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Abstract

Sovereign debt crises have regained attention since the recent crises in several European countries. This paper focuses on a particular aspect of the debt crisis literature: the impact of sovereign default on economic growth. Previous research agrees on the negative impact, but not on size and duration. We are particularly interested in the heterogeneity of crisis impacts: Why are some crises deeper and longer than others? And what is the role of business cycles?

We analyze four Latin American countries–Argentina, Brazil, Chile and Mexico—for the period 1870–2012, covering 14 sovereign debt defaults. We find that most sovereign defaults start in recessions, and in unfavorable international circumstances. Economic growth is heavily affected in the year of the default and the year after. Then economic growth picks up, but recovery is far from smooth, including periods of recurrent negative growth. We observe strong heterogeneity in the impact, which we attribute to commodity price changes, economic growth and government expenditure in the run-up to the crisis.

Keywords: Sovereign debt crises, Latin America, economic impact of crises, business cycles
JEL-code: C25, G01, N26

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1 Introduction

With the continuation of the European debt crisis, attention has surged on one of the relatively understudied fields in the sovereign debt crisis literature: the impact from sovereign debt crises[1] on economic growth. Although there seems to be consensus on the negative impact, the size and duration of the impact are still debated. Instead of the usual large sample-small history sample we analyze a particular region, for an extended horizon. Latin America has a rich history of sovereign debt crises, and yet is a relatively understudied region. We extend the work of Aiolfi, Catao and Timmermann (2011) on business cycles to sovereign defaults for the four largest Latin American economies, Argentina, Brazil, Chile and Mexico, who cover roughly 70% of Latin America's GDP. During the period 1870–2012 these countries experienced 14 sovereign debt crises, and were in sovereign debt crises more than 20% of the time.

We address three questions. Our first question considers business cycles. Are debt defaults procyclical and does this play any role in the severity of the crisis? Empirical research has found that in emerging economies sovereign borrowing and defaults are typically procyclical i.e. defaults take place in recessions. However, Tomz and Wright (2007) find that the relationship between output and default is unexpectedly weak. They suspect that other factors play a role, such as political circumstances, external trade, fiscal balance and international conditions. Our second question deals with the impact of debt defaults on economic growth. Does it take a long time to recover, and is the economic loss substantial in the short and long run? Unfortunately, there is no single or widely accepted measure for the impact of financial crises (Bordo et al., 2001). The impact of crises is relatively understudied, partly due to concerns regarding an appropriate definition and

[1]We use the definition for sovereign debt crises from Standard and Poor's, as reported in Borensztein and Panizza (2009): a country defaults when sovereign debt (bonds or bank loans) in foreign currency is delayed in its payment obligations (interest and principal). In that case the credit rating is below C. A crisis ends when the restructuring process has terminated.

methodology to quantify output losses (Angkinand, 2008). Typically, economic growth or the output gap is analyzed in the run-up and aftermath of a debt default, but definitions of length and pre-crisis trend vary. Various authors have investigated the impact of debt defaults on economic growth, but no consensus has been found. On the one hand, De Paoli, Hoggarth and Saporta (2009) find that sovereign crisis episodes last up to ten years with output losses of at least 5 percent per year. On the other hand, Levy Yeyati and Panizza (2011) find that the economy recovers within one year after a default. Our third question is related to the heterogeneity in the impact. Why are some crises very deep and last long, while others do not have much impact? Is it due to crisis characteristics, external or domestic conditions prior to the default? Several authors have hinted further research into the heterogeneity of the crisis impact, such as Furceri and Zdzienicka (2012) and Tomz and Wright (2007). Reinhart and Rogoff (2008) note that external conditions such as world interest rates, global business cycles, commodity prices and contagion play an important role in the occurrence of debt crises, but nothing is mentioned on the depth of the crisis.

We contribute to the debt crisis literature in two ways. First, we analyze the causes of the heterogeneity of the crisis impacts, which to the best of our knowledge has not yet been done for sovereign debt crises. Second, we focus on Latin America, a relatively underinvestigated region with a rich history of sovereign debt crises, a large commodity production and open economies during most of its history after Latin American countries gained independence.

Our findings can be summarized as follows. The majority of the debt crises (11 out of 14, or 80%) starts in the recession phase of the business cycle, and reaches the trough of the business cycle within two years. The impact is immediate and negative, and recovery sets in two years after the default, which is in line with the findings of Levy Yeyati and Panizza (2011). However, the recovery is not smooth; the cumulative output gap is negative five

to ten years after default—which confirms Furceri and Zdzienicka (2012). These findings are in line with the stylized facts explained by the stochastic general equilibrium model of Arellano (2008). In this model default risk is endogenous and interest rate spreads form the center of a framework for the mechanisms between sovereign default (probability), interest rate spreads, economic output, consumption and trade balance. Our conclusions can also match the sudden stop model of Calvo (2003). We observe great heterogeneity in the impact. Crisis severity is associated with domestic indicators: pre-crisis government expenditure and the stance of the business cycle. The time it takes an economy to reach the trough of the business cycle (the "contraction period") is associated with international variables—particularly pre-crisis commodity price increases tend to lengthen the contraction period. The latter is interesting in light of the significant differences between autocracies and democracies, as found by Frankel, Vegh and Vuletin (2013) and Arezki and Bruckner (2010). In autocracies fiscal policy is procyclical, and windfalls from international commodity price shocks increase the risk of default on external debt. The four Latin American countries that we investigate pursue procyclical fiscal policy during most of its history. In the run-up to debt defaults these countries had an autocracy in 11 out of 14 crises. With our findings we extend the conclusions of Arezki and Bruckner (2010): not only is the probability of default greater after a period of commodity price increases, but also the contraction period that follows the debt default is longer.

Our work may be useful for policy makers to smoothen the impact of debt crises. The government can implement countercyclical rules that ensure that temporarily high fiscal revenues are saved rather than spent, which is precisely the path that Chile has followed since 2001 (Frankel et al., 2013).

The remainder of the paper is structured as follows. After a review of the literature on sovereign defaults in Section 2, Section 3 discusses how we measure the impact and

the severity of the crisis, and how we determine the causes of the severity. The data are presented in Section 4, followed by the empirical results in Section 5. Section 6 concludes.

2 Review

2.1 Theoretical models

An intriguing question has always been why countries would repay debt. Since there is no legal mechanism or international institution that guarantees property rights for creditors, strictly speaking there is no incentive to pay back sovereign debt. Different theoretical models have been developed to come up with plausible explanations. All agree that there is a cost of default for the debtor country, but the transmission channels have not been agreed upon. Exclusion from capital markets and higher interest costs, collateral damage in the form of decline in output and trade, and contagion to the financial sector are the main channels (Das, Papaioannou and Trebesch 2012, Panizza, Sturzenegger and Zettelmeyer 2009).

In the classical models borrowing is countercyclical, in line with Keynesian policies and neoclassical models of optimal fiscal policy (Barro, 1979). However, empirical research has found opposite stylized facts in emerging economies, such as procyclical sovereign borrowing and defaults, and countercyclical interest rate spreads. In other words, defaults often take place in recessions, when interest rates are high.

Recently, Arellano (2008) proposed a dynamic stochastic general equilibrium model with endogenous default risk. She develops a small open economy model to study interactions between default, foreign debt, interest rates and output in emerging markets. In emerging markets business cycles tend to be more volatile and financial crises more frequent than in developed economies. In the model the interest rate is the transmission channel: endogenous time-varying default probabilities influence interest rate spreads, which affect

economic output. In booms debt is cheap and borrowing is abundant, because high output today predicts a high growth in the future. Consumption is even higher than economic output, resulting in a negative trade balance. Defaults occur in recessions, and also when the borrower cannot roll over the current debt. After a prolonged recession, debt grows so much that the economy faces net capital outflows. Then default can be more attractive than continuing to service the capital outflows. The interest rates will increase as a consequence of the higher probability of a default. This amplifies the recession: consumption and investments drop, trade balance reverses. In other words, borrowing and defaulting is procyclical, interest rates and current accounts are countercyclical. The model is successful in replicating Argentina's business cycle features and predicting the 2001-2005 sovereign debt crisis.

Another strand of the literature that fits stylized facts of crises in emerging economies are the Sudden Stop models, described by a.o. Calvo (2003). A period of high economic growth based on unsustainable policies is followed by a sharp and rapid contraction of international capital flows, large depreciations and major financial disruptions, leading to significantly lower rates of return, investment and growth. Whether the shock is internal or external is irrelevant. In our empirical analysis below we do allow for differences between internal and external shocks.

2.2 Empirical research

Business cycles and sovereign debt crises

Conventional wisdom is that countries default when output is low, and that default provides costly insurance against economic adversity. In an unbalanced panel of 106 countries from 1820 to 2012 Tomz and Wright (2007) observe that only 62% of 169 default episodes begin in the recession phase. This is a less clear-cut relationship than expected according to

theoretical models for emerging economies, where default is procyclical. Levy Yeyati (2006) finds that private lending to sovereigns is procyclical and official lending to sovereigns is countercyclical. Uribe and Yue (2006) confirm that the external spread is negatively correlated with business cycles in Argentina, Brazil, Mexico and four other emerging countries. Country interest rates drive business cycles in emerging countries and vice versa (explaining 12% either way), and U.S. interest rate shocks explain about 20% of movements in aggregate activity in these emerging countries.

Costs of debt crises

Most studies find that sovereign debt defaults have a negative impact on economic growth, but the size and duration of the impact vary greatly. For instance Sturzenegger (2004) estimates output losses at around 0.6 percent of GDP for 100 countries in the period 1974-1999. De Paoli, Hoggarth and Saporta (2009) investigate the impact of debt crises on output for 35 countries for the 1970–2000 period. They find that sovereign crisis episodes last up to ten years with output losses of at least 5 percent per year. Mendoza and Yue (2011) find empirical evidence that default events are associated with deep recessions. In a cross-country sample of 23 default events in the 1977—2009 period, GDP and consumption fall on average about 5 percent below trend. Levy Yeyati and Panizza (2011) use samples of annual and quarterly data for 40 countries, which contain ten defaults in the 1980s and ten defaults from 1990 to 2006. They find that output contractions *precede* defaults. In addition economic growth picks up fast: one year after a default economic growth is already positive. Sovereign defaults are postponed as much as possible because of the high political costs. Once a country defaults, it has already passed a period of low economic growth. Furceri and Zdzienicka (2012) use an unbalanced panel of 154 countries from 1970 to 2008 to estimate the short and medium term impact of debt crises on output, and whether the impact of a debt crisis is larger than the impact of banking and currency crises. They find

that sovereign debt crises have a deep and long-lasting effect on economic growth (10% of output after 8 years), and that debt crises have a stronger effect than currency or banking crises.

Determinants of impact of debt default on economic growth

The literature distinguishes five transmission channels of debt defaults on economics growth:

- Capital market access and borrowing costs. Most studies find that defaulters regain access to new credit shortly after the end of the crisis. For example, Panizza et al.(2009) find that most countries regain access within one or two years after a debt crisis. Global credit cycles and the size of the "haircut" (creditor losses as a consequence of a default) are more important for re-access than default history (Richmond and Dias, 2009). Borensztein and Panizza (2009) find that the cost of borrowing immediately after the default is significantly higher, but that this effect fades away in approximately two years. On the other hand, Cruces and Trebesch (2011) and Richmond and Dias (2009) find that debt restructuring can have a significant and lasting impact on access to the financial markets after a crisis. The effect depends mainly on the outcome of restructuring, in particular the size of the "hair cut".

- Impact on trade. For the impact on international trade there are ambiguous findings. Rose (2005) studies the Paris Club rescheduling and observes big and long lasting declines in bilateral trade. Both importers and exporters have less access to credit as a consequence of the default, which causes lower trade activity. On the other hand, Borensztein and Panizza (2009) find that export oriented industries suffer more, but the effect is fairly short-lived.

- Contagion to the financial sector. Sovereign defaults are associated with an increased probability of a banking crisis (Borensztein and Panizza, 2009; Levy Yeyati and

Panizza, 2011). A sovereign debt restructuring can strongly affect the financial position of banks, pension funds and other financial institutions, particularly if these have exposure on the affected instruments. An important issue is the possible endogeneity between debt, banking and currency crises (Furceri and Zdzienicka, 2012).

- Reputational spillovers. "Reputational spillover" or panic and pessimism that follows a default may undermine the confidence in the government, with direct consequences for the corporate sector: sovereign defaults lead to a fall in FDI flows into the country (Fuentes and Saravia, 2010), foreign credit to the private sector collapses after a default (Arteta and Hale, 2008), and sovereign downgrading will affect corporate ratings and thus increase the cost of funding for corporations (Borensztein and Panizza, 2009).

- Political costs. Policy makers who take the decision to default run a significant and high probability of damage: they may loose their jobs and political career, and the ruling party typically loses in the next elections (Borensztein and Panizza, 2009). Levy Yeyati and Panizza (2011) show that policy makers have incentives to postpone the default. They will wait until there is no other way out then default, which will save their reputation, because a forced default is considered better than a strategic default.

Wherever possible we have tried to distinguish the different channels, but limited data availability made identification of the channels difficult.

3 Methodology

Business cycles and sovereign debt crises

To check whether sovereign debt crises are related to business cycles or fluctuations in a narrower component of economic activity, such as exports and fiscal balance, we plot the behavior of the variables around the time of the debt crisis, and compare this with the average in tranquil times. We also check international, external indicators such as US interest rate, US economic growth and commodity prices. Furthermore, we count the number of crises for which the business cycle is in expansion phase in the year before the default, the number of crises for which the US economic growth is below its level in tranquil times, etc.

The impact of sovereign default on economic growth

To answer our second research question ("What is the impact of a debt default on economic growth?"), we use two approaches: the dummy variable approach and the output gap approach.

Dummy variable approach

Following Levy-Yeyati and Panizza (2011) we specify an economic growth equation with crisis dummy variables and a wide range of control variables (international growth, interest rates, fiscal, debt, trade and monetary series). This solves one of the issues to account for when analyzing the impact of debt crises on economic growth: economic growth is not only influenced by debt defaults, but by a range of economic, social and political factors. Possibly endogenous control variables are included with a lag. This avoids another one of the issues to account for: the possible endogeneity of defaults and economic growth. An alternative approach for these two issues is the Two Stage Least Squares, as applied by

a.o. Furceri and Zdzienicka (2012). However, for our dataset it is not feasible because it is impossible to find good instruments due to the limited data availability of various series.

We test for autocorrelation and heteroskedasticity and where necessary use robust estimators.

Output gap approach

In this approach actual GDP growth is compared to potential GDP growth, which is commonly based on pre-crisis GDP growth. One of issues is the length of the pre-crisis period. Using a long time horizon (5–10 years) raises the question whether the pre-crisis period was truly a tranquil period, since crises may recur in some countries. Using a short horizon (1–3 years) may not be representative due to the relative unstable pre-crisis conditions in the economy (Angkinand, 2008). We use 5-year averages as in Bordo et al. (2001), and the Hodrick-Prescott (HP) filter, as in Tomz and Wright (2007), De Paoli, Hoggarth and Saporta (2009) and Furceri and Zdzienicka (2012).[2]

Severity and contraction period

To answer our third research question ("Why is the impact of some debt defaults on economic growth greater than others?") we summarize the total impact of a debt crisis in a single measure. We construct a measure for the depth or severity and a measure for the contraction period after a sovereign debt default. We use the definition related to the business cycle contraction (as in Levy Yeyati and Panizza, 2011): the current depth of a recession is defined as the total cumulative output loss from the pre-default peak to the post-default trough of the business cycle. We make one adjustment: we start at the year before the default instead of the last peak before the default (unless the peak coincides with the default: then we take the year of the peak). In other words: the deviation of the

[2]For the HP filter we use a smoothness parameter of 100, which is standard in annual frequency data.

real GDP growth from its pre-crisis trend, from the year of the default until the trough of the business cycle is reached.[3]

For the cumulative output loss we calculate the pre-crisis trend real GDP growth, based on the 5 year pre-crisis (geometric) mean ($\bar{g}_{T,5}$):

$$\bar{g}_{T,5} = [(1 + g_{T-1})(1 + g_{T-2}) \dots (1 + g_{T-5})]^{1/5} - 1, \tag{1}$$

where T is year of default; g_t is the arithmetic growth in year t:
$g_t \equiv (RGDP_t - RGDP_{t-1}) \ / \ RGDP_{t-1}$, and $RGDP$ is the real GDP in constant local currency.

We define N as the length of the crisis contraction period, from the year of the default until the trough of the business cycle is reached. The cumulative output loss during the contraction period is determined as:

$$G_{T+N} = \ln [RGDP_{T+N}] - \ln \left[(1 + \bar{g}_{T,5})^{N+1} \, RGDP_{T-1} \right]. \tag{2}$$

The second term in equation (2) is the trend real GDP—what the real GDP would have been if there had not been a debt crisis.

The determinants of the impact

To analyze why some crises are more severe than others, we use bivariate linear regressions as in Cecchetti, Kohler and Upper (2009) for banking crises and Gupta et al. (2007) for currency crises. The severity of the crisis is the dependent variable, and the regressors are selected from a set of potentially relevant indicators. We include all crises for which we have a measure for the severity and length of the crisis.

[3] An overview of alternative measures is provided in Appendix A.

4 Data

We analyze four Latin American countries, Argentina, Brazil, Chile and Mexico, for the period 1870–2012. We use annual data from several sources: Aiolfi, Catao and Timmermann (2011), Barro and Ursua (2008), Reinhart and Rogoff (2011), Blattman, Hwang and Williamson (2004), Polity IV, World Bank, IMF, Maddison and OxLAD a.o. See Appendix B for details.

Three periods

To identify periods with distinct regimes we follow Aiolfi et al. (2011). The period from 1870 to 1930 is characterized by tight financial and trade integration with the world economy. This "outward-looking regime", also known as the "Belle Epoque", features the absence of foreign exchange and capital controls, almost no trade restrictions and a high share of exports and imports in GDP. In the aftermath of the Great Depression stringent capital controls are introduced, followed by trade restrictions and the Bretton Woods system. This "inward-looking regime" or "import substitution period" (1931-1971) ends with the breakup of the Bretton Woods system in the early 1970s, and the world capital markets open again for developing countries. In the period following the breakup of the Bretton Woods system ("market reform period") financial openness rises in Latin America and globalization increases once again. The modern era is also characterized by a high number of financial crises in emerging markets, similar to the 1870–1913 period (Bordo and Meissner, 2007 and Della Paoleri and Taylor, 2012). There is some controversy as on the dates of these three periods. The break up of the Bretton Woods in 1971–1972 has been the start of the modern era, but for Latin America it is more common to date the end of the second period at the end of the 1970s. This dating problem is not relevant in our database, because no debt crises occurred in the 1970s.

Sovereign debt crises

We follow the definition from Standard and Poor's, as reported in Borensztein and Panizza (2009). We choose this definition because it is based on sovereign debt crises only, unlike Reinhart and Rogoff (2009) who include both external public and private debt, and Purcell and Kaufman (1993) who include also suppliers' credits.

Table 1: Sovereign debt default episodes

	Period I: 1870-1930	Period II: 1931-1971	Period III: 1972-2012
Argentina	1890–1893	-	1982–1993, 2001–2005
Brazil	1898–1910, 1914–1919	1931–1933, 1937–1943	1983–1994
Chile	1880–1883	1931–1947	1983–1990
Mexico	1914–1922, 1928–1942	-	1982–1990

Notes:
Based on S&P, from Borensztein and Panizza (2009). Window exclusion period of 3 years.
Mexico's series start in 1895, due to missing observations. As a consequence
we shall not take into account the 1866–1885 crisis.

Table 1 presents the crisis episodes for our dataset. There are six crises in the "Belle Epoque" (1870–1930), three crises in the "import substitution period" (1931–1971), and five crises in the "market reform period" (1972–2012). The 1980s debt crisis hit all four countries, and there were no defaults in the period between 1948 and 1981.

Business cycles

Aiolfi, Catao and Timmermann (2011) have analyzed the business cycles in the same four Latin American countries that we study. The average business cycle volatility in Latin America is much higher than in advanced economies and higher than other emerging economies. Volatility was particulaly high in the "Belle Epoque" period (1870-1930) and in the "market reform period" (1970-2012). The business cycles show large shocks with high

amplitude and long duration of output fluctuations relative to advanced country standards. External terms of trade is procyclical, trade balance countercyclical, fixed investments more volatile than output, fiscal policy procyclical, and inflation countercyclical. Business cycles among the four countries have been correlated throughout history, which is mostly caused by global factors such as commodity prices, global economic growth and global interest rates.

We use a business cycle dummy based on the turning points of the business cycle index, the short cycle as constructed by Aiolfi, Catao and Timmermann (2011), which has a two-year window (a minimum of two years between peaks).

Domestic and international variables

For economic growth we use the difference in the natural log of GDP, measured in constant local currency. Furthermore, monetary variables (inflation, domestic real interest rate) enter our regressions, as well as fiscal variables (change in government expenses and ratio of government's expenses to revenues), debt variables (gross external debt to GDP), trade variables (terms of trade, ratio of exports to imports) and other variables such as population growth and a political indicator (polity2). Details on the data definitions and sources can be found in Appendix B. For international growth we use the difference in natural log of the U.S. GDP in constant USD, and for the international credit markets we use the U.S. 3-months nominal interest rate. Finally, we include prices of nine commodities that are relevant for Latin America and which are available for the entire time horizon.

5 Empirical results

5.1 Debt crises and business cycles

Table 2 provides an overview of the timing of the first year of the debt crisis in relation to the business cycle turning points. Most sovereign debt crises start in the recession phase (11 out of 14, or 80%), which is a stronger relationship than Tomz and Wright (2007) find. This difference could be caused by the data: we use a more homogeneous dataset, with less sovereign debt crises than Tomz and Wright (2007) do. Also, we use different business cycle turning points: Aiolfi et al. (2011) have based their index on a wider set of variables than just the real GDP which is used by Tomz and Wright (2007). The top row refers to the time between the peak and the first year of the debt crisis. Five crises start two years after the peak. The bottom row refers to the contraction period that follows the default. Seven crises reach the trough within 1 year, which confirms Levy Yeyati and Panizza (2011).

Table 2: Debt crises and business cycles

	1 year	2 years	3 years	4 or more years
Default after BC peak	2	5	1	3
	0 year	1 year	2 years	3 or more years
Before BC trough	3	4	1	3

Notes:
The row "Default after BC peak" refers to the number of crises that start 1, 2, 3 or more than 3 years after the business cycle peak was reached. The row "Before BC trough" refers to the number of crises that reach the trough 0, 1, 2, or more than 2 years after the first year of default. Three crises reach the trough in the same year as the first year of the default.

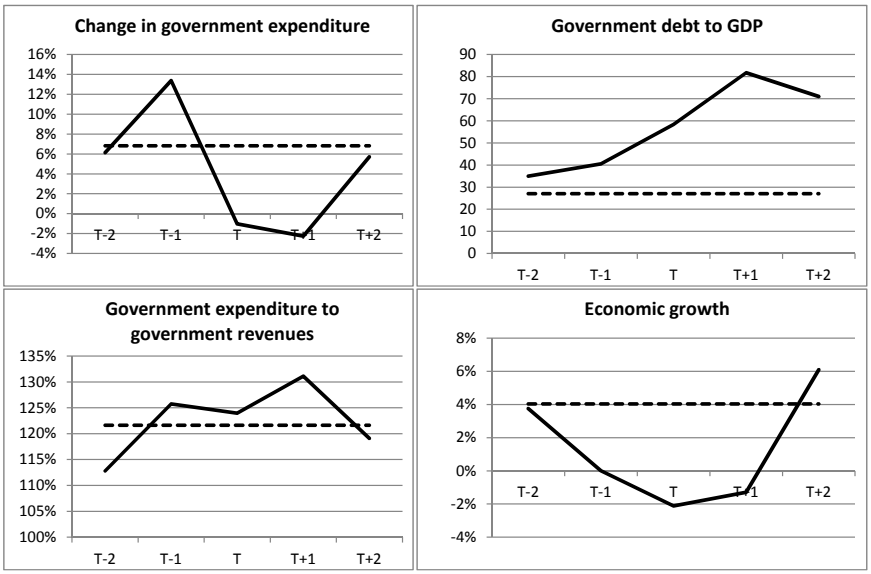
In Argentina all defaults take place in the recession phase of business cycles. The trough is reached shortly after the default and long before the debt crisis is formally ended. For

Brazil all defaults occur in the recession phase of business cycles, except for the 1937–1943 crisis. Two out of three debt crises in Chili occur in the recession phase. For these two crises the business cycle trough is reached shortly after the default. For Mexico, two crises occur in the recession phase and one at a business cycle peak. Of all four countries, Mexico takes the longest time to reach the business cycle trough and start an expansion phase. Particularly the 1982 crisis has a long-lasting effect on economic performance.

Following suggestions for future research from Tomz and Wright (2007) we check whether sovereign debt crises are related to fluctuations in exports, government balance, or international circumstances. Figures 1 and 2 show how these variables behave around the time of the debt crisis. The horizontal axis records the number of years before and after the beginning of the crisis. In Figure 1 we see that government expenditure increases sharply in the year before the default, which deteriorates the fiscal balance deficit and increases the debt ratio.

Figure 2 suggests that there is a pattern in the behavior of the international and external trade variables in the run-up to the default. Out of 14 sovereign debt crises, 11 occur when US economic growth is below its long term average growth rate, and 9 occur when US interest rate is above its long term average level. The majority of the crises starts when international conditions are unfavorable, which confirms Reinhart and Rogoff (2008). Regarding the external trade position: 8 out of 14 sovereign debt crises occur when terms of trade are above its long term average level, and 11 occur when exports to imports ratio is below its long term average level. Prior to the debt crisis, the currency is overvalued and exports is relatively low. After the debt crisis starts, the situation reverses: overvaluation decreases, exports increases and/or imports decrease. This points towards a currency devaluation or depreciation, which is no surprise since debt crises are often accompanied by currency crises ("twin crises").

Figure 1: Behavior of national indicators around the time of the first year of a sovereign debt crisis (pooled data).



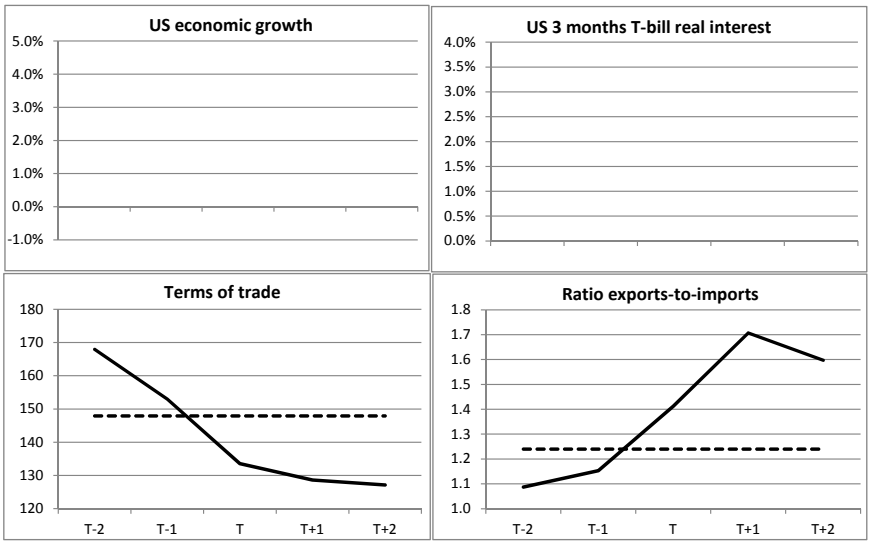
Notes:
The dotted line represents the average level of the indicator during tranquil periods.
The solid line represents the indicator around the time of the beginning of the debt crisist. T = first year of the debt crisis, or year of default; $T-1=1$ year before the default, $T+1=1$ year after the default.

5.2 Impact of default on economic growth

Dummy variable approach

Table 3 shows the impact of default on economic growth for the entire pool (first column), and for the three periods with different features (last three columns). There is no evidence of fixed effects; the null that the cross-section effects are redundant is not rejected. In all three periods there is negative and significant growth in the year after the default, with the deepest contraction in the second period (1931-1971). In the following years the economic growth shows a bumpy ride: recovery is alternated by setbacks. Debt crises in the 1972-2012 period show a different picture: economic growth is negative for a prolonged period—up to seven years after the default. The Wald test on the cumulative impact of

Figure 2: Behavior of international and external trade indicators around the time of the first year of a sovereign debt crisis (pooled data).



debt default on economic growth reveals only a significant impact in the 1972–2012 period: up to 7 lags there is a cumulative impact of -17.9% at the 5% significance level. This finding is in line with the results of Furceri et al. (2012), who analyze the 1970-2008 period.

Splitting the sample at the country level (see Table 4) reveals that in Argentina, Chile and Mexico economic growth in the aftermath of a debt crisis is similar. The impact of default on economic growth is negative and significant in the year following the debt default. After this, positive and negative economic growth alternate, with significant coefficients up to eight years after the default. Brazil's economic growth is not affected in a significant way after a sovereign default.

Wald tests on the joint significance of the lagged default dummies reveal that the lagged debt default dummies are significant at the 5% level for Argentina and Mexico. Wald tests on the cumulative impact of debt defaults on economic growth show that the cumulative impact is insignificant for all countries, and for all cumulatives (cumulative effect in the first 2 years, cumulative effect in the first 3 years, etc.).

Table 3: Impact of debt default on economic growth, for sub periods (pooled data): dummy variable approach

	Dependent variable: change in log of total real GDP			
	All: 1870-2012	Period 1: 1870-1930	Period 2: 1931-1971	Period 3: 1972-2012
Debt default: lag 1 year	**-0.0445 (0.005)**	**-0.0487 (0.081)**	**-0.0829 (0.034)**	**-0.0441 (0.053)**
Debt default: lag 2 year	0.0157 (0.346)	0.0114 (0.694)	0.0265 (0.587)	-0.0299 (0.272)
Debt default: lag 3 year	0.0054 (0.735)	0.0266 (0.389)	-0.0123 (0.672)	-0.0395 (0.102)
Debt default: lag 4 year	-0.0259 (0.101)	-0.0029 (0.928)	**-0.0804 (0.005)**	-0.0154 (0.505)
Debt default: lag 5 year	-0.0016 (0.919)	0.0150 (0.623)	-0.0245 (0.375)	-0.0146 (0.521)
Debt default: lag 6 year	0.0107 (0.493)	0.0331 (0.268)	-0.0109 (0.674)	-0.0094 (0.681)
Debt default: lag 7 year	-0.0178 (0.249)	**-0.0639 (0.037)**	0.0139 (0.606)	-0.0294 (0.179)
Debt default: lag 8 year	-0.0078 (0.614)	-0.0143 (0.637)	-0.0385 (0.213)	0.0135 (0.565)
Debt default: lag 9 year	0.0140 (0.363)	0.0027 (0.929)	-0.0282 (0.263)	0.0039 (0.867)
Debt default: lag 10 year	-0.0203 (0.183)	-0.0462 (0.127)	-0.0334 (0.167)	0.0173 (0.424)
Regression statistics				
R-squared	0.1570	0.2299	0.3283	0.3816
Adjusted R-squared	0.1205	0.1269	0.2080	0.2901
F-statistic	1.8387	1.3479	1.9321	0.8819
Prob (F-statistic)	0.0518	0.2097	0.0460	0.5518

Notes.
Coefficients with corresponding p-values in parentheses; printed in bold when significant at the 10% level.
Control variables: change in government expenses, ratio of government expenses to revenues, population growth, ratio of gross debt to GDP, inflation, terms of trade, ratio of exports to imports, polity2, U.S. 3 months T-bill rate, U.S. economic growth, U.S. business cycle dummy; Also includes a constant.
Variables that are considered potentially endogenous are lagged one period.
F-statistic from the Wald test on joint significance of the lagged sovereign debt dummies. Null hypothesis: none of the lagged sovereign debt dummies is significant, versus at least one coefficient of the lagged sovereign debt dummies is significant.

Output gap approach

In this approach the cost of a crisis is the deviation of the real GDP from its trend. For the trend we use the pre-crisis 5 year average.[4] We pool all crises, and take the average output gap of all crises for each year. In the year of the default the average output gap is -5.5%. In the first year after default the average output gap is -4.4%, while the average cumulative output gap is -10.0%. Figure 3 shows the output gap and the cumulative output gap up to ten years after default. Recovery follows two years after the default, with

[4]We also applied the HP trend, which generate similar results (available upon request).

Table 4: Impact of debt default on economic growth, for countries, 1870—2012: Dummy variable approach

	Dependent variable: change in log of total real GDP			
	Argentina	Brazil	Chile	Mexico
Debt default: lag 1 year	**-0.0761 (0.048)**	0.0071 (0.777)	**-0.0709 (0.079)**	**-0.0441 (0.090)**
Debt default: lag 2 year	0.0562 (0.157)	-0.0031 (0.900)	0.0496 (0.262)	-0.0100 (0.714)
Debt default: lag 3 year	-0.0057 (0.882)	0.0338 (0.178)	-0.0016 (0.970)	0.0171 (0.505)
Debt default: lag 4 year	**0.0747 (0.056)**	-0.0298 (0.237)	-0.0321 (0.420)	**-0.0745 (0.011)**
Debt default: lag 5 year	0.0294 (0.443)	-0.0092 (0.720)	-0.0427 (0.273)	**0.0529 (0.056)**
Debt default: lag 6 year	0.0178 (0.640)	0.0123 (0.612)	0.0076 (0.843)	0.0323 (0.191)
Debt default: lag 7 year	**-0.1091 (0.005)**	-0.0142 (0.559)	0.0173 (0.662)	0.0284 (0.234)
Debt default: lag 8 year	0.0056 (0.891)	0.0094 (0.702)	**-0.0657 (0.090)**	0.0200 (0.383)
Debt default: lag 9 year	**0.0914 (0.020)**	0.0000 (0.999)	-0.0236 (0.537)	0.0087 (0.716)
Debt default: lag 10 year	-0.0162 (0.671)	-0.0163 (0.499)	-0.0338 (0.372)	-0.0155 (0.502)
Regression statistics				
R-squared	0.2499	0.1821	0.3650	0.4622
Adjusted R-squared	0.1314	0.0529	0.2380	0.3433
F-statistic	2.6926	0.6067	1.1137	2.5058
Prob (F-statistic)	0.0053	0.8054	0.3585	0.0102

Notes.
Coefficients with corresponding p-values in parentheses; printed in bold when significant at the 10% level.
Control variables: see Table 3.
F-statistic from the Wald test on joint significance of the lagged sovereign debt dummies. Null hypothesis: none of the lagged sovereign debt dummies is significant, versus at least one coefficient of the lagged sovereign debt dummies is significant.

a setback in the eighth year after the default. The cumulative output gap does not turn positive until the ninth year after the default.

Figure 4 shows the average cumulative output gap for each of the three different periods. We accumulate all sovereign debt crises for all countries. We observe a negative cumulative output gap in the year of the default and the four years that follow. The strongest negative impact occurred in the 1931-1971 period. After the fourth year we see increasing differences between the periods. Whereas the 1870-1930 period shows a complete recovery reflected by a positive cumulative output gap, the 1931-1971 period shows a mild recovery with a cumulative output gap around zero, and the 1972-2012 period shows a further deterioration of the output gap, particularly 7 and 8 years after the default.

Figure 3: Output gap approach: Output gap and cumulative output gap for pooled observations

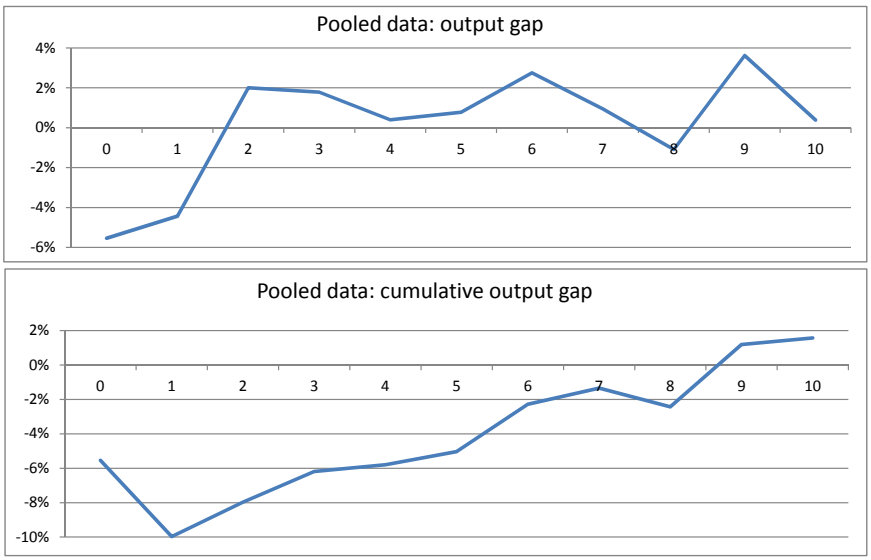
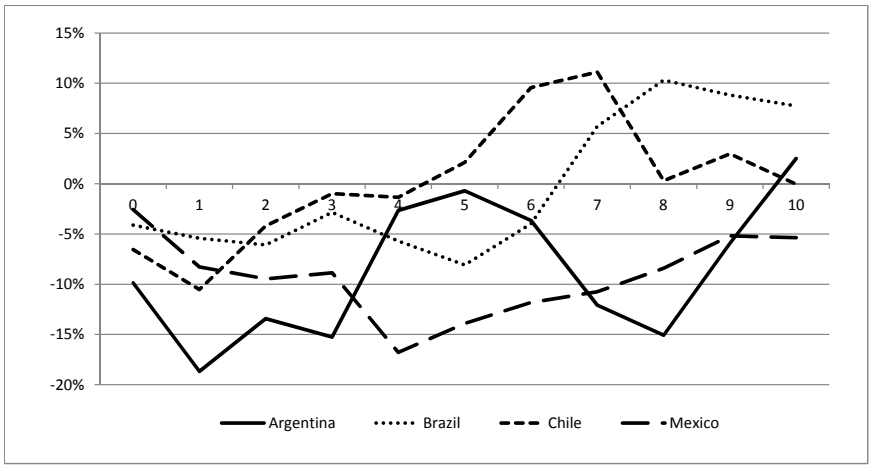


Figure 4: Output gap approach: Cumulative output gap per period (pooled data)

Figure 5 shows the average cumulative output gap per country. All four countries experience a negative output gap in the year of the default and the following year. The situation reverses after two to three years: the cumulative output gap diminishes, and even becomes positive for Chile and Brazil. Argentina shows a setback 5 years after default, but ends with a positive cumulative output gap. Mexico's output gap increases until 4 years after the default, then it diminishes steadily, but remains negative up to 10 years after default.

Figure 5: Output gap approach: Cumulative output gap per country



Severity and contraction period of the crises

Table 5 shows a listing of the fourteen sovereign debt crises, ordered for cumulative output loss during the crisis contraction period. The debt crises of Mexico in 1982 and 1928, Chile in 1931, Argentina in 1890, and Brazil in 1937 have a deep impact on the economic growth. The 1980s Latin American debt crisis has stronger effects in Mexico than in the other three countries. The 1930s crises are disproportionally represented in this "top 5". On the other side of the spectrum we see that debt crises in Mexico in 1914, Brazil in 1898 and Chile 1880 are followed by *positive* economic growth.

Table 5: Severity and contraction period of the crises

	Country	Year of default	Contraction period	Cum. output loss
1	Mexico	1982	7	53.4%
2	Chile	1931	2	37.3%
3	Argentina	1890	2	33.4%
4	Mexico	1928	4	32.0%
5	Brazil	1937	4	28.9%
6	Argentina	2001	2	21.5%
7	Brazil	1914	2	12.2%
8	Brazil	1931	1	8.7%
9	Argentina	1982	4	8.3%
10	Brazil	1983	1	6.4%
11	Chile	1983	1	3.5%
12	Mexico	1914	3	-11.1%
13	Brazil	1898	4	-16.7%
14	Chile	1880	NA	NA

Note:
Cumulative output losses are defined as positive, so a negative coefficient implies a cumulative output gain.

5.3 Analyzing the determinants of the impact of sovereign defaults

The variables significant at the 10% level that affect the *severity* are listed in Table 6. The domestic indicators (business cycle dummy, economic growth before the default and government expenditure) dominate. If a business cycle is in expansion in the year before the default, then the impact is deeper. Similarly, high pre-crisis growth is associated with a deeper crisis impact. In other words, crises that occur shortly after the economy was in expansion tend to have a deep impact, while crises that occur when the economy was in the recession phase for at least one year prior to the default and experienced low growth tend to have a less severe impact. We should be careful generalizing this point due to the low number of observations of debt crises that start at or shortly after the business cycle peak. An increase in government expenditures prior to a default is associated with a deeper crisis impact. This finding is relevant for policy purposes: increasing the government expenses

can worsen the crisis impact, an undesired effect. Latin American countries typically have procyclical fiscal policies (Ocampo, 2009). Higher expenditures prior to a debt crisis will require a larger cut in government expenditures during a debt crisis, because access to credit is limited when the country has defaulted. These cuts will further affect economic output. The international post-default copper price is negatively correlated with the severity of a default: an increase (decrease) in the copper price reduces (amplifies) the impact from the debt crisis. Particularly the 1931 crisis in Chile, the largest copper producer in the world, drives this effect.

Table 6: Determinants of severity: bivariate regressions

	coefficient	standard error	p-value
Business cycle dummy (–1)	0.2833	0.1073	0.023
Pre-default 3 year average real GDP growth	3.3635	1.0870	0.010
Change in government expenditure (–1)	0.7371	0.3450	0.056
Change in government expenditure in default year	0.6928	0.3337	0.062
Pre-default 3 year average change in government expenditure	1.4121	0.7272	0.078
Post-default 3 year average change in copper price	-0.8101	0.4076	0.072

Table 7 presents the variables that affect the *contraction period* that follows the default. The dominance of commodity price changes prior to the debt crises is striking. Increasing commodity prices in the three years before the default lead to a longer contraction period, while decreasing prices prior to the default are associated with shorter contraction periods. Latin America is a large commodity producer. Commodities do not only have a direct impact on output, but also an indirect effect, because it sustains government revenues, and export revenues generate foreign currency. Arezki and Bruckner (2010) find that autocracies spend a large part of the additional revenues from international commodity price windfalls on government expenditures, while democracies use the additional revenues to reduce their external debt levels. In autocracies the risk of default on external debt increases when international commodity prices increase. The four Latin American countries

that we investigate experience an equal number of years with autocracy and with democracy. However, in the year of the default there is autocracy in 11 (out of 14) crises. The transmission may run through a boom-bust mechanism: Higher commodity prices lead to increased expectations, resulting in overinvestments, capital inflows, and overborrowing. Government revenues as well as government expenditures increase. If commodity prices fall, then output, forex inflows and government revenues decrease. The government has to cut expenditure and/or borrow more, which increases the debt level even more. Interest rates increase because of an increased probability of a default. This affects the government budget, private and public investments, and economic output. Depending on the situation in the international capital markets, access to additional debt to finance the deficit may be difficult or expensive to obtain. The increase in fiscal deficit, combined with difficulties to finance the deficit may then lead to a financial crisis (debt or currency). Domestic variables play a role in the explanation in the length of a contraction too. As was the case for the severity, the stance of the business cycle is significant: when the economy is in an expansion phase one year before the default, the contraction period lasts longer. As was the case for severity, changes in government expenditures prior to a default are significant: higher government expenditures in the run-up to the beginning of the crisis causes a longer contraction period. An increase in the terms of trade in the pre-default year is associated with a longer recovery period. High terms of trade point towards an overvalued currency, which increase the probability of a depreciation or devaluation. This leads to difficulties servicing foreign currency sovereign debt. We find no evidence that the impact of debt crises is related to banking or currency crises, nor to the debt-to-GDP ratio.

Table 7: Determinants of crisis length or recovery period: bivariate regressions

	coefficient	standard error	p-value
Change in government expenses (–1)	7.5604	2.5285	0.012
Business cycle dummy (–1)	1.9333	1.0326	0.088
Terms of Trade (–1)	0.0140	0.0063	0.047
U.S. real GDP growth (–1)	13.1856	7.2178	0.095
Pre-default 3 year average change in copper price	15.1192	5.6467	0.022
Pre-default 3 year average change in oil price	6.8089	3.2767	0.062
Pre-default 3 year average change in silver price	11.3634	2.6892	0.001
Pre-default 3 year average change in sugar price	6.3105	2.2944	0.002
Pre-default 3 year average change in tin price	7.9003	4.1469	0.083
Pre-default 3 year average change in zinc price	17.3129	5.2086	0.007

6 Conclusion

This paper analyzes the relation between sovereign debt defaults, business cycles and economic growth for four Latin American countries: Argentina, Brazil, Chile and Mexico. These countries experienced 14 sovereign defaults during the period from 1870 to 2012. We address three research questions: Are debt defaults procyclical and does this play any role in the severity of the crisis? What is the impact from debt defaults on economic growth in the short and long run? Why are some crises very deep and last long, while others do not have much impact?

We use the dummy approach and output gap approach to get insight in the impact of sovereign debt defaults. We construct a measure to capture the severity of the impact and use bivariate regressions to investigate which factors determine the size and length of the contraction.

We find that the majority of the debt crises (11 out of 14, or 80%) start in the recession phase of the business cycle. In the run up to a debt default international circumstances are unfavorable: global economic growth is low and interest rates are high. Also, the terms of trade are above its long term average level, and the exports to imports ratio is below its

long term average level. The situation reverses sharply after the outbreak of the debt crisis, pointing towards a correction of an overvalued currency in a fixed exchange rate system. This does not come as a surprise, because a large number of debt crises is accompanied by a currency crisis ("twin crisis"). We observe a negative impact of a default on economic growth in the year of the default and the year after the default. Typically, two years after the default the economy recovers, although the recovery path is far from smooth: it takes five to ten years to overcome the negative cumulative effect. Higher government expenditures in the years prior to a default lead to a deeper contraction of economic growth, which can be attributed to Latin American countries' procyclical fiscal policies. Debt crises that occur when the economy is in the expansion phase of the business cycle have a deeper impact on economic growth. Increasing commodity prices in the run-up to the crisis lead to a longer contraction period. This complements Arezki and Bruckner (2010)'s findings for emerging countries: the contraction period lasts longer when international commodity prices have increased prior to the default.

Latin America has a long history of recurrent debt crises. Our findings show that procyclical fiscal policy and changes in prices of commodities have made the countries vulnerable for unfavorable international circumstances (low economic growth, high interest rates and low commodity prices). Chile's recent change towards a countercyclical fiscal policy seem to breaks this pattern, and could serve as an example for the other countries.

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A Definitions of impact: severity and length

De Paoli *et al.* (2009) use a cumulative output loss during the period of a sovereign crisis as shown in Equation (A.1)

$$\sum_{t=0}^{T_X} \frac{Y_{ti} - Y_{0i}(1+g_{it}^*)^t}{Y_{-1i}}, \tag{A.1}$$

where g_{it}^* is the potential growth rate, t = 0 is the year of default and $t = T_X$ is the last year of the debt crisis.

Levy-Yeyati and Panizza (2011) use a measure from the business cycle literature: the current depth of a recession (CDR), which is based on Beaudry and Koop (1993). CDR is defined as cumulated drop since the last peak. $CDR_t = y_s - y_t$, where y_s measures log GDP at the last peak and y_t measures log of GDP at time t.

Kapp and Vega (2012) estimate the total output losses by adding up the difference between actual and potential output over the duration of the crisis. They propose in total 13 possible ways to measure output losses, severity and frequency, with varying definitions for potential GDP and end dates of a crisis.

The banking and currency crisis literature has proposed several alternatives, of which we mention a few. Bordo and Schwartz (2000) measure the severity and duration of a crisis in various ways: the growth rate in the crisis year relative to its trend over the five years preceding the crisis; crisis-year growth relative to its three-year trend preceding the crisis; the difference between crisis-year growth and the preceding year's growth rate; the difference between growth the year following the crisis and the crisis-year growth rate; the difference between the three-year trend growth rate following the crisis and the crisis-year growth rate; and the difference between the five-year trend growth rate following the crisis and the crisis-year growth rate.

Bordo *et al.* (2001) use two measures. The first measure defines the length and depth of a crisis. They define the length of a crisis as the number of years until GDP growth returns to its pre-crisis trend, including the year when it returns to that trend (trend: five year average economic growth preceding the event). Crisis depth is defined as the cumulative output loss from the event until the economic growth returns to its pre-crisis trend: the difference between pre-crisis trend growth and actual growth. The second measure is designed to compare recessions with a banking and/or currency crisis with recessions without a financial crisis: the cumulative output loss is taken during the recession phase.

Cecchetti *et al.* (2009) use the contraction to measure the impact. The length of the contraction is defined as the number of years before the real GDP is back at the pre-crisis level. The cumulative output loss of the contraction is defined as the difference between the pre-crisis real GDP and the actual real GDP during the length of the contraction.

To measure the impact from currency crises on economic growth Gupta, Mishra and Sahay (2007) use the difference of the average growth during the first years of the crisis and the average pre-crisis growth. More specific: the average of the annual GDP growth rate in the crisis and first post-crisis year minus the average annual GDP growth rate in the three pre-crisis tranquil years:

$$\frac{(g_0 + g_1)}{2} - \frac{(g_{-1} + g_{-2} + g_{-3})}{3}, \tag{A.2}$$

with g_0 the economic growth in the year of the default, g_1 the economic growth in the year after the default, g_{-1} the economic growth in the year before the default, etc.

B Variables: definition and sources

Variable	Definition	Source
Real GDP	Total real GDP, in constant local currency 2006 prices	1870–2003: Real GDP per capita: BU2008, population: ACT2011; 2004–2012: IFS (Brazil 2012: WDI)
Population	Population at mid-year	1870–2003: ACT2011, 2004–2011: IFS, 2012: WDI (Mexico 2012: growth derived from WDI)
Exports	Exports, in millions of USD	1870–2003: ACT2011, 2004–2012: IFS
Imports	Imports, in millions of USD	1870–2003: ACT2011, 2004–2012: IFS (Brazil and Mexico: 1948-2012: IFS)
Export volume	Exports volume index, 2000 = 100	1870–2003: ACT2011, 2004–2012: IFS (Argentina and Brazil), growth from WDI (Chile and Mexico)
Import volume	Imports volume index, 2000 = 100	1870–2003: ACT2011, 2004–2012: IFS (Argentina and Brazil), growth from WDI (Chile and Mexico)
Terms of trade	Terms of trade, index: 2000 = 100	1870–2003: ACT2011, 2004–2012: calculation: ToT = [exports / export volume] / [imports / import volume]
Inflation	Consumer Price Inflation (CPI), annual, geometric change	1870–2003: ACT2011, 2004–2012: IFS
Domestic interest	Domestic, nominal interest rate	1870–2003: ACT2011, 2004–2012: IFS (money market rate)
Domestic real interest	Domestic, real interest rate	Nominal domestic interest rate deflated by CPI
External spread	Interest difference between USA and domestic government; difference in yield on 10 year government bonds denominated in USD	Argentina, Brazil and Chile 1870–2004: ACT2011, 2004–2012: Bloomberg; Mexico 1996–2012: Bloomberg
Government expenditure	Government expenses, in constant 1995 local currency; index: 1995 = 100	1870–2004: ACT2011, 2005–2012: WEO (adjusted for structural break)
Government revenues	Government revenues, in constant 1995 local currency; index: 1995 = 100	1870–2004: ACT2011, 2005–2012: WEO (adjusted for structural break)
Gross debt to GDP	Central government (external and domestic) debt to GDP	1870–2009: RR2011, 2010–2012: Ministerio de Economia (Argentina), Tesouro Nacional (Brazil), Banco de Chile (Chile), Secretaria de Hacienda y Finanzas Publicas (Mexico)

Continued on next page

Variable	Definition	Source
Polity2	Polity2 index: -10 (autocracy) to +10 (democracy)	1870–2012: Polity IV project, Center for Systemic Peace
War	Intrastate war and interstate war (binary dummy)	1870–2012: Correlates of War
Years no change	# years since the last substantial regime change	1870–2012: Polity IV project, Center for Systemic Peace
BC index	Business Cycle Indicator	1870–2004: ACT2011
BC expansion dummy	Dummy for the short business cycle: 1 if in expansion phase (incl. peak), 0 otherwise	1870–2004: ACT2011
Real GDP USA	US real GDP, in billions of USD	1870–2012: Maddison
Real GDP core	Real GDP, in billions of USD of four major countries: USA, UK, Germany and France	1870–2012: Maddison
US 3 months interest rate	3 months US T-Bill nominal interest rate, deflated with U.S. CPI	1870–2003: ACT2011, 2004–2012: IFS
US 10 years interest rate	10 years US bond nominal interest rate, deflated with U.S. CPI	1870–2003: ACT2011, 2004–2012: IFS
Commodity price: cacao, coffee, copper, iron, petrol, silver, sugar, tin and zinc	Price, index: 1900 = 100	1870–1899: BHW2004, 1900–1999: OxLAD, 2000–2012: WB
Sovereign debt crisis	Sovereign debt crisis dummy	1870–2004: BP2009, 2005–2012: Standard and Poor's
Currency crisis	Currency crisis dummy	1870–2010: RR2011, 2011–2012: own calculations
Banking crisis	Banking crisis dummy	1870–2010: RR2011, 1970–2011: LV2012

Notes:

ACT2011: Aiolfi, Catao and Timmermann (2011)

BHW2004: Blattman, Hwang and Williamson (2004)

BP2009: Borensztein and Panizza (2009)

BU2008: Barro and Ursua (2008)

IFS: International Financial Statistics, from IMF

LV2012: Laeven and Valencia (2012)

OxLAD: Oxford Latin America Economic History Database

RR2011: Reinhart and Rogoff (2011)

WB: World Bank

WDI: World Development Indicators, from WB

WEO: World Economic Outlook, from IMF

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