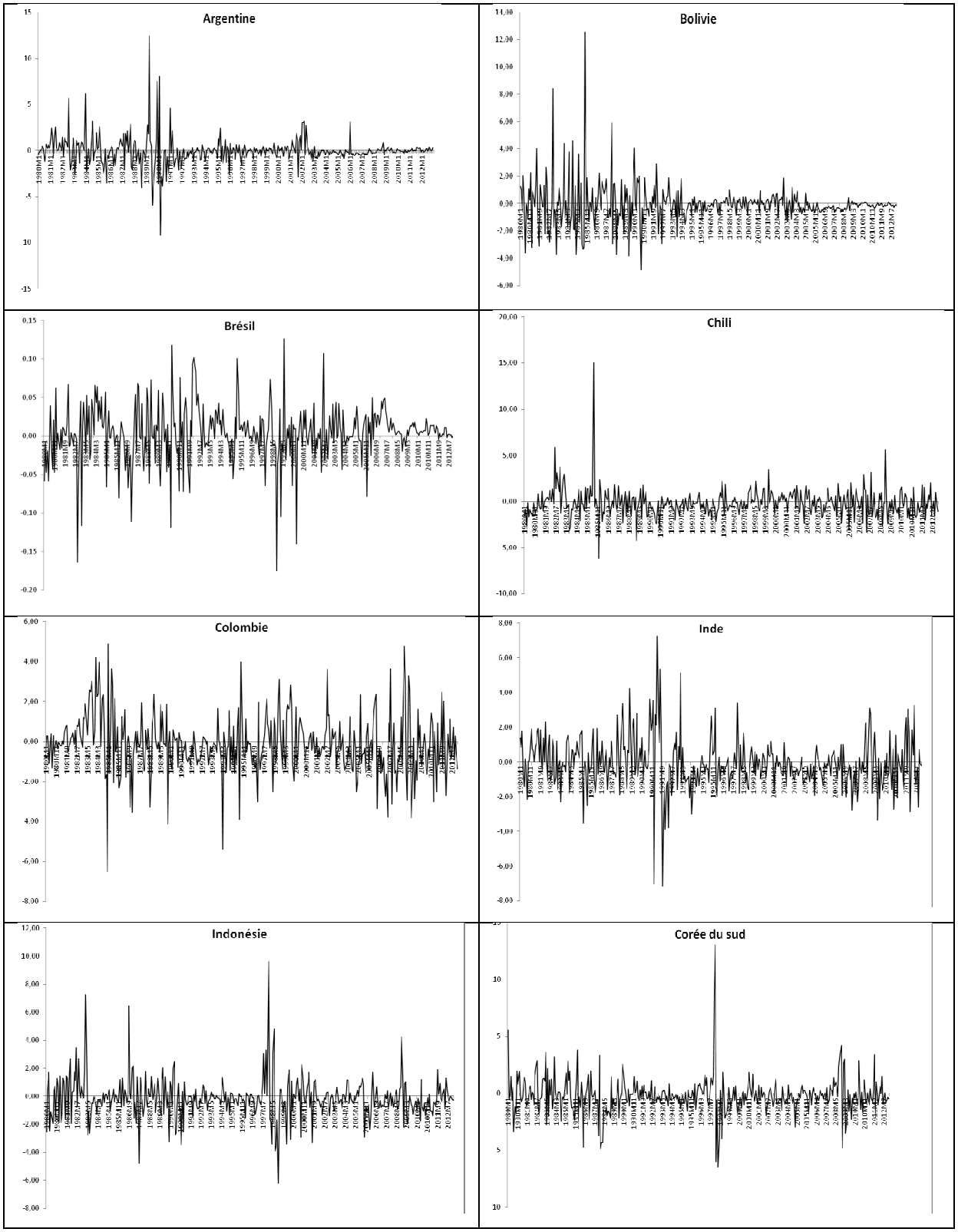
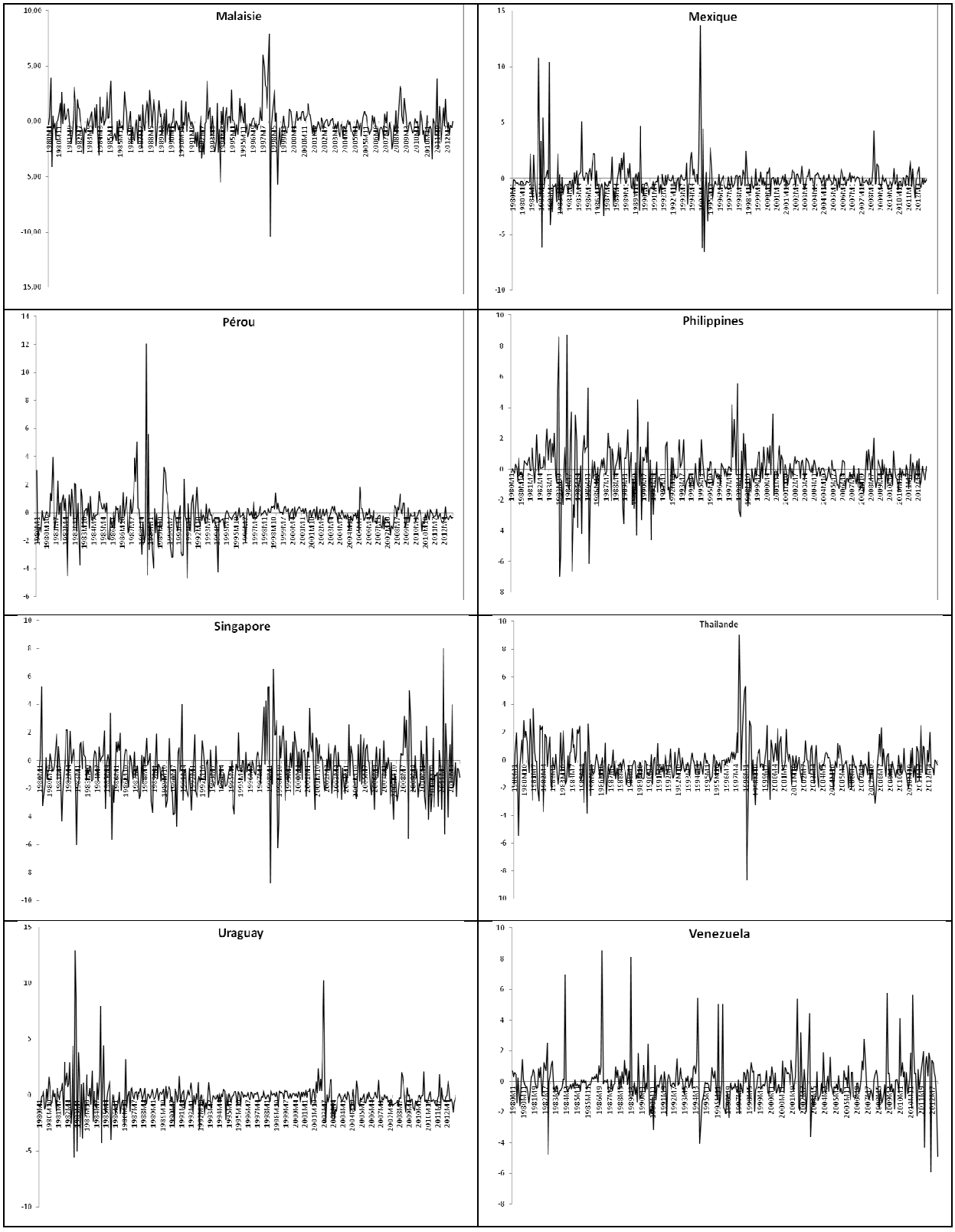
Appendix: The Crises Index




Malaisie
Mexique
Pérou
Philippines
Singapore
Thailande
Uraguay
Venezuela

Appendix 2
Descriptive Statistics

indicateur	LOG (TCR)	X	M	PIB	CC	TID	M2	DB	TIE	CD
Moyenne	3.289041	1.68E+08	94329258	1.34E+19	0.215510	1.03E+09	6.98E+17	2460.916	0.080791	4889.929
Médiane	2.711209	2321.000	2015.000	9.30E+12	-2.38E-13	0.164388	16706950	540.9013	0.060267	2.01E-09
Maximum	10.12246	1.05E+10	6.45E+09	8.23E+20	310.6574	3.51E+11	4.71E+19	30949.98	0.317121	2160143.
Minimum	-0.586320	0.000000	0.000000	2.394921	-32.50077	0.001043	9.71E-16	2.261096	0.004506	-1.36E-08
E-Type.	2.667113	8.53E+08	4.70E+08	6.58E+19	6.997178	1.36E+10	4.34E+18	4516.492	0.072763	81147.35
Skewness	0.755559	6.761760	6.931665	8.093293	29.70059	17.66443	6.533035	2.772753	1.508424	20.39316
Kurtosis	2.325445	54.57216	60.38611	77.68295	1029.216	354.5753	46.36478	11.62766	4.847677	456.5741
Jarque-Bera	722.6216	750083.9	919698.6	1540911.	2.79E+08	32945666	541267.3	27756.81	3302.470	54725833
Somme	20829.50	1.06E+12	5.97E+11	8.51E+22	1364.824	6.50E+12	4.42E+21	15584983	511.6487	30967919
Sum Sq. Dev.	45042.62	4.61E+21	1.40E+21	2.74E+43	310017.9	1.17E+24	1.19E+41	1.29E+11	33.52486	4.17E+13

Unit Root Test

- Unit root test

variable: TCR		
Method	**Statistic**	**Prob.****
ADF - Fisher Chi-square	48.9025	0.0284
ADF - Choi Z-stat	-2.51124	0.0060

variable: D(X)		
Method	**Statistic**	**Prob.****
ADF - Fisher Chi-square	801.961	0.0000
ADF - Choi Z-stat	-24.6777	0.0000

variable: D(M)		
Method	**Statistic**	**Prob.****
ADF - Fisher Chi-square	1068.97	0.0000
ADF - Choi Z-stat	-28.8917	0.0000

variable: D(PIB)		
Method	**Statistic**	**Prob.****
ADF - Fisher Chi-square	1408.33	0.0000
ADF - Choi Z-stat	-34.4628	0.0000

variable: CC		
Method	Statistic	Prob.**
ADF - Fisher Chi-square	302.803	0.0000
ADF - Choi Z-stat	-12.3456	0.0000

variable: TID		
Method	**Statistic**	**Prob.****
ADF - Fisher Chi-square	511.968	0.0000
ADF - Choi Z-stat	-16.5373	0.0000

variable: M2		
Method	**Statistic**	**Prob.****
ADF - Fisher Chi-square	373.549	0.0000
ADF - Choi Z-stat	-7.76881	0.0000

variable: D(DB)		

Method	Statistic	Prob.**
ADF - Fisher Chi-square	1766.09	0.0000
ADF - Choi Z-stat	-37.6133	0.0000

variable: TIE		
Method	**Statistic**	**Prob.****
ADF - Fisher Chi-square	160.593	0.0000
ADF - Choi Z-stat	-9.91023	0.0000

variable: CD		
Method	**Statistic**	**Prob.****
ADF - Fisher Chi-square	175.533	0.0000
ADF - Choi Z-stat	-8.07817	0.0000

Correlation Matrix

	TCR	D(X)	D(M)	D(PIB)	CC	TID	M2	D(DB)	TIE	CD
TCR	1.000000	-0.010360	-0.016007	0.012193	-0.030126	-0.074459	0.353428	0.019686	-0.025259	-0.069523
D^6(X)	-0.010360	1.000000	0.214183	-6.65E-05	-0.004234	-0.000810	-0.001729	-0.002292	0.000942	-0.000636
D(M)	-0.016007	0.214183	1.000000	-2.22E-05	-0.001520	-0.001153	-0.002462	0.001005	0.001802	-0.000906
D(PIB)	0.012193	-6.65E-05	-2.22E-05	1.000000	-0.000179	-0.000472	0.039796	-0.017177	-0.004337	-0.000370
CC	-0.030126	-0.004234	-0.001520	-0.000179	1.000000	0.791954	-0.004630	-0.006442	0.099001	-0.000743
TID	-0.074459	-0.000810	-0.001153	-0.000472	0.791954	1.000000	-0.012187	-0.010717	0.186498	-0.003648
M2	0.353428	-0.001729	-0.002462	0.039796	-0.004630	-0.012187	1.000000	0.041799	-0.107051	-0.009569
D(DB)	0.019686	-0.002292	0.001005	-0.017177	-0.006442	-0.010717	0.041799	1.000000	-0.063200	-0.008505
TIE	-0.025259	0.000942	0.001802	-0.004337	0.099001	0.186498	-0.107051	-0.063200	1.000000	0.159153
CD	-0.069523	-0.000636	-0.000906	-0.000370	-0.000743	-0.003648	-0.009569	-0.008505	0.159153	1.000000