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Determinants of Banking, Inflation, and Foreign Reserves Crises: The Case of Bolivia

Antonio N. Bojanic*

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Abstract

Utilizing logit econometric models, this paper investigates the primary factors contributing to the onset of banking, inflation, and foreign exchange reserve crises in Bolivia. The analysis reveals that banking crises are more likely when the terms of trade improve, with greater monetary independence, greater income inequality, and higher poverty levels. Principal deterrents are a stronger economy, greater financial openness, and better health outcomes. Increases in the money supply mostly drive inflation crises, hence the principal deterrent is the Central Bank of Bolivia suppressing monetary expansion. Finally, foreign exchange reserves crises are more likely when the money supply grows, the country experiences higher levels of external and short-term debt, and as Bolivia becomes more open to financial transactions with the rest of the world. Deterrents include increasing levels of per capita income, moderate inflation, increasing levels of total reserves, and improvements in the current account balance. The principal lesson that can be drawn from the Bolivian experience is that policymakers can act in ways that will decrease the probability of these crises happening in the first place.

Keywords: Bolivia, Banking Crises, Inflation Crises, Foreign Reserves Crises.
JEL codes: E00, G01, O10.

*Tulane University. Email: abojanic@tulane.edu.

1. Introduction

Economic crises have become prevalent, impacting both developed and developing economies. Within the dynamics of financial environments, events such as banking collapses, inflation spikes, and decreases in foreign reserves stand out as key moments that significantly influence economic stability, growth potential, and overall welfare.

Understanding the determinants of these crises is important for policymakers, economists, and market participants, as it allows for implementing proactive measures to mitigate their occurrence and alleviate their impact. This paper analyzes the specific case of Bolivia, a country that has continuously experienced every type of economic crisis imaginable and hence serves as a useful benchmark for other developing and emerging economies.

Banking crises, characterized by widespread bank failures, liquidity shortages, and systemic disruptions to the financial sector, pose grave threats to economic stability and growth. The triggers and vulnerabilities leading to banking crises are many, encompassing factors such as excessive credit expansion, weak regulatory frameworks, asset price bubbles, and macroeconomic imbalances. By analyzing the root causes of a banking crisis in Bolivia, the hope is to provide insights into the key determinants that render financial systems susceptible to destabilizing shocks.

Inflation crises, marked by rapid and unsustainable increases in the general price level, erode purchasing power, disrupt economic planning, and engender social unrest. The drivers of inflation crises are varied, encompassing monetary policy mismanagement, supply-side shocks, fiscal imbalances, and external pressures. Through an examination of these determinants, this study aims to shed light on the underlying mechanisms that propel economies into episodes of severe inflation or persistent inflationary pressures.

Studying the determinants of foreign exchange reserves crises is critical for several reasons. First, foreign exchange reserves serve as a crucial buffer for countries to manage external shocks and maintain macroeconomic stability. Understanding the factors that contribute to the depletion of reserves helps policymakers anticipate and mitigate vulnerabilities in the financial system. Second, foreign exchange reserves crises can have profound economic consequences, including currency depreciation, capital flight, and sovereign default risks, which can destabilize financial markets and hinder economic growth. By identifying the root causes of this type of crisis, policymakers can implement preemptive measures to strengthen resilience and prevent the recurrence of such episodes in the future. Moreover, studying reserves crises provides valuable insights into the effectiveness of macroeconomic policies, exchange rate regimes, and international financial architecture, informing policymakers' decisions to enhance economic governance and promote sustainable development.

Examining banking, inflation, and foreign exchange reserve crises in Bolivia holds particular significance due to the unique economic landscape of the country and the lessons it offers – good and bad – for other nations facing similar challenges. Bolivia's experiences provide valuable insights into the interplay of various factors that contribute to financial instability and macroeconomic imbalances. By studying these crises in Bolivia, policymakers can gain a deeper understanding of the specific vulnerabilities and structural weaknesses in the economy that may lead to such crises. Moreover, Bolivia's checkered policy responses and strategies for crisis management offer important lessons for other countries grappling with similar issues. For instance, the country's efforts to strengthen financial regulations (positive lesson) while at the same time diminishing central bank independence (negative lesson) serve as useful examples for policymakers in other emerging economies. Additionally, Bolivia's experience with inflation targeting and exchange rate management provides important lessons for countries seeking to maintain price stability and manage external vulnerabilities. By drawing on Bolivia's experiences, policymakers in other nations can better anticipate and address potential challenges, implement effective policy measures, and promote macroeconomic stability and sustainable growth. Therefore, studying banking, inflation, and foreign exchange reserve crises in Bolivia not only con-

tributes to a deeper understanding of economic dynamics within the country but also offers valuable lessons and insights for policymakers worldwide.

As far as I can tell, this is the first study analyzing Bolivia's banking, inflation, and foreign exchange reserves crises. Specifically, it represents the first attempt at analyzing the probabilities of these crises occurring in this Latin American nation. In addition to being the first study focusing on this topic in Bolivia, additional contributions to the literature include novel definitions for what constitutes banking, inflation, and foreign exchange reserves crises, and the inclusion of socioeconomic variables into the econometric models to determine whether they play a significant role in these events.

A summary of the findings is this: banking crises are more likely when the terms of trade improve, with greater monetary independence, greater income inequality, and higher poverty levels. Principal deterrents are a stronger economy, greater financial openness, and better health outcomes. Increases in the money supply mostly drive inflation crises, hence the principal deterrent is the Central Bank of Bolivia suppressing monetary expansion. Finally, foreign exchange reserves crises are more likely when the money supply grows, the country experiences higher levels of external and short-term debt, and as Bolivia becomes more open to financial transactions with the rest of the world. Deterrents of this type of crisis include increasing levels of per capita, moderate inflation, increasing levels of total reserves, and improvements in the current account balance.

The rest of the paper is organized as follows: the literature review is presented in section two; the data and methodology are described in section three; the empirical results are analyzed in section four, and section five concludes.

2. Literature review

While the economics literature extensively covers the determinants of banking, inflation, and foreign exchange reserve crises, research on the specific approach utilized in this study – estimating the probability of crisis eruption – remains limited. Additionally, specific studies analyzing the Bolivian case are, to my knowledge, rare, hence the contribution of this paper highlighting the experiences of this country. The following is a sample of articles utilizing a similar methodological approach to the questions posed in this study.

Two important articles on banking crises are Demirgüç-Kunt and Detragiache (1998), who, utilizing a logit model for a large sample of developed and developing countries, find that crises tend to erupt when the macroeconomic environment is weak, particularly when growth is low and inflation is high; and Reinhart and Rogoff (2013), using historical data spanning from the early 1800s, and finding that the frequency of banking crises is similar in advanced and developing countries. Several other studies have expanded on these earlier contributions, including Von Hagen and Ho (2007); Ahrend and Goujard (2014); Pereira Pedro et al. (2018); Othman et al. (2018); Gaies et al. (2019), and Casabianca et al. (2022).

Studies on the determinants of inflation crises are also abundant, including Bruno and Easterly (1995) who propose a nonparametric definition of high-inflation crises as periods when annual inflation is above 40 percent; excluding countries with high inflation crises, they find no evidence of a consistent relationship between growth and inflation at any frequency. García and Manzanares (2007) also analyze what probability forecasts can tell about inflation risks and show that measures of inflation risks can explain inflation scares. Other contributions include Kang et al. (2004); Hilscher et al. (2022); Magud and Pienknagura (2024) and Kim (2024).

Studies analyzing the role of foreign exchange reserves include García and Soto (2004), empirically assessing the contribution of international reserves vis-à-vis institutional variables in reducing the risk of a

currency crisis and finding that the ratio of reserves to short-term debt is robust in explaining international crisis, even after controlling for financial development and political variables; and Aydın and Tunç (2023), who focus on the predictive powers of three indicators of international reserve adequacy, namely short-term debt-to-total reserves ratio, broad money-to-total reserves ratio, and reserves in months of imports and find that broad-to-total reserves ratio is the most robust indicator. Other significant contributions include Obstfeld et al. (2010); Steiner (2013); Ghosh et al. (2017) and Aydın and Tunç (2024).

Studies focusing on the specific case of Bolivia include Kehoe et al. (2022) with a comprehensive analysis of the monetary and fiscal history between 1960 and 2015 and the several economic crises experienced by the country; Jemio (2001) analyzes the period 1970–1995 as the Bolivian economy transitioned from severe indebtedness and profound economic crisis to a period of economic stability and structural reform; Machicado (2012) focuses on the economic crisis of 1999–2004 and, utilizing a general equilibrium model under the Great Depressions methodology, finds that most output fluctuations were due to changes in total factor productivity; and Bojanic (2013), Bojanic (2021) and Morales (1988) analyze the determinants of inflation, with an emphasis on the hyperinflationary period of the mid-1980s.

Evident from the preceding survey is that much remains to be learned about the determinants of banking, inflation, and foreign exchange reserve crises, particularly from the perspective of individual developing countries, hence the contribution of this paper focusing on Bolivia – a country that has gone through several episodes of economic and financial crisis that can elicit useful lessors to other developing economies.

3. Data and methodology

The period of interest is 1960-2023, but for most variables, data is only available from the 1990s onward; quarterly data is utilized for all regression analyses. Most of the data comes from the World Bank Indicators[1] database and the IMF International Financial Statistics[2], but some data is also extracted from Bolivian and other sources. The descriptive statistics shown in Table 1 list all variables utilized in the study along with their corresponding sources.

The probabilities of banking, inflation, and foreign exchange reserves crises are estimated using multivariate logit regressions. In each period, the country is either experiencing a crisis (banking, inflation, or foreign exchange reserves crisis), or it is not, hence, the dependent variable takes the value of one if there is a crisis, and zero if there is no crisis. For each type of crisis, the probability that one will occur is a function of a vector of macroeconomic, financial (domestic and external), institutional, and socio-economic variables. Specifically,

$$P(Y = 1|X) = \frac{1}{1 + e^{-(\beta_0+\beta_1 X_1+\beta_2 X_2+\cdots+\beta_n X_n)}}$$

where:

- $P(Y = 1|X)$ is the probability that the dependent variable Y equals 1 (i.e., there is a crisis) given the values of the independent variables $X = (X_1, X_2, \ldots X_n)$;
- β_0 is the intercept term;
- $\beta_1, \beta_2, \ldots, \beta_n$ are the coefficients of the independent variables $X_1, X_2, \ldots, X_n$; and

[1] https://data.worldbank.org/indicator/NY.GDP.MKTP.CD?locations=BO
[2] https://data.imf.org/?sk=4c514d48-b6ba-49ed-8ab9-52b0c1a0179b&sid=1409151240976

Table 1: *Descriptive statistics*

Variable	Observations	Mean	St. Deviation	Minimum	Maximum
Outcome variables					
Dummy banking[1] (1 = crisis; 0 = no crisis)	105	0.314	0.466	0.000	1.000
Dummy inflation[1] (1 = crisis; 0 = no crisis)	105	0.057	0.233	0.000	1.000
Dummy reserves[1] (1 = crisis; 0 = no crisis)	105	0.457	0.501	0.000	1.000
Macroeconomic variables					
Real GDP[2] ($, base month = Jan 2015)	252	4,240,258,783	2,454,727,885	1,181,934,937	9,579,932,083
Real GDP growth[2] (%)	245	0.856	1.052	-4.369	4.265
Real GDP per capita[2] ($, base month = Jan 2015)	252	527.598	129.977	318.794	820.410
Real GDP per capita growth[2] (%)	251	0.370	1.483	-4.369	4.265
Terms of trade[2] (2015 = 100)	172	111.29	30.88	9.90	171.73
Change in terms of trade[2]	171	-0.946	5.215	-39.600	12.710
Depreciation[2] (%)	175	1.169	14.222	-85.063	97.245
Real interest rate[2] (%)	144	9.338	11.132	-19.257	34.199
Inflation rate[3] (%)	223	10.674	45.436	-0.840	493.206
Growth M2[3] (%)	253	8.961	73.536	-81.546	902.341
Public sector budget[4] ($)	96	-300,410,375	390,308,683	-1,160,489,464	129,677,787
Financial variables					
Total reserves[3] ($)	214	2,558,856,306	3,863,746,015	26,320,000	13,606,740,000
M2/Total reserves[3]	214	13.243	35.192	1.452	378.160
Credit private sector/GDP[2] (%)	249	31.519	21.371	1.680	80.170
Liquid reserves/Bank assets[2] (%)	85	20.206	9.066	5.560	35.180
Growth real domestic credit[2] (%)	251	6.010	48.785	-81.614	534.404
External financial position variables					
External debt/Total reserves[2] (%)	212	312.349	341.785	14.393	2,226.845
Short-term debt/Total reserves[2] (%)	212	12.298	12.132	0.434	49.069
Current account balance[3] (millions $)	151	-18.492	302.043	-1,060.230	762.560
Institutional variables					
Deposit insurance[5] (1 = insurance; 0 = no insurance)	256	0.164	0.371	0.000	1.000
Capital adequacy ratio[6]	107	18.016	2.372	11.250	21.624
Monetary independence index[8] (0 = less; 1 = more)	240	0.717	0.452	0.000	1.000
Financial openness index[8] (0 = less; 1 = more)	200	0.660	0.475	0.000	1.000
Rule of law[7] (-2.5 to +2.5)	108	-0.861	0.362	-1.300	-0.230
Government effectiveness[7] (-2.5 to +2.5)	108	-0.489	0.188	-0.790	-0.100
Political stability[7] (-2.5 to +2.5)	108	-0.437	0.222	-0.971	-0.135
Socio-Economic variables					
Gini index[2] (%)	128	51.121	6.235	40.900	61.600
Poverty gap[2] (%)	128	5.034	3.780	0.200	15.100
Life expectancy[2] (years)	248	56.611	8.123	43.100	67.841

Sources:
1. Author's own estimation
2. World Bank Indicators - https://data.worldbank.org/indicator/NY.GDP.MKTP.CD?locations=BO
3. International Financial Statistics IMF - https://data.imf.org/?sk=4c514d48-b6ba-49ed-8ab9-52b0c1a0179b&sid=1409151240976
4. Banco Central de Bolivia - https://www.bcb.gob.bo?q=pub$_b oletin - estadistico$
5. Ley 393, Capitulo IV, articulo 515 - https://servdmzw.asfi.gob.bo/circular/leyes/Ley393ServiciosFinancieros.pdf
6. Datax - https://datax.com.bo/
7. World Bank Worldwide Governance Indicators - https://www.worldbank.org/en/publication/worldwide-governance-indicators
8. Aizenman, Chinn, and Ito (2013)

- e is the base of the natural logarithm (approximately equal to 2.71828).

The logit function is given by:

$$P = \log\left(\frac{p}{1-p}\right) = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \cdots + \beta_n X_n \tag{1}$$

where P is the probability $P(Y = 1|X)$ and the coefficients $\beta_0, \beta_1, \ldots, \beta_n$ are estimated using Maximum Likelihood (ML). The dynamic aspects of crises are captured by adding a one-period lagged value of the dependent variable as a regressor.

This work's critical element is the construction of dummy variables for banking, inflation, and foreign exchange reserves crises. The rationale for each is detailed below, and though previous work was considered when thinking about what would constitute a crisis, the definitions utilized here reflect episodes that best represent full-fledged crises in the Bolivian context.

The banking crisis variable (dummy banking, 1 = crisis; 0 = no crisis) is based on the percentage growth change of the ratio of risk-weighted financial assets/total financial assets Category 1.[3] If this growth rate is greater than two percent in a particular quarter, it is assumed that the country is experiencing a banking crisis. A higher ratio of risk-weighted financial assets/total financial assets might signal a banking crisis for several reasons: (a) a higher ratio indicates that a greater proportion of a bank's assets are considered riskier according to the Financial Services Law.[4] When this ratio grows rapidly (two percent or more), it suggests that banks are increasingly holding more high-risk assets relative to their total assets, which can heighten their vulnerability to financial shocks; (b) as banks take on more risk-weighted assets, the likelihood of asset quality deterioration increases; (c) risk-weighted assets often include loans and other financial products that carry higher default probabilities. A growing proportion of such assets implies that banks are more exposed to potential defaults, which can strain their financial health and liquidity positions; (d) regulators (Autoridad de Supervisión del Sistema Financiero – ASFI[5]) use the ratio of risk-weighted assets to total assets to assess the capital adequacy and stability of banks (article 186, Financial Services Law). A significant increase in this ratio can trigger regulatory concerns and possibly stricter oversight or requirements for additional capital buffers to mitigate potential risks; and (e) rapid growth in risk-weighted assets can negatively impact investor and market confidence in the banking sector. Investors may perceive the banks as being too aggressive in their risk-taking, leading to potential capital outflows and increased funding costs. Other authors (e.g., Demirgüç-Kunt and Detragiache, 1998; Gaies et al., 2019) have used a different definition of a banking crisis. A contribution of this paper is to use an alternative, equally useful banking crisis variable that is likely to apply to any other country where exposure to riskier assets is an important parameter of stability of the banking sector.

The inflation crisis variable (dummy inflation, 1 = crisis; 0 = no crisis) is based on the quarterly inflation rate the country experiences over time. If the quarterly inflation rate is greater than three percent, it is deemed that the country is in an inflation crisis. Kang et al. (2004) and García and Manzanares (2007), are a few of the authors who utilize a different approach to define an inflation crisis; another contribution of this paper is to use an alternative definition that best reflects the realities of the Bolivian economy.

Finally, the foreign exchange reserves crisis variable (dummy reserves, 1 = crisis; 0 = no crisis) is based on the percentage quarterly growth of reserves. If the growth rate of total reserves is negative in (i) at least

[3]Financial assets category 1 refer to a classification of assets that are considered to be of the highest quality and lowest risk. This category often includes highly liquid and low-risk assets like cash, government securities, and highly-rated corporate bonds.

[4]Ley de Servicios Financieros No. 393 (August 5, 2013), articles 449, 450, 451. https://servdmzw.asfi.gob.bo/circular/Leyes/Ley393ServiciosFinancieros.pdf

[5]Ley de Servicios Financieros No. 393, article 8.

two consecutive quarters; and/or (ii) greater than -10 percent in any quarter, the country is deemed to be experiencing a crisis. As with the other two crisis variables, other authors (e.g., Aydın and Tunç, 2023) have used different definitions. However, the one used here seems equally effective in explaining this type of crisis in the Bolivian context.

The selection of explanatory variables for each type of crisis reflects both the theory of the determinants of banking, inflation, and foreign exchange reserves crises and data availability. For banking crises, the *macroeconomic* regressors are real GDP growth, real GDP per capita, change in terms of trade, depreciation, real interest rate, and the inflation rate. The assumption is that higher growth and higher output levels act as deterrents to a banking crisis, as a growing, healthy economy is deemed less likely to encounter an economic crisis. Change in the terms of trade and depreciation are included to account for external shocks that are especially important in an economy like Bolivia, heavily dependent on a narrow range of (mainly commodity) exports; the real interest rate is included because, as argued by Galbis (1993), it may act as a proxy for financial liberalization, which tends to lead to higher real rates; and the inflation rate is included because it is a proxy for macroeconomic mismanagement. The *financial* regressors are M2 as a share of total reserves, credit to the private sector as a share of GDP, liquid reserves as a share of total bank assets, and growth of domestic credit in real terms. The ratio of M2 to total reserves is included because it acts as a predictor of Bolivia's vulnerability to balance of payments crises (Calvo, 1996); credit to the private sector and the growth of domestic credit are included to account for the extent of financial liberalization; and the ratio of liquid reserves to total bank assets is included because it directly affects a bank's ability to manage liquidity, respond to financial shocks, and maintain market and regulatory confidence. *Institutional* regressors are a dummy variable for deposit insurance, indices of monetary independence and financial openness, the capital adequacy ratio, and an indicator for the rule of law. The deposit insurance variable takes the value of one for the periods in which an explicit deposit insurance scheme is in place (August 2013 onwards; Financial Services Law[6]), zero otherwise, and it is included to account for the moral hazard such an insurance program might generate in the banking sector; the level of independence of the central bank and the extent to which the Bolivian economy is open to cross-border capital transactions are also likely to affect the stability of the banking sector; the capital adequacy ratio measures a bank's ability to absorb losses, manage risks, and maintain market confidence; it plays a crucial role in regulatory compliance, crisis prevention, and mitigating systemic risk, hence its importance as a potential determinant of banking crises; finally, the rule of law indicator is included to account for the extent to which Bolivian citizens have confidence in and abide by the rules of society, in particular the quality of contract enforcement – key aspect of the banking industry – the police and the courts, as well as the likelihood of crime and violence. *Socio-economic* regressors are the Gini index, poverty gap (at $2.15 per day), and life expectancy, and they are included to account for the extent to which quality of life indicators (income inequality, poverty levels, and life span) affect the stability of the banking sector.

For inflation crises, the *macroeconomic* regressors are the growth of M2, the public sector budget, depreciation, change in terms of trade, consumer price index, and real GDP growth. M2 growth is included to account for the extent to which inflation crises are the result of monetary expansion; if budget deficits are financed by printing money (i.e., expanding the money supply), then public sector budgets are also potential drivers of an inflation crisis; currency depreciation and a change in the terms of trade can lead to an inflation crisis through various channels, including higher import costs, increased production costs, and altered inflation expectations, hence their inclusion as regressors. While the consumer price index is a measure of inflation rather than a cause, significant increases in the CPI reflect underlying inflationary pressures that can lead to an inflation crisis. These pressures include cost-push factors (like rising production costs), demand-pull factors (like increased consumer spending), and expectations of future inflation. The response of monetary and fiscal authorities to rising CPI and the behavior of consumers and businesses can either mitigate or exacerbate the inflationary trends. Therefore, monitoring and responding to changes in the CPI is crucial for maintaining economic stability and preventing an inflation crisis; finally, while real GDP growth is generally

[6]Ley de Servicios Financieros No. 393 (August 5, 2013), Chapter IV, articles 515-529.

positive for an economy, it can lead to inflation if it results in excessive aggregate demand, strains production capacity, causes resource constraints, or is accompanied by expansionary monetary and fiscal policies, hence its inclusion as a regressor. The *institutional* regressors are indices for government effectiveness, political stability, monetary independence, and financial openness. All of these indices are vital indicators that influence economic stability. Negative trends in any of them can contribute to inflation in the following ways: (i) government effectiveness, which may lead to poor governance, leads to inefficient policy implementation, fiscal mismanagement, and supply bottlenecks, driving up prices. (ii) political instability erodes confidence, leads to policy uncertainty, and disrupts economic activities, increasing costs and prices; (iii) lack of central bank autonomy can result in inflationary monetary policies and mismanagement of inflation expectations; and (iv) financial openness might increase vulnerability to external shocks and capital flow volatility, leading to currency depreciation and higher import costs. *Socio-economic* regressors are the Gini index, poverty gap (at $2.15 per day), and life expectancy. They are included to account for the extent to which quality of life indicators impact price stability.

For foreign exchange reserves crises, the *macroeconomic* regressors are real GDP, real GDP per capita growth, depreciation, inflation rate, and terms of trade. Real GDP and real GDP per capita growth are generally positive indicators of economic health, reflecting increases in the overall economic output and improvements in the standard of living, hence they are expected to act as deterrents to this type of crisis; the inflation rate is a key indicator of macroeconomic stability and should therefore be an important determinant as well; depreciation makes imports more expensive and it increases the domestic currency needed for foreign-denominated debt, hence it may lead to a depletion of foreign exchange reserves. Improvements in terms of trade increase foreign currency inflows, while deteriorated terms reduce them, hence its inclusion as a regressor. The *financial* explanatory variables are M2 as a share of total reserves, and credit to the private sector as a share of GDP. The ratio of M2 to total reserves is included because a high ratio suggests (i) high demand for foreign currency during economic instability; (ii) increased risk of devaluation of the Boliviano and subsequent reserve depletion; (iii) inflationary pressures, reducing confidence in the Bolivian currency; and (iv) difficulties in managing interest rates and capital controls without depleting reserves. The ratio of credit to the private sector to GDP might reflect high private sector debt, which increases the risk of financial instability and central bank interventions; and rapid credit expansion can lead to inflation and increased demand for foreign currency. The *external financial position* regressors are total reserves, external debt as a share of total reserves, short-term debt as a share of total reserves, and the current account balance. Total reserves play a key role in preventing and mitigating foreign exchange reserves crises through various channels: (i) it supports the currency (i.e., the Boliviano) during periods of volatility and maintains a stable exchange rate; (ii) it enhances investor confidence and policy credibility, reducing the risk of capital flight; (iii) enough reserves provides liquidity and servicing external debt during financial crises (iv) it ensures the ability to finance essential imports and cover balance of payments deficits; (v) it allows the Bolivian Central Bank to manage interest rates and avoid drastic measures; and (vi) it acts as a buffer to external shocks and providing time for necessary economic adjustments. External debt and short-term debt are included because large debt obligations strain reserves and increase default risk; high debt ratios undermine investor confidence, leading to capital flight and higher borrowing costs; lastly, high debt ratios limit flexibility for monetary and fiscal policies, with more resources needed for debt servicing. The current account balance is included because surpluses increase reserve accumulation, enhancing economic stability, while deficits deplete reserves and increase crisis risk. *Institutional* regressors are indices of government effectiveness and financial openness. An effective government might act as a deterrent for a crisis, while an ineffective government is likely to increase the probability of one occurring. An economy more open to cross-border capital transactions is also more likely to experience a reserves crisis. The *socio-economic* regressor is the Gini index to account for the extent to which income inequality may affect the stability of the foreign exchange reserves market.

4. Results

As an introduction to the empirical results, Table 2 reports the different types of economic and financial crises that Bolivia has experienced since 1950.

Table 2: *Economic crises in Bolivia since 1950*

Type of crisis	*Years*	*Principal reasons*
Severe inflation	1953–56	Expansionary fiscal and monetary policies, external shocks
Exchange rate	1972	Devaluation of the Bolivian peso
Foreign debt	1977–86	Excessive foreign borrowing
Balance of payments	1979	High external debt burden, decline in export revenues, external shocks, unsustainable fixed exchange rate regime
Hyperinflation	1982–85	Expansionary fiscal and monetary policies, growing budget and trade deficits, external credit severely curtailed
Financial	1998–2002	External shocks, deterioration of terms of trade, significant drop in external funding
Foreign exchange reserves; balance of payments	2021–present	Unsustainable fixed exchange rate regime, excessive subsidization of commodities, growing budget deficit, growing government debt (internal and external)

Source: Bojanic (2019); The Economist (April 18, 2023)

Table 2 makes clear that this country has experienced at least seven significant economic and financial crises in the last seven decades. The types of crises range from the well-known episodes of severe inflation (1950s) and hyperinflation (1980s), to exchange rate (1970s, 2020s), foreign debt (1970s-80s), balance of payments (late 1970s, 2020s), financial (late 1990s-early 2000s), and foreign exchange reserves crises (2020s). With this background, the determinants of banking, inflation, and foreign exchange reserves crises are presented below.

Table 3 reports the estimation results of the logit model in equation (1) where the dependent variable represents the probability of a banking crisis. Column (1) displays the regression results with macroeconomic regressors only. Columns (2) to (11) report regression results as other financial, institutional, and socioeconomic explanatory variables are added to the baseline specification. Appendix 1 reports empirical findings with alternative definitions of the banking crisis variable; the results align with those presented below[7].

The results indicate that the two most important macroeconomic deterrents of a banking crisis are, as expected, output growth and income per capita. The coefficients for these two regressors are consistently negative and (mostly) statistically significant, implying that increases in both reduce the probability of a banking crisis. Focusing on column (1) results, the coefficient of -0.539 for real GDP growth indicates that as real GDP growth increases, the likelihood (or probability) of a banking crisis decreases. Specifically, each one-unit increase in real GDP growth decreases the log-odds of a banking crisis by 0.539, which corresponds to reducing the odds of a banking crisis by approximately 41.7 percent[8]. This suggests that higher economic

[7]There are two alternative definitions of a banking crisis. The first considers a banking crisis to have occurred if the percentage change in the ratio of risk-weighted financial assets to total financial assets Category 1 exceeds 1.5%. The second defines a banking crisis if this ratio exceeds 3%. Additionally, results are also reported using the baseline specification and the definition of a banking crisis provided by Laeven and Valencia (2018). They identify banking crises in Bolivia in only 2 years, 1986 and 1994, which may explain the lack of statistical significance in the results using their definition of a banking crisis.

[8]The odds ratio is given by $e^{-0.539} \approx 0.583$, implying that for each one-unit increase in real GDP growth, the odds of a banking crisis are multiplied by approximately 0.583. Thus, the odds of a banking crisis decrease by around 41.7% (1 - 0.583=0.417) for each

Table 3: *Determinants of a Banking Crisis*

Dep. variable: dummy banking crisis

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
dummy banking crisis (-1)	-0.560	-1.179*	-1.124	-1.748**	-1.002	-1.202*	-1.267*	-1.557*	-1.641**	-1.157	-1.316*
	(0.544)	(0.712)	(0.716)	(0.843)	(0.791)	(0.721)	(0.726)	(0.898)	(0.808)	(0.723)	(0.732)
Macroeconomic variables											
Real GDP growth	-0.539**	-0.421	-0.406	-0.569	-0.740*	-0.390	-0.311	-0.922*	-0.519	-0.603*	-0.440
	(0.269)	(0.363)	(0.363)	(0.414)	(0.450)	(0.388)	(0.387)	(0.544)	(0.364)	(0.356)	(0.368)
Real GDP per capita	-0.016***	-0.019**	-0.014	-0.038**	-0.032**	-0.020**	-0.029**	-0.037	-	-	-
	(0.005)	(0.009)	(0.014)	(0.016)	(0.016)	(0.010)	(0.015)	(0.041)			
Change in terms of trade	0.135	0.178	0.181	0.309**	0.328**	0.172	0.163	0.514**	0.283**	0.284**	0.193
	(0.095)	(0.121)	(0.121)	(0.147)	(0.163)	(0.123)	(0.125)	(0.233)	(0.133)	(0.134)	(0.125)
Depreciation	0.082	0.124	0.131	0.123	0.156	0.129	0.124	0.164	0.070	0.088	0.132
	(0.108)	(0.148)	(0.148)	(0.167)	(0.173)	(0.149)	(0.145)	(0.192)	(0.159)	(0.150)	(0.147)
Real interest rate	-0.147***	0.060	0.078	0.074	0.098	0.061	0.083	0.304	0.068	0.131	0.089
	(0.053)	(0.134)	(0.138)	(0.150)	(0.157)	(0.134)	(0.143)	(0.214)	(0.136)	(0.131)	(0.132)
Inflation rate	-0.017	0.161	0.196	-0.221	0.240	0.162	0.190	0.191	0.182	0.281	0.179
	(0.261)	(0.376)	(0.385)	(0.433)	(0.470)	(0.376)	(0.380)	(0.605)	(0.391)	(0.387)	(0.375)
Financial variables											
M2/Total reserves	-	-0.280	-0.288	-0.960	-0.683	-0.301	-0.348	-1.404*	-0.181	-0.124	-0.475*
		(0.247)	(0.248)	(0.604)	(0.619)	(0.273)	(0.280)	(0.823)	(0.216)	(0.188)	(0.282)
Credit private sector/GDP	-	0.084	0.098	0.268*	0.048	0.092	0.120	0.308	0.113	0.018	0.023
		(0.075)	(0.081)	(0.144)	(0.117)	(0.084)	(0.088)	(0.221)	(0.075)	(0.055)	(0.059)
Liquid reserves/Bank assets	-	0.054	0.045	0.095	-0.004	0.055	0.039	-0.053	0.191**	0.092	0.026
		(0.064)	(0.066)	(0.070)	(0.079)	(0.065)	(0.067)	(0.100)	(0.094)	(0.074)	(0.063)
Growth real domestic credit	-	-0.309*	-0.325**	-0.401**	-0.417**	-0.308*	-0.320*	-0.624**	-0.321*	-0.377**	-0.316**
		(0.164)	(0.166)	(0.191)	(0.192)	(0.164)	(0.172)	(0.253)	(0.172)	(0.167)	(0.167)
Institutional variables											
Deposit insurance	-	-	-1.271	-	-	-	-	-4.940	-	-	-
			(2.643)					(5.231)			
Monetary independence index	-	-	-	3.078***	-	-	-	2.916*	-	-	-
				(1.161)				(1.737)			
Financial openness index	-	-	-	-	-3.371*	-	-	-1.278	-	-	-
					(2.053)			(3.832)			
Capital adequacy ratio	-	-	-	-	-	0.054	-	-0.628	-	-	-
						(0.237)		(0.415)			
Rule of law	-	-	-	-	-	-	-3.551	-9.099	-	-	-
							(3.956)	(9.007)			
Socio-Economic variables											
Gini index	-	-	-	-	-	-	-	-	0.512**	-	-
									(0.199)		
Poverty gap	-	-	-	-	-	-	-	-	-	0.437**	-
										(0.227)	
Life expectancy	-	-	-	-	-	-	-	-	-	-	-1.090**
											(0.499)
# of obs	99	85	85	80	76	85	85	76	84	84	84
McFadden R^2	0.24	0.37	0.37	0.45	0.42	0.37	0.38	0.49	0.40	0.36	0.37
AIC	1.12	1.07	1.09	1.04	1.07	1.09	1.08	1.10	1.04	1.09	1.07
Time-period (year/quarter)	97/1–22/1	01/1–22/1	01/1–22/1	01/1–20/4	01/1–19/4	01/1–22/1	01/1–22/1	01/1–19/4	01/1–21/4	01/1–21/4	01/1–21/4

Notes:
1. The dependent variable takes the value one if there is a crisis, 0 otherwise
2. Standard errors in parenthesis
3. All specifications include an intercept term (not shown in table)
4. *:$p < 0.1$; **:$p < 0.05$; ***:$p < 0.01$

growth is associated with greater stability in the banking sector. A similar conclusion can be made regarding the regressor *real GDP per capita*: higher per capita income levels are associated with a more stable banking sector. The *change in terms of trade* regressor is, on the other hand, consistently positive and (in specifications (4), (5), (8), (9), and (10)) statistically significant, implying that as the terms of trade improve, the likelihood (or probability) of a banking crisis increases. Specifically, and focusing on the results in column (4), each one-unit increase in the change in terms of trade increases the log-odds of a banking crisis by 0.309, which corresponds to increasing the odds of a banking crisis by approximately 36.2 percent ($e^{0.309} \approx 1.362$, hence, 1.362 - 1 = 0.362). This suggests that improving terms of trade might make the banking sector more vulnerable to crises, potentially due to over-reliance on favorable trade conditions or exposure to external economic shocks. The remaining macroeconomic regressors do not seem to play a consistent and significant role in increasing (decreasing) the probability of a banking crisis in the country.

Regarding financial regressors, real domestic credit growth is the only consistent variable that seems to affect the probability of a banking crisis. Its coefficient is negative and statistically significant in all specifications, implying that as the growth of real domestic credit increases, the likelihood (or probability) of a banking crisis decreases. This finding is consistent with Tunay et al. (2020) who found that, contrary to the expectation that rapid increases in credit to the private sector usually lead to economic crises, private sector lending by banks and non-performing loans reflecting credit risk do not explain bank crises in emerging economies. Specifically and focusing on the results in column (2), each one-unit increase in the growth of real domestic credit decreases the log-odds of a banking crisis by 0.309, which corresponds to reducing the odds of a banking crisis by approximately 26.6 percent (the odds ratio is $e^{-0.309} \approx 0.734$, hence 1 - 0.734 = 0.266). This suggests that higher growth in real domestic credit is associated with greater stability in the banking sector[9]. The remaining financial variables do not seem to consistently impact the dependent variable.

Two institutional regressors -an index of monetary independence and another one for financial openness- show a statistically significant impact on the probability of a banking crisis. The monetary independence index increases the probability of a banking crisis, while the financial openness index acts as a deterrent. Focusing on the results shown in column (4), the coefficient of 3.078 for the index of monetary independence indicates that as this variable increases (i.e., the Central Bank of Bolivia exerts greater independence in its conduct of monetary policy), the likelihood (or probability) of a banking crisis increases significantly. Specifically, each one-unit increase in the monetary independence index increases the log-odds of a banking crisis by 3.078, which corresponds to increasing the odds of a banking crisis by a factor of approximately 21.71[10]. This suggests that higher monetary independence might be associated with greater risk of banking instability, potentially due to the challenges and volatility that can accompany more autonomous monetary policy[11]. Greater financial openness, on the other hand, hinders the occurrence of a banking crisis. As shown in column (5), the coefficient of -3.371 indicates that as the financial openness index increases, the likelihood (or probability) of a banking crisis decreases significantly. Specifically, each one-unit increase in the financial openness index decreases the log-odds of a banking crisis by 3.371, which corresponds to reducing the odds of a banking crisis by approximately 96.6 percent (the odds ratio is given by $e^{-3.371} \approx 0.034$, hence 1 - 0.034

additional unit of real GDP growth.

[9]For this result to be credible, however, other things not explicitly accounted for here, must hold true. First, it presupposes that financial markets are well-regulated (i.e., prudent lending standards and adequate capitalization requirements); credit is financing productive investment opportunities rather than speculative activities; there is macroeconomic stability (i.e.,low inflation, sustainable fiscal policies, and a stable exchange rate); and there is an absence of credit bubbles. Given that the regressions analyzing the determinants of banking crises (Table 3) mostly cover the period 2001-late 2021 (and hence exclude the hyperinflationary 1980s), these pre-conditions are largely met.

[10]The odds ratio is given by $e^{3.078} \approx 21.71$.

[11]Though this result may seem counterintuitive, it really isn't given the monetary history of Bolivia. As traced in Bojanic (2019, chapter 2), monetary policy has been at the center of every economic and financial crisis the country has experienced. The autonomy to print money to fund recurring government deficits is the principal reason for the severe inflation of the mid-1950s and the hyperinflation of the 1980s. Had the Central Bank of Bolivia had 'less' monetary autonomy – say, by being anchored to gold, silver, or the US Dollar – it is conceivable that those inflation episodes that gave rise to banking crises may not have happened.

= 0.966). This suggests that greater financial openness is associated with lower risk of banking instability, potentially due to better integration with global financial markets and improved financial practices. It should be noted that if these institutional regressors are included in the same specification (column (8)), they lose their explanatory power in predicting a banking crisis[12], which is not surprising as these two regressors are likely capturing similar aspects of financial and economic policy.

The three socio-economic variables are also important in predicting a banking crisis. As shown in columns (9), (10), and (11), the positive coefficient for the Gini index (+0.512) suggests that greater income inequality increases the likelihood of a banking crisis[13]; the positive coefficient for the poverty gap (+0.437) suggests that greater depth of poverty increases the likelihood of a banking crisis[14]; and the negative coefficient for life expectancy (-1.090) suggests that better health outcomes and longer life expectancy reduce the likelihood of a banking crisis[15]. These interpretations highlight the significant impact that socio-economic factors can have on financial stability, with higher inequality and deeper poverty contributing to increased risk, while better health outcomes and longer life expectancy contribute to financial stability.

Table 4 reports the estimation results when the dependent variable in equation (1) represents the probability of an inflation crisis. Columns (1) and (2) display the regression results with macroeconomic regressors only. Columns (3)-(9) report regression results as other institutional, and socio-economic explanatory variables are added to the baseline specification. Appendix 2 reports empirical findings with alternative definitions of the inflation crisis variable; the results align with those presented below[16].

The results demonstrate that the most important determinant of an inflation crisis is the growth of M2 (broad money). Consistently, its coefficient is positive and (except in specifications (7) and (8)), statistically significant, implying that increases in this variable increase the probability of a crisis. Additionally, the coefficient size is similar in all specifications where it is statistically significant, reflecting the consistent impact of this variable. Focusing on the results in column (1), a positive coefficient of 0.510 indicates that an increase in the growth rate of the money supply (M2) is associated with a higher probability of an inflation crisis. Specifically, for each one-unit increase in the growth rate of M2, the odds of a crisis increase by approximately 66.5 percent (the odds ratio is $e^{0.510} \approx 1.665$). This finding aligns with economic theory, which suggests that rapid increases in the money supply can lead to higher inflation rates, thereby increasing the likelihood of an inflation crisis.

The *change in terms of trade* regressor is also marginally significant in specifications (1) and (3), suggesting that under certain conditions an improvement in the terms of trade is associated with a higher probability of an inflation crisis. This might seem counterintuitive, but there are at least two potential explanations for this relationship: (i) if a country experiences a significant improvement in its terms of trade (as Bolivia did during the latter part of the 2000s and the 2010s), it could lead to a substantial increase in export revenues[17]. This influx of foreign currency might lead to increased spending and investment within the country, which could drive up aggregate demand and, consequently, inflation; and (ii) an improvement in terms of trade might lead to currency appreciation, making imports cheaper[18] and potentially increasing domestic money supply if the

[12]The results shown in column (8) report estimates when all institutional regressors are included in the specification. Similar results are obtained if only the monetary independence and financial openness index are included in the same specification.

[13]The odds ratio is $e^{0.512} \approx 1.669$, implying that for each one-unit increase in the Gini index, the odds of a banking crisis increase by approximately 66.9%.

[14]The odds ratio is $e^{0.437} \approx 1.548$, implying that for each one-unit increase in the poverty gap, the odds of a banking crisis increase by approximately 54.8%.

[15]The odds ratio is $e^{-1.090} \approx 0.336$, implying that for each one-unit increase in life expectancy, the odds of a banking crisis decrease by approximately 66.4%.

[16]The two alternative definitions of an inflation crisis are (i) when the quarterly inflation rate exceeds 2%; and (ii) when the quarterly inflation rate is greater than 3.5%.

[17]During the 2010s, export revenues reached record levels (Bojanic, 2019, chapter 1).

[18]Import expenditures also reached record levels during the 2010s and early 2020s (Bojanic, 2019, chapter 1; World Bank Economic Indicators).

Table 4: *Determinants of an Inflation Crisis*

Dep. variable: dummy inflation crisis

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
dummy inflation crisis (-1)	-0.300	1.170	-0.754	1.031	-0.391	-1.011	0.292	-1.910	1.565
	(1.578)	(1.439)	(2.079)	(1.456)	(1.722)	(2.020)	(1.758)	(88.482)	(1.574)
Macroeconomic variables									
Growth M2	0.510*	0.521*	0.750*	0.647*	0.573**	0.544*	1.154	4.470	0.629*
	(0.276)	(0.313)	(0.437)	(0.380)	(0.286)	(0.292)	(0.935)	(29.279)	(0.380)
Public sector budget	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Depreciation	0.303	0.274	0.191	0.342	0.391	0.366	0.930	5.469	0.468
	(0.252)	(0.283)	(0.269)	(0.319)	(0.302)	(0.295)	(0.930)	(34.514)	(0.424)
Change in terms of trade	0.348*	0.518	0.804*	0.559	0.418	0.450	0.663	-2.286	0.423
	(0.219)	(0.345)	(0.503)	(0.392)	(0.353)	(0.365)	(0.925)	(26.494)	(0.396)
Consumer price index	0.067	0.067	0.358	-0.049	0.057	0.127	-0.796	-3.552	-0.402
	(0.054)	(0.059)	(0.243)	(0.126)	(0.062)	(0.090)	(0.665)	(17.771)	(0.592)
Real GDP growth	-	-1.104	-1.928	-1.592	-1.019	-1.220	-3.589	-2.119	-1.563
		(1.360)	(1.948)	(1.779)	(1.411)	(1.595)	(4.412)	(79.989)	(1.719)
Institutional variables									
Government effectiveness	-	-	-34.111	-	-	-	-	-	-
			(25.846)						
Political stability	-	-	-	10.153	-	-	-	-	-
				(10.871)					
Monetary independence index	-	-	-	-	-1.296	-		-	-
					(2.253)				
Financial openness index	-	-	-	-	-	2.364		-	-
						(2.700)			
Socio-Economic variables									
Gini index	-	-	-	-	-	-	-3.636	-	-
							(2.949)		
Poverty gap	-	-	-	-	-	-	-	-62.390	-
								(315.145)	
Life expectancy	-	-	-	-	-	-	-	-	8.789
									(11.099)
# of obs	96	93	93	93	88	84	92	92	92
McFadden R^2	0.49	0.52	0.59	0.54	0.50	0.51	0.67	1.00	0.53
AIC	0.36	0.37	0.37	0.39	0.42	0.44	0.34	0.20	0.39
Time-period (year/quarter)	99/1–22/4	99/1–22/1	99/1–22/1	99/1–22/1	99/1–20/4	99/1–19/4	99/1–21/4	99/1–21/4	99/1–21/4

Notes:
1. The dependent variable takes the value one if there is a crisis, 0 otherwise
2. Standard errors in parenthesis
3. All specifications include an intercept term (not shown in table)
4. *:p $<$ 0.1; **:p $<$ 0.05; ***:p $<$ 0.01

Bolivian central bank intervenes in the foreign exchange market to stabilize the currency, which could lead to inflationary pressures.

The remaining macroeconomic, institutional, and socio-economic regressors are not statistically significant, demonstrating that in Bolivia, inflation crises are – as famously advocated by Friedman (1970) – almost exclusively a monetary phenomenon.

Table 5 reports the estimation results of the logit model in equation (1) where the dependent variable represents the probability of a foreign exchange reserves crisis. Column (1) displays the regression results with the baseline specification only. Columns (2) to (10) report regression results as other explanatory variables are added to this specification. Appendix 3 reports results with alternative definitions of the foreign exchange reserves crisis variable; as was the case with banking and inflation crises, the results align with those presented below[19].

Focusing first on the macroeconomic regressors, even though the statistical significance for real GDP is consistent in most specifications, the size of the coefficient in all cases is nearly zero (e.g., in column (1), the coefficient is 0.000000000050076), indicating a minimal positive association with the probability of a crisis. In practical terms, this suggests that real GDP does not significantly affect the likelihood of a foreign exchange reserves crisis. On the other hand, real GDP per capita growth and the inflation rate are important deterrents. In all specifications, their coefficients are negative and (mostly) statistically significant, implying that increases in both decrease the probability of a crisis. Focusing on the results shown in column (1), a negative coefficient of 0.392 for real GDP per capita growth indicates that when output per person grows, it can have a stabilizing effect on the economy, reducing the likelihood of a crisis in foreign exchange reserves. Specifically, for each one-unit increase in the real GDP per capita growth rate, the odds of a foreign exchange reserves crisis decrease by approximately 32.4 percent (the odds ratio is $e^{-0.392} \approx 0.676$, hence 1 - 0.676 = 0.32). Likewise, a negative coefficient of -0.249 for inflation (column (1)) suggests that an increase in the inflation rate is associated with a lower probability of a foreign exchange reserves crisis. This indicates that when inflation is higher, it can stabilize the probability of a reserves crisis, potentially because inflation may reflect underlying economic adjustments or policies that contribute to overall stability[20]. Specifically, for each one-unit increase in the inflation rate, the odds of a foreign exchange reserves crisis decrease by approximately 22 percent (the odds ratio is $e^{-0.249} \approx 0.780$, hence 1 - 0.780 = 0.220).

The ratio of M2 to total reserves (expressed in natural logs) is a significant financial determinant of a foreign exchange reserves crisis. As shown in column (4), its coefficient is positive and statistically significant, suggesting that an increase in the M2 to total reserves ratio is associated with a higher probability of a crisis. The coefficient of 1.129 means that for each one-unit increase in the natural logarithm of the M2 to total reserves ratio, the log-odds of a foreign exchange reserves crisis occurring increase by 1.129. More precisely, for each one-unit increase in the natural logarithm of the M2 to total reserves ratio, the odds of a foreign exchange reserves crisis increase by approximately 209 percent (the odds ratio is $e^{1.129} \approx 3.09$). There are several reasons why this might be the case: (i) a high ratio of M2 to total reserves indicates that there is a large amount of money in the economy relative to the foreign exchange reserves. This can lead to liquidity risks if

[19]Three additional definitions of a foreign exchange reserves crises are reported in Appendix 3. The first defines a crisis if the quarterly growth rate in total reserves is negative in any quarter; the second if there is a negative growth rate in total reserves in three consecutive quarters; the final definition is taken from Laeven and Valencia (2018) who assessed that Bolivia experienced a currency crisis in 1973 and 1981. For the period of interest, insufficient number of observations with a value of 1 (1=crisis; 0=no crisis) for the Laeven-Valencia dummy reserves crisis variable may explain the lack of statistical significance. The sign of the coefficients, however, mostly align with the overall results presented here.

[20]Moderately high inflation can sometimes reflect necessary price adjustments that help correct external imbalances, such as overvalued exchange rates, thus improving the trade balance and reserves; additionally, central banks might implement tighter monetary policies to control inflation, which could enhance investor confidence and stabilize foreign exchange reserves; finally, moderate inflation might indicate strong domestic demand, which could be a sign of economic health, reducing the likelihood of sudden capital outflows and reserve depletion.

Table 5: *Determinants of a Foreign Exchange Reserves Crisis*

Dep. variable: dummy reserve crisis

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
dummy reserves crisis (-1)	1.027**	0.954**	0.862*	0.925**	0.822*	1.372**	0.992*	1.238**	1.032**	0.567
	(0.457)	(0.460)	(0.468)	(0.464)	(0.488)	(0.646)	(0.532)	(0.571)	(0.532)	(0.513)
Macroeconomic variables										
Real GDP	0.000**	0.000***	0.000***	0.000***	0.000	0.000	0.000	0.000	0.000	0.000*
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Real GDP per capita growth	-0.392**	-0.437**	-0.416**	-0.438**	-0.417**	-0.508**	-0.503***	-0.606***	-0.483***	-0.424**
	(0.166)	(0.169)	(0.169)	(0.170)	(0.174)	(0.240)	(0.187)	(0.211)	(0.185)	(0.184)
Depreciation	-	-	-	-	-	-	-	-	0.089	-
									(0.087)	
Inflation rate	-0.249*	-0.328**	-0.316**	-0.330**	-0.321**	-0.542*	-0.516**	-0.759**	-0.559**	-0.253
	(0.147)	(0.153)	(0.151)	(0.153)	(0.157)	(0.333)	(0.228)	(0.298)	(0.228)	(0.159)
Terms of trade	-	-	-	-	-	-	-0.029	-	-	-
							(0.027)			
Financial variables										
M2/Total reserves (logs)	-	-	-	1.129***	0.842	4.751	0.992	0.908	1.215	0.834
				(0.376)	(2.110)	(5.026)	(3.669)	(4.476)	(3.743)	(2.127)
Credit private sector/GDP	-0.019	-0.021	-0.013	-0.035*	-0.005	-0.072	-0.022	0.028	-0.011	-0.006
	(0.019)	(0.019)	(0.018)	(0.021)	(0.064)	(0.152)	(0.096)	(0.119)	(0.098)	(0.063)
External financial position variables										
Total reserves (logs)	-	-	-0.886***	-	-2.323	6.100	-0.588	-1.628	-0.454	-3.237
			(0.304)		(3.229)	(11.860)	(8.093)	(9.758)	(8.299)	(3.258)
External debt/Total reserves (logs)	-	0.769***	-	-	-1.669	3.413	-0.278	-0.752	0.044	-2.367
		(0.270)			(1.897)	(7.502)	(4.780)	(5.783)	(4.897)	(1.971)
Short-term debt/Total reserves (logs)	0.623**	-	-	-	-0.451	-0.796	-1.023	-1.443	-0.887	-0.734
	(0.329)				(0.987)	(1.726)	(1.128)	(1.338)	(1.131)	(1.000)
Current account balance	-0.002**	-0.002**	-0.002**	-0.003**	-0.003**	-0.003**	-0.002	-0.003**	-0.003**	-0.004**
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.002)
Institutional variables										
Government effectiveness	-	-	-	-	-	1.154	-	-	-	-
						(2.952)				
Financial openness index	-	-	-	-	-	-	-	-	-	2.580*
										(1.467)
Socio-Economic variables										
Gini index	-	-	-	-	-	-	-	-0.017	-	-
								(0.093)		
# of obs	145	145	145	145	145	105	137	128	137	136
McFadden R^2	0.27	0.30	0.30	0.30	0.31	0.38	0.35	0.38	0.35	0.30
AIC	1.10	1.06	1.06	1.06	1.09	1.09	1.06	1.02	1.06	1.10
Time-period (year/quarter)	77/1–22/1	77/1–22/1	77/1–22/1	77/1–22/1	77/1–22/1	96/1–22/1	88/1–22/1	90/1–21/4	88/1–22/1	77/1–19/4

Notes:
1. The dependent variable takes the value one if there is a crisis, 0 otherwise
2. Standard errors in parenthesis
3. All specifications include an intercept term (not shown in table)
4. Logs refers to natural logs
5. *:$p < 0.1$; **:$p < 0.05$; ***:$p < 0.01$

there is a sudden demand for foreign currency, as the reserves may not be sufficient to cover the outflows; (ii) an increasing M2 to total reserves ratio may reflect excess money supply, which can fuel inflation and create pressure on the exchange rate, leading to reserve depletion; and (iii) a high ratio suggests that the country is more vulnerable to external shocks, such as capital flight or a sudden stop in capital inflows, which can quickly drain reserves and trigger a crisis. Arguably, the current crisis (as of June 2025) experienced by Bolivia reflects all these considerations.

External financial position regressors are also important in predicting a foreign exchange reserves crisis. As shown in columns (1) and (2), positive coefficients of 0.769 for *external debt/total reserves* and 0.623 for *short-term debt/total reserves* suggest that these ratios are associated with higher probabilities of a crisis. These relationships indicate that higher levels of external and short-term debt relative to total reserves increase the vulnerability of the country's foreign exchange reserves to crises. More specifically, for each one-unit increase in the natural logarithm of the external debt to total reserves ratio, the odds of a foreign exchange reserves crisis increase by approximately 116 percent (the odds ratio is $e^{0.769} \approx 2.16$, hence (2.16 – 1)*100 = 116%). Similarly, for each one-unit increase in the natural logarithm of the short-term debt to total reserves ratio, the odds of a foreign exchange reserves crisis increase by approximately 86 percent (the odds ratio is $e^{0.623} \approx 1.86$, hence (1.86 – 1)*100 = 86%). These relationships are unsurprising as higher levels of debt (external or short-term) are likely to strain the country's ability to serve its debt, particularly if foreign exchange reserves are inadequate. High debt levels will also likely erode investor confidence, leading to capital flight and pressure on reserves. In contrast, the amount of total reserves held by the country act – unsurprisingly – as a deterrent to a crisis. Its coefficient is negative and statistically significant (column (3)), implying that higher total reserves significantly decrease the likelihood of a foreign exchange reserves crisis. More specifically, the coefficient of -0.886 means that for a one-unit increase in the natural log of total reserves, the log odds of a foreign exchange reserves crisis decreases by 0.886, implying that the odds of a crisis occurring will be reduced to about 41.2 percent (the odds ratio is $e^{-0.886} \approx 0.412$). The coefficient for the current account balance is also negative and statistically significant in all cases, implying that for each one-unit increase, the log odds of a crisis decrease by 0.003 in most specifications (the odds ratio is $e^{-0.003} \approx 0.997$). This result suggests that an increase (i.e., an improvement) in the current account balance is associated with a slight decrease in the odds of a crisis occurring. However, the change is very small, given the coefficient's magnitude. It is important to point out that when all financial and external financial position regressors are included in the same specification (columns (5) to (10)), they lose their explanatory power in predicting a crisis[21]. This is unsurprising as most of these regressors are highly correlated, and it becomes difficult to disentangle their individual effects on the probability of a foreign exchange reserves crisis.

The financial openness index is the only institutional regressor that is a significant determinant of a crisis. Its coefficient is positive and statistically significant (column (10)), implying that higher financial openness is strongly associated with the likelihood of a crisis. Specifically, for each one-unit increase in the financial openness index, the log odds of a foreign exchange reserves crisis occurring are expected to increase by 2.580, meaning that the odds of a crisis are multiplied by approximately 13.20 (the odds ratio is $e^{2.580} \approx 13.20$).

The conclusion is that in Bolivia there are clear determinants of banking, inflation, and foreign exchange reserves crises. The challenge for economists, and particularly for policymakers, is to design policies that will make their occurrence less likely, hopefully by strengthening those factors that act as deterrents for these crises.

[21]The exception is the current account balance regressor; it remains statistically significant in all specifications.

5. Conclusions and recommendations

The principal objective of this study is to investigate the primary factors contributing to the onset of banking, inflation, and foreign exchange reserves crises in Bolivia. Utilizing logit models and quarterly data from 1960 to 2023, the empirical findings demonstrate that banking crises are more likely as the terms of trade improve, perhaps due to over-reliance on favorable trade conditions and greater exposure to external economic shocks. Higher monetary independence is also associated with a greater risk of banking instability, potentially due to the challenges and volatility that can accompany more autonomous monetary policy. Lastly, the findings show that greater income inequality and higher poverty levels are likely to threaten the banking sector's stability, highlighting that socioeconomic factors play a significant role in the proper functioning of this industry. The principal deterrents for a banking crisis are, unsurprisingly, a stronger economy – reflected in high output growth, increasing income per capita, and strong domestic credit growth – and greater financial openness, potentially due to better integration with global financial markets and improved financial practices. The findings also demonstrate that better health outcomes, reflected in longer life expectancy, reduce the likelihood of a banking crisis.

Regarding inflation crises, the empirical results demonstrate that in the case of Bolivia, the most important determinant is the growth of M2 (broad money). Consistent with economic theory, the findings show that rapid increases in the money supply can lead to higher inflation rates, thereby increasing the likelihood of an inflation crisis. Change in the terms of trade is also marginally significant, suggesting that under certain conditions, an improvement in the terms of trade is associated with a higher probability of an inflation crisis. The principal inference that can be made from these findings is that the best way to avoid an inflation crisis is by preventing the Bolivian Central Bank from engaging in permanent monetary expansion.

Finally, foreign exchange reserves crises are more likely when (i) the money supply (M2) grows relative to the total reserves; (ii) the country experiences higher levels of external and short-term debt relative to total reserves, and (iii) as the country becomes more open to financial transactions with the rest of the world.

Deterrents of this type of crisis include growing levels of output per person and inflation: increasing income per capita reflects a growing economy, and moderately high inflation reflects underlying economic adjustments or policies that contribute to overall stability. Increasing levels of total reserves and improvements in the current account balance are also likely to decrease the probability of a foreign exchange reserves crisis.

The principal lesson that can be drawn from the Bolivian experience is that policymakers can act in ways that will decrease the probability of banking, inflation, and foreign exchange reserves crises. However, strengthening those factors that make these crises less likely and suppressing those that increase their likelihood remains a formidable challenge, particularly in developing countries like Bolivia.

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6. Appendix

Appendix 1: *Determinants of a Banking Crisis with Alternative Thresholds*

Dep. variable: dummy banking crisis

	1.5 % threshold (1)	3.0 % threshold (2)	Laeven-Valencia (3)	1.5 % threshold (4)	3.0 % threshold (5)	1.5 % threshold (6)	3.0 % threshold (7)	1.5 % threshold (8)	3.0 % threshold (9)	1.5 % threshold (10)	3.0 % threshold (11)
dummy banking crisis (-1)	-0.205	-1.122*	5.386***	-0.567	-1.458**	-0.705	-2.613**	-0.217	-1.420*	-0.869	-2.266***
	(0.495)	(0.605)	(1.993)	(0.620)	(0.727)	(0.691)	(1.009)	(0.680)	(0.834)	(0.673)	(0.855)
Macroeconomic variables											
Real GDP growth	-0.354	-0.536**	0.255	-0.145	-0.579	-0.214	-0.806*	-0.444	-0.898**	-0.247	-0.693*
	(0.240)	(0.276)	(1.051)	(0.320)	(0.370)	(0.350)	(0.453)	(0.384)	(0.455)	(0.321)	(0.397)
Real GDP per capita	-0.010***	-0.015***	-0.030	-0.015**	-0.014*	-0.025**	-0.038**	-0.027**	-0.017	-	-
	(0.003)	(0.005)	(0.040)	(0.008)	(0.009)	(0.011)	(0.018)	(0.014)	(0.014)		
Change in terms of trade	0.108	0.137	0.188	0.121	0.193	0.220**	0.394**	0.291**	0.298*	0.184*	0.286**
	(0.083)	(0.097)	(0.377)	(0.099)	(0.127)	(0.117)	(0.174)	(0.140)	(0.162)	(0.099)	(0.139)
Depreciation	0.007	-0.054	0.112	-0.021	0.040	-0.013	-0.011	0.046	0.082	-0.075	-0.087
	(0.095)	(0.120)	(0.394)	(0.114)	(0.149)	(0.132)	(0.180)	(0.134)	(0.167)	(0.126)	(0.171)
Real interest rate	-0.071*	-0.144***	-0.049	0.095	0.069	0.114	0.111	0.156	0.116	0.079	-0.005
	(0.043)	(0.055)	(0.157)	(0.118)	(0.139)	(0.129)	(0.167)	(0.137)	(0.167)	(0.117)	(0.144)
Inflation rate	0.064	-0.131	-0.850	0.306	-0.264	-0.048	-0.834*	0.223	-0.299	0.284	-0.353
	(0.242)	(0.266)	(1.096)	(0.327)	(0.362)	(0.361)	(0.455)	(0.394)	(0.391)	(0.331)	(0.414)
Financial variables											
M2/Total reserves	-	-	-	-0.092	-0.241	-0.730*	-1.180*	-0.583	-0.455	0.009	-0.209
				(0.132)	(0.231)	(0.434)	(0.705)	(0.548)	(0.618)	(0.142)	(0.241)
Credit private sector/GDP	-	-	-	0.078	0.042	0.213**	0.283*	0.051	-0.026	0.095	0.122
				(0.059)	(0.071)	(0.107)	(0.160)	(0.102)	(0.112)	(0.062)	(0.078)
Liquid reserves/Bank assets	-	-	-	0.092*	0.043	0.095	0.096	0.040	-0.016	0.200**	0.224**
				(0.055)	(0.065)	(0.060)	(0.075)	(0.070)	(0.081)	(0.080)	(0.100)
Growth real domestic credit	-	-	-	-0.165	-0.320**	-0.262*	-0.476**	-0.308**	-0.420**	-0.139	-0.271
				(0.126)	(0.169)	(0.145)	(0.217)	(0.151)	(0.200)	(0.128)	(0.179)
Institutional variables											
Monetary independence index	-	-	-	-	-	2.156**	3.943***	-	-	-	-
						(0.870)	(1.299)				
Financial openness index	-	-	-	-	-	-	-	-3.613**	-1.839	-	-
								(1.775)	(1.665)		
Socio-Economic variables											
Gini index	-	-	-	-	-	-	-	-	-	0.412**	0.622***
										(0.170)	(0.223)
# of obs	99	99	124	85	85	80	80	76	76	84	84
McFadden R^2	0.16	0.22	0.54	0.25	0.33	0.33	0.46	0.32	0.37	0.27	0.41
AIC	1.28	1.09	0.26	1.28	1.09	1.23	0.98	1.25	1.11	1.25	1.00
Time-period (year/quarter)	97/3–22/1	97/3–22/1	87/1–17/4	01/1–22/1	01/1–22/1	01/1–20/4	01/1–20/4	01/1–19/4	01/1–19/4	01/1–21/4	01/1–21/4

Notes:
1. The dependent variable takes the value one if there is a crisis, 0 otherwise
2. Standard errors in parenthesis
3. All specifications include an intercept term (not shown in table)
4. *:p<0.1; **:p<0.05; ***:p<0.01

Appendix 2: *Determinants of an Inflation Crisis with Alternative Thresholds*

Dep. variable: dummy inflation crisis

	2.0 % threshold (1)	3.5 % threshold (2)	2.0 % threshold (3)	3.5 % threshold (4)	2.0 % threshold (5)	3.5 % threshold (6)
dummy inflation crisis (-1)	1.576*	-0.962	2.010**	-0.908	1.559	1.457
	(0.890)	(2.448)	(1.034)	(2.607)	(1.127)	(2.543)
Macroeconomic variables						
Growth M2	0.422**	0.627*	0.389**	0.628*	0.491**	0.489
	(0.201)	(0.346)	(0.182)	(0.345)	(0.253)	(0.437)
Public sector budget	0.000	0.000	0.000	0.000	0.000	0.000
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Depreciation	0.156	0.584*	0.084	0.585*	0.080	0.420
	(0.132)	(0.326)	(0.142)	(0.328)	(0.149)	(0.410)
Change in terms of trade	0.116	0.423	0.088	0.435	0.018	0.532
	(0.142)	(0.302)	(0.171)	(0.376)	(0.198)	(0.467)
Consumer price index	0.026	0.041	0.021	0.041	0.060	0.210
	(0.030)	(0.063)	(0.028)	(0.063)	(0.067)	(0.347)
Real GDP growth	-	-	-0.811	-0.077	-0.743	-0.088
			(0.530)	(1.429)	(0.535)	(2.018)
Institutional variables						
Government effectiveness	-	-	-	-	-9.063	-18.854
					(8.252)	(38.387)
# of obs	96	96	93	93	93	93
McFadden R^2	0.42	0.57	0.45	0.56	0.48	0.63
AIC	0.56	0.30	0.57	0.33	0.57	0.32
Time-period (year/quarter)	99/1–22/4	99/1–22/4	99/1–22/1	99/1–22/1	99/1–22/1	99/1–22/1

Notes:
1. The dependent variable takes the value one if there is a crisis, 0 otherwise
2. Standard errors in parenthesis
3. All specifications include an intercept term (not shown in table)
4. *:p<0.1; **:p<0.05; ***:p<0.01

Appendix 3: *Determinants of a Foreign Exchange Reserves Crisis with Alternative Definitions*

Dep. variable: dummy reserve crisis

	Negative growth in any quarter	Negative growth in 3 consecutive quarters	Laeven-Valencia	Negative growth in any quarter	Negative growth in 3 consecutive quarters	Laeven-Valencia	Negative growth in any quarter	Negative growth in 3 consecutive quarters	Laeven-Valencia	Negative growth in any quarter	Negative growth in 3 consecutive quarters	Laeven-Valencia
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
dummy reserves crisis (-1)	0.367	3.612***	6.069***	0.177	3.603***	5.859***	0.228	3.676***	5.869***	0.284	3.625***	6.287***
	(0.437)	(0.675)	(2.252)	(0.449)	(0.687)	(1.910)	(0.447)	(0.690)	(1.797)	(0.440)	(0.674)	(2.004)
Macroeconomic variables												
Real GDP	0.000**	0.000	0.000	0.000***	0.000	0.000	0.000***	0.000	0.000	0.000***	0.000	0.000
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Real GDP per capita growth	-0.346**	-0.216	-0.680	-0.366**	-0.226	-0.681	-0.386**	-0.232	-0.730	-0.384**	-0.229	-0.698
	(0.159)	(0.224)	(0.537)	(0.162)	(0.222)	(0.526)	(0.163)	(0.221)	(0.550)	(0.161)	(0.221)	(0.551)
Inflation rate	-0.235*	0.031	-0.149	-0.302**	0.026	-0.138	-0.321**	0.032	-0.137	-0.312**	0.025	-0.146
	(0.140)	(0.205)	(0.105)	(0.144)	(0.204)	(0.098)	(0.146)	(0.205)	(0.085)	(0.145)	(0.204)	(0.100)
Financial variables												
M2/Total reserves (logs)	-	-	-	-	-	-	1.181***	0.042	1.509	-	-	-
							(0.377)	(0.498)	(1.345)			
Credit private sector/GDP	-0.012	0.005	-0.199	-0.005	0.008	-0.173	-0.028	0.007	-0.403	-0.013	0.006	-0.269
	(0.018)	(0.027)	(0.166)	(0.017)	(0.026)	(0.161)	(0.020)	(0.028)	(0.267)	(0.018)	(0.026)	(0.193)
External financial position variables												
Total reserves (logs)	-	-	-	-0.921***	-0.149	-0.828	-	-	-	-	-	-
				(0.306)	(0.405)	(1.424)						
External debt/Total reserves (logs)	-	-	-	-	-	-	-	-	-	0.761***	0.125	0.838
										(0.265)	(0.370)	(1.063)
Short-term debt/Total reserves (logs)	0.609**	0.187	-0.081	-	-	-	-	-	-	-	-	-
	(0.322)	(0.487)	(2.783)									
Current account balance	-0.002**	-0.002*	-	-0.002**	-0.002*	-	-0.002**	-0.002*	-	-0.002**	-0.002*	-
	(0.001)	(0.001)		(0.001)	(0.001)		(0.001)	(0.001)		(0.001)	(0.001)	
# of obs	145	145	207	145	145	207	145	145	207	145	145	207
McFadden R^2	0.22	0.53	0.66	0.25	0.53	0.66	0.26	0.53	0.67	0.24	0.53	0.67
AIC	1.19	0.66	0.18	1.14	0.66	0.18	1.14	0.66	0.17	1.15	0.66	0.18
Time-period (year/quarter)	77/1–22/1	77/1–22/1	70/3–22/1	77/1–22/1	77/1–22/1	70/3–22/1	77/1–22/1	77/1–22/1	70/3–22/1	77/1–22/1	77/1–22/1	70/3–22/1

Notes:

1. The dependent variable takes the value one if there is a crisis, 0 otherwise
2. Standard errors in parenthesis
3. All specifications include an intercept term (not shown in table)
4. Logs refers to natural logs
5. According to the Laeven-Valencia definition, Bolivia experienced a crisis in only 2 years – 1973 and 1981 – during the period of interest; insufficient number of observations with value 1 explain lack of statistical significance in reported results
6. *:$p < 0.1$; **:$p < 0.05$; ***:$p < 0.01$