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Abstract

The Global Financial Crisis (GFC) has affected many regions including Latin America. This paper focuses on currency crises in Argentina, Brazil and Mexico. We estimate an Early Warning System, consisting of a dynamic factor model and an ordered logit model, with monthly data for 1990-2007. Ex ante forecasts for 2008-2009 do not produce currency crises in the fall of 2008, in sharp contrast with reality. Our model only predicts an increased probability of a currency crisis for Argentina in 2009.

Keywords: Global Financial Crisis, Currency crises, Early Warning Systems, Latin America, Dynamic factor model, Ordered logit model
JEL-code: C25, G01, N26

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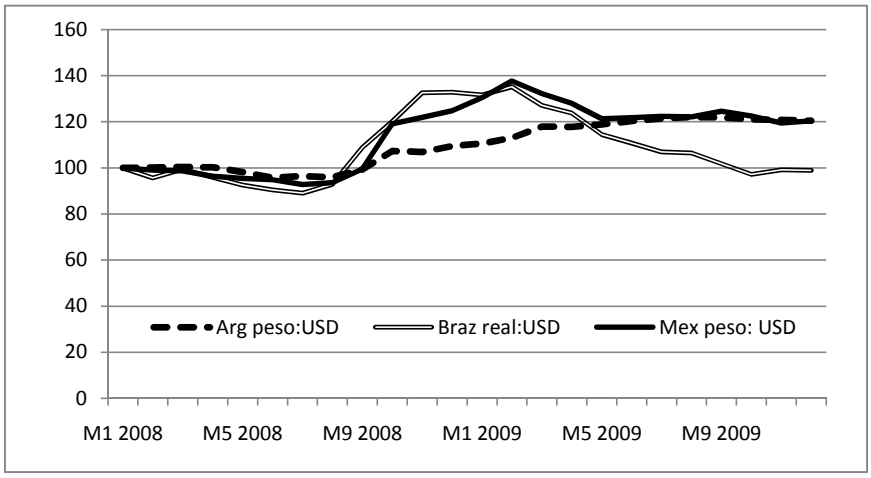
1. Introduction

The 2007–2009 Global Financial Crisis has affected many countries including the three largest economies in Latin America: Brazil, Mexico and Argentina. In the fall of 2008, Latin American currencies depreciated sharply versus the US dollar (see also Coudert, Couharde and Mignon, 2011). In Brazil and Mexico the local currencies quickly depreciated by more than 40%, and the Argentinian peso gradually depreciated by 20% vis-à-vis the US dollar (see Figure 1). The stock markets plunged with approximately 50%, and the sovereign bond interest rate spread in Argentina quadrupled, while the spread doubled in Mexico and Brazil. Ocampo (2009), Porzecanski (2009) and Jara, Moreno and Tovar (2009) agree that the Global Financial Crisis has hit Latin America very hard, but that the financial impact has been less severe. Various reasons have been provided. After a period of economic prosperity in the 2002–2007 boom, the initial situation was much better due to high commodity prices, increasing international trade and exceptional financing conditions. Also reduced currency mismatches played an important role, as well as the introduction of a more flexible exchange rate regime, improved supervision on banking sector, and more credible monetary and fiscal policies, including high foreign reserves and low sovereign external debt levels.

This paper investigates the experience of Latin America with currency crises since the 1990s. We address two questions. First, what were the main determinants for the currency crises and the run-up to currency crises? Second, does the model we develop in this paper pick up the crisis in the aftermath of the fall of Lehman Brothers in September 2008, and more generally how did the countries perform in the run up to and the aftermath of the 2008 event?

We confine our attention to the three most important economies of Latin America: Brazil, Mexico and Argentina that account for over 70% of regional GDP. We focus on the period 1990 to 2009 because this period has entirely different characteristics than the

Figure 1: Nominal exchange rates indexed (2008M1 = 100) for the period 2008-2009 for Mexico, Argentina and Brazil



1970s and 1980s (hyperinflation, 1980s debt crisis, political system) and because of data availability. In this paper, we model the probability of a currency crisis in an ordered logit model to include the severity of currency crises. We use a dynamic factor model to cope with the large number of crisis indicators. In that respect our paper is related to Cipollini and Kapetanios (2009), who also apply dynamic factors in their Early Warning System (EWS).[1] We estimate the ordered logit models up to and including 2007, and present forecasts for 2008-2009.

We contribute to the EWS literature in three ways. We are the first to apply the two stage approach in dynamic factor modeling of Doz et al. (2011) in an EWS for currency crises, in combination with the ordered logit model such that the severity of the currency crises is accounted for. Second, we include a wide range of variables in explaining currency crises. This allows us to investigate the role of institutional, political, global and commodity-related indicators, as suggested by Alvarez Plata and Schrooten (2004), and others. Finally, we focus on Latin America, a region that is currently under investigated.

[1] An alternative is Innoue and Rossi (2008), who apply a diffusion index method to forecast currency crises.

The remainder of the paper is structured as follows. After a review of financial crises and models, early warning systems and empirical studies for Latin America in Section 2, Section 3 discusses our method. The data are presented in Section 4, followed by the empirical results in Section 5 and the analysis of out of sample performance in Section 6. We discuss our results in Section 7, and Section 8 concludes.

2. Review

2.1. Four generations of crises and models

Theoretical models for currency crises have been developed since the late 1970s, based on the seminal work of Krugman (1979). The characteristics of crises have changed over time, and so have the models. The literature distinguishes four generations of financial crises (models).

The *first generation models* explain the crises as the result of fundamental inconsistencies in domestic policies, which at that time (1960s and 1970s) characterize the crises. The crises are preceded by a deterioration in the fundamentals, such as recurring budget deficits which are monetary financed, or persistent current account deficits which exhaust the foreign reserves.

With the crisis of the European Monetary System in 1992-1993 a *second generation crisis* appears, because the weak economic fundamentals alone could not explain such a dramatic drop in the exchange rate. If fundamentals are strong then no currency attack will take place, and if they are weak then the government will not defend the currency. But when the fundamentals are in a "grey zone", multiple equilibria are possible. Relative small changes can have a big impact. When speculators suspect that the government is not committed to defend the exchange rate (e.g. for restoring international competitiveness), then a massive attack follows which can trigger a self-fulfilling devaluation of the domestic currency (Obstfeld, 1996).

The Asian crisis of 1997–1998, a *third generation crisis*, gives a new boost to crisis research. Banks and financial institutions expand and ease their loan granting policies prior to the crisis, because they count on a government bailout in case of solvency problems. This moral hazard behavior leads to an excessive build-up of external private debt followed by a collapse (McKinnon and Pill, 1997). A currency devaluation can trigger a banking and debt crisis when banks and government have a mismatch on the balance sheet: domestic assets financed by foreign liabilities (Chang and Velasco, 1998). Krugman (2003) adds that a combination of factors such as panics in the international investment community, policy mistakes in handling the crisis, and poorly designed international rescue programs cause a financial panic which results in currency crises, runs on banks, massive bankruptcies and political turmoil.

The development of *fourth generation models* of financial crises is ongoing. Breuer (2004) argues that poor institutional factors are the underlying cause for unsustainable policies, excessive borrowing and lending, hyperinflation, etc. Although economic factors also play a role in fourth generation models, the institutional factors set the conditions for economic outcomes. Many databases that quantify institutional factors have become available recently, enabling more research.

2.2. Early Warning Systems

Early Warning Systems (EWS) are models that send signals or warnings well ahead of a potential financial crisis. The dozens of EWS that have been developed differ widely in the definition of a financial crisis, the period of estimation, data frequency, the countries included in the database, the inclusion of indicators, the forecast horizon, and the statistical or econometric method (Jacobs, Kuper and Lestano, 2008). For extensive overviews see Kaminsky, Lizondo and Reinhart (1998) or Abiad (2003). Most studies use binary methods (logit or probit), the signals approach, Ordinary Least Squares, Markov Switching models, binary recursive trees, contingent claims analysis, or a combination of these methods.

The typical EWS is applied to a large number of emerging countries in order to obtain sufficient crisis observations. This approach has received criticism. To quote Abiad (2003): "The one-size-fits-all, panel data approach used in estimating most Early Warning Systems (EWS) might be one of the causes of their only moderate success". Kaminsky (2006) confirms this and Beckmann, Menkhoff and Sawischlewski (2006) also suggest that differences between geographical regions justify a regional approach. A growing number of studies focuses on a geographic region—particularly South East Asia, Central Europe and Latin America. Even within a region distinctions can be made. Van den Berg, Candelon and Urbain (2008) construct country clusters for six Latin American countries. In their study for the period 1985-2004, Argentina, Brazil and Peru are grouped in one cluster because of similar inflation patterns, while Mexico, Uruguay and Venezuela are grouped in the other cluster, due to important privatizations in the early 1990s.

2.3. Empirical studies for Latin America

With its rich history of financial crises (Reinhart and Rogoff 2009), Latin American countries—particularly Argentina, Brazil and Mexico—have been included in EWS's applied to emerging economies from all over the world.

There are also studies with an exclusive focus on the region. Kamin and Babson (1999) construct an EWS to predict currency crises for a pooled dataset of six Latin American countries for the period 1981–1998. They use a binomial probit model to identify the deeper causes of Latin America's volatility. They find that domestic policy and economic imbalances (large fiscal deficits, excessive money creation, overvalued exchange rate) are more related with currency crises than exogenous external shocks (increase in international real interest rates, recession in developed countries, decrease in commodity prices). Herrera and Garcia (1999) construct the simplest possible EWS which can be updated every month at a low cost. For this reason they select the lowest number of variables in their model: real effective exchange rate, domestic credit growth in real terms, ratio of M2 to international

reserves, inflation and stock market index in real terms. They use the signals approach from Kaminsky et al. (1998), but with one difference: they first aggregate the indicators into a composite index and then generate signals depending on the behavior of this composite index. They apply their model to eight Latin American countries. They acknowledge that including external interest rates, commodity prices and the state of the real economy will probably improve the performance, but that this will add to the complexity. To handle this, they suggest the use of factor models to be estimated with the Kalman filter technique, or regime switching methods.

Argentina's long history of currency and other financial crises is analyzed in various studies. Kaminsky, Mati and Choueiri (2009) use a VAR model to quantify the role of domestic and external shocks in currency crises. They analyze Argentina's currency crises from 1970 to 2001 and find that the crises have different causes. In some crises the domestic fundamentals matter, in particular inconsistent monetary and exchange rate policies. Typically these policies are accompanied by hyperinflation, confiscations of bank deposits, and price and wage controls, which cause uncertainty and risk aversion of households and foreign investors. In other crises the monetary tightening in industrial countries is the key: the resulting capital flow reversals lead to currency crises. Contagion also plays a role in some crises in the 1990s. Cerro and Iajya (2009) analyze Argentina's crises from 1862 to 2004. They use different techniques and a set of institutional and macroeconomic variables. They find that institutions and their volatility are key indicators for currency crises. Alvarez Plata and Schrooten (2004) apply the signal approach from Kaminsky et al. (1998) and find that the Argentinian currency crisis from 2002 could not have been foreseen by the leading indicators. They suggest that in future research institutional indicators such as political turbulence and corruption should be included.

Another crisis that has been researched widely is the Mexico 1994/1995 "tequila" crisis. Sachs, Tornell and Velasco (1996) focus on contagion. They identify fundamentals that

explain why some countries are hit and others not: high real exchange rate, lending boom and low reserves. Beziz and Petit (1997) study the use of real time data on predicting the crisis. They find that the 1994 crisis could well have been foreseen with information available before the crisis. They use the composite leading indicator which was constructed by the OECD in 1996 and consist of financial series (total industrial production in USA, total imports from USA, share prices, real effective exchange rate and CPP), business surveys (production and employment tendencies) and employment in manufacturing.

Summarizing, our work builds upon previous empirical research on Latin America. In line with a suggestion of Herrera and Garcia (1999) we use factor models and the Kalman filter. Our choice to to include a wide range of variables instead of preselecting explanatory variables is inspired by Kaminsky, Mati and Choueiri (2009) who find that no category dominates. We follow Cerro and Iajya (2009) and Alvarez Plata and Schrooten (2004) by including institutions as explanatory variables in our model.

3. Method

We first apply dynamic factor models to extract the factors from a set of indicators, use the estimated factors as regressors in the ordered logit model, with a crisis dating dummy as dependent variable, and then compute ex ante forecasts. Before we turn to these models, we first discuss the crisis dating dummy.

3.1. Crisis dating

Identifying and dating currency crises has been debated since the mid 1990s. Two approaches can be distinguished: the *successful attack* approach and the *speculative pressure* approach. In this study, we opt for the speculative pressure approach, inspired by Girton and Roper (1977), and later used by Eichengreen, Rose and Wyplosz (1995) for currency crisis purposes.

We follow the Exchange Market Pressure Index (EMPI) of Kaminsky and Reinhart (1999) and Kaminsky (2006) defined as the weighted average of exchange rate changes and reserve changes, with weights such that the two components of the index have equal conditional volatilities. To determine the crises we deviate from Kaminsky and Reinhart (1999), who identify a crisis when the observation exceeds the mean by more than three standard deviations. We use this definition to identify "very deep" crises. Similar to Cerro and Iajya (2009) we extend the definition of crises by introducing "deep" crises (which we define as two adjacent months with exceedance between 2 and 3 times the standard deviation) and "mild" crises (which we define as two adjacent months with exceedance between 1 and 2 times the standard deviation). The ordinal variable that indicates crises periods is constructed as follows: the value 0 indicates no crisis periods, the value 1 is assigned to mild crises, 2 to deep crises and 3 to very deep crises. As is common in early warning systems of currency crisis, we will use the same dummy variable for the crisis entry month and the run-up to the crisis. In this paper we choose a period of six months preceding the onset of a crisis. In case a crisis follows within six months after a previous crisis, then the second crisis is considered a continuation of the earlier one. If types of crises overlap we assign the highest ordinal number to that crisis.

3.2. Dynamic factor models

Dynamic factor models exploit the idea that movements in a large number of variables are driven by a limited number of common factors, which may enter with leads and lags

$$\boldsymbol{X}_t = \boldsymbol{A}_0 \boldsymbol{f}_t + \boldsymbol{A}_1 \boldsymbol{f}_{t-1} + \ldots + \boldsymbol{A}_p \boldsymbol{f}_{t-p} + \boldsymbol{\epsilon}_t, \tag{1}$$

where $\boldsymbol{X}_t$ is a $N \times 1$ vector of observations of explanatory variables in period t, $\boldsymbol{f}_t$ is a $r \times 1$ vector of common components or factors, and $\boldsymbol{\epsilon}_t$ is a vector of idiosyncratic components,

$\boldsymbol{\epsilon}_t \sim \mathcal{N}_N(0, \boldsymbol{\Phi})$. The variables are typically stationary, demeaned and standardized. For a review of dynamic factor models we refer to e.g. Stock and Watson (2011).

Dynamic factor models can take several forms. Stock and Watson (1998) allow for time-varying loadings, but do not allow for autoregressive dynamics in the idiosyncratic components. Forni, Hallin, Lippi and Reichlin (2005) adopt a different form, which is christened a *static factor representation of the DFM* by Stock and Watson (2005)

$$\boldsymbol{X}_t = \boldsymbol{A}\boldsymbol{F}_t + \boldsymbol{\epsilon}_t, \tag{2}$$

where $\boldsymbol{A} \equiv [\boldsymbol{A}_0 \ \boldsymbol{A}_1 \ \ldots \boldsymbol{A}_p]$ and $\boldsymbol{F}_t \equiv [\boldsymbol{f}_t' \ldots \boldsymbol{f}_{t-p}']'$. Hence, a dynamic factor model with r common factors can be written as a static factor model with $(p+1)r$ static factors.

The dynamics of the r common factors is represented by a vector autoregressive VAR(m) process of order m

$$\boldsymbol{F}_t = \boldsymbol{\Gamma}(L)\boldsymbol{F}_t + \boldsymbol{\nu}_t, \tag{3}$$

where $\boldsymbol{\Gamma}(L)\boldsymbol{F}_t \equiv \boldsymbol{\Gamma}_1\boldsymbol{F}_{t-1} + \ldots + \boldsymbol{\Gamma}_m\boldsymbol{F}_{t-m}$ and $\boldsymbol{\nu}_t \sim N(\boldsymbol{0}, \boldsymbol{\Sigma}_\nu)$.

The factors can be estimated in the frequency domain (Forni et al., 2000, 2002), by principal components (Bai and Ng, 2002; Stock and Watson, 2002a, 2002b), or by principal components in combination with the Kalman filter (Forni et al. 2009; Doz, Giannone and Reichlin, 2011). In this paper we employ the two-step approach of Doz et al. (2011), which is based on a slightly different version of the static factor representation of the dynamic

factor model in combination with a VAR(p) for the r common factors in the state equation:

$$\boldsymbol{X}_t = \begin{pmatrix} \boldsymbol{A}_0 & 0 & \dots & 0 \end{pmatrix} \begin{pmatrix} \boldsymbol{f}_t \\ \boldsymbol{f}_{t-1} \\ \vdots \\ \boldsymbol{f}_{t-p+1} \end{pmatrix} + \boldsymbol{\epsilon}_t \tag{4}$$

$$\begin{pmatrix} \boldsymbol{f}_t \\ \boldsymbol{f}_{t-1} \\ \vdots \\ \boldsymbol{f}_{t-p+1} \end{pmatrix} = \begin{pmatrix} \boldsymbol{A}_1 & \boldsymbol{A}_2 & \dots & \boldsymbol{A}_{p-1} & \boldsymbol{A}_p \\ \boldsymbol{I}_r & 0 & \dots & 0 & 0 \\ 0 & \boldsymbol{I}_r & \dots & 0 & 0 \\ \vdots & \vdots & \ddots & \vdots & \vdots \\ 0 & 0 & \dots & \boldsymbol{I}_r & 0 \end{pmatrix} \begin{pmatrix} \boldsymbol{f}_{t-1} \\ \boldsymbol{f}_{t-2} \\ \vdots \\ \boldsymbol{f}_{t-p} \end{pmatrix} + \begin{pmatrix} \boldsymbol{I}_r \\ 0 \\ \vdots \\ 0 \end{pmatrix} \boldsymbol{\nu}_t. \tag{5}$$

In the first step preliminary estimates of the factors and estimates of the parameters of the dynamic factor models are computed by principal components. In the second step the factors are updated via the Kalman filter.[2]

Determination of the number of factors

One of the issues in factor analysis is the determination of the optimal number of factors. Various procedures have been proposed, e.g. the Bayesian Information Criterium, the Kaiser Criterium and Cattell's scree test. The number of factors is better overestimated than underestimated, because in the first case the factors are still estimated consistently (Breitung and Eickmeier, 2006).

With the large dimensional factor models of recent years many studies have proposed solutions and consistent estimators for the number of factors using different factor models

[2]The Kalman filter is a forward recursion procedure with uses all information up to and including period t to compute the value of the state at period t. We do not use the Kalman smoother (which uses all information in the sample) because if we extend the database in our out-of-sample forecast exercise in section 6 the smoother would change the past values of the factors.

and distributional assumptions. Here we employ the criterion of Otter, Jacobs and den Reijer (2011; henceforth OJdR), which is associated with Onatski's (2009) test statistic, and related to the scree test.

Interpreting the factors

Using factor models comes at a cost. Determining the economic relevance of factors and interpreting the factors in a meaningful way is problematic. Most indicators feature in more than one factor, so focusing on a single factor only partially explains the full impact of an indicator on the probability of a crisis, and may even lead to counterintuitive results. Here we look at correlations between dynamic factors and the indicators (following e.g. Breitung and Eickmeier, 2006).[3]

3.3. Ordered logit model

As our dependent variable can only take four values ($y_t = 0$: no crisis; $y_t = 1$: mild crisis; $y_t = 2$: deep crisis, and $y_t = 3$: very deep crisis), we employ an ordered choice model, which extends the binary choice model, allowing for a natural ordering in the outcomes y. Assume that there are $K + 1$ possible outcomes, then

$$y_t = \begin{cases} 0 \quad \text{if} \quad y_t^* \leq \mu_1, \\ 1 \quad \text{if} \quad \mu_1 < y_t^* \leq \mu_2, \\ 2 \quad \text{if} \quad \mu_2 < y_t^* \leq \mu_3 \\ \vdots \\ K \quad \text{if} \quad \mu_K < y_t^*, \end{cases} \tag{6}$$

[3] An alternative is to place the set of variables in well-defined groups, and apply factor analysis to each of the groups.

where y_t is the observed ordinal variable, and y_t^* is the continuous latent variable that is equal to

$$y_t^* = Z_t = \alpha + \boldsymbol{X}_t\boldsymbol{\beta}. \tag{7}$$

The thresholds μ_i which separate the various outcomes are estimated simultaneously with the parameters α and β.

We use the ordered logit model, because the logistic distribution (logit model) has wider tails than the normal distribution (probit model). This is preferable if an event has a very low frequency, as is the case with financial crises (Manasse, Roubini and Schimmelpfennig 2003). The probabilities for each of the outcomes are:

$$\begin{aligned} P(y_t = 0) &= \frac{1}{1 + e^{-(Z_t - \mu_1)}}, \\ P(y_t = 1) &= \frac{1}{1 + e^{-(Z_t - \mu_2)}} - \frac{1}{1 + e^{-(Z_t - \mu_1)}}, \\ &\vdots \\ P(y_t = K) &= 1 - \frac{1}{1 + e^{-(Z_t - \mu_K)}}. \end{aligned} \tag{8}$$

For each country we will estimate two versions of the ordered logit model. The first uses dynamics factors calculated from the data set, excluding institutional variables, because the low variation of some discrete variables (particularly institutional variables) may cause quasi complete separation (Zorn, 2005). This occurs when there is limited overlap in the values of (a set of) explanatory variables and the outcomes of the dependent variable, and causes large estimates and standard errors. The second model adds (a subset of) institutional and political variables to the dynamic factors as separate regressors, and may also include a contagion dummy. These models are estimated using data until and including 2007, and used to forecast the period 2008–2009.

3.4. Ex ante forecasts

We test the out-of-sample performance of the estimated model for the period 2008M1–2009M12. We forecast the probabilities of a mild, deep and very deep crisis with our ordered logit model. We use realized monthly data for the indicators for the years 2008 and 2009, and extrapolate the dynamic factors using the Kalman filter without re-estimating the loadings of the dynamic factor model.

4. Data

Our sample starts in the early 1990s, when the effects of spillovers of the 1980s Latin American debt crisis had faded out. The analysis for Argentina starts after the introduction of the Convertibility Plan (April 1991) and for Brazil after the introduction of the Real Plan (July 1994), which both can be regarded as a structural break with the hyperinflation periods. Mexico did not experience any period of hyperinflation in the 1990s.

As explained above, we distinguish mild, deep and very deep crises. Figures 2, 3 and 4 show that very deep crises are rare; each of the countries under investigation experienced only a few very deep crises: Mexico (December 1994 and October 2008), Brazil (January 1999) and Argentina (January 2002). We split the sample in two periods: the period until and including December 2007 is used to estimate the models, and the period January 2008 until and including December 2009 is used to forecast currency crises. We estimate the EMPI based on the period up to December 2007, and extend this to December 2009 using the same weights (standard deviations).

For the explanatory variables we select apart from the "usual suspects"—the common macroeconomic and financial variables—we include institutional variables, commodity-related and global indicators. There are however some data limitations. Not all time series are sufficiently long which limits the selection of explanatory variables. The quality of some of Argentinas national statistics after 2007 is doubtful (The Economist, 2012).

Figure 2: Actual crisis dates for Argentina for the period 1991-2009

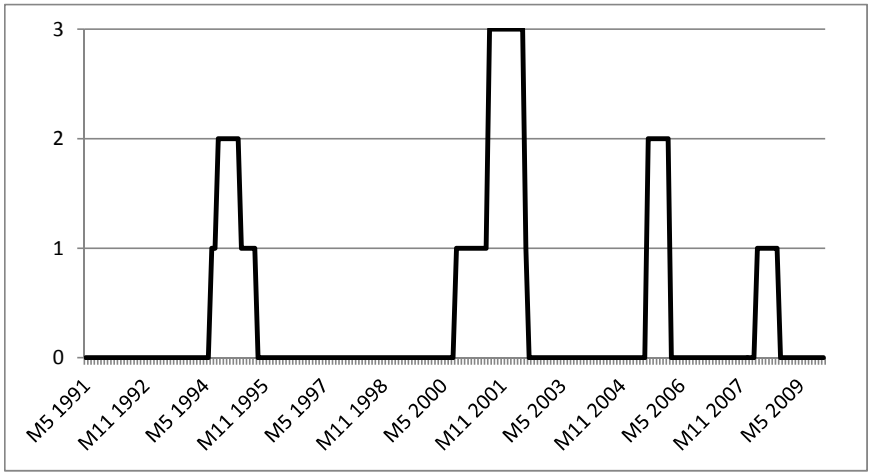


Figure 3: Actual crisis dates for Brazil for the period 1994-2009

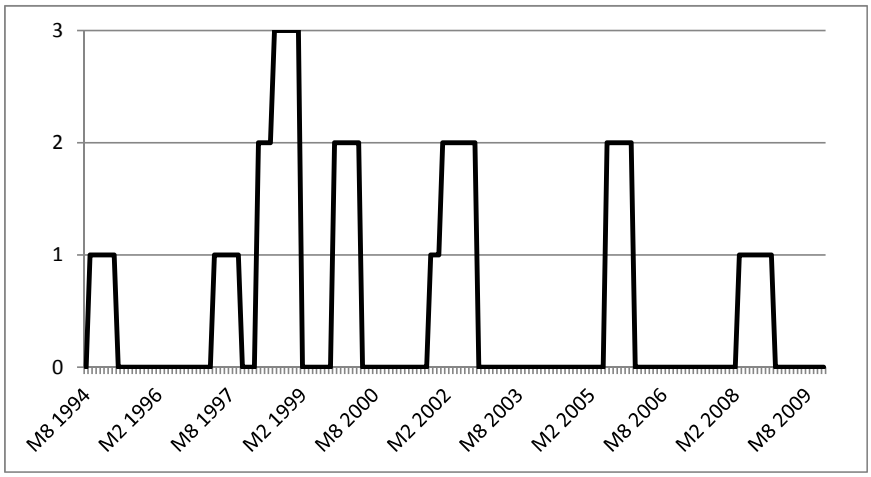
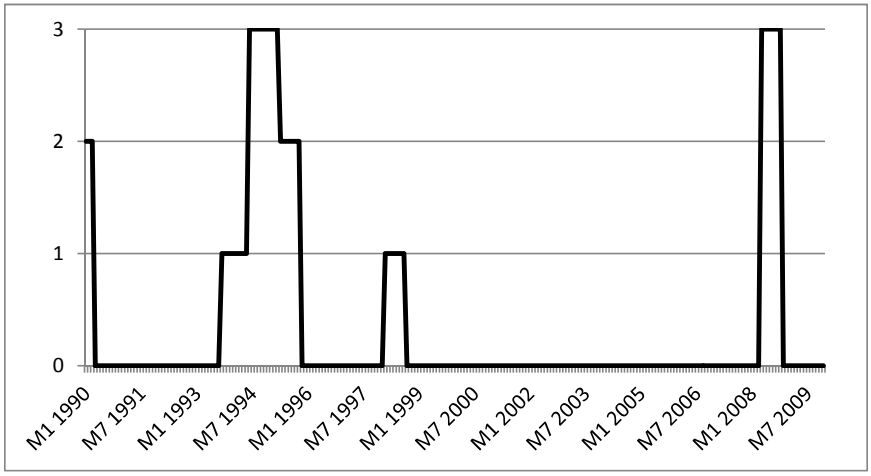


Figure 4: Actual crisis dates for Mexico for the period 1990-2009



The selected indicators can be classified into separate categories:

- 13 external economic indicators, among which the deviation from real exchange rate trend, exchange rate volatility, growth of exports, imports and foreign reserves, import cover, ratio of M2 to foreign reserves.

- 19 domestic economic indicators, among which domestic real interest rate, inflation, M2 multiplier, industrial production, share market index return.

- 14 institutional indicators, among which Herfindahl indices, political stability, corruption, investment profile, internal conflict, election years.

- 10 debt indicators, among which total debt, short term debt, debt service, arrears.

- 14 banking sector indicators (25 for Argentina), among which credit to public sector, to private sector, ROE, deposits.

- 5 global and regional indicators, among which world economic growth, US yield, contagion dummy.

- 12 commodity related indicators, among which prices of oil, metals, agricultural products, exports and imports of fuel, agricultural products, food and metals as percentage of GDP.

The main sources for the data are the International Financial Statistics (IFS) database of the IMF, the World Development Indicators (WDI) from the World Bank, International Country Risk Guide (ICRG) database of the Political Risk Services Group, and Beck, Demirgüç-Kunt and Levine (2009).[4]

The series have been tested for non-stationarity (using Augmented Dickey-Fuller tests) and visually inspected for seasonal effects. Where necessary a transformation is made to render them stationary. To deal with mixed frequencies in series, we apply simple quadratic interpolations. All series are normalized, i.e. demeaned and divided by its sample standard deviation.

5. Empirical results

We estimate the ordered logit model for Argentina, Brazil and Mexico for the period up to and including 2007. In this section we discuss both the dynamic factor model outcomes, and the estimation results for the ordered logit models. We do not include institutional variables in the model, because these cause quasi complete separation due to their low variation. We introduce a second model in which a subset of the institutional variables are added to the dynamic factors in the ordered logit model. The extended model allows us to test whether the institutional variables contain additional information that is significant for currency crisis periods.

[4]For a complete overview, including definitions, transformations, and sources we refer to Appendix A.

Table 1: Indicators with highest correlation with the dynamic factors (DF), with correlation coefficients between brackets.

DF	Argentina	Brazil	Mexico
1	Banks: change in claims on private sector (0.889)	Ratio of debt service to exports (0.853)	Real Exchange Rate: deviation from trend (-0.844)
2	Arrears to total debt (0.874)	Long term private debt / total debt (-0.774)	Inflation (CPI) (0.963)
3	Change in US short term interest rate (0.728)	Debt reduction / total debt (-0.755)	Domestic real interest rate (0.795)
4	Ratio of debt service to reserves (0.814)	Change in deposit money bank assets (% of GDP) (-0.733)	US short term interest rate (-0.630)
5	Deposit money banks and other banking institutions: Change in assets (0.523)	Agriculture: Change in value added (% of GDP) (0.716)	Change in US real GDP growth (0.616)
6	Change in import coverage (-0.554)	Change in long term public and publicly guaranteed debt / total debt (0.639)	Change in long term private debt / total debt (0.632)
7	Short term debt / total debt (0.550)	Agriculture: Change in raw materials imports (-0.514)	
8	Change in oil prices (-0.531)	Change in central bank assets as % of GDP (0.662)	
9	Change in international reserves to total external debt (-0.464)		
10	Change in long term public and publicly guaranteed debt / total debt (-0.578)		

5.1. Argentina

The OJdR criterion suggests 10 factors for Argentina. When focusing on the variables with the largest correlation (either positive or negative) we can label each factor (see Table 1). Factors 1 and 5 are dominated by bank indicators, while factors 2, 4, 7, 9, and 10 are labeled as debt factors. We label factor 3 as a global factor, and factor 6 as an external economic factor. Finally, factor 8 is driven by commodities.[5]

Estimation results

The dynamic factor combination which yields the best fit in the ordered logit model has 4 dynamic factors and 2 lags. Column (1) in Table 2 shows that all factors, except 9 and 10, are significant at a 5% significant level. Factors 2, 3, 6 and 8 increase the probability of a crisis.

Including institutional variables

To identify the importance of the institutional indicators we add a selection of the institutional variables to the factors. The results are reported in column (2) in Table 2. The institutional variables that add most information while not causing quasi complete separation are changes in law and order, investment profile and whether there is an election year or not. An additional contagion variable is also included. This variable is a dummy that has a value 1 if there is a deep or very deep currency crisis in Brazil or Mexico, and 0 elsewhere. The fit is illustrated for the period 1991M5 to 2007M12 in Figure 5.

The Wald test (F-value is 0.439; the p-value equals 0.780) shows that the institutional variables do not contribute to explaining currency crises in Argentina. So, we conclude that institutional indicators do not play an important role in the model for Argentina.

[5]If we consider the five indicators with the highest correlations instead of the single indicator with the higest correlation, then factors 2, 7, and 8 are not dominated by a single category, and commodities also play a role in factors 1 and 10.

Table 2: Ordered logit estimation results for Argentina, with standard errors in brackets

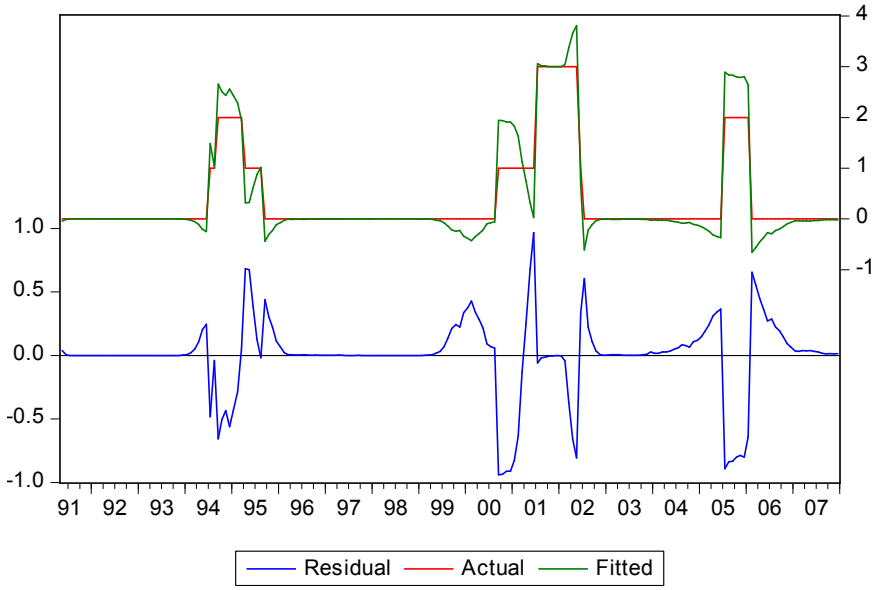
	(1)	(2)
	Factors only	Institutional variables included
DF1	−0.737 ***	−0.955 ***
	(0.366)	(0.370)
DF2	−0.466 ***	−0.572 ***
	(0.156)	(0.217)
DF3	0.972 ***	1.111 ***
	(0.365)	(0.405)
DF4	0.697 ***	0.704 ***
	(0.205)	(0.211)
DF5	−1.387 ***	−0.975 **
	(0.343)	(0.451)
DF6	1.439 ***	1.458 ***
	(0.392)	(0.406)
DF7	−1.412 ***	−1.133 ***
	(0.401)	(0.411)
DF8	1.044 **	1.057 *
	(0.449)	(0.608)
DF9	0.093	0.447
	(0.268)	(0.351)
DF10	−0.173	−0.852
	(0.346)	(0.752)
D_LAWORD		0.266
		(0.739)
D_INVPROF		1.466
		(1.137)
ELECLEGYR		0.055
		(0.331)
CONTAG		−0.013
		(0.189)
R^2	0.530	0.535

Notes

D_LAWORD	changes in law and order
D_INVPROF	changes in investment profile
ELECLEGYR	election year dummy
CONTAG	contagion dummy (crisis in Brazil or Mexico)

*** significant at 1% level, ** significant at 5% level,
* significant at 10% level

Figure 5: Actual and fitted data, and the residuals from the ordered logit model for Argentina for the period 1991-2007; including institutional variables



5.2. Brazil

The OJdR criterion suggests 8 factors for Brazil. When focusing on the variables with the largest correlation (either positive or negative) we label factors 1, 2, 3 and 6 as debt-related factors (see Table 1). Factors 4 and 8 are interpreted as bank factors, and factors 5 and 7 are driven by commodities.[6]

Estimation results

The combination of 4 dynamic factors and 2 lags yields the best fit in the ordered logit model for Brazil. Column (1) in Table 3 shows that all factors, except 4 and 7, are significant at a 5% significant level. Except for factor 2 all factors increase the probability of a crisis.

[6]If we consider the five indicators with the highest correlations instead of the single indicator with the higest correlation, then factors 2, 3 and 6 become combined factors consisting of debt and to a lesser extent external economy variables.

Table 3: Ordered logit estimation results for Brazil, with standard errors in brackets

	(1)	(2)
	Factors only	Institutional variables included
DF1	0.178 ***	0.226 **
	(0.065)	(0.113)
DF2	−0.181 ***	−0.239 ***
	(0.066)	(0.082)
DF3	0.250 ***	0.437 ***
	(0.088)	(0.153)
DF4	−0.116	−0.117
	(0.099)	(0.116)
DF5	0.549 ***	0.332 **
	(0.135)	(0.157)
DF6	0.389 **	0.088
	(0.152)	(0.212)
DF7	−0.096	−0.306
	(0.155)	(0.214)
DF8	0.395 ***	0.098
	(0.129)	(0.157)
D_GOVSTAB		−0.195
		(0.462)
D_CORRUPT		−0.986 *
		(0.524)
ELECLEGYR		1.088 ***
		(0.328)
R^2	0.200	0.251

Notes

D_GOVSTAB changes in government stability

D_CORRUPT changes in corruption

ELECLEGYR election year dummy

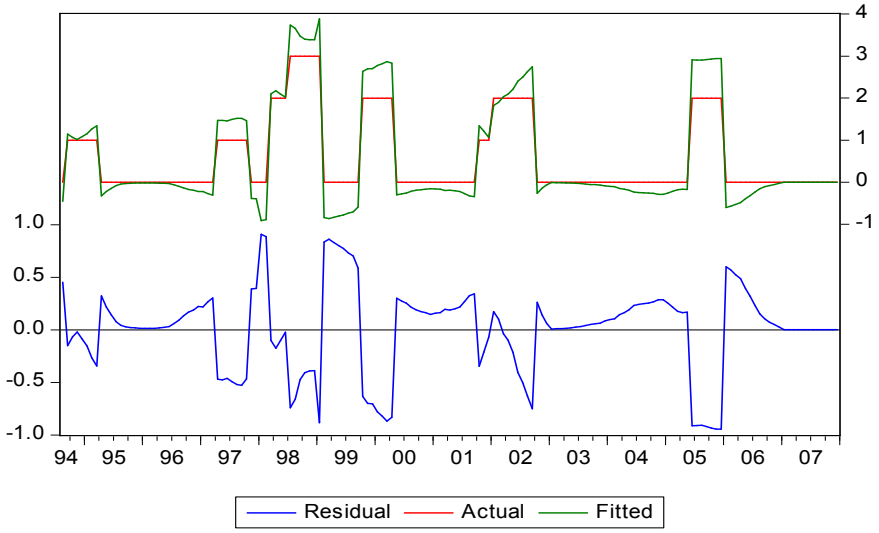
*** significant at 1% level, ** significant at 5% level,

* significant at 10% level

Including institutional variables

To identify the importance of the institutional indicators we add a selection of the institutional variables to the factors. The results are reported in column (2) in Table 3. The institutional variables that add most information while not causing quasi complete separation are changes in government stability and corruption and whether there is an election year or not. The pseudo R^2 improves and the fit is illustrated for the period 1994M8 to 2007M12 in Figure 6.

Figure 6: Actual and fitted data, and the residuals from the ordered logit model for Brazil for the period 1994-2007; including institutional variables



We conclude that institutional and political indicators do play an important role in the model. Not only does the fit improve, the Wald test (F-value is 4.108, and the p-value equals 0.008) shows that the included institutional variables contribute to explaining the currency crisis in Brazil.

5.3. Mexico

According to the OJdR criterion the number of factors for Mexico is 6. Based on the variables with the largest correlation (either positive or negative) we label factor 1 as an

external economic factor (see Table 1). Factors 2 and 3 and related to domestic economic indicators. Factors 4 and 5 are interpreted as global factors, and factor 6 is dominated by debt indicators.[7]

Estimation results

The combination of 3 dynamic factors and 3 lags yields the best fit in the ordered logit model for Mexico. Column (1) in Table 4 presents the estimation results for the period 1990M1 to 2007M12. Table 4 shows that factors 2, 3 and 5 are significant at a 5% significant level. Factor 1 is significant at a 10% significance level. All factors increase the probability of a crisis.

Including institutional variables

Including institutional indicators improves the pseudo R^2 (see column (2) in Table 4) and the fit is illustrated for the period 1990M1 to 2007M12 in Figure 7. The institutional variables that add most information while not causing quasi complete separation are changes in bureaucratic quality, democratic accountability and investment profile. A contagion variable is included that has a value 1 if there is a deep or very deep currency crisis in Argentina or Brazil.

The institutional indicators do play an important role in the model; the Wald test (F-value is 5.291, and the p-value is smaller than 0.001) shows that the included institutional variables contribute to explaining the currency crisis in Mexico.

[7]If we consider the five indicators with the highest correlations instead of the single indicator with the higest correlation, then factors 2 and 3 are related to both domestic economic and debt indicators, and factors 4 and 5 are mixed factors, with a strong correlation with global indicators.

Table 4: Ordered logit estimation results for Mexico, with standard errors in brackets

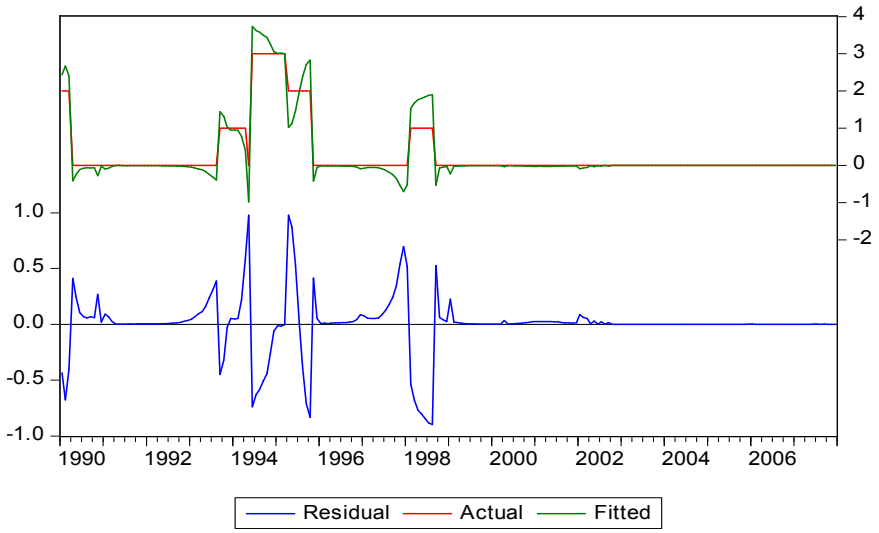
	(1)	(2)
	Factors only	Institutional variables included
DF1	0.221 *	0.266
	(0.122)	(0.289)
DF2	0.556 ***	0.816 **
	(0.164)	(0.396)
DF3	0.863 ***	1.171 ***
	(0.125)	(0.316)
DF4	−0.080	−0.048
	(0.145)	(0.305)
DF5	0.614 ***	0.091
	(0.172)	(0.376)
DF6	0.350	0.199
	(0.217)	(0.278)
D_BURQUAL		1.172 ***
		(0.307)
D_DEMACC		0.825
		(0.591)
D_INVPROF		1.267 *
		(0.664)
CONTAG		0.681 **
		(0.311)
R^2	0.483	0.604

Notes

CONTAG	contagion dummy (crisis in Argentina or Brazil)
D_BURQUAL	changes in bureaucratic quality
D_DEMACC	changes in democratic accountability
D_INVPROF	changes in investment profile

*** significant at 1% level, ** significant at 5% level,
* significant at 10% level

Figure 7: Actual and fitted data, and the residuals from the ordered logit model for Mexico for the period 1990-2007; including institutional variables



6. Out-of-sample performance

In this section we investigate the out-of-sample performance of the estimated model for the period 2008M1–2009M12.

Argentina

Figures 8 and 9 show crises forecasts for Argentina for the model with only dynamic factors and the model including institutional variables. Since the institutional variables are not significant the differences in the graphs are small. Our model does not forecast the mild currency crisis that occurred in 2008, but both models predict an increase in the probability of a mild and deep currency crisis towards the end of 2009.

Figure 8: Forecasts for Argentina for the period 1991-2009; excluding institutional variables

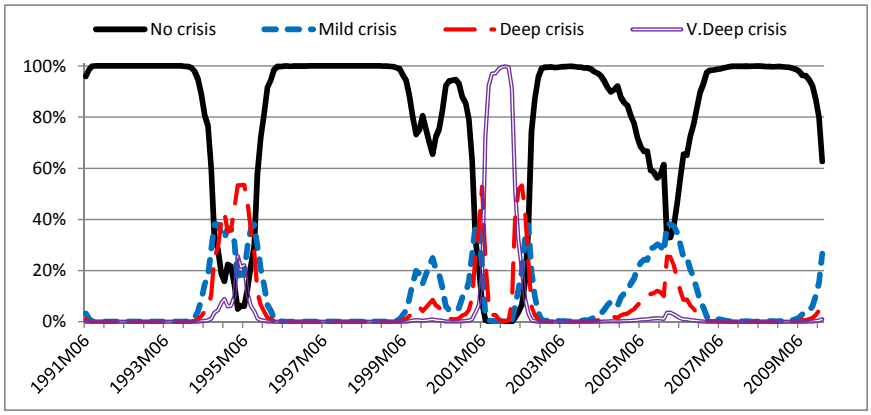
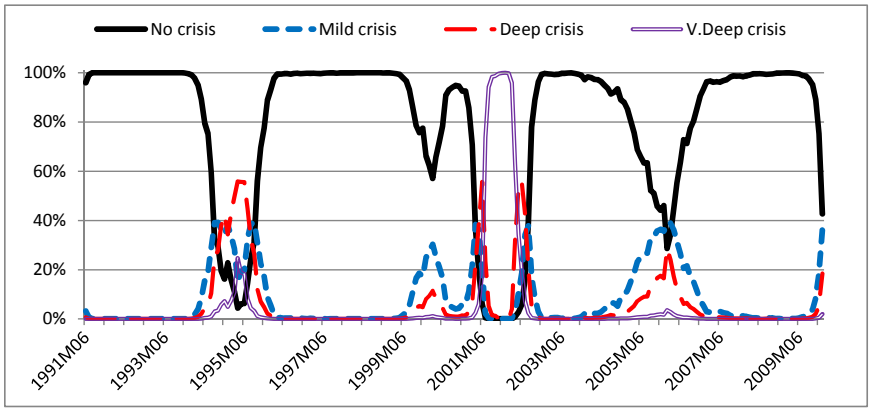


Figure 9: Forecasts for Argentina for the period 1991-2009; including institutional variables



Brazil

For Brazil the model without institutional variables shows an increase in the probability of a deep currency crisis starting already at the end of the year 2008 (see Figure 10). The model including institutional variables does not predict any crisis at all (see Figure11), which is in contrast with Brazil's currency crisis.

Figure 10: Forecasts for Brazil for the period 1994-2009; excluding institutional variables

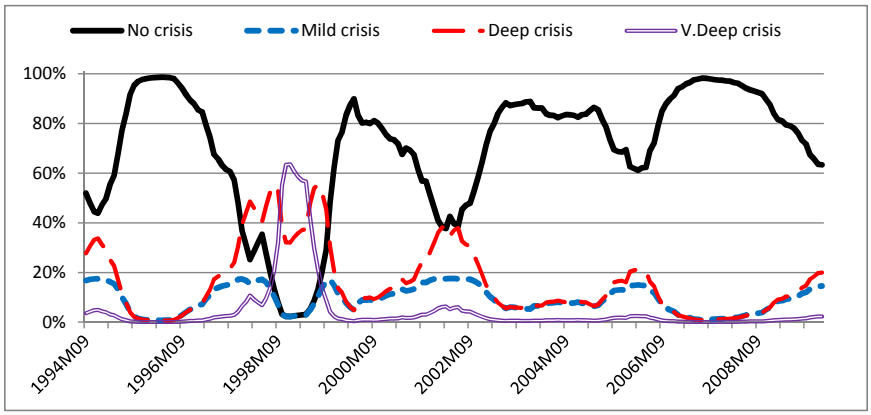
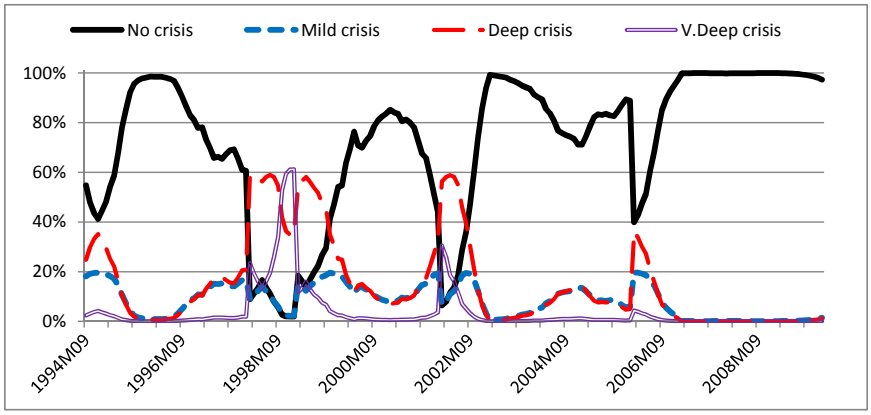


Figure 11: Forecasts for Brazil for the period 1994-2009; including selected institutional variables



Mexico

Figure 12 is based on the model with dynamic factors only, while Figure 13 is based on the model including institutional variables. The graphs are almost identical, and our EWS does not predict a currency crisis in Mexico. Nevertheless, Mexico experienced a deep currency crisis in October 2008.

Figure 12: Forecasts for Mexico for the period 1990-2009; excluding institutional variables

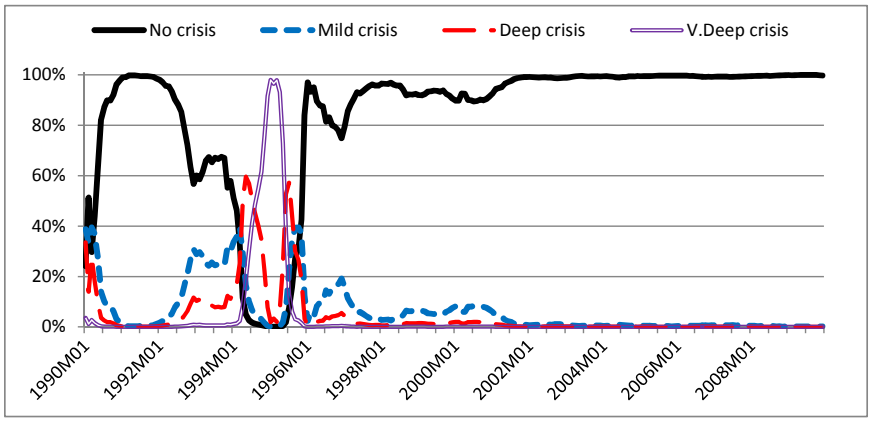
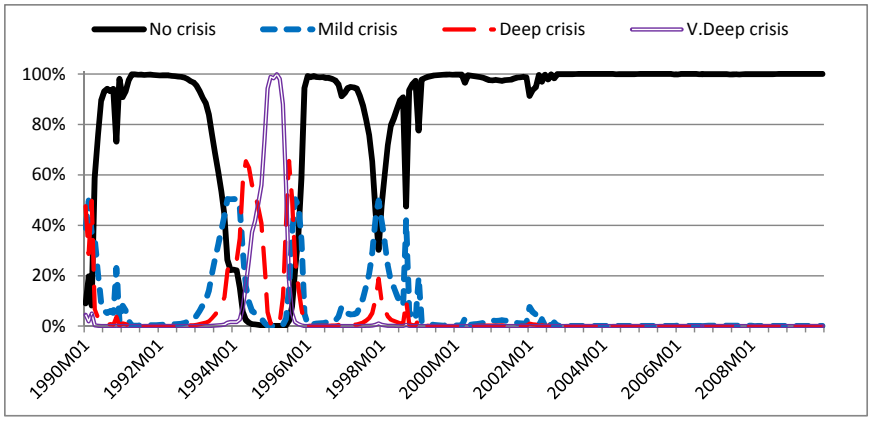


Figure 13: Forecasts for Mexico for the period 1990-2009; including selected institutional variables



7. Discussion

In the run-up to the crisis, the three Latin American countries experienced a period of economic prosperity in the 2002-2007 boom, high foreign reserves, low sovereign external debt levels, low fiscal deficit (or even surplus), and a more flexible exchange rate regime. Brazil faced a strongly appreciated currency before the onset of the crisis and had an unprecedented high level of foreign reserves (Ocampo, 2009). Mexico depended strongly on the US economy and had a highly regulated financial sector. The peso appreciated in the summer of 2008. For Argentina key economic conditions were less favorable, in particular the high and persistent inflation, which reflected important macroeconomic imbalances (Rojas Suarez, 2011). In addition, the central government debt was higher than in the other two countries (Ocampo, 2009), as well as the ratio of short term external debt to international reserves (Rojas Suarez, 2011). Political risk increased because of its macroeconomic and debt-servicing policies (Porzecansky, 2009), the anti-globalization policies that it shared with Ecuador and Venezuela (Rojas Suarez, 2011), and through government's decisions such as the nationalization of its private pension regime in the late 2008.

In the fall of 2008 all three countries experience a currency crisis. The Mexican peso depreciates strong and fast. The Brazilian real depreciates in a similar magnitude as the Mexican peso, but over a longer time span. The Argentinian peso depreciates less than the other two currencies. According to our crisis classification the crises in Argentina and Brazil are mild, but in Mexico the crisis is very deep. Our EWS does not predict a crisis for any of the countries in 2008.

The picture is different for 2009. In Brazil and Mexico the exchange rates appreciate in 2009—in Brazil the exchange rate falls even below the pre-crisis level—what makes this crisis more special compared to previous currency crises. Argentina's peso does not appreciate.

All three countries were hit by an unusually heavy drop in export earnings between the fourth quarter of 2008 and the first quarter of 2009. Brazil was hit by a second exogenous shock: heavy reversals in capital flows in the fourth quarter of 2008. Surprisingly, Brazil did not experience a major financial crisis—or even a worse-than-average deceleration in economic growth (Porzecanski, 2009). During the crisis Brazil implemented both counter-cyclical fiscal and monetary policies (Rojas Suarez, 2011). In our EWS the probability of a currency crisis in Brazil in 2009 becomes much lower when institutional variables are included. This indicates that the structural reforms that Brazil has adopted since the 1999 financial crisis seem to have worked. Mexico experienced a deep economic contraction in 2009, heavily affecting its fiscal revenues. Mexico responded by pro-cyclical fiscal policy and counter-cyclical monetary policy (Rojas Suarez, 2011).

In 2009 economic conditions prevented Argentina to undertake counter-cyclical monetary policy, but it implemented counter-cyclical fiscal policy. Rating agencies downgraded Argentinian government bonds and the spread surged, even to higher values than during the 2002 crisis. The institutional environment did not help to deal with the crisis. The elections scheduled for October 2009 were held already in June 2009 in order to deal with the GFC. However, the outcomes of the elections made things worse for the ruling president's party who lost its majority in parliament.

8. Conclusion

The fall of Lehman Brothers in September 2008 affected many countries and regions including Latin America. In Brazil and Mexico the exchange rates depreciated by more than 40%, the Argentinian peso depreciated 20% and financial markets (stocks, bonds) were hit hard. This paper investigates the experience of Latin America with currency crises since the 1990s.

We first determine which indicators are related to past currency crises, including the run-up to the crises. For that reason we develop an Early Warning System for currency crises. We develop an EWS consisting of an ordered logit model, using dynamic factor models to reduce the dimension of the information set. We find that currency crises are driven by a limited number of indicator categories. Argentina's crises are correlated with debt, banking, external economy, global and commodity-related indicators, while Brazil's crises are related to debt, institutional and commodity-related indicators. Mexico's crises are related to domestic economy, institutional and global indicators.

Secondly, we use our EWS to forecast the probability of currency crises in 2008 and 2009, which is the period in which the GFC hit the region the hardest. Our model does not predict the crisis in Mexico, it predicts a crisis for Brazil but only when institutional and political variables are excluded, and it predicts a crisis for Argentina, more than one year late. Since all countries experienced a currency crisis in 2008, we conclude that our model does not pick up the impact of the GFC. The GFC episode has different features compared to earlier currency crisis episodes, which leads us to conclude that this time was different (after Reinhart and Rogoff (2009)).

Appendix A. Data

	Indicator	*Code*	*Definition and source*	*Transformation*	*Data freq*	*Countries*
Economic indicators: external sector						
1	Real Exchange Rate (RER): deviation from trend	RER_DEV	RER = e (P_f / P), with: e = nominal exchange rate Local Currency Unit per US dollar (IFS: AE.ZF) P = domestic price level: Consumer Price Index (IFS: 64..ZF) P_f = foreign price level: Consumer Price Inflation in USA (IFS 111.64..ZF)	deviation from 5 year moving average	Monthly	A, B, M
2	Exchange rate volatility	ERVOL	Monthly volatility of the nominal exchange rate (IFS: AE..ZF) in the current month and the 47 months preceding.	Standard deviation	Monthly	A, B, M
3	Export growth	D_EXP	Exports F.O.B.; in USD (IFS: 70.D..ZF)	12 months percentage change	Monthly	A, B, M
4	Import growth	D_IMP	Imports F.O.B.; in USD (IFS: 71.VD..ZF)	12 months percentage change	Monthly	A, B, M
5	Terms of Trade	TOT	ToT = exports prices / imports prices Two ways to define this: (i) Export price index (= IFS-76) / import price index (= IFS-76X) -Mex; (ii) Unit value of exports: IFS-74D ; Unit value of imports: IFS-75D - Arg & Bra	None (ratio)	Arg & Bra (series 74, 75): quarterly, Mex (series 76): monthly	A, B, M
6	Ratio of Current Account to GDP	CA_GDP	Current account, in USD: IFS-78AL (78ALDZF…) = balance on goods, services and income plus current transfers. GDP, in nominal USD: IFS 99, converted in USD by average nominal exchange rate (IFS: ..RF.ZF... for Arg & Bra, ..WF.ZF... for Mexico).	None (ratio)	Quarterly	A, B, M
7	Net Portfolio Investment / GDP	NETPI_GDP	Portfolio assets (IFS: 78BFDZF...) - portfolio liabilities (IFS: 78BGDZF...). Both in USD. GDP in USD: see CA_GDP	None (ratio)	Quarterly	A, B, M
8	Ratio FDI to GDP	NETFDI_GDP	FDI outflow = IFS series 78BDDZF… and FDI inflow = IFS series 78BEDZF… (both in USD). Arg and Bra: net FDI; Mex: FDI inflow GDP in USD: see CA_GDP	None (ratio)	Quarterly	A, B, M
9	Ratio of Financial Account to GDP	FA_GDP	Financial account = balance of all accounts: from trade to FDI and portfolio investments. Financial Account = IFS: 78BJDZF… GDP in USD: see CA_GDP.	None (ratio)	Quarterly	B, M
10	Trade openness	D_TRD_OPEN	Trade openness = sum of absolute value of exports and imports, divided by nominal GDP in USD. IFS: 78AADZF… + 78ADDZF… (= exports of goods and services) and 78ABDZF… + 78AEDZF… (= imports of goods and services) GDP in USD: see CA_GDP	12 months percentage change	Quarterly	A, B, M
11	Growth of forex reserves	D_RES	Foreign exchange reserves, excluding gold; in USD (IFS: 1.LD..DZF)	12 months percentage change	Monthly	A, B, M
12	Ratio of M2 to forex reserves	M2RES	M2: IFS series 59MB.ZF… (Arg > 2000; Bra & Mex), Central Bank Rep.Argentina (< 2000, Arg). Converted into USD with end-of-period nominal exchange rate: IFS series ..AE.ZF...; Foreign Exchange Reserves: IFS series .1L.DZF…	None (ratio)	Monthly	A, B, M
13	Import cover	D_IMPCOV	Forex Reserves excl.gold from IFS, in USD (.1L.DZF…) and imports F.O.B. from IFS, in USD (IFS: 71.VD..ZF)	12 months percentage change	Monthly	A, B, M

Economic indicators: domestic real and public sector

1	real GDP growth	D_RGDP	GDP in nominal LCU. IFS: 99B..ZF... (Arg > 1995; Bra & Mex), INDEC (Arg < 1995). Consumer Price index (IFS: 64..ZF…);	12 months percentage change	Quarterly	A, B, M
2	GDP per capita	D_RGDPCAP	GDP divided by total population; GDP: see D_RGDP; Total population: IFS-99Z.	12 months percentage change	Annual	A, B, M
3	Unemployment	D_UNEMPL	Unemployment as % of total of unemployed and employed. IFS: 67R..ZF…	12 months percentage change	Annual < 2001, quarterly > 2001	B
4	Government consumption expenditure to GDP	GOVCONS_GDP	Gov.Cons. (in LCU): IFS 91F..ZF… GDP (in LCU): IFS 99B	None (ratio)	Quarterly	B, M
5	Household consumption expenditure (incl. NPISHS) to GDP	HHCONS_GDP	Household cons: IFS series 96F..ZF… GDP (in LCU): IFS 99B	None (ratio)	Arg < 1993: annual, > 1993 quarterly; Bra & Mex: quarterly	A, B, M
6	Ratio of government revenues to GDP	D_GOVREV	Gov't revenues: integrate two incomplete series (IFS: c1...BA… and a1...CG…). GDP (in LCU): IFS 99B	12 months percentage change	Quarterly	B, M
7	Ratio of government expenses to GDP	D_GOVEXP	Gov't expenses: integrate two incomplete series (IFS: c2...BA… and a2...CG…). GDP (in LCU): IFS 99B	12 months percentage change	Quarterly	B, M
8	fiscal balance to GDP	GOVBAL_GDP	Budget = difference between revenues (IFS: c1...BA… and a1...CG…) and expenses (IFS: c2...BA… and a2...CG…) GDP (in LCU): IFS 99B	None (ratio)	Quarterly	B, M
9	Change in inventories to GDP	INVCHG_GDP	Change in inventories (in LCU) IFS 93I.CZF... GDP (in LCU): 99B.RWF…	None (ratio)	Quarterly	M
10	Inflation (CPI)	INFLAT	Consumer Price Inflation (IFS: 64..ZF)	12 months percentage change	Monthly	A, B, M
11	Growth of industrial production	D_INDPROD	Industrial production index: Bra & Mex: IFS-66. Arg: Datastream (code AGIPTOT.G)	12 months percentage change	Monthly	A, B, M
12	Domestic Savings	GDSAV_GDP	Ratio of savings to GDP: WDI-code: NY.GDS.TOTL.ZS	None (ratio)	Annual	A, B, M
13	Gross capital formation	GFCAP_GDP	Arg & Mex: 93E.CZF... and 99B.RWF… (quarterly) Bra: WDI code: NE.GDI.TOTL.KD.ZG (annual)	12 months percentage change	Arg & Mex: quarterly, Bra: annual	A, B, M
14	Domestic real interest rate	REALINT	6 month time deposit rate deflated by CPI: $(1+R_{nominal}) / (1+Inflation) - 1$, with: 6 months time deposit rate (IFS: 60L..ZF) CPI (IFS: 64..ZF)	See formula	Monthly	A, B, M
15	M2 growth (real LCU)	D_M2	M2: see M2RES	12 months percentage change	Monthly	A, B, M
16	M2 money multiplier	M2MULT	Ratio of M2 to monetary base. M2: see M2RES Base money: IFS: 19MA.ZF…	ratio	Monthly	A, B, M

17	Sovereign Bond Interest Rate Spreads, basis points over US Treasuries	INTSPREAD	GEM: difference between local government interest rate on bonds in USD and US government on bonds in USD.	None (spread)	Monthly	B
18	J.P. Morgan Emerging Markets Bond Index (EMBI+): monthly return	EMBI_RET	GEM: index that measures the value of the bonds.	Monthly return	Monthly	B
19	Return on the major stock index	STOCKRET	Major stock index from each country (IPC for Mexico, Merval for Argentina and BOVESPA for Brazil). In own currency. Source: Economatica.	Monthly return	Monthly	A, B, M
Debt indicators						
1	Ratio total debt to GDP	DEBT_GDP	WDI code for total -external- debt (in USD): DT.DOD.DECT.CD GDP (in USD): see CA_GDP	None (ratio)	Annual	A, B , M
2	Short term debt / total debt	STD_DEBT	Short term debt: (WDI code) DT.DOD.DSTC.CD Total debt: (WDI code) DT.DOD.DECT.CD	None (ratio)	Annual	A, B , M
3	Use of IMF credit to GDP	IMF_GDP	IMF credit: (WDI code) DT.DOD.DIMF.CD GDP (in USD): see CA_GDP	None (ratio)	Annual	A, B , M
4	Arrears to total debt	ARR_TDEBT	WDI code for interest arrears (USD): DT.IXA.DPPG.CD WDI code for principal arrears (USD): DT.AXA.DPPG.CD WDI code for total external debt (USD): DT.DOD.DECT.CD	None (ratio)	Annual	A, B , M
5	Debt reduction / total debt	REDU_TDEBT	Debt reduction: (WDI code) DT.DFR.DPPG.CD Total debt: (WDI code) DT.DOD.DECT.CD	None (ratio)	Annual	A, B , M
6	Long term private non guaranteed debt / total debt	LTDPNG_TDEBT	LT PNG debt: (WDI code) DT.DOD.PRVS.CD Total debt: (WDI code) DT.DOD.DECT.CD	12 months percentage change.	Annual	A, B , M
7	Long term public and publicly guaranteed debt / total debt	LTDPPG_TDEBT	LT PPG debt: (WDI code) DT.DOD.PUBS.CD Total debt: (WDI code) DT.DOD.DECT.CD	12 months percentage change.	Annual	A, B , M
8	International reserves to total external debt	D_RES_DEBT	Total debt: (WDI code) DT.DOD.DECT.CD Reserves (IFS code): .1L.DZF…	12 months percentage change	Annual	A, B , M
9	Ratio of debt service to exports	DSERV_EXP	WDI code for debt service (current USD): DT.TDS.DECT.CD IFS code for exports (*millions* of current USD): 70..DZF...	None (ratio)	Annual	A, B , M
10	Ratio of debt service to reserves	DSERV_RES	Debt service (WDI code): DT.TDS.DECT.CD Reserves (IFS code): .1L.DZF…	None (ratio)	Annual	A, B , M
Bank sector indicators						
1	Ratio of domestic credit to the public sector to GDP	DCREDPUB	Domestic credit provided by banking sector (% of GDP) (WDI code = FS.AST.DOMS.GD.ZS) minus Domestic credit to private sector (% of GDP) (WDI code = FS.AST.PRVT.GD.ZS)	None (ratio)	Annual	A, M

2	Ratio of commercial bank lending to GDP	DCREDBANK	Domestic credit provided by banking sector (% of GDP). WDI code = FS.AST.DOMS.GD.ZS	None (ratio)	Annual	A, B, M
3	Liquid liabilities (% of GDP)	D_LIQLIAB	Code: ll_usd. Source: Financial Structure, from World Bank (FS/WB) and Beck et al. 2000, 2009	12 months percentage change	Annual	A, B, M
4	Central bank assets (% of GDP)	D_CBASSET	Claims on domestic real nonfinancial sector by the Central Bank as a share of GDP. FS/WB code: cbagdp	12 months percentage change	Annual	B
5	Deposit money bank assets (% of GDP)	D_DMBANKAS	Claims on domestic real nonfinancial sector by deposit money banks as a share of GDP. FS/WB code: dbagdp	12 months percentage change	Annual	A, B, M
6	Private credit by all financial institutions (% of GDP)	D_PCRED_GDP	Private credit by deposit money banks and other financial institutions to GDP. FS/WB code: pcrdbofgdp	12 months percentage change	Annual	A
7	Private credit by deposit money banks (% of GDP)	D_PCRED_DMB	Private credit by deposit money banks to GDP. FS/WB code: pcrdbgdp	12 months percentage change	Annual	A, B, M
8	Private credit by other financial institutions (% of GDP)	D_PCRED_OTH	Private credit by other financial institutions to GDP. Difference between private credit by all fin.institutions and private credit by deposit money banks. FS/WB code: pcrdbofgdp - pcrdbgdp	12 months percentage change	Annual	B, M
9	Financial system deposits (% of GDP)	D_FSDEPOS	Demand, time and saving deposits in deposit money banks and other financial institutions as a share of GDP. FS/WB code: fdgdp	12 months percentage change	Annual	A, B, M
10	Ratio Bank credit to bank deposits	D_BCRED_BDEP	Private credit by deposit money banks as a share of demand, time and saving deposits in deposit money banks. FS/WB code: bcbd	12 months percentage change	Annual	A, B, M
11	Net interest margin	NETINTMG	Accounting value of bank's net interest revenue as a share of its interest-bearing (total earning) assets. FS/WB code: netintmargin	None	Annual	A, B, M
12	Bank concentration	BANKCONC	Assets of three largest banks as a share of assets of all commercial banks. FS/WB code: concentration	None	Annual	A, B, M
13	Bank ROE	BANKROE	Average Return on Equity (Net Income/Total Equity). FS/WB code: roe	None	Annual	A, B, M
14	Bank Z-Score	BANKZ	Z = 1.2A + 1.4B + 3.3C + 0.6D + 1.0E with: A = Working Capital/Total Assets B = Retained Earnings/Total Assets C = EBIT/Total Assets D = Market Value of Equity/Total Liab E = Sales/Total Assets	None	Annual	B
15	Deposit money banks and other banking instit: assets	D_BANKASSET	Sum of: Deposit money banks Assets (IFS: 7A.DZF…) Other banking institutions Assets (IFS: 7E.DZF…)	12 months percentage change	Monthly	A
16	Deposit money banks and other banking institutions: liabilities	D_BANKLIAB	Sum of: Deposit money banks Liabilities (IFS: 7B.DZF…) Other banking institutions Liabilities (IFS: 7F.DZF…)	12 months percentage change	Monthly	A
17	CB: foreign assets - foreign liabilities	D_CB_FA_FL	Difference between: Foreign assets (IFS: 11…ZF…) Foreign liabilities (16C..ZF…)	12 months percentage change	Monthly	A

18	CB: claims - deposits from central government	D_CB_CGVT	Difference between: Claims on central government (IFS: 12A..ZF…) Central government deposits (IFS 16D..ZF…)	12 months percentage change	Monthly	A
19	CB: claims on deposit money banks and other banking inst.	D_CB_BANKS	Sum of: Claims on Deposit Money Banks (IFS: 12E..ZF…) Claims on Other banking institutions (IFS: 12F..ZF…)	12 months percentage change	Monthly	A
20	Bank sector: reserves	D_BANKRES	Sum of: Reserves from DMB (IFS: 20...ZF…) Reserves from other banking institutions (IFS: 40...ZF…)	12 months percentage change	Monthly	A
21	Bank sector: Foreign assets - foreign liabilities	D_BANK_FA_FL	Difference between: Foreign assets from banks (IFS: 21...ZF… + 41...ZF…) Foreign liabilities from banks (IFS: 26C..ZF… + 46C..ZF…)	12 months percentage change	Monthly	A
22	Bank sector: claims on PPG	D_BANK_PPG	Claims on PPG: Claims on central govt (IFS: 22A..ZF… + 42A..ZF…) Claims on state and local government (IFS: 22B..ZF… + 42B..ZF…) Claims on official entities (IFS: 22BX.ZF… + 42BX.ZF…)	12 months percentage change	Monthly	A
23	Banks: claims on private sector	D_BANK_PRIV	Claims from DMB and other banking instit. on private sector (IFS: 22D..ZF… and 42D..ZF…)	12 months percentage change	Monthly	A
24	Banks: demand deposits	D_BANK_ DEM_DEPOS	Demand deposits in DMB (IFS: 24...ZF…)	12 months percentage change	Monthly	A
25	Banks: time, savings and foreign currency deposits	D_BANK_TSFC_DE POS	Time, savings and foreign currency deposits (IFS: 25...ZF… + 45...ZF…)	12 months percentage change	Monthly	A

Institutional indicators: indices

1	Herfindahl Index Government	HERFGOV	DPI (World Bank / Beck et al. 2001): HERFGOV represents a measure of government coalition concentration, by squaring the percentage of parties in the government coalition. The presence of a majority party in the government coalition increases the index. Having many (small) parties in the government reduces it.	None.	Annual	A, B, M
2	Herfindahl Index Opposition	HERFOPP	DPI: herfopp. Idem herfgov, but now for government opposition.	None.	Annual	B, M
3	Political stability	D_GOVSTAB	On a scale from 0 to 12, with 12 the highest level of stability and 0 the highest level of instability. Source: ICRG	12 months percentage change.	Annual	A, B, M
4	Socioeconomic Conditions	D_SOCIOECO	On a scale from 0 to 12, with 12 the highest level of socioeconomic conditions and 0 the lowest level. Source: ICRG	12 months percentage change	Annual	A, B, M
5	Investment Profile	D_INVPROF	On a scale from 0 to 12, with 12 the best investment profile (= low risk) and 0 the worst profile. Source: ICRG	12 months percentage change	Annual	A, B, M
6	Internal Conflict	D_INTCONFL	On a scale from 0 to 12, with 12 the lowest level of internal conflict (low risk) and 0 the highest level (high risk). Source: ICRG	12 months percentage change	Annual	A, B, M

7	Democratic Accountability	D_DEMACC	On a scale from 0 to 6, with 6 the highest level of dem.accountability and 0 the lowest level. Source: ICRG	12 months percentage change	Annual	A, B, M
8	Corruption	D_CORRUPT	ICRG. Scale 6 (low corruption) to 0 (high corruption).	12 months percentage change	Annual	A, B, M
9	Law and Order	D_LAWORD	ICRG. Scale 6 (high law and order) to 0 (low law and order).	12 months percentage change	Annual	A, B, M
10	Bureaucracy Quality	D_BURQUAL	ICRG. Scale 4 (high bureaucratic quality) to 0 (low bureaucratic quality).	12 months percentage change	Annual	A, B, M
11	Party orien-tation with resp. to econ. policy	GOVT_RLC	Dummy indicates orientation of the executive power. Right (1); Left (3); Center (2); No information (0). DPI code: execrlc	None	Annual	A, B, M
12	Absolute majority in the houses	GOVT_MAJ	Dummy indicates if executive has absolute majority in the houses. 1 = yes, 0 = no. DPI code: allhouse	None	Annual	A, B, M
13	Degree of polarization	POLARIZ	Polarization is the maximum difference between the chief executive's party's value (EXECRLC) and the values of the three largest government parties and the largest opposition party. 0 = no polarization. DPI code: polariz	None	Annual	A, B, M
14	election year for executive power	ELECEXEYR	Dummy variable with value 1 in the year of elections for executive power and 0 otherwise (DPI: exelec)	The calender year of the elections is assigned 1.	Annual	A, B, M
15	election year for legislative power	ELECLEGYR	Dummy variable with value 1 in the year of elections for legislative power and 0 otherwise (DPI: legelec)	The calender year of the elections is assigned 1.	Annual	A, B, M
Global economy indicators						
1	US long term interest rate	D_USYIELD	Yield on the 10 year US government bond (IFS: 111.61.ZF)	12 months percentage change	Monthly	USA
2	US short term interest rate	TBILL	IFS: 11160C..ZF...	None	Monthly	USA
3	US real GDP growth	D_GDPUSA	IFS series: 11199B.CZF… and 11164..ZF…	12 months percentage change	Quarterly	USA
4	GDP volume % change	D_GDPWORLD	Change (year-on-year) of the volume of the GDP growth. IFS series 00199BPXZF...	None	Annual	world
5	Contagion of crises in the region	CONTAG	Based on EMPI calculations: dummy = 1 if there is a financial crisis in one of the other LA3 countries	None	Monthly	A, B, M
Commodity indicators						
1	Agriculture, value added (% of GDP)	D_VA_AGRI	WDI code: NV.AGR.TOTL.ZS	12 months percentage change	Annual	A, B, M
2	Oil prices	D_PR_PETROL	World oil price (IFS: 00176AADZF...)	12 months percentage change	Monthly	world
3	Agricultural commodities price index	D_PR_AGRI	Global agricultural raw materials price index (IFS: 00176BXDZF)	12 months percentage change	Monthly	world
4	Metals commodities price index	D_PR_METAL	Global metals price index (IFS: 00176AYDZF)	12 months percentage change	Monthly	world

5	Agricultural raw materials exports:	D_AGRI_EXP	Agricultural raw material exports, expressed as % of GDP. Elaborated from the following series: Agricultural raw material exports, as % of merchandise exports. Source: WDI, code: TX.VAL.AGRI.ZS.UN Goods exports (BoP, current US$; Source: WDI, code: BX.GSR.MRCH.CD) GDP (current US$; Source: WDI, code: NY.GDP.MKTP.CD)	12 months percentage change	Annual	A, B, M
6	Food materials exports:	D_FOOD_EXP	Idem, but food materials exports. Source: WDI, code: TX.VAL.FOOD.ZS.UN	Idem	Annual	A, B, M
7	Fuel exports:	D_FUEL_EXP	Idem, but fuel exports. Source: WDI, code: TX.VAL.FUEL.ZS.UN	Idem	Annual	A, B, M
8	Ores and metals exports:	D_METAL_EXP	Idem but ores and metals exports. Source: WDI, code: TX.VAL.MMTL.ZS.UN	Idem	Annual	A, B, M
9	Agricultural raw materials imports:	D_AGRI_IMP	Agricultural raw material imports, expressed as % of GDP. Elaborated from the following series: Agricultural raw material imports, as % of merchandise imports. Source: WDI, code: TM.VAL.AGRI.ZS.UN Goods imports (BoP, current US$; Source: WDI, code: BM.GSR.MRCH.CD) GDP (current US$; Source: WDI, code: NY.GDP.MKTP.CD)	Idem	Annual	A, B, M
10	Food materials imports:	D_FOOD_IMP	Idem, but food materials imports. Source: WDI, code: TM.VAL.FOOD.ZS.UN	Idem	Annual	A, B, M
11	Fuel imports:	D_FUEL_IMP	Idem, but fuel imports. Source: WDI, code: TM.VAL.FUEL.ZS.UN	Idem	Annual	A, B, M
12	Ores and metals imports:	D_METAL_IMP	Idem, but ores and metals imports. Source: WDI, code: TM.VAL.MMTL.ZS.UN	Idem	Annual	A, B, M

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