ABSTRACT

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This dissertation attempts to address the elusive concept of "graduation", that is the emergence from frequent crisis suffering status. It contains two chapters. The first uses a data set covering over two hundred years of sovereign debt, banking and inflation crises to explore the question of how long does it take a country to "graduate" from the typical pattern of serial crises that most emerging markets experience. We find that for default and inflation crises, twenty years is a significant period, but the distribution of recidivism has extremely fat tails. In the case of banking crises, it is unclear whether countries ever graduate. We also examine the more recent phenomenon of IMF programs, which sometimes result in "near misses" but sometimes end in default even after a program is instituted.

The second chapter investigates the impact of countries' institutions on their likelihood of sovereign default from both an empirical and theoretical perspective. By employing a dataset of more than 80 countries, two facts emerge: 1) high institutional

quality is associated with a low frequency of sovereign default crisis**,** and 2) in particular, polarized governments tend to default more often. To explain these facts, we developed a model that establishes a link between institutions, government polarization and sovereign default crises. Countries that lack rules and institutional settings to limit the pressure of powerful groups on a central government's policies default more often than countries that do have good institutions. Given that there are no barriers to limit the influence of powerful groups, a more polarized government defaults more because groups do not coordinate, giving rise to a negative externality. Simulations of the model succeed in matching the cross-country differences in sovereign default frequencies, given their institutional quality and degree of government polarization in the data.

ESSAYS ON GRADUATION

By

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Dedication

To my parents and my husband

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Table of Contents

Dedication ii
Acknowledgements iii
List of Tables vi
List of Figures vii
Introduction 1
1 On Graduation from Default, Inflation and Banking Crisis: Elusive or Illusion? 5
1.1 Introduction 5
1.2 Definition of Crises 9
1.3 A time line of financial crises and the early history of sovereign defaults 12
1.4 The Duration and Prevalence of Crises: The Post 1800 Experience 18
1.5 The interval between consecutive crises 26
1.6 Time since last crisis 32
1.7 Macroeconomic volatility 37
1.8 Crisis and Role of IMF programs: 1952-2007 40
1.9 Graduation and the Theory of Sovereign Default 42
1.10 Conclusions 45
2 Why do some countries default more often than others? The role of institutions 47
2.1 Introduction 47
2.2 Data and Findings 51
2.2.1 Data Description and Source 51
2.2.2 Facts 53
2.2.3 Discussion 61
2.3 A Simple Theory of Government Polarization and Default Probability 63
2.3.1 Optimization Problem of the Unified Government 65
2.3.2 Optimization Problem of the Polarized Government 67
2.3.3 Foreign Lenders 68
2.3.4 Timing of the Events 70
2.3.5 The Equilibrium 71
2.4 Extending the Model to Infinite Periods 76
2.4.1 Model Setup 76
2.4.2 Default Decision in Unified Government 77
2.4.3 Default Decision in the Polarized Government 79
2.4.4 The Equilibrium Bond Price 80
2.5 Quantitative Analysis 81
2.5.1 Functional Forms and Parameters 81
2.5.2 Simulation Results 82
2.6 Conclusions 87
Appendices 90
Bibliography 103

List of Tables

Table 1. Table 1- Timeline of crises 1550-2010

Table 2- External defaults: Europe, 1550-1850

Table 3- Summary statistics of crisis probabilities

Table 4- Medians of distance (in years) to last crisis in 2010

Table 5- Examples of cases where IMF programs are introduced but there is subsequent default

Table 6- Summary Statistics of Institutional Quality and Default Probability

Table 7- Summary Statistics of Government Characteristics and Default Probability

Table 8 - Cross-country regression of sovereign default risk and institutions

Table 9- Summary Statistics of Default Probabilities: Simulations Results

Table A1- Average duration of crises

Table A2- Default episodes that began after and during severe wars

Table B1- Parametric analysis: hazard rate of default reversal

List of Figures

Figure 1- External default crises: Duration of "tranquil time". Frequency distribution (in percent): 1300-1799. High income countries

Figure 2- Share of countries in inflation crisis: 1800-2008. World

Figure 3- Share of countries in banking crisis: 1800-2008. World

Figure 4- Share of countries in external default crisis: 1800-2008. High income vs. Middle and Low income

Figure 5- Share of countries in inflation crisis: 1800-2008. High income vs. Middle and Low income

Figure 6- Share of countries in banking crisis: 1800-2008. High income vs. Middle and Low income

Figure 7- Duration of "tranquil times" conditional on having had at least one crisis. Frequency distribution (in percent): 1800-2008

Figure 8 - External default crises: Duration of "tranquil time" conditional on having had at least one crisis. Frequency distribution (in percent): 1800-2008. High vs. Middle and Low income

Figure 9 - Inflation crises: Duration of "tranquil time" conditional on having had at least one crisis. Frequency distribution (in percent): 1800-2008. High vs. Middle and Low income

Figure 10- Banking crises: Duration of "tranquil time" conditional on having had at least one crisis. Frequency distribution (in percent): 1800-2008. High vs. Middle and Low income

Figure 11- Time elapsed by 2010 since last external default crisis, 1800 or year of independence: High vs. Middle and Low income

Figure 12- Time elapsed by 2010 since last inflation crisis, 1800 or year of independence: High vs. Middle and Low income

Figure 13- Time elapsed by 2010 since the last banking crisis, 1800 or year of independence: High vs. Middle and Low income

Figure 14- Evolution of GDP growth rate volatility: 1950-2006. High vs. Middle and Low income

Figure 15- Evolution of GDP growth rate volatility: 1950-2006. Commodities exporting countries: Emerging vs. Benchmark

Figure 16- The Incidence of IMF Programs in Advanced and Emerging Economies: 1952-2007

Figures 17- Default Probability versus ICRG institutional index

Figures 18- Default Probability versus Government Effectiveness

Figures 19- Default Probability versus Control for Corruption

Figures 20- Default Probability versus Fragmentation

Figures 21- Default Probability versus Polarization

Figure 22- Bond price schedule: Unified government

Figure 23- Default rule: Unified government

Figure 24- Bond price schedule: Polarized government (η=0.5)

Figure 25- Default rule: Polarized government (η=0.5)

Figure 26- Bond price schedule: Polarized government (η=0.1)

Figure 27- Default rule: Polarized government (η=0.1)

Figure A1- Duration of external default crises. Frequency distribution (in percent): 1800-2008. High vs. Middle and low income

Figure A2- Duration of "tranquil times" conditional on having had at least one crisis. Frequency distribution (in percent): 1800-2008. Excluding defaults started after and during severe wars.

Figure A3- External default crises*: Duration of "tranquil times" conditional on having had at least one crisis. Frequency distribution (in percent): 1800-2008. High vs. Middle and Low income

Figure B1- Hazard rate of default reversal: Full sample

Figure B2- Hazard rate of default reversal: High vs. Middle and Low income

Introduction

How a country "graduates"—emerges from recurrent financial crisis bouts—is probably one of the most important issues in macroeconomics and international finance. Many advanced countries had enjoyed a long hiatus from systemic banking crises after World War II, and yet had huge problems during the recent global financial crisis. After ninety years of serial default running from 1557 to 1647, Spain did not default again until 1809. More recently, Greece was in "near" default, 76 years after its last episode that started in 1932. Even the advanced countries had high inflation as recently as the 1970s and early 1980s, while many emerging markets had hyperinflation less than two decades ago. Is the advent of modern independent central banks sufficient to guarantee that fiscal dominance never again reasserts itself? Have the rich countries that have supposedly "graduated" from serial default on external debt, shifted the locus of risk to de jure or de facto (via inflation or financial repression) default on domestic debt? Does the theory of sovereign default or of financial development tell us that we should expect richer and more advanced countries to be immune? What makes some countries more prone to crises than others? Is it possible that graduation is just a mirage, with the "graduates" really being at best "star pupils"? And, how can we distinguish "graduates" from patients in remission?

There has been remarkably little theoretical or empirical investigation of the subject. For example, the large theory literature on sovereign lending and default, while producing many important insights on the fundamental distinction between willingness to pay and ability to pay, largely treats a country's basic developmental

and political characteristics as parametric. There is very little on explaining the political, social, economic and financial dynamics that ultimately lead a country to be less prone to certain types of crises.

In Chapter 1, we examine the incidence and the risk of reversals of default, inflation and banking crises across advanced economies versus middle and low income countries. The data covers sixty-six countries over more than two hundred years. We find that the process of "graduation" is seldom accomplished in a short time frame. Because financial crises tend to occur only at very long periodicities, it is easy to forget that they happen at all. Premature declaration of victory is a recurrent mistake. For example, Argentina was the poster child within the international community as late as 1998-1999 (on the eve of disaster) and is an illustration of this tendency. In our study, we find that two decades without a relapse is an important marker to signal the "first step" toward graduation, but there are still relatively high odds of relapsing into crisis even after several decades of tranquility.

In terms of vulnerability to crisis, high income countries differ from middle and low income countries mostly in external default crisis. On the one hand, the inferior performance of middle and low income countries is easy to explain. Emerging market countries face deeper and more permanent shocks (as Aguiar and Gopinath, 2006, emphasized), at the same time, tend to engage in procyclical macroeconomic policy, as Kaminsky, Reinhart and Vegh (2004) documented. On the other hand, explaining graduation is quite difficult, because standard models of default (following Eaton and Gersovitz, 1981) do not necessarily suggest that richer countries should necessarily be less prone to default. The key penalty to default in the canonical model that is a cutoff from international capital markets and an inability to

smooth national consumption through international markets. Obstfeld and Rogoff (1996) found that the empirical cost of exclusion from international markets is considerably greater for emerging markets than for advanced economies; thus, emerging economies should have more incentive to repay than advanced economies.

An even more striking finding is that Latin America countries defaulted more times than other countries. Venezuela defaulted 10 times and Argentina 7 times over the last 200 years while India and Malaysia have never done so. The fact that they presumably faced similar external shocks and were at a similar stage of development suggests that factors other than macroeconomic fundamentals may be important in determining countries' likelihoods of default, for example, political factors.

The importance of institutions in growth performance and debt crises has been highlighted in the empirical literature. Acemoglu et al. (2003) argued that countries pursuing poor macroeconomic policies also have weak institutions. Kraay and Nehru (2004) found the quality of policies and institutions are an important determinant of debt distress. Government polarization has been argued to explain over-accumulation of public debt either because the current government has different preferences on spending than their opponent; hence, it does not internalize the full future cost of serving the debt, Alesina and Tabellini (1990); or because polarization brings delay stabilization, Alesina and Drazen (1991). Another strand of the literature emphasizes the role of budgetary institutions on fiscal and debt outcomes. Von Hagen (1992) and von Hagen and Harden (1995) found that budget institutions have a significant impact on debt ratios in the countries of the European Union. Alesina, Hausmann, Hommes and Stein (1996) have extended this line of research to developing countries. They found evidence that, in Latin America, budgetary institutions have had an important

effect on primary deficits. Sanguinetti and Tommassi reported similar findings (1997) in their study of Argentine provinces. However, a theoretical analysis and empirical evidence that links institutions, government polarization and default crisis has been lacking. This provides the motivation for chapter 2.

In chapter 2, we focus on the institutions environment as an important arena in which powerful groups take action. Such powerful groups can be political leaders, provincial governments, labor unions, parastatal enterprises and financial backers of the ruling government. Institutions matter because they can affect the rule of the game under which groups interact. Countries with good institutions are those where the budgetary process has clear and enforceable legal rules that make it almost impossible for powerful groups to influence the central government's fiscal and debt policies, or those in which powerful groups coordinate and act as one agent. In a bad institutional environment, the budgetary process is flawed or there are soft budget constraints; limits to powerful groups are absent. Powerful groups that act in a non-cooperative manner maximize their own welfare ignoring the consequence of their actions on other groups. Under this situation, the size of the inefficiency, in the form of a higher risk premium, compared to the planner's solution that maximizes the collective welfare, will be increasing in the degree of government polarization.

Chapter 1

On Graduation from Default, Inflation and Banking Crisis: Elusive or Illusion?

1.1 Introduction

This paper addresses the concept of "graduation" from external default, banking and inflation crises.[1] Employing a vast data set cataloging more than two centuries of financial crises for over sixty countries developed in Reinhart and Rogoff, (2009), we explore the risk of recidivism across advanced economies versus middle and low income countries. We show that two decades without a relapse (falling into crisis) is an important marker. Post 1800, roughly two thirds of recurrences of external default on sovereign debt, and three quarters of recurrence of inflation crisis, occur within twenty years.[2] However, crisis recidivism distributions have very fat tails, so that it takes at least fifty and perhaps a hundred years to meaningfully speak of "graduation". Indeed, in the case of banking crises in particular, it is hard to argue that any country in the world has truly graduated.

Given that graduation (with its companion question—*will this ever happen again*) is arguably one of the most important issues in macroeconomics and development, there has been remarkably little theoretical or empirical investigation of

[1] The notion of "graduation" was introduced in Reinhart, Rogoff, and Savastano (2003). An inflation crisis is defined as an annual inflation rate of twenty percent or higher. Given the very large correlation between exchange rate and inflation crises over this period (Reinhart and Rogoff, 2004, 2010), we do not to treat exchange rate crises separately in this paper.

[2] Pre-1800, the twenty-year marker only subsumes about half of external default relapses.

the subject. For example, the large theory literature on sovereign lending and default, while producing many important insights on the fundamental distinction between willingness to pay and ability to pay, largely treats a country's basic developmental and political characteristics as parametric. There is very little on explaining the political, social, economic and financial dynamics that ultimately lead a country to be less prone to certain types of crises.

We acknowledge that the concept of graduation is a hard nut to crack. Many advanced countries had enjoyed a long hiatus from systemic banking crises after World War II, and yet had huge problems during the recent global financial crisis. After ninety years of serial default running from 1557 to 1647, Spain did not default again until 1809. Even the advanced countries had high inflation as recently as the 1970s and early 1980s, while many emerging markets had hyperinflation less than two decades ago. Is the advent of modern independent central banks sufficient to guarantee that fiscal dominance never again reasserts itself? Have the rich countries that have supposedly "graduated" from serial default on external debt, shifted the locus of risk to de jure or de facto (via inflation or financial repression) default on domestic debt? Does the theory of sovereign default or of financial development tell us that we should expect richer and more advanced countries to be immune? Or is graduation a mirage, with the "graduates" really being at best "star pupils", and can graduates be distinguished from patients in remission?

Our goals in this paper are fairly narrowly circumscribed. Most of our analysis is based on data on the dates and duration of the crises themselves. We speculate on

underlying causal factors but do not approach them empirically here.[3] Although the various types of crises often occur in clusters, our quantitative analysis mainly treats individual crises separately.

We begin the paper by defining the crises that we will catalogue. In the next section of the paper, we present a summary timeline of crisis, followed by a brief overview of the early history of serial default on external debt. An interesting case is France, which defaulted on its external debt no less than nine times from the middle of the sixteenth century through the end of the Napoleonic War, but has not defaulted on external debt since. France is a canonical case of what we define as an "external default graduate." (This did not stop France from having numerous severe banking crises in the past two centuries.)

In the main body of the paper, we provide a broad aggregative historical overview of the data across different types of crises, distinguishing between advanced countries and emerging markets, also taking into account the advent of IMF programs after World War II as another marker of a debt crisis.

In the final section of the paper before the conclusions, we speculate on links between graduation and development, and the possibility for recidivism among richer countries. The fact that the canonical theory of sovereign default does not strongly predict smaller problems in richer countries (it does not strongly predict graduation) might be considered a flaw in theory. But it might also be taken as warning sign that graduation can be more difficult and take even more time, than our data of "just" a

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[3] Reinhart and Rogoff (2010) formally investigate the predictive power of past banking and sovereign default crises and future ones. Among their results is the finding that banking crises do help predict sovereign default crises, that private debt levels help predict banking crises and public debt sovereign default.

few centuries can reveal. On banking crises, the theory needs to better explain why countries never seem to graduate.

The main empirical results from our long-dated historical time series on financial crises may be described as follows:

First, the process of "graduation", that is emergence from frequent crisis suffering status, is a long process. False starts are common and recurrent. This is especially true in the case of banking crises, for both high and middle and low income countries.

Second, the vulnerability to crisis in high income countries versus middle and low income countries differs mostly in external default crises, to a lesser extent in inflation crises, and differs surprisingly little in banking crises.[4]

Third, the sequence of graduation for most of countries is first to graduate from external default crisis, then from inflation crisis, and eventually from banking. The last stage of graduation is extremely difficult, even for high income countries. Among high income countries, even though most of them have graduated from external default crisis and inflation crisis, more than 20 percent recently experienced a banking crisis, and far more when weighted by size. Schularick and Taylor (2009) speculate that advanced countries continue to experience credit busts despite arguably advancing regulation and institutions, because as risks moderate, financial systems grow and restore them.

Finally, the role of IMF programs in crises in the modern period is important. The availability of IMF bridge loans certainly has increased countries' resilience to

[4] Reinhart and Rogoff (2008, 2009) emphasize that banking crises are an "equal opportunity menace."

"sudden stops" but, even setting aside moral hazard problems, is by no means a cure-all. Countries entering IMF programs are still forced to undergo painful macroeconomic adjustments in an attempt to regain sound fiscal footing and regain access to private capital markets. The challenges of successfully implementing IMF programs are underscored by the fact that there are many significant cases where countries default within three years of an IMF bailout. IMF programs may help facilitate orderly debt workouts but do not guarantee them. We also note that in its early history, many of today's rich countries regularly drew on IMF resources, although there has been a three-decade hiatus.

1.2 Definition of Crises

External debt crisis: We distinguish between external and internal debt based on the legal jurisdiction where the debt contracts are enforced. This is a convenient construct given the history and evolution of sovereign debt. Obviously it may be useful to parse the data in other ways for some exercises, and in principle our data set allows that.

Although there are exceptions and there has been some evolution in recent years, typically in our long-dated historical dataset, external debt is denominated in foreign currency and held by foreign creditors. There are certainly important examples, such as Mexico's short-term Tesobono bonds in the mid 1990s, where the debt is domestic yet denominated in foreign currency and held primarily by foreign creditors. Although we regard the US abrogation of the gold clause in the early 1930s – when gold was revalued from $21 to $35 per ounce – to be a default on domestic debt, many non-US residents were also holding the debt at the time. In general,

following standard practice, we define an external debt crisis as any failure to meet contractual repayment obligations on foreign debts, including both rescheduling or repayments and outright default. (As both of these examples make clear however, one ultimately needs to think carefully about whether graduation from external default may sometimes just mean a shift to episodic de facto and de jure internal default.)

In practice, most defaults on external debt end up being partial, with creditors typically (but not always) repaying thirty to seventy cents or more on the dollar, admittedly not adjusting for risk. The rationale for lumping together defaults regardless of the ultimate haircuts creditors are forced to absorb is that in practice, the fixed costs of external debt default (which include difficulties in obtaining trade credits and loss of reputation) tend to be large relative to the variable costs. In principle, one could parse episodes more finely here according to, say, output or tax revenue loss depending on data availability, although we do not undertake that exercise here. See, however, Tomz (2007), and Tomz and Wright (2007).

Inflation crises: Following Reinhart and Rogoff, we define inflation crises as episodes where annual inflation exceeds 20%. This threshold is lower than the 40% others and we have used in related studies on post war data (e.g., Reinhart and Rogoff, 2004), but is a compromise reflecting that prior to World War I, average inflation rates were much lower, and 20% inflation generally represented a significant level of dysfunction. Indeed, since we are particularly interested here in inflation as vehicle for partial default, one clearly would also want to consider lower levels of sustained unanticipated inflation such as many advanced countries experienced in the 1970. Depending on the maturity structure of debt, sustained ten percent inflation can certainly be tantamount to de facto default. A proper calibration, however, would

require detailed data on the maturity structure of debt (as in Missale and Blanchard, 1994) and, ideally, also on the evolution of inflation expectations. We do not attempt this here, though again, this is an important caveat to interpreting the concept of "graduation" from external debt crises.

Banking crises: Our definition of banking crises follows standard practice (e.g., Caprio and Klingebiel (2003) or Kaminsky and Reinhart (1998).) Following our own earlier work, "We mark a banking crises by two types of events: (1) bank runs that lead to the closure, merging or takeover by the public sector of one or more financial institutions and (2) if there are no runs, the closure, merging, takeover, or large-scale government assistance of an important financial institution (or group of institutions) that marks the start of a string of similar outcomes for other financial institutions." (Reinhart and Rogoff, 2009, p. 11)

We recognize that our listing of systemic (on a national scale) banking crises may be incomplete, especially prior to 1970, especially for crises outside the large money centers that attract the attention of the world financial press. [5]

Having set out basic definitions, we are now ready to view some basic characteristics of the data. To provide context and motivation for the concept of graduation, we begin with a summary time line of financial crises since 1550, followed by a brief overview of the early history of sovereign defaults.

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[5] We do not include domestic debt crises or exchange rate crises in this study, but some comment is warranted to put the overall exercise in perspective. Although overt de jure defaults on domestic debt have been received very little attention in the literature, Reinhart and Rogoff (2008, 2009) show that they were once surprisingly common, cataloging over 70 cases of domestic default. We do not explore exchange rate crises here, in part because inflation and exchange rate crises are highly correlated (see Reinhart and Rogoff, 2009, 2010). Also, it is clear that standard definitions of exchange rate crises (emphasizing very large short term exchange rate movements) would show very few potential "graduates".

1.3 A time line of financial crises and the early history of sovereign defaults

Table 1 provides a summary historical perspective that helps show how the three different varieties of financial crisis have spread over time and across country groups. Between 1550 and 1800, sovereign defaults on external were relatively common in Europe, but they were relatively rare elsewhere if only because (a) there were few other independent nations in a position to default and (b) given the crude state of global capital markets, relatively few countries were wealthy enough to attract international capital flows. Thus defaults were relatively insignificant in the regions that constitute today's emerging markets. Systemic banking crises, on the other hand, were relatively rare everywhere. The legal and technological underpinnings of modern private banking simply had not reached a stage of maturity and depth sufficient to cause systemic crises in most instances. (Of course, there are exceptions. Following Cipolla (1982) and MacDonald (2006), Reinhart and Rogoff (2009) discuss how England's 1340 default to Florentine bankers triggered a financial crisis in Italy.) Similarly, inflation crises were relatively rare, although again there are many exceptions.[6] Prior to the widespread adoption of paper currency, bouts of very high inflation were relatively difficult to engineer.

The end of Napoleonic War in the early 1800s marks a significant transition. The largest advanced countries were increasingly able to avoid external default, albeit partly by their ability to issue an increasing share of their debt domestically. Default, however, became common on "peripheral" advanced countries such as Spain and

[6] See Reinhart and Rogoff (2009), ch 12

Portugal, while newly independent emerging markets such as Greece and Latin America entered a long period of serial default. Over the same period, as advanced countries developed more sophisticated banking systems, banking crises became far more common. Emerging markets were certainly affected by advanced country banking crisis but did not have so many of their own, if only because their financial systems were dominated by foreign banks.

By the turn of the twentieth century, emerging market financial institutions had developed to the point where domestic banking crises became more common. By the time of the Great Depression of the 1930s, banking crises were a worldwide phenomenon. Due in no small part to the financial repression that followed in reaction to the Great Depression, banking crises were relatively rare during the period from the end of World War II until the early 1970s. As financial repression thawed, banking crises became more frequent in the advanced economies and serial in many emerging markets, bringing us to the recent financial crisis episode.

Finally, table 1 gives a timeline of inflation crises, which of course were quite common in all countries in the 1970s and remained a problem in emerging markets until the past decade.

Table 1- Timeline of crises 1550-2010

		External debt crises	Banking crises	Inflation crises
	1550	frequent in advanced economies (including the "world powers" of the time) Serial in some cases	rare	rare
Napoleonic wars end	1815			
	1826	frequent in "peripheral' advanced economies and most emerging markets	serial in advanced/ rare in emerging	
	1850			
	1900		serial in advanced/ more frequent in emerging	frequent in advanced and emerging
WWI begins	1913			
WWII ends	1945		rare in advanced **and** emerging	
	post-1945			
	1964			rare
	1973		more frequent in advanced/serial in emerging	frequent in advanced and emerging
	early 1980s			
	early 1990s			frequent in emerging
	2000	Serial in some emerging markets		
	2009			rare
	2010	??		

We thus focus our early history on sovereign external defaults. As Reinhart, Rogoff and Savastano (2003) and Reinhart and Rogoff (2009) emphasize, many of today's advanced economies had recurrent problems with default on sovereign debt during the period when they might arguably have been characterized as emerging markets. Table 2 illustrates the case of Europe for the three century period 1550-1850, with the years listed marking the beginning of a sovereign default episode.

Table 2- External defaults: Europe, 1550-1850

Country	*Years of default*	*Number of defaults*
Austria-Hungary	1796, 1802, 1805, 1811, 1816	5
England	1594*	1*
France	1558, 1624, 1648 1661, 1701, 1715 1770, 1788, 1812	9
Germany (*Prussia*)	1683, 1807, 1813	3
Germany (*Hesse*)	1814	1
Germany (*Schleswig-Holstein)*	1850	1
Germany (*Westphalia*)	1812	1
Netherlands	1814	1
Portugal	1560, 1828, 1837, 1841,	5
Russia	1845 1839	1
Spain	1557, 1575, 1596, 1607, 1627, 1647 1809, 1820, 1831, 1843	10
Sweden	1812	1

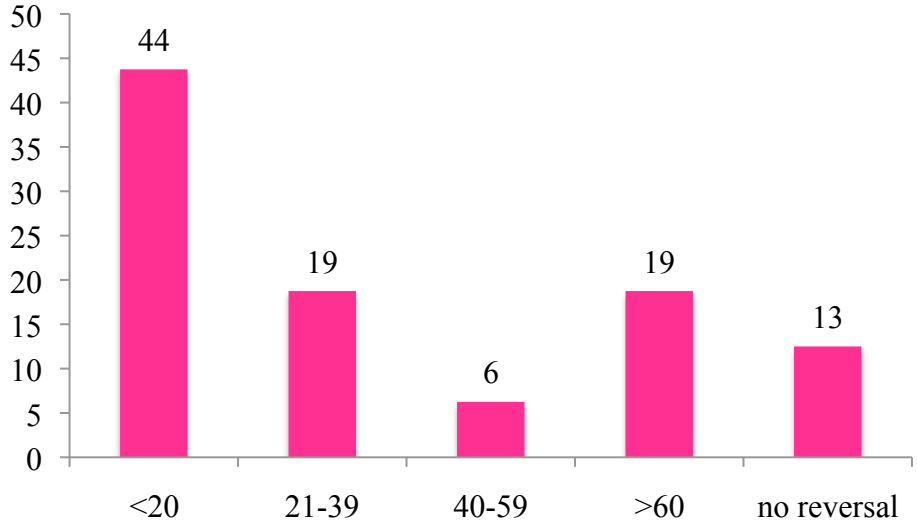
Sources: Reinhart, Rogoff and Savastano (2003), Reinhart and Rogoff (2009) and sources cited therein. The "*" for England denotes our uncertainty at this time about whether its default involved external (as opposed to purely domestic) debt. The table excludes Greece (which gained independence in 1829). Note that for some countries, even if there was default on external debt, there may have been a default on domestic debt, as was the case for Denmark (1813).

As one can see clearly from the table, serial default was quite common among the major European powers during the sixteenth through nineteenth centuries, with France defaulting on its external debt nine time and Spain defaulting ten times (with three more to follow in the second half of the nineteenth century). One important observation, immediately apparent from the table, is that there is typically a substantial interval between defaults, typically decades, but sometimes centuries.

(Note that we require at least two years between default episodes to regard them as independent events.) After defaulting in 1683, Prussia's next default episode did not follow for more than a century in 1807. Portugal, after defaulting in 1560, did not default again until 1828, when the country lapsed into a period of serial default that did not end until 1890. At this writing, Portugal has not defaulted again since. (Importantly, during a significant portion of Portugal's quiescent period, it had effectively lost its independence.)

Figure 1 gives a measure of the duration of periods of recidivism during the pre-Napoleonic era for the independent (relatively) high income countries our sample. The figure captures the length of time between default episodes (including cases where there was no recidivism) As one can see from the figure, fully half of all default recurrences occurred after a more than 20 year hiatus, with a significant percentage occurring even after a sixty year hiatus.

Figure 1
External default crises: Duration of "tranquil time"
Frequency distribution (in percent): 1300-1799
High income countries



Note: Duration of tranquil time is calculated as number of years between two consecutive external defaults starting years. We first count the number of external default episodes; then calculate the duration of tranquil time if it was reversed and finally we calculate the frequency distribution.
Sample coverage: 14 episodes of default crisis with reversal and 2 episodes with no reversal, six countries (United Kingdom, Spain, Germany (Prussia), Portugal, Austria and France)
Sources: Reinhart and Rogoff (2009), sources cited therein and authors' calculations.

Advanced country external sovereign debt defaults have become much rarer events in the modern era. Germany's most recent default occurred in 1939, Austria's in 1940 and Hungary's in 1941 (Reinhart and Rogoff, 2009). Especially interesting are the cases of Sweden and France. France, despite a near record level of defaults in its pre-Napoleonic era, has not defaulted on external debt since. Sweden, too, has not defaulted on external debt since its default at the end of the Napoleonic War in 1812. It would be interesting to explore whether war time defaults are less damaging to reputation than peacetime defaults, though of course over many episodes, it is precisely the propensity to wage war that motivates many countries to build up large debts (as in the tax smoothing model of Barro, 1979). Later, we will consider the robustness of our recidivism results to exclusion of wartime.

Reinhart and Rogoff (2009) also show that the kind of long cycles illustrated in Table 2 to be quite characteristic of some of today's emerging markets, many of whom have defaulted at least once during the past two to three decades. The number of emerging markets that have experienced external debt crises expands considerably if one includes "near default" episodes in which country's averted technical default thanks to IMF bridge loans. In virtually of all these cases, the countries still suffered massive recessions as governments were forced to tighten fiscal policy as borrowing options dried up. Importantly, we do not include these in our calculations below, although arguably from the point of view of understanding macroeconomic volatility and the dangers of excessive debt accumulation, they are equally important. We return to this issue later when we study IMF programs.

1.4 The Duration and Prevalence of Crises: The Post 1800 Experience

We now proceed to focus on the more "recent" period, 1800-present, at the same time expanding the analysis to include banking and inflation crises, which, as shown in table 2, emerged as important in this era. The past two centuries also give a much broader sample of independent nations to study, as various regions of the world threw off the yoke of colonialization. In table 3 below, we present measures of crisis probability. Each measure takes the number of years a country experienced each kind of crisis (including all years and not just the initial one) divided by the number of years since independence (or since 1800).

Table 3 shows that the biggest difference between high income countries and the rest of the world lies in exposure to external default crisis. The average external

default crisis probability of high income group is less than half of middle and low income countries and almost one fifth of Latin America countries. The difference would be even larger if we included only 20th and 21st century defaults. Inflation crisis probabilities are also higher in the rest of the world than in high income countries although the gap is smaller. Interestingly, the average probability of banking crises in high income countries and the rest of the world is similar.[7] The results in Table 3 are, of course, complete consistent with the time line in table 1.

Table 3- Summary statistics of crisis probabilities

	External Default		Inflation		Banking	
	Average	Std Dev	Average	Std Dev	Average	Std Dev
World	0.19	0.18	0.12	0.12	0.08	0.07
High income	0.07	0.13	0.06	0.05	0.07	0.04
Middle and low*	0.19	0.17	0.17	0.17	0.11	0.09
Latin America	0.34	0.13	0.12	0.07	0.04	0.03

Notes: crisis probability is calculated as the number of years in crisis divided by number of years since independence. Probabilities were calculated for each country since 1800 or country's independence year

* Excluding Latin America

Sample coverage: 66 countries for external default crisis; 67 countries for inflation and banking crisis.

Sources: Reinhart and Rogoff (2009), sources cited therein and authors' calculations.

Note that inflation and banking crisis probabilities are lower in part because the average duration of these crises tends to be much shorter compared to external default crises. (Note also that we are counting years in crisis, as opposed to the number of independent events.) [8]

[7] The similarity of banking crises across countries was first noted in Reinhart and Rogoff, 2009, ch 10, who also show that the macroeconomic effects of banking crises are remarkably similar as well across advanced economies and emerging markets.

[8] Interestingly, inflation crisis probabilities are higher among middle-low income countries (excluding Latin America) than in Latin America, while their default crisis probability is lower. This is partly due to the fact that low income countries are often excluded from international capital markets, therefore external default crises are less common.

Appendix A Table A1, which gives the average duration of crises, shows the striking difference between the mean and median duration of external default crises versus inflation and banking crises. The median duration of banking crises is less than 3 years or less across all income classes, where the world median for default crises is 8 years. For inflation crises, the median is only 1 year across all income classes. Presumably this implies that a country can find ways to trudge in a state of sovereign default far more easily than it can continue any semblance of business as usual during a banking or inflation crisis.

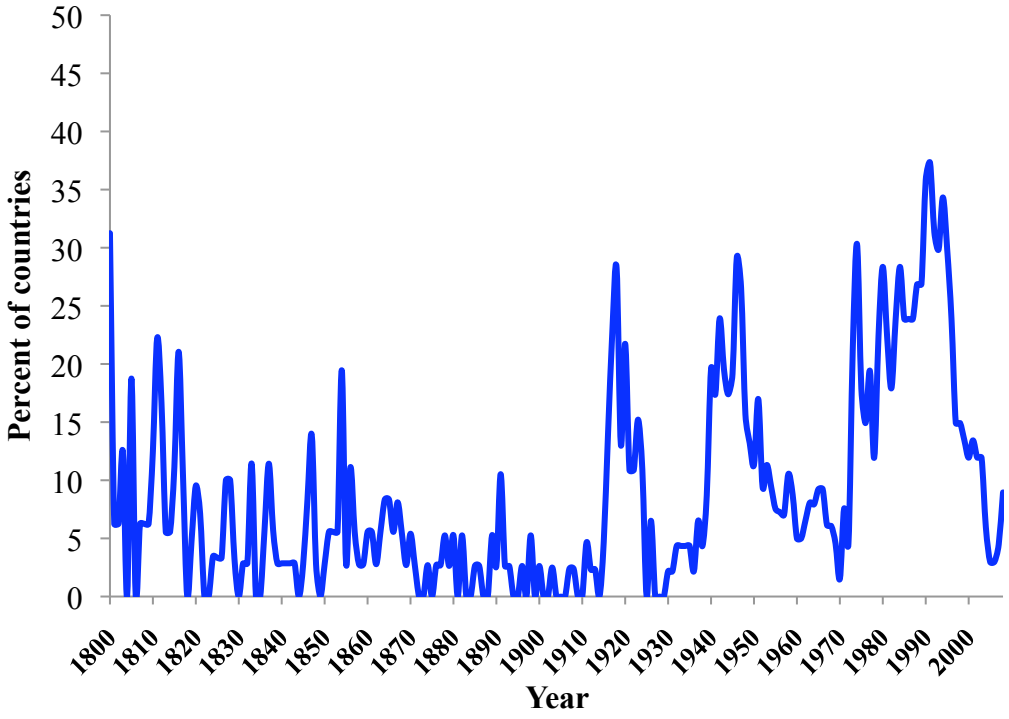
Given the long duration of external default crises, and their frequency, it is not surprising that large portions of the world have been in default over much of the last 200 years, as illustrated by Reinhart and Rogoff (2009, p. 72). Some of the major default episodes include the Napoleonic Wars in the early 19th century, and then Latin America countries once independent, Greece, Spain and Portugal in the first quarter of the century. The biggest default spike occurs during the era bridged the Great Depression and World War II, when at the peak more than 40% of the world, weighted by GDP, was in default on external debt.

Figure 2 gives the share of countries in inflation crisis over the same period. Note the huge rise in inflation crises starting after World Wars I and II, again in the 1980s and early 1990s. The very recent history of low inflation throughout most of the world indeed represents a major shift from the preceding 80 years. It remains to be seen whether inflation is a scourge that has been slain. As Rogoff (2003) has argued, institutional changes, including especially the advent of independent central banks with a strong anti-inflation commitment has been an important factor in this dramatic fall in inflation, but so too was the pre-crisis boom which alleviated political

pressures on central banks to engage in unanticipated inflation. It remains to be seen whether the current period will prove merely another lull (one sees many in Figure 2) as opposed to permanent structural shift towards universal low and stable inflation.

Indeed, if one truly believes that fiscal dominance will never again assert itself in most countries, and then arguably, historical measures of outright default may underestimate the true probabilities (if the option of default via surprise inflation has been effectively erased). The recent explosion of public debt globally underscores this concern.

Figure 2
Share of countries in inflation crisis: 1800-2008
World

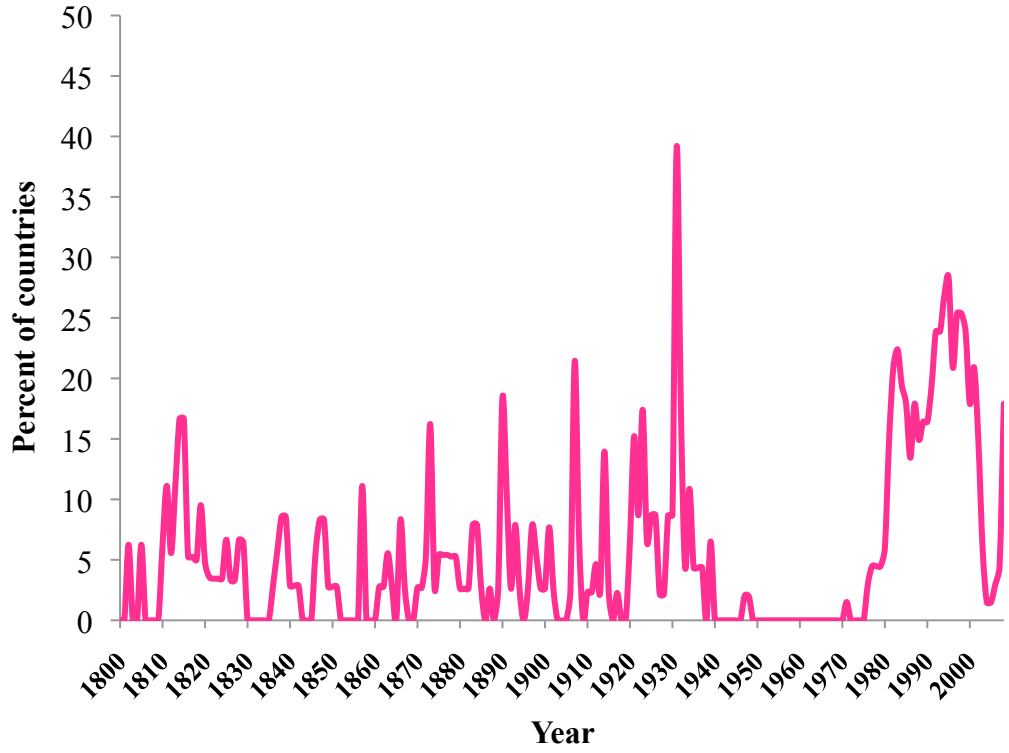


Sample coverage: 66 countries that were independent in the given year.
Sources: Reinhart and Rogoff (2009), sources cited therein and authors' calculations.

Figure 3 gives the share of the world experiencing banking crises since 1800. Note the remarkably small number of banking crises during the years of financial repression that began during World War II and continued in many countries well into

the 1970s. By historical standards, this was a uniquely quiescent period. It is clear also from the figure that this era has been long but seems coming to an end.

Figure 3
Share of countries in banking crisis: 1800-2008
World

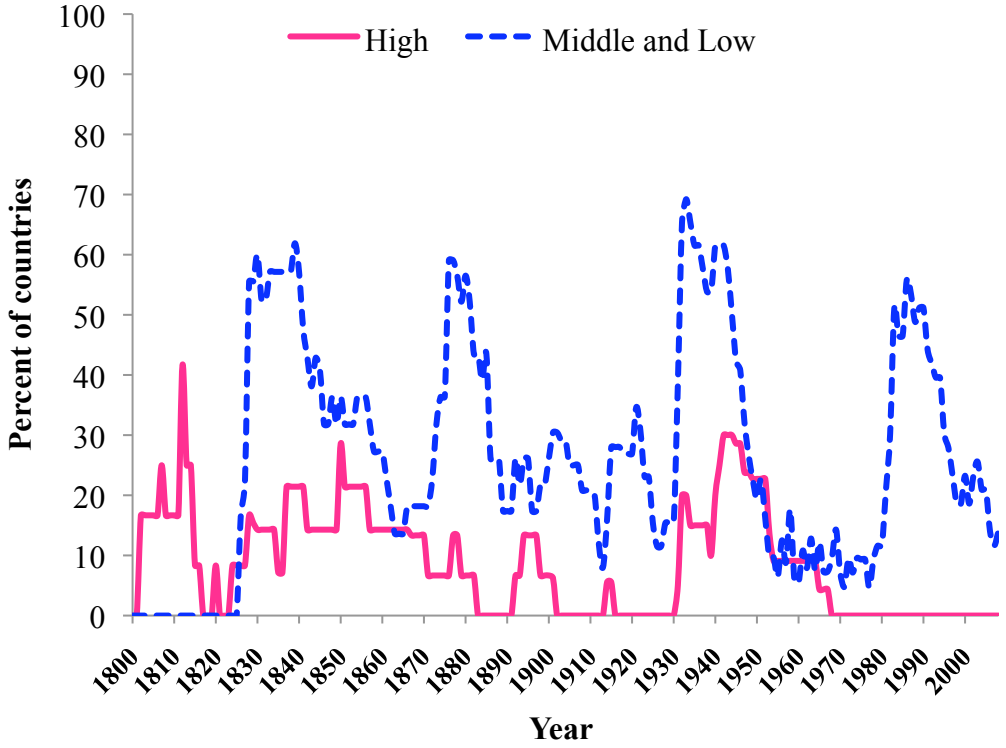


Sample coverage: 66 countries that were independent in the given year.
Sources: Reinhart and Rogoff (2009), sources cited therein and authors' calculations.

The next three figures contrast the experiences of high income countries with middle and low income countries (including Latin America). They corroborate what we have already seen in Table 3, but give more detail. Figure 4 on external debt crises, for example, illustrates two points. First, as already noted, middle and low income countries are in technical default on external debt a significantly higher percentage of the time than high income countries. Second, the high income countries had a dramatic drop of external defaults starting in the late 1960s with none (as of this

writing!) since the advent of floating exchange rates in the 1970s. Later we shall look at evidence on distance since the last default crisis. (Note: We exclude from our middle and low income countries very low income countries who do not have external default by virtue of the fact they are not able to borrow at all on private markets.)

Figure 4
Share of countries in external default crisis: 1800-2008
High income vs. Middle and Low income



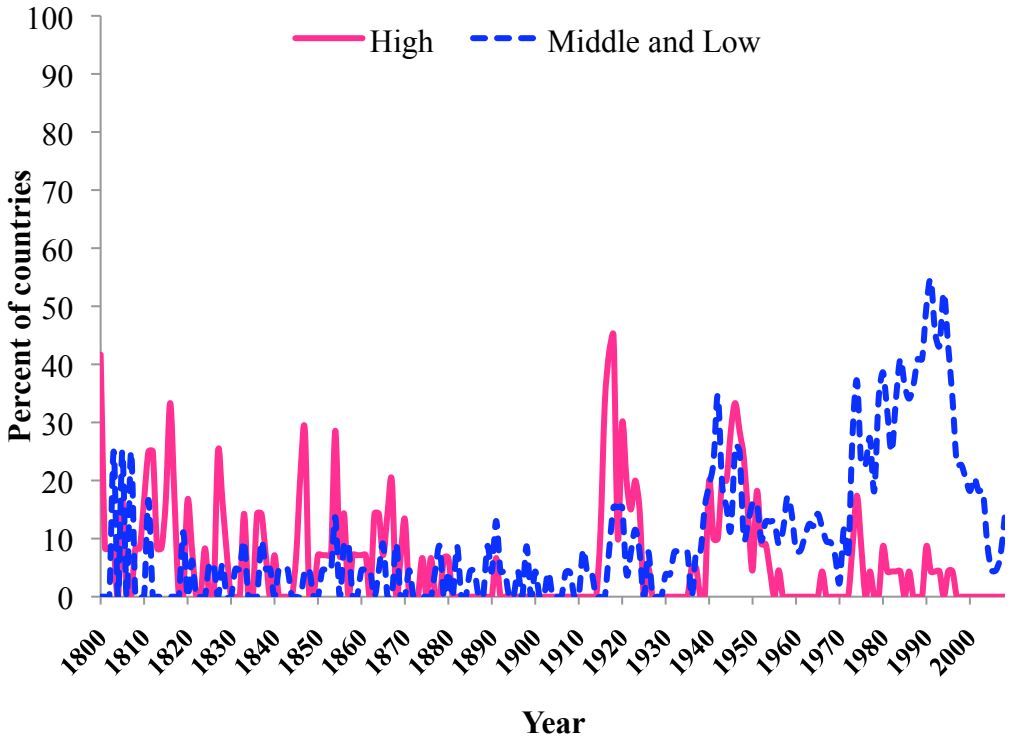
Sample coverage: 66 countries (23 high income and 43 middle and low income countries) that were independent in the given year.
Sources: Reinhart and Rogoff (2009), sources cited therein and authors' calculations.

High income countries seem to have graduated from default crisis, or at least gone into deep remission. But most middle and low income countries have not yet graduated.

Figure 5 shows inflation crises frequencies in middle and low income countries versus high income countries. High income countries have had inflation crises more recently than external default crises, but the frequency has dropped to

zero since the early 1990s. For middle and low income countries, a spike in the 1990s has been followed by a sharp tapering during the 2000s.

Figure 5
Share of countries in inflation crisis: 1800-2008
High income vs. Middle and Low income



Sample coverage: 67 countries (23 high income and 44 middle and low income countries) that were independent in the given year.
Sources: Reinhart and Rogoff (2009), sources cited therein and authors' calculations.

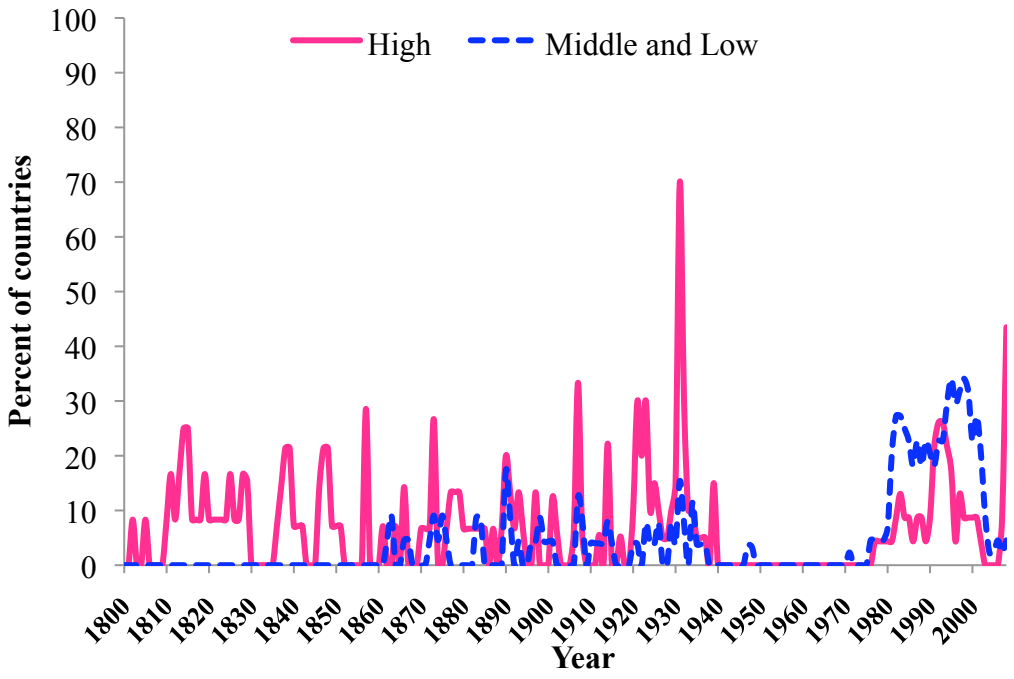
Whereas figure 5 is illustrative of the frequency of very high inflation episodes, we note that it does not capture episodes of sustained high inflation below 20% that, if significantly unanticipated and depending on the maturity structure of government debt, may represent a substantial de facto default on domestic debt.

Figure 6 on banking crises tells a very different story (our data for developing countries begins more recently; hence the dashed line for middle and low income only begin in the 1860s; of course, many of today's developing countries did not gain their independence until later.) One can see that in sharp contrast to external default and

inflation crises, banking crises are "an equal opportunity menace" (Reinhart and Rogoff, 2009, chapter 10). Although banking crises have picked up dramatically in emerging markets since 1980, they have recently picked up in rich countries as well. Again, note the hiatus in banking crises across both groups of countries during the years of financial repression from World War II until the 1970s.

Clearly, neither high nor middle and low income countries are in imminent danger of graduating from banking crises.

Figure 6
Share of countries in banking crisis: 1800-2008
High income vs. Middle and Low income



Sample coverage: 67 countries (23 high income and 44 middle and low income countries) that were independent in the given year.
Sources: Reinhart and Rogoff (2009), sources cited therein and authors' calculations.

1.5 The interval between consecutive crises

Having presented evidence on the incidence of crises, we next examine the duration of tranquil times or the interval between crises.

In our first pass here, we do not make any attempt to deal with the possible non-stationarity of the time series, and take simple averages. In particular, we do not deal with the possible structural breaks that occur at World War II, when default and banking crises frequencies sharply increased; in the early 1970s, when they rose again; and in the 1990s when inflation crises frequencies fell dramatically. From the broader sweep of history, it is not easy to determine what constitutes a structural break, but clearly further analysis is needed. It should also be noted that in the main text, we present only unconditional measures of lulls between crises; institutions and political stability are no doubt extremely important. Yet, many of these factors, too, are highly persistent and difficult to measure, which is precisely why previous experience with crises is such a powerful predictor of future ones.[9] (We do present hazard analysis results in the Appendix B, which in principle allow for conditioning on a broader range of variables.)

In figure 7, we look at the frequency distribution of "tranquil" periods, how long before one crisis episode stops and the next crisis starts. The figure gives the statistics separately for external default, inflation and banking crises. The frequencies shown are conditional on having had at least one crisis of a particular type over 1800-2008. Of the 66 countries in our sample, 65 had at least one systemic banking crisis; 64 had at least one inflation crisis; and 50 had at least one sovereign default on

[9] Again, Reinhart, Rogoff and Savastano (2003) and Reinhart and Rogoff (2010) provide concrete empirical measures of how past crises experience measures a country's vulnerability to future crisis, an exercise we do not take up here.

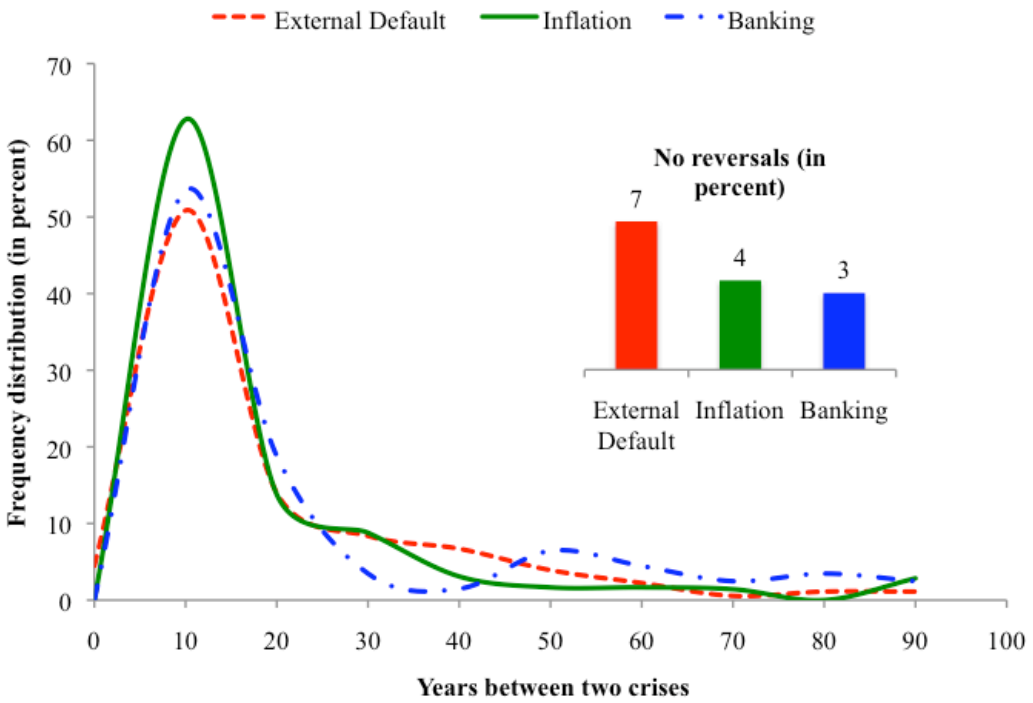
external debt.[10] The conditional frequency distributions are similar, with a significant share of distribution falling between ten and twenty years.

The conditional frequency of recidivism (conditional on a crisis recurring) is broadly similar across different types of crises. Twenty years without a default, banking or inflation crisis is hardly evidence of "graduation". But it does appear to be a notable break, where the odds of recidivism over any medium term period, drop notably. As already mentioned and as documented in Table A1 as well as figure A1, the duration of default crises is much longer than of inflation or banking crises.

As the inset highlights, conditional on having had at least one crisis, the percent of no reversal cases is significantly higher for default (7 percent) than for banking or inflation crises. If the 16 countries that never had an external default in the first place were counted in this tally the "graduation" or no reversal percentage gap between external default and banking and inflation crises would be far greater.

[10] Mauritius is the only country to have avoided a systemic banking crisis altogether; New Zealand and Panama managed to escape inflation crises.

Figure 7
Duration of "tranquil times" conditional on having had at least one crisis
Frequency distribution (in percent): 1800-2008



Note: Duration of tranquil time is calculated as number of years between end year of a crisis and start of a new crisis. For example: Argentina had defaulted in 1982 and it didn't resolve it until 1994. In 2001 Argentina entered into default crisis again. In this case the tranquil time for Argentina was between 1994 and 2001. The main figure shows the frequency distribution of years between two crises (or number of years reversals took place). The inset smaller figure shows the frequency distribution of crises that have not reversed (for a period of more than 50 years). For each type of crisis, we count the number of crisis episodes that have reversed and those that haven't for more than 50 years; then we calculate the duration of tranquil time when crisis was reversed and finally we calculate the frequency distribution. For example: 77% of inflation crises were reversed within 20 years; 4% of inflation crises were not reversed.
Sources: Reinhart and Rogoff (2009), sources cited therein and authors' calculations.

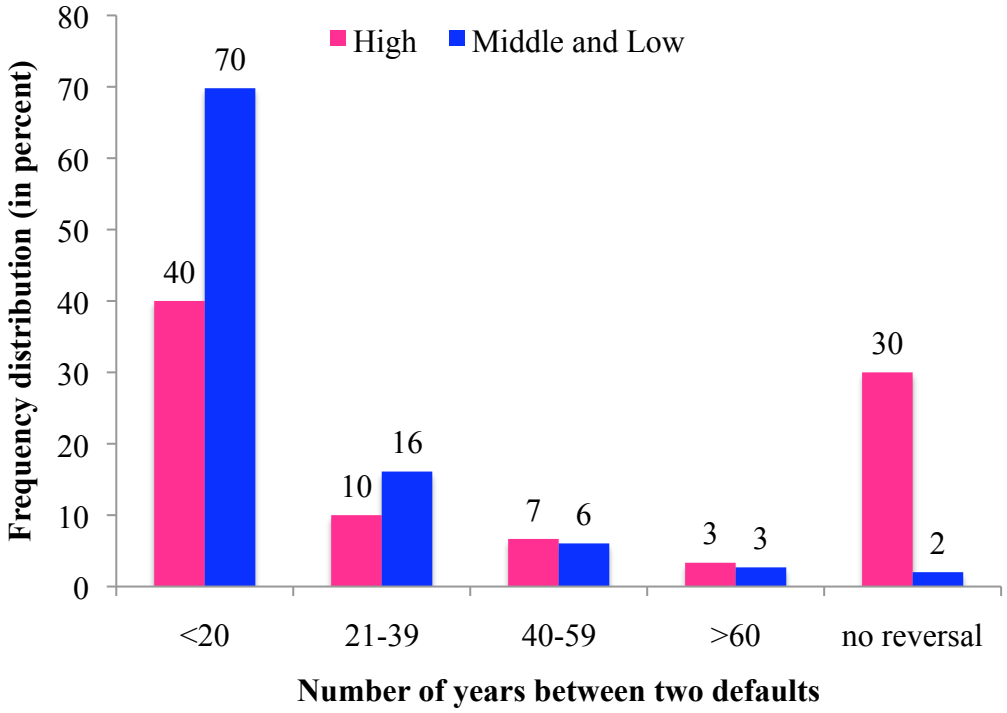
Figures 8-10 illustrate the distribution of time between crises using a histogram, and distinguishing between high and middle and low income countries. The charts give a more nuanced picture of the differences between crises than the world aggregates do. The "no reversal" bars denote cases where at least 50 years has passed without a crisis reversal; using a cutoff of 20 years does not lead to

dramatically different results.[11] For external defaults, figure 8 illustrates that whereas most emerging market recurrences happen within twenty years (two decades is an important marker), only few countries that have once defaulted have avoided any further defaults, at least not long enough to pass the 50-year filter we use. For inflation and banking crises, the twenty year mark contains an even larger percentage of reversals and, at the same time, the cases of no reversal are scarce.

Since many crises happen during and episodes of war and civil unrest, one might reasonably ask whether excluding these events dramatically affects recidivism rates or the difference between advanced and middle and low income economies. In the appendix A, we reproduce figures 7 and 8 excluding episodes surrounding severe wars (deaths greater than 0.8% of population). The results are little affected, as is the case for the other figures. We also checked a milder war filter (deaths greater than 0.29% of the population), again without substantially changing the results. In any event, given the risk of war is a major factor surrounding default risk, and that propensity to wage war is an important risk to creditors, it is not entirely clear that this measure is more meaningful than the simpler one of the text; further study is needed.

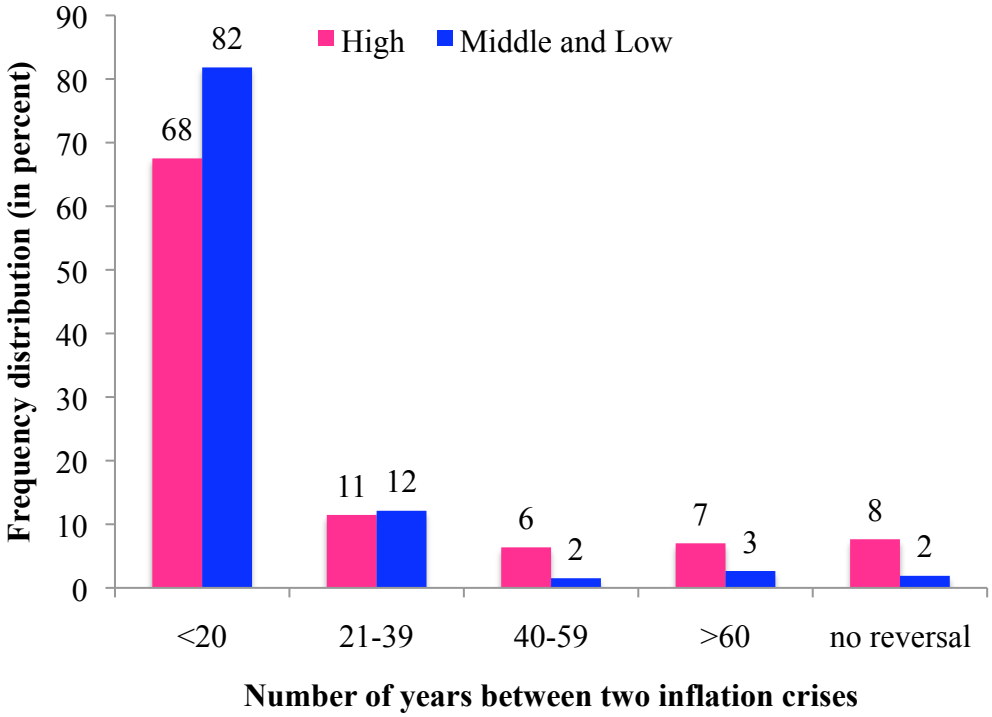
[11] The bars in figures 7-9 add to less than 100% because they excludes episodes where there has not yet been recidivism, but where the 50 year cut-off for "no reversal" has not yet been reached.

Figure 8
External default crises: Duration of "tranquil time" conditional on having had at least one crisis
Frequency distribution (in percent): 1800-2008
High vs. Middle and Low income



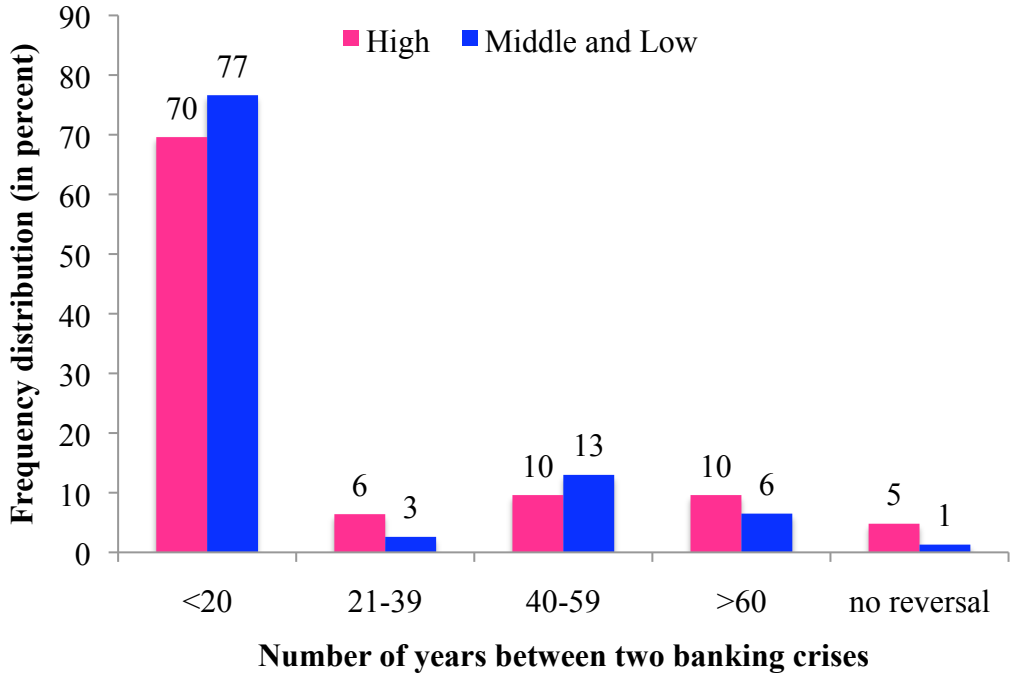
Note: Duration of tranquil time is calculated as number of years between two consecutive default episodes. The end of a default episode is considered as the year the country regains access to the capital market. In other words, as long as the country is excluded from the international capital market, it is not considered as having resolved its default crisis. The start of a new default episode is the year the country declares default on its external debt.
For each income group, we count the number of external default episodes that have reversed and those that haven't for more than 50 years; then we calculate the duration of tranquil time when default was reversed and finally we calculate the frequency distribution. For example: for high income group, 40% of default crises were reversed within 20 years and 30% of default crises were not reversed. The bars do not sum to 100% because the cutoff excludes cases where the last default occurred within 50 years but there has been no second default.)
Sample coverage: 167 episodes of default crisis with reversal and 12 episodes with no reversal.
Sources: Reinhart and Rogoff (2009), sources cited therein and authors' calculations.

Figure 9
Inflation crises: Duration of "tranquil time" conditional on having had at least one crisis
Frequency distribution (in percent): 1800-2008
High vs. Middle and Low income



Note: Duration of tranquil time is calculated as number of years between two consecutive inflation crises.
For each income group, we count the number of inflation crisis episodes that have reversed and those that haven't for more than 50 years; then we calculate the duration of tranquil time when inflation crisis was reversed and finally we calculate the frequency distribution. For example: for high income group, 68% of inflation crises were reversed within 20 years and 8% of inflation crises were not reversed.
Sample coverage: 404 episodes of inflation crisis with reversals and 17 episodes with no reversal.
Sources: Reinhart and Rogoff (2009), sources cited therein and authors' calculations.

Figure 10
Banking crises: Duration of "tranquil time"
conditional on having had at least one crisis
Frequency distribution (in percent): 1800-2008
High vs. Middle and Low income



Note: Duration of tranquil time is calculated as number of years between two consecutive banking crisis episodes.
For each income group, we count the number of banking crisis episodes that have reversed and those that haven't for more than 50 years; then we calculate the duration of tranquil time when banking crisis was reversed and finally we calculate the frequency distribution. For example: for high income group, 70% of banking crises were reversed within 20 years and 5% of banking crises were not reversed.
Sample coverage: 195 episodes of banking crisis with reversals and 7 episodes with no reversal.
Sources: Reinhart and Rogoff (2009), sources cited therein and authors' calculations.

1.6 Time since last crisis

To gain a deeper insight into recidivism – or its complement, graduation -- we look at measures of distance since the last crisis. In figure 11, three countries, the United States, Denmark and the United Kingdom have been independent the entire post-1800 period and never defaulted on external debt. (Although as we have already noted, the US and UK did effectively default on domestic debt by going off the gold standard in the early 1930s; Denmark also defaulted on domestic debt in 1813 at the

end of the Napoleonic Wars). At the other extreme, a number of African countries remain in default today.

Stunningly, the median time since last default is just over a century for the advance countries (105 years) versus only 14 years for the developing countries. The world median is 23 years.

Figure 12 on inflation crises tells a similar story with the median again being only fifteen years for the middle and low income countries, but 59 years for high income countries. Many high income countries, of course, had high inflation in the years after World War II, so the average time is lower than for default.

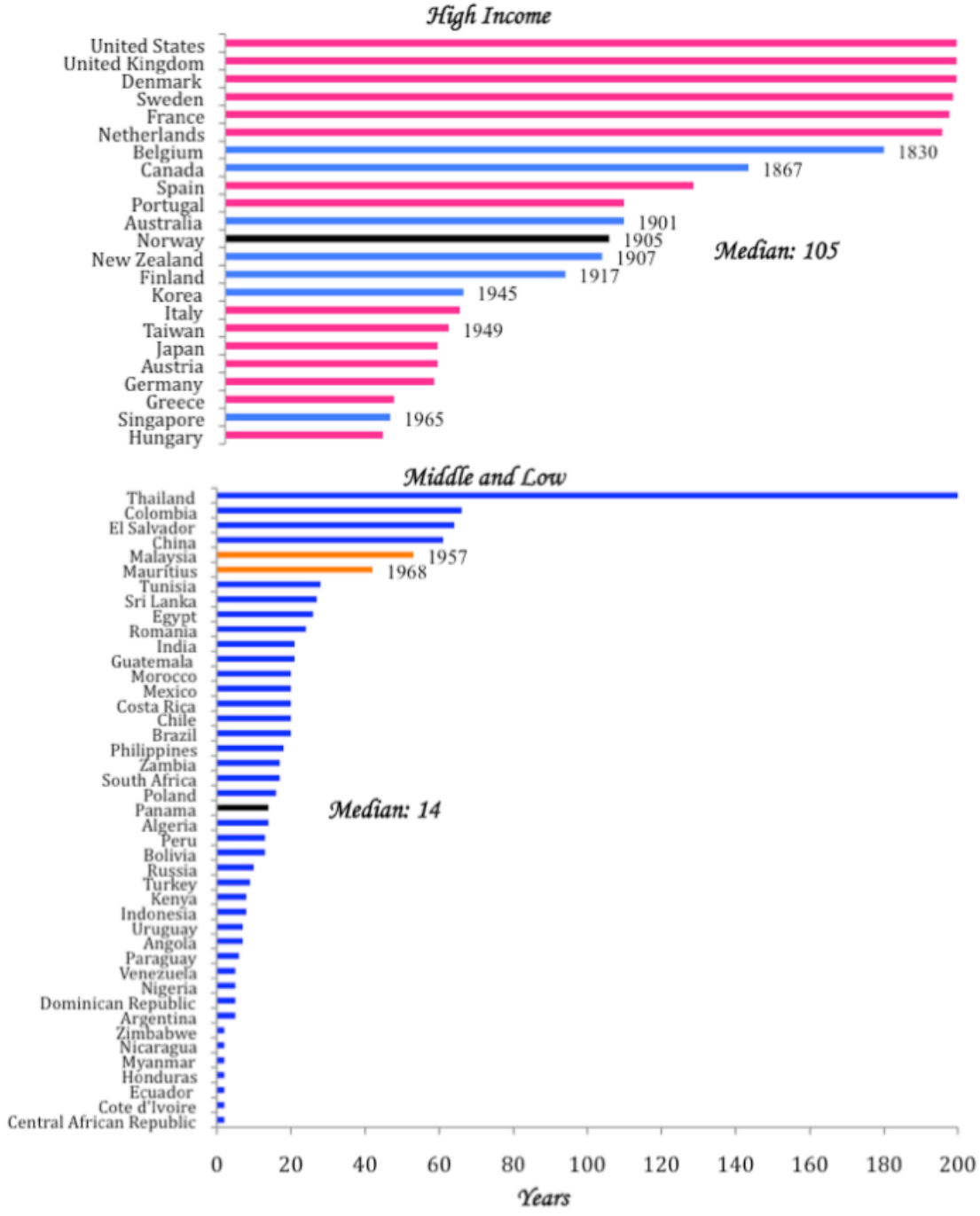
Finally, for banking crises, the difference between income groups is even smaller. Notice that even prior to the crisis, the distinction between high income countries and the rest of the world is not as large as for other type of crises. See figure 13 and table 4.

Table 4- Medians of distance (in years) to last crisis in 2010

Type of crisis	World	High income	Middle and low income
External default	23	105	14
Inflation	19	59	15
Banking	12	9	12

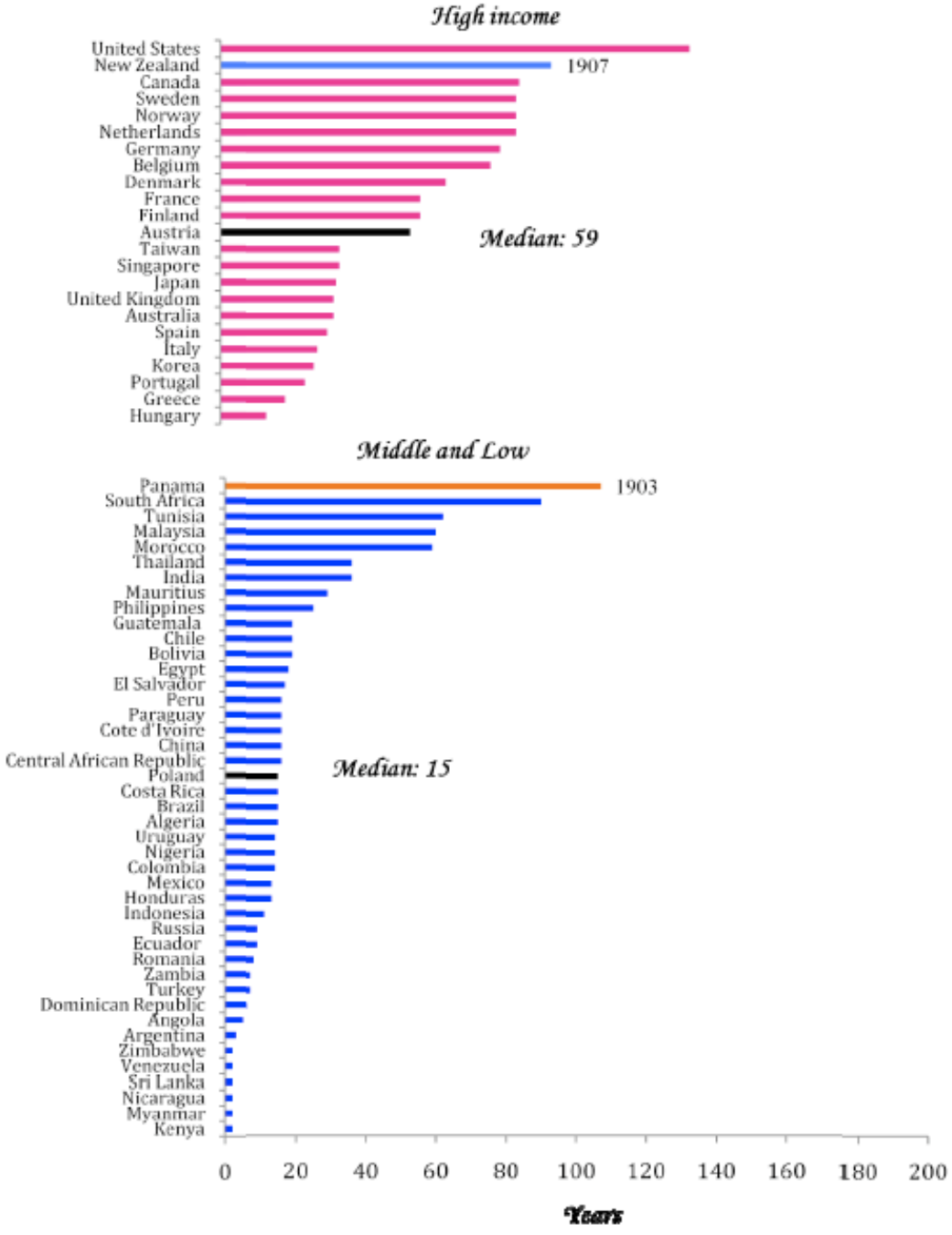
Notes: distance to last crisis is calculated as 2010 minus either the last year that the country was in crisis, 1800 or year of independence. Medians are calculated for each income group and each type of crisis.
Sample coverage: 66 countries (23 high income and 43 middle and low income countries) for external default, inflation and banking crisis.
Sources: Reinhart and Rogoff (2009), sources cited therein and authors' calculations.

Figure 11
Time elapsed by 2010 since last external default crisis, 1800 or year of independence: High vs. Middle and Low income



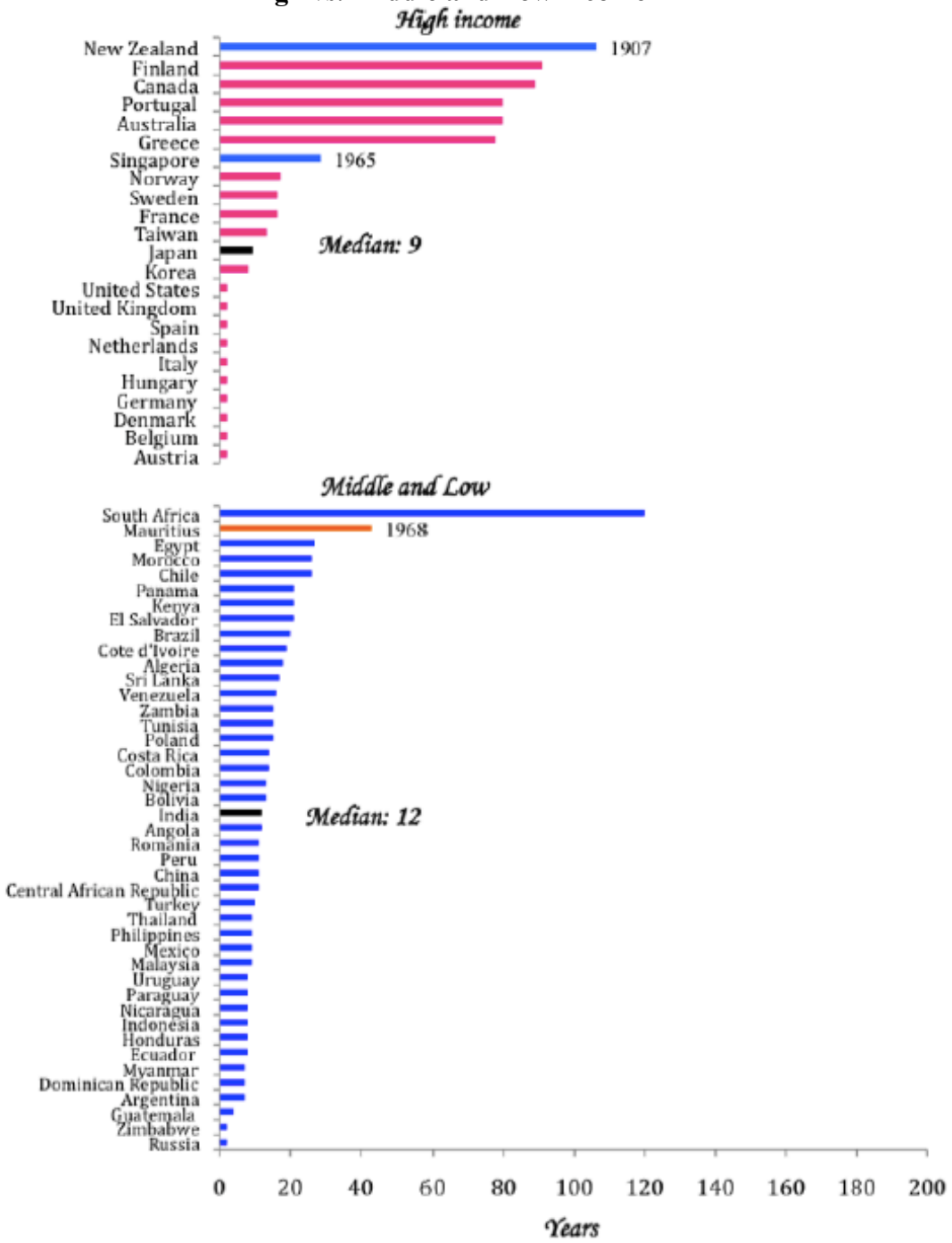
Note: distance calculated as 2010 minus either the last year that the country was in external default crisis, 1800 or year of independence.
Sample coverage: 66 countries (23 high income and 43 middle and low income countries).
Sources: Reinhart and Rogoff (2009), sources cited therein and authors' calculations.

Figure 12
Time elapsed by 2010 since last inflation crisis, 1800 or year of independence: High vs. Middle and Low income



Note: distance calculated as 2010 minus either the last year that the country was in inflation crisis, 1800 or year of independence.
Sample coverage: 66 countries (23 high income and 43 middle and low income countries).
Sources: Reinhart and Rogoff (2009), sources cited therein and authors' calculations.

Figure 13
Time elapsed by 2010 since the last banking crisis, 1800 or year of independence: High vs. Middle and Low income



Note: distance is calculated as 2010 minus either the last year that the country was in banking crisis, 1800 or year of independence.
Sample coverage: 66 countries (23 high income and 43 middle and low income countries).
Sources: Reinhart and Rogoff (2009), sources cited therein and authors' calculations.

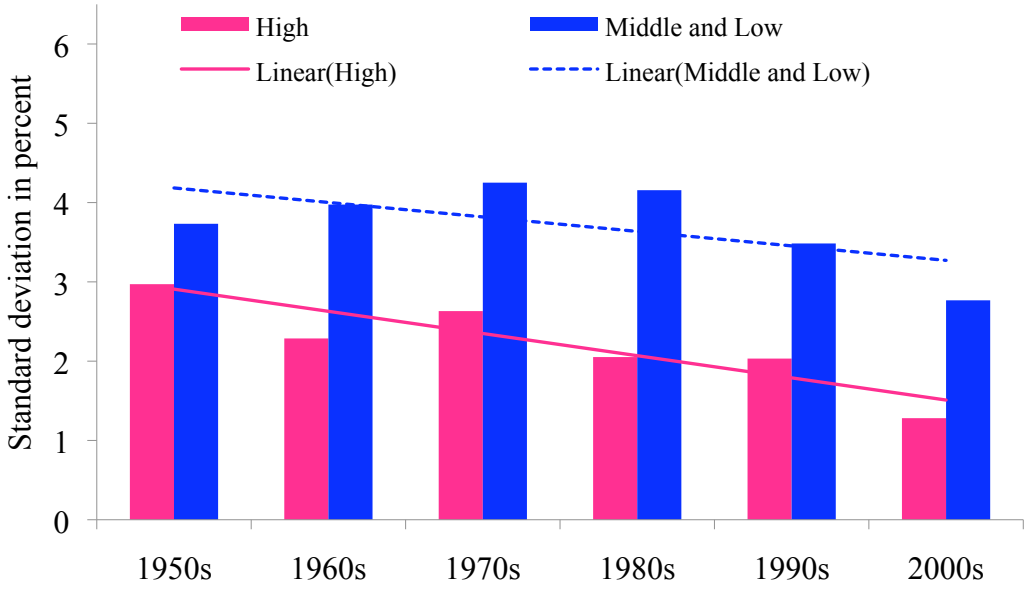
1.7 Macroeconomic volatility

What are the reasons why, at least until the recent global financial meltdown, financial crises have become less prevalent, especially in high income countries? Certainly, one possible reason was the general drop in macroeconomic volatility that took place particularly in the rich countries, that is the great moderation, as figure 14 illustrates, particularly the drop in volatility from the 1980s in advanced countries and from the 1990s in emerging markets. The table also illustrates, however, that our warnings about "early celebrations" for declaring countries to have graduated from financial crises may also apply to the Great Moderation. The decline in volatility from the 1970s may be as much due to a spike in the 1970s as due to great moderation after. The 1950s were also a period of relatively low volatility. In any event, it is clear that emerging markets face higher volatility than advanced countries.

Acemoglu et al. (2003) "Institutional causes, macroeconomic symptoms: volatility, crises and growth" argue that countries that inherited more ''extractive'' institutions from their colonial past were more likely to experience high volatility, lower growth rate and more economic crises during the postwar period. This is an interesting hypothesis that merits further research, also on the difficulties of graduation. We note that countries with extractive resources are more likely to face very high terms of trade volatility and face higher risk of default for this reason as well, see Catao (2009).) Aguiar, Amador and Gopinath (2010) argue that credibility problems may endogenously create greater persistence in productivity shocks in emerging markets, while one can also make the case that the countries with abundant natural resources are more likely to experience a generalized tragedy of the commons problem in governance, as emphasized in the voracity model of Tornell and Lane

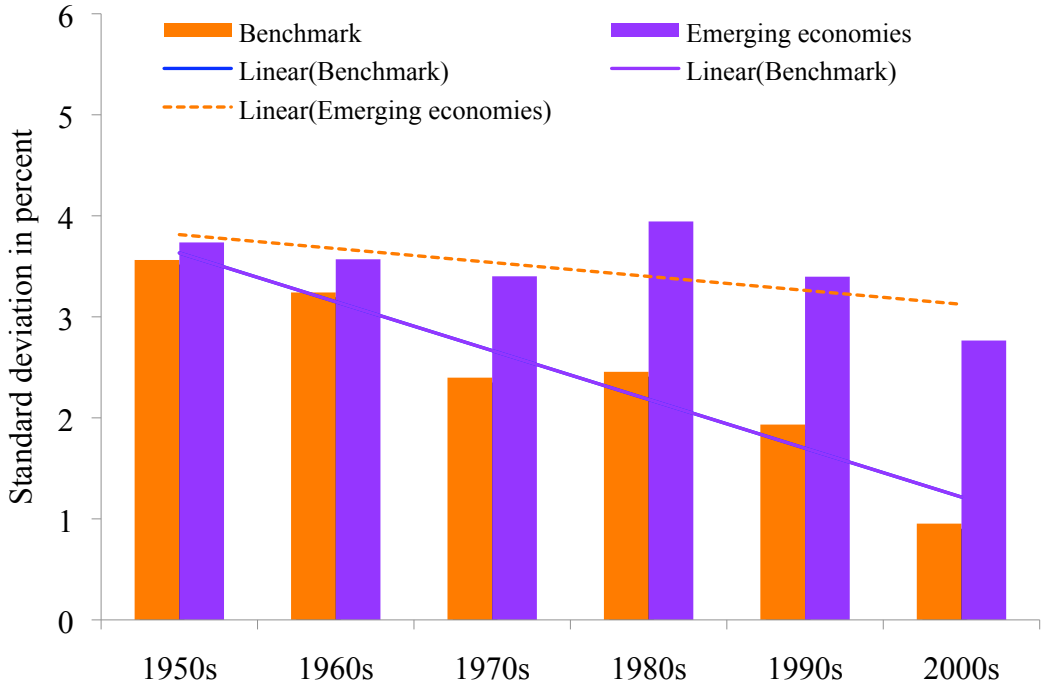
(1999). The institutional failure of coordinating interests of different power groups might be another reason why some countries, facing similar external shocks, are more prone to default than others, as it is modeled in Chapter 2 of this thesis. Figure 15 suggests that indeed, higher volatility in emerging market growth is not simply due to terms of trade volatility, as advanced country commodity exporters have experienced dramatically greater drops in volatility than emerging markets over the recent period.

Figure 14
Evolution of GDP growth rate volatility: 1950-2006
High vs. Middle and Low income



Notes: For each country the volatility is calculated as the standard deviation of its growth rate during the 10 years interval.
Sample coverage: 66 countries (23 high income and 43 middle and low income countries) that were independent in the given year.
Source: Maddison (2004), Total Economy Database (2008).

Figure 15
Evolution of GDP growth rate volatility: 1950-2006
Commodities exporting countries: Emerging vs. Benchmark



Notes: For each country the volatility is calculated as the standard deviation of its growth rate during the 10 years interval.
Benchmark: Australia and New Zealand. Emerging economies: Argentina, Bolivia, Brazil, Chile, Columbia, Cote d'Ivoire, India, Indonesia, Kenya, Malaysia, Mexico, Nigeria, Peru, Philippines, South Africa, Thailand, Uruguay and Venezuela.
Source: Maddison (2004), Total Economy Database (2008).

Similar patterns to those illustrated in figures 14 and 15 emerge using swing[12] of GDP growth rate instead of volatilities.

[12] Calculated as the average swing of each group. For each country the swing is calculated as the difference between the maximum growth rate and the minimum growth rate during the 10 years interval.

1.8 Crisis and Role of IMF programs: 1952-2007

We next turn to look at IMF programs. The presence of the IMF constitutes a major structural change. As emphasized by Bordo and Eichengreen (1999), crises have been more frequent but shorter since the advent of the IMF. What is interesting is how often the introduction of the IMF program does not necessarily halt the ultimate crisis. A famous example is Argentina, which received large (as a share of GDP) bailout packages in 2000 and again in 2001, but nevertheless went ahead and defaulted in 2002. But the case of Argentina is hardly exceptional as Table 5 illustrates.

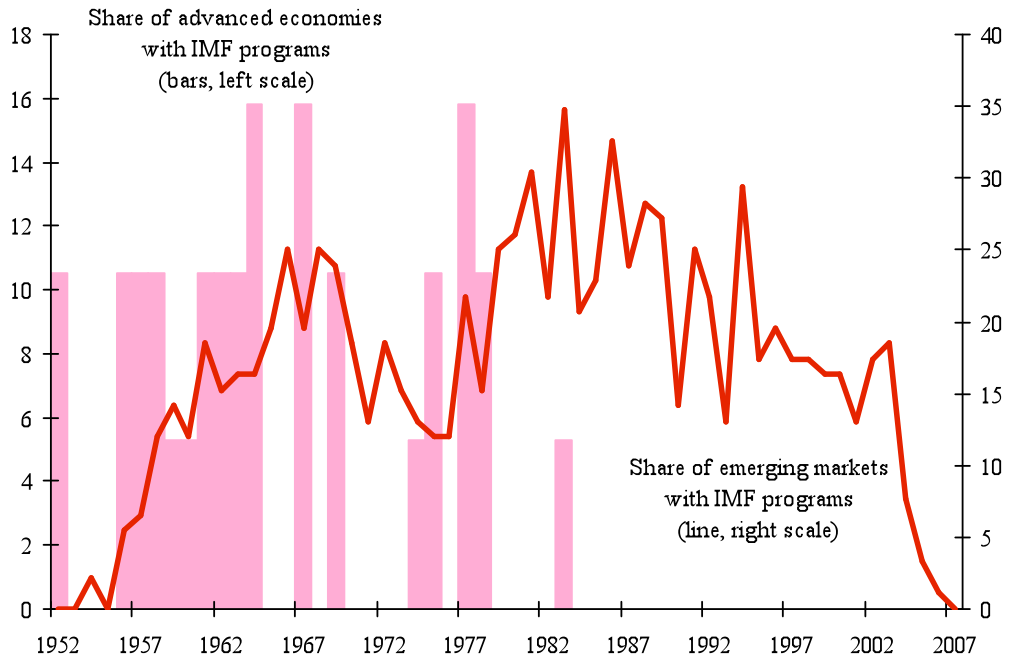
During 1952-2008, there were in total 85 default episodes and 538 IMF programs. If one restricts attention to cases where IMF programs were implemented 1-2 years before the crisis, we have 36 cases, or 42% of all default episodes.

Finally, in figure 16, we graph the incidence of IMF programs across advanced and emerging economies. The United Kingdom famously called repeatedly on IMF help, but so too did many other advanced economies until the early 1980s. So it is important to recognize that even though countries "graduated" from external default, there can be a further transition period of calling on outside help in "near default" incidents.

Table 5- Examples of cases where IMF programs are introduced but there is subsequent default

		IMF program			
	Default starting year	Program year	Approved date	Expiration /cancelation date	Amount in millions of SDRs
India	1958	1957	3/11/57	3/10/58	72.5
Chile	1961	1959	4/1/59	12/31/59	8.1
		1961	2/16/61	2/15/62	75
	1963	1963	1/15/63	1/14/64	40
	1966	1964	2/14/64	1/15/65	25
Costa Rica	1962	1961	10/4/61	10/3/62	15
	1981	1980	3/12/80	6/16/81	60.5
Paraguay	1968	1966	9/1/66	8/31/67	7.5
Peru	1969	1967	8/18/67	8/17/68	42.5
	1978	1977	11/18/77	9/14/78	90
	1980	1978	9/15/78	8/9/79	32.2
		1979	8/10/79	12/31/80	285
	1983	1982	6/7/82	4/26/84	650
Turkey	1982	1980	6/18/80	6/17/83	1250
Panama	1983	1982	4/28/82	4/27/83	29.7
Uruguay	1983	1983	4/22/83	4/21/85	378
	1987	1985	9/27/85	3/26/87	122.9
	2003	2002	4/1/02	3/18/03	1988.3
Guatemala	1989	1988	10/26/88	2/28/90	54
Venezuela	1990	1989	6/23/89	3/22/93	3703.1
Indonesia	1998	1997	11/5/97	8/25/98	8338.2
	2002	2000	2/4/00	1/29/02	3638
Argentina	2001	2000	3/10/00	1/23/03	16936.8
Dom Republic	2005	2003	8/29/03	1/30/05	438

Figure 16
The Incidence of IMF Programs in Advanced and Emerging Economies: 1952-2007



Source: Reinhart (2010).

1.9 Graduation and the Theory of Sovereign Default

Having now given a quantitative overview of the remarkable serial nature of sovereign default, banking and inflation crises, what does theory about graduation? Since by far the most striking empirical differences between advanced economies and middle and low income countries are for sovereign debt, we will focus mainly on this question.

At one level, the inferior performance of middle and low income countries is easy to explain. Emerging market countries face deeper and more permanent shocks (as Aguiar and Gopinath, 2006, emphasize), at the same time, tend to engage in

procyclical macroeconomic policy, as Kaminsky, Reinhart and Vegh (2004) document. During periods of surges in global capital flows, emerging markets rush in with a plethora of supposedly high return projects, at the risk of being stuck with incomplete, illiquid investments if capital flows reverse or capital evaporates. Corruption and the influence of interest groups is another important factor in developing countries that can undermine fiscal stability and potentially over borrowing as it is showed in Chapter 2 of this thesis. France's status as a centuries long serial defaulter during its years of monarchy has often been blamed on the government's failure to establish a rationale and orderly system of centralized tax collection (see MacDonald, 2006). Clearly, "graduation" if it can be achieved is also linked to a country's institutions and not just its level of wealth.

At another level, explaining graduation is quite difficult, because standard models of default (following Eaton and Gersovitz, 1981) do not necessarily suggest that richer countries should be able to borrow more (as a percent of their income) or that they should necessarily be less prone to default. As detailed in Obstfeld and Rogoff, the key penalty to default in the canonical model is a cutoff from international capital markets and an inability to smooth national consumption through international markets. As Obsteld and Rogoff show, the calibration of the costs to default is quite similar to that of Lucas (1988) on the gains to smoothing out business cycles. Obstfeld and Rogoff (1996, p. 369) find that, in fact, the empirical cost of exclusion from international markets is considerably greater for emerging markets than for rich countries. Admittedly, the canonical models illustrate model implicit contracts, so the issue of actual default is left in the background. Bulow and Rogoff (1989a) and Grossman and Van Huyck (1988) argue that if shocks are observable but not

verifiable, then optimal contracts may call for a premium in good states of nature, and negotiate partial default in bad states of nature, depending on the two sides' relative bargaining power. In any event, the fact that actual insolvency is seldom an issue in sovereign debt contracts, and that willingness to pay is invariably the binding constraint, underscores the point that countries cannot be expected to graduate simply by virtue of growing richer.

Of course, one way countries can graduate from default on external debt is by borrowing entirely (or almost entirely) through domestically administered markets. As Reinhart and Rogoff (2009) show, domestic debt has long been a quite important source of debt for most countries in the world, even though this fact has not been widely recognized. Also contrary to conventional belief, there are many cases of outright default on domestic debt (Reinhart and Rogoff document over seventy). Some of these defaults involved breaking indexation clauses (to inflation, gold, etc.), but in some cases, countries prefer outright default on domestic debt to achieve the same end through inflation.

In general, the fact that rich countries tend to have far fewer problems with serial default, most likely traces to collateral outside the usual type considered in the literature (see Cole and Kehoe, 1995 or Bulow and Rogoff, 1989b, for discussions of possible collateral outside the direct risk sharing gains from financial integration. For example, a breakdown in debt payments can spill over into reputation in trade relationships.) Another factor, of course, is that richer countries with better developed domestic credit markets are in position to rely far less on external financing, which in turn plausibly lowers the risk of external default.

At the other extreme are models of banking and financial crises that certainly do not suggest any reason why richer countries should be less prone. As already noted, Schularick and Taylor (2009) argue that even where greater macroeconomic and policy stability ought to ensure a more stable environment and fewer crisis, the financial system may expand to become crisis prone, offsetting the benefits of greater stability.

Thus, in addition to needing a better theory of serial default on sovereign external debt and a country's ultimate "graduation," it is also important to better understand the transitions countries experience as they develop, as illustrated in table 1 earlier.

1.10 Conclusions

In this paper, we have taken at trying to quantify and better understand countries 'risks of recidivism for different types of financial crises, and the duration of time that must pass before one can consider a country to have "graduated." Twenty years without a crisis is an important marker, but the tails of the recidivism distribution are very large. Countries do seem to graduate from external default crises, although further study is required to understand how much this is due to greater institutional and macroeconomic stability, and how much is due to enhanced ability to partially default in other ways (eg, inflation and financial repression), especially as advanced countries are typically able to finance a far larger share of their debt under domestic law and in domestic currency. Of course, if one also includes borrowing under duress from the International Monetary Fund as a measure of debt crisis recidivism, the evidence on "graduation" for advanced countries from external

default crisis is less convincing. Graduation from inflation crises is a relatively recent phenomenon, and here the evidence on graduation is suggestive but less decisive. Banking crises are a completely different animal; there is no compelling evidence that any country has outgrown them. However, the very low rate of banking crises that occurred between the end of World War II and the break-up of Bretton Woods at the beginning of the 1970s is a notable phenomenon that requires further study.

Chapter 2

Why do some countries default more often than others? The role of institutions

2.1 Introduction

There is a striking difference between the incidence of sovereign debt crisis in advanced economies and middle- and low-income countries. The average sovereign default probability of high-income countries is 7% over the past two centuries, less than half of middle- and low-income countries, 17%, and almost one-fifth of Latin America countries, 34%. See Chapter 1 of this thesis. Standard theoretical models like Eaton and Gersovitz (1981) do not offer explanations about why rich countries have less incentive to default on their external debt than middle- and low-income countries. The fact that Latin America countries defaulted more times than other countries that presumably faced similar external shocks and were at a similar stage of development, suggests that factors other than macroeconomic fundamentals may be important in determining countries' likelihoods of default, for example, political factors.

The objective of this paper is twofold. First, we present an empirical analysis to show: 1) a negative correlation between institutional quality and frequency of sovereign defaults, and 2) the particular institutional feature that matters for sovereign debt occurrence is the degree of government polarization. The second objective is to provide a theory of sovereign default that takes into account institutions. Countries with good institutions are characterized by well-developed legal structures that make it impossible for powerful groups to influence central government policies. The

central planner maximizes collective welfare by setting economy-wide expenditure and debt. In contrast, countries with bad institutions are characterized by a lack of barriers to limit the influence of powerful groups in the government decision-making process. Powerful groups act in a non-cooperative manner; they behave in ways that are better from their own point of view, without taking into account the effect of their actions on other groups.[13] Under this situation, the more polarized the groups are, the larger the size the inefficiency will be.

A two-period model is derived to demonstrate that regardless of the degree of polarization of government, in countries with good institutions, default probabilities are lower than in countries with bad institutions. In addition, we show that when there are bad institutions, the likelihood of default increases with the degree of polarization. The model is then extended to an infinite horizon setup adopting the standard sovereign default framework. Numerical simulations are able to explain a large part of the cross-country difference in sovereign default frequencies observed in the data.

This paper is related to both the politico-institutional and the sovereign default literature. In the politico-institutional literature, there is a set of papers that studies the role of institutions on shaping macroeconomic policies that ultimately explain the cross-country differences in growth, output volatilities and vulnerability to crisis. Acemoglu et al. (2003) argued that countries pursuing poor macroeconomic policies also have weak institutions. Kraay and Nehru (2004) found the quality of policies and institutions are an important determinant of debt distress. In this paper, the particular

[13] Argentina is a clear example of uncoordinated behavior among several public agencies, particularly, between the Provinces and the Federal government. Sanguinetti (1994)

institutional quality that we focus on is the influence of powerful groups on the policy determination and the degree of polarization in the government.

Another set of papers studied how budgetary institutions affect fiscal and debt policy. Von Hagen (1992) and Stein, Talvi and Gruisanti (1998) argued that budget institutions matter because they can affect the rules of the game under which political agents interact. They find that countries with better budgetary institutions display relatively smaller fiscal deficits and public debt. We do not model the budgetary process; we simply assume that bad budgetary institutions allow powerful groups to influence government policies.

Aizenman (1993), Von Hagen and Harden (1995) and Velasco (1999) studied the role of interest groups in shaping macroeconomic policies. In their models, government resources are a "common property" out of which interest groups can finance expenditure on their preferred items. Knowing that at least part of the cost would be borne by others, interest groups are tempted to overspend and over-borrow. Therefore, if fiscal policy is decided in a decentralized manner, a negative externality arises. In our model, the negative externality comes from the fact that groups do not internalize the full cost of engaging more debt reflected in the risk premium the country has to pay in the international capital market, and when a group chooses to default, it forces the country (all groups) to default.

The paper is also related to works that examine the role of polarization in macroeconomic policies. Alesina and Tabellini (1990) argued that polarization leads to over-accumulation of public debt because the current government has different preferences on spending than their opponent. Hence, when it borrows it does not internalize the full future cost of serving the debt because there is a risk of losing

power to the opponent group. Alesina and Drazen (1991) showed that polarization leads to higher deficit and debt because it delays stabilization. In both papers there is no default. In our paper, we model default decision that is affected by government polarization. More polarization leads to higher default probabilities because the more polarized the groups are, the higher the default costs not internalized by the defaulting group will be. Therefore, more defaults occur in equilibrium.

Studies of sovereign defaults pioneered by Eaton and Gertsovitz (1981) and followed by recent quantitative models such as Aguiar and Gopinah (2006), Arellano (2008), Mendoza and Yue (2008), among others, have modeled default episodes as an equilibrium outcome in which creditors agree to offer debt contracts even in cases when defaults are possible outcomes. These papers provide a framework to study sovereign defaults but do not provide reasons why some countries default considerably more times than others given similar fundamentals.

Recent works of Hatchondo, Martinez and Sapriza (2008) and D'Erasmo (2010) take a political economy approach. In their models, international lenders face different types of borrowers. Policymakers of the borrowing country have different degrees of impatience and they alternate in power. Lenders cannot directly observe a borrower's type, and hence have to infer from borrower's actions. Our paper differs from these in two ways. First, we do not assume that the default decision depends on the policymaker in power. In our model the policymaker in place, the number of powerful groups and their relative powers in the government are important, but they do not determine the ultimate outcome. What is essential in our model is the institutional environment in which these powerful groups take actions. Second, we

focus on explaining the cross-country difference in terms of sovereign default frequencies rather than matching a particular country's data, as these papers do.

This paper is organized as follows. In Section 3.2, we provide details of the data used in our cross-country empirical analysis and show the findings. In Section 3.3, we present a two-period model with an option to default in period two. We show that in countries with bad institutions default is more likely. Furthermore, the default probability increases with the degree of government polarization. In Section 3.4, we embed the two-period model into an infinite horizon framework. In Section 3.5 we compare simulation results to the data. Section 3.6 concludes the paper.

2.2 Data and Findings

In this section we document the cross-country differences in terms of institutional quality and external default incidence, and establish the facts we aim to explain using the models that we will develop in sections 3 and 4. The dataset covers more than 80 countries. It includes measures of institutional quality, frequencies of sovereign default and economic indicators from 1960 to 2008.[14]

2.2.1 Data Description and Source

We use three market assessment measures of institutional quality: the International Country Risk Guide (ICRG) institutional index, the Government Effectiveness and the Control for Corruption. The ICRG institutional index from the PRS Group is based on investors' evaluation regarding the rule of law, bureaucratic

[14] Our main dataset spans from 1960 to 2008. However, we use sovereign default crisis data from 1800 to 1959 to construct a measure of default history.

quality, corruption, expropriation risk, and government repudiation of contracts. It ranges from 0 to 1, with high values representing better institutions. The Government Effectiveness index captures the degree of a government's independence from political pressures, and the Control for Corruption index measures the extent to which public power is exercised for private gain, as well as the influence of elites and private interests in policymaking. Both measures are from the World Bank Governance Matters VIII, Kaufmann, Kraay and Mastruzzi (2009).[15] They range from -2.5 to 2.5, the higher being the better.

A caveat of these measures is that they tend to be correlated with income level rather than simply reflect durable institutional constraints in the government. A potential problem of using only these measures as independent explanatory variables to analyze default probabilities is that they might already contain information about past defaults. Furthermore these measures reflect the perception of the market about the overall quality of the institutions in a country, therefore we can learn little about which aspect of the government is relevant to determine the default risk. With the purpose of finding the particular government feature that matters for debt policies, we explore two underlying characteristics of the government structure: government fragmentation and government polarization. To capture government fragmentation, we use government fractionalization: the probability of two randomly chosen deputies in the government belonging to different parties. A higher value will indicate a larger number of political parties in the government. Following Franzese (2008), government polarization is calculated as the weighted standard deviation of ideologies of the three largest parties in the government, where the weight given to each party is

[15] Serial defaulters are countries that have had two or more default episodes.

its voting share in the legislature. A higher index implies higher polarization. The data source for both government fragmentation and government polarization is the Database of Political Institutions (2009). Data on sovereign defaults are from Reinhart and Rogoff (2009). Default probability for each country is calculated as the number of sovereign default episodes that occurred between 1960 and 2008 divided by the number of years since 1960 (or year of independence). For countries' default history, we use the number of default episodes that occurred between 1800 (or year of independence) and 1959. Additional control variables include the log of average real GDP per capita in 1990 international Geary-Khami dollars between 1970 and 2007 from the Maddison database, and the average debt to Gross National Income (GNI) ratio between 1970 and 2008 from the Global Development Finance database.

An obvious objection to this research strategy, trying to explain default risk with institutions, is that institutions are themselves endogenous. In particular institutions may be changed as a result of unsatisfactory economic performance, for example, after an economic collapse. If this is the case, institutions cannot be used as explanatory variables in analysis where crisis incidence in the variable trying to be explained. However institutions are costly to change, and hence they are changed relatively infrequently, they can be considered "exogenous" at least in the short to medium run (See Alessina and Perotti (1996) for discussion).

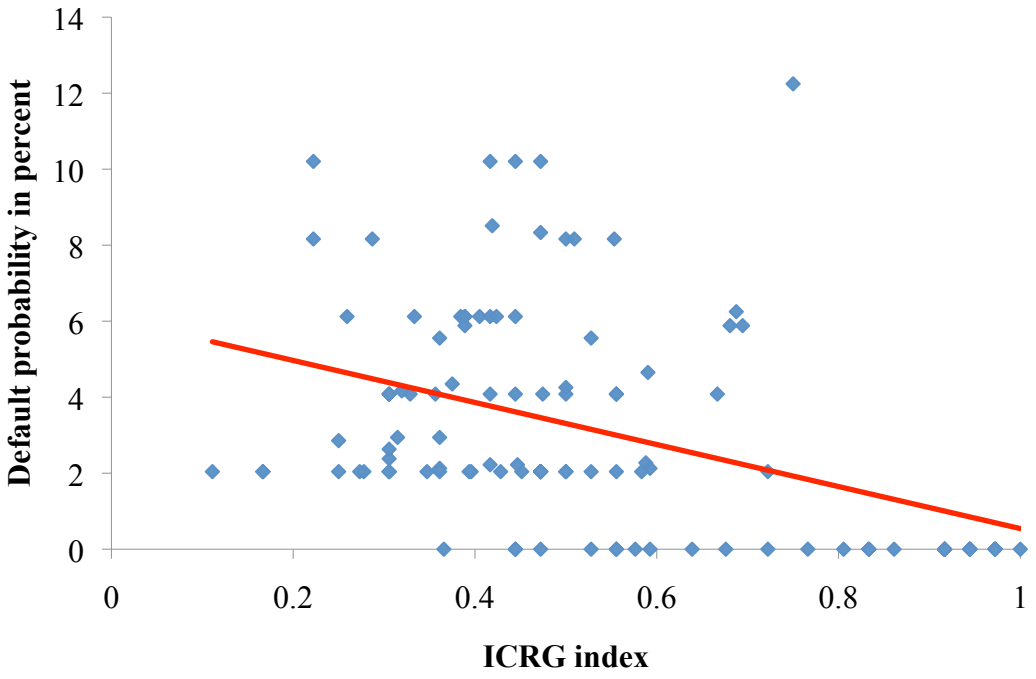
2.2.2 Facts

The main objective of this paper is to explain why some countries default on its external debt more times than other countries. The key findings using the dataset described above are:

Fact 1: Institutional quality and sovereign default probability are negatively correlated.

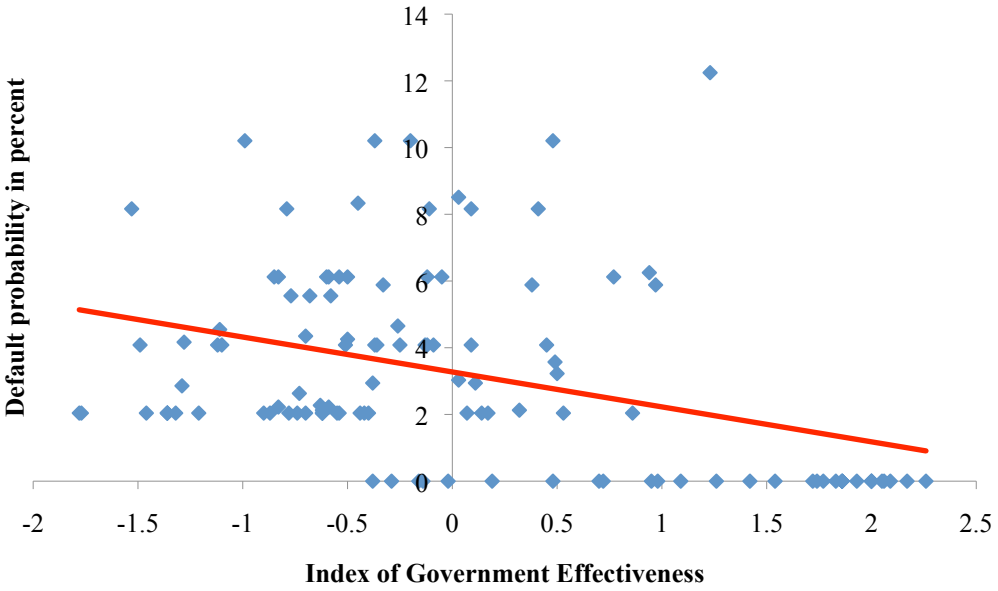
Countries with good institutions rarely default. Figures 17 to 19 show the negative relationship between our three measures of institutional quality and sovereign default probability. The correlation of sovereign default probability with ICRG institutional index, government effectiveness and control of corruption is -0.39, -0.36 and -0.37, respectively. They are all significant at 5%.

Figures 17- Default Probability versus ICRG institutional index



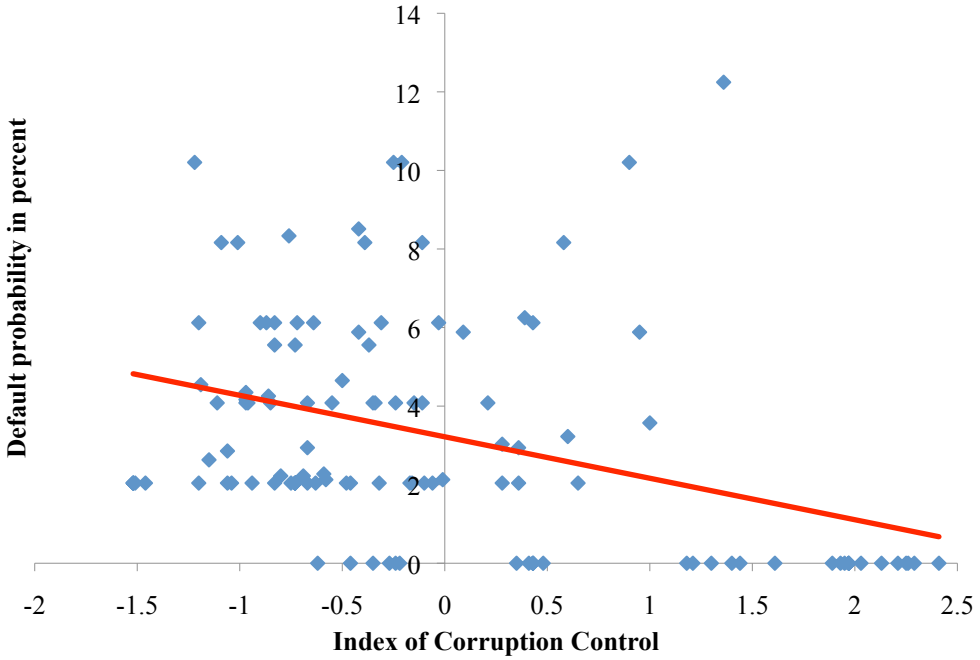
Source: World Bank, Worldwide Governance Indicators (WGI) project, Reinhart & Rogoff (2009).

Figures 18- Default Probability versus Government Effectiveness



Source: World Bank, Worldwide Governance Indicators (WGI) project, Reinhart & Rogoff (2009).

Figures 19- Default Probability versus Control for Corruption



Source: World Bank, Worldwide Governance Indicators (WGI) project, Reinhart & Rogoff (2009).

Table 6 reports the summary statistics of institutional quality of non-defaulters, one-time defaulters and serial defaulters. Non-defaulters, countries that have not defaulted during this period, have a substantially higher index in all three measures of institutions than defaulters, and there is no big difference between one-time defaulters and serial defaulters.[16]

Table 6- Summary Statistics of Institutional Quality and Default Probability

	ICRG inst. index	Government effectiveness	Control of corruption
Non-defaulters	0.75	1.23	1.15
Defaulter	0.42	-0.42	-0.46
One-time Defaulters	0.42	-0.46	-0.45
Serial Defaulters*	0.43	-0.38	-0.48

* Countries that had two or more default episodes.
Samples size: 118 countries, 30 non-defaulters, 50 one-time defaulter and 38 serial defaulters.
Source: Worldwide Governance Indicators (WGI) project, World Bank and The PRS Group, Reinhart & Rogoff (2009).

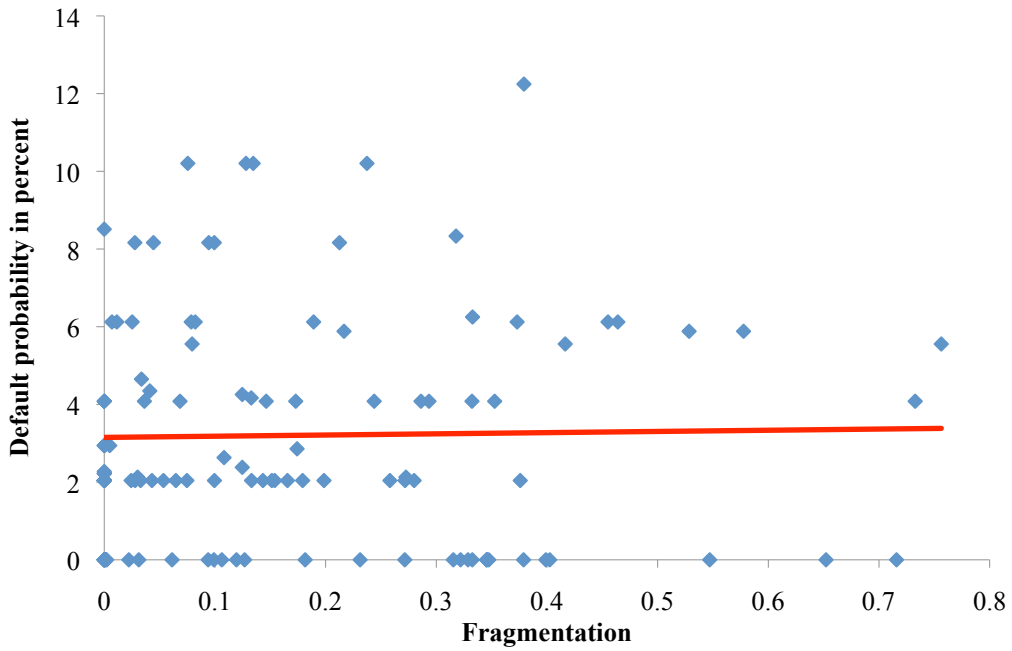
Fact 2: High government polarization is associated with high default probabilities.

Figures 20 and 21 show that government fragmentation is not positively correlated with default probability, but government polarization is.[17] The correlation between default probability and government fragmentation is 0.02 and it is not significant. The correlation between default probability and polarization is 0.28 and it is significant at 5%.

[16] We perform the mean test to check if the sample mean are significantly different. The null hypothesis is that the sample means of the two groups are equal. Comparing defaulters to non-defaulters, for all three measures, we reject the null hypothesis at 5 percent significance level, thus we conclude that means are unequal. Comparing one-time defaulters to serial defaulters, we could not reject the null hypothesis, so we conclude they are equal.

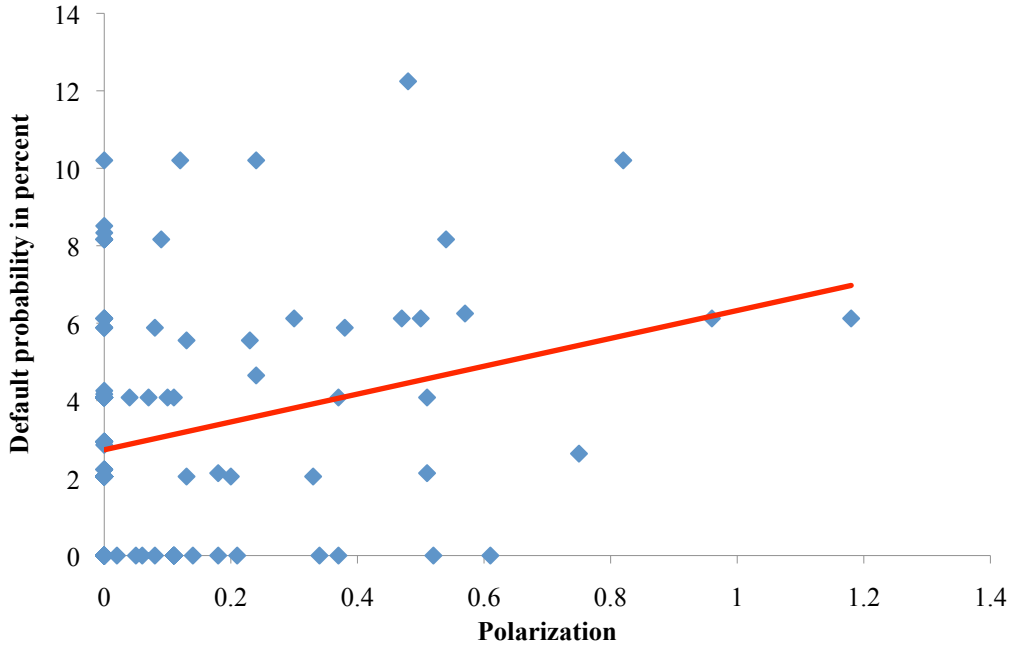
[17] There is empirical evidence that shows higher fragmentation is associated with higher fiscal deficit. Mukherjee, (2003), Bawn & Rosenbluth (2006)

Figures 20- Default Probability versus Fragmentation



Source: DPI (2009), Reinhart & Rogoff (2009).

Figures 21- Default Probability versus Polarization



Source: author's calculation based on DPI (2009), Reinhart & Rogoff (2009).

Table 7 reports the corresponding summary statistics. Defaulters and non-defaulters differ largely in their degree of government polarization, 0.17 versus 0.10. Furthermore, serial defaulters' degree of government polarization (0.22) is two times that of one-time defaulters' (0.11).[18] This suggests that a more fragmented government (i.e., more players in the decision process) does not necessarily imply more defaults; but a more polarized government is associated with higher default risk. A possible explanation for the positive correlation between polarization and default probability is that polarization leads to coordination failure between parties in the government regarding macroeconomic policies, in particular, debt policies. As a consequence, countries with more polarization are more likely to default than others given the same types of external shocks.

Table 7- Summary Statistics of Government Characteristics and Default Probability

	Government fragmentation	Government polarization
Non-defaulters	0.23	0.10
Defaulters	0.16	0.17
One-time Defaulters	0.15	0.11
Serial Defaulters*	0.17	0.22

* Countries that had two or more default episodes.
Samples size: 118 countries, 30 non-defaulters, 50 one-time defaulter and 38 serial defaulters.
Source: Database of Political Institutions (2009), Reinhart & Rogoff (2009).

One can argue that there might be omitted variables that can explain cross-country differences, both institutional quality and default frequencies; for example,

[18] We perform the mean test to check if the sample mean are significantly different. The null hypothesis is that the sample means of the two groups are equal. Comparing defaulters to non-defaulters and then one-time defaulter to serial defaulters in term of government fragmentation, in both tests we could not reject the null hypothesis. In the case of government polarization, comparing defaulters to non-defaulters and then one-time defaulter to serial defaulters, in both tests we reject the null hypothesis at 5 percent significance level.

stage of development. This is a valid argument since most advanced economies enjoy better institutions and rarely default. Indeed, the correlation between real GDP per capita and default probability is -0.29, significant at 5%. Another issue is that if a country does not have external debt, either because it does not need to borrow abroad or it has no access to foreign funding, its sovereign default probability will be zero. In fact, countries with higher external debt as percent of GNI are also those that default more often. The average external debt to GNI ratio of non-defaulters is 0.16 while the average of defaulters is 0.76. Finally, countries that have defaulted in the past are more likely to default again in the future. As discussed in Reinhart and Rogoff (2005), history matters and one possible explanation is the inertia of institutions. Adopting this interpretation, past defaults should be seen as symptoms of deeper institutional failures and not just contemporaneous policies or external shocks. The market penalizes countries with default records by charging them a higher risk premium, which will in turn exacerbate the vulnerabilities of these countries.

Taking into account these issues, we perform a regression analysis including as explanatory variable real GDP per capita, external debt to GNI ratio and default history. Table 8 reports the OLS cross-country regression analysis. Columns 1-3 use market assessment measures of countries' institutional qualities. They are all significant at 5% with the expected negative sign indicating that countries with better institutions are less likely to default. As we argued before, these institutional quality measures tend to improve with income level and may contain information about past defaults. Not surprisingly, both real GDP per capita and default history are not significant in column 1-3. When we use government fragmentation in column 4, income level and default history become significant with the expected sign. High-

income countries are associated with low default probabilities, and countries with default histories tend to default more times.

When we introduce government fragmentation, it has the expected positive sign. Having more parties in the government is associated with higher default probabilities, but the coefficient is not significant. However, when we interact government fragmentation with government polarization, fragmentation becomes significant.[19] This suggests that government fragmentation is a relevant determinant of default probability only in the presence of some degree of government polarization. We can interpret this result as the following: in the absence of polarization, an increase in the number of participants in the decision-making process does not imply a suboptimal decision about repaying or repudiating the debt. It is only when there is a fundamental difference between parties, measured by ideological polarization, that parties fail to coordinate on debt policy resulting in higher default risk. In Columns 6-10, we include government polarization as an explanatory variable. The coefficients are of the expected positive sign, significant at 1%. In column 10, we include both the overall measure of the institutional quality (ICRG) and government polarization; they are both significant. From this analysis, we conclude that countries with better institutions default less. Furthermore, controlling for the quality of institutions, countries with higher government polarization default more times. In the model that we will develop in the next section, both elements are important in determining the default risk.

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[19] The interaction term is constructed as the product of government fragmentation and a dummy variable that takes the value of one when there is some degree of polarization (i.e., government polarization $\neq 0$), zero otherwise.

Table 8 - Cross-country regression of sovereign default risk and institutions

Dependent Variable: Default Probability										
Variable	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Log of GDP per capita	0.22	-0.04	-0.04	-0.93***	-1.05***	-1.05***	-1.06***	-0.05	-0.41	-0.32
	-0.55	-0.49	-0.48	-0.32	-0.32	-0.34	-0.35	-0.63	-0.53	-0.55
Debt/GNI	0.07	0.25	0.32	0.22	0.12	0.4	0.4	0.29	0.4	0.48
	-0.62	-0.62	-0.62	-0.63	-0.61	-0.8	-0.8	-0.81	-0.81	-0.81
Default history	0.21	0.23	0.21	0.33**	0.32**	0.34**	0.34**	0.22	0.26*	0.24
	-0.15	-0.14	-0.15	-0.14	-0.14	-0.14	-0.14	-0.15	-0.15	-0.16
Polarization						4.14***	4.13***	4.27***	4.17***	3.94***
						-1.27	-1.28	-1.26	-1.27	-1.29
Gov. Effectiv.	-1.48**							-1.32*		
	-0.61							-0.7		
Control of Corruption		-1.12**							-0.84	
		-0.5							-0.54	
ICRG			-5.60**							-4.43*
			-2.37							-2.62
Fragmentation				1.23	-0.88		0.18			
				-1.64	-1.81		-1.76			
Fragm*Polariz					2.67**					
					-1.08					
# of observations	98	98	93	99	99	84	84	83	83	80
R-squared	0.21	0.2	0.22	0.16	0.21	0.27	0.27	0.31	0.3	0.3

Note: * significant at 10%, ** significant at 5%, *** significant at 1%

Source: Worldwide Governance Indicators (WGI) project, Political Institutions Database DPI (2009) and Reinhart & Rogoff (2009).

2.2.3 Discussion

From the empirical analysis, we conclude that institutions and default are correlated. Our insight is that many countries are plagued by weak institutional environment. Spending and borrowing decisions are often the result of negotiation within politico-business elite. Such powerful groups can be political leaders, provincial governments, labor unions, parastatal enterprises and financial backers of the ruling government. The determination of macro policies in such an economy depends on the interaction between these groups. Unless these groups perfectly cooperate, this interaction need not result in collective efficient outcomes.

An example of a country with these characteristics is Argentina, the most decentralized country in Latin America, with approximately 50% of total public spending occurring at subnational levels. In addition, it has a high degree of vertical

fiscal imbalance. From 1985 to 1995, two-thirds of provincial expenditures were financed by taxes collected by the central government through the federal tax-sharing agreement. Provinces have wide autonomy in deciding the financing of their expenditures with the guarantee of the central government, both domestically and abroad. The fact that bonds emitted by the provinces are guaranteed by the central government with the national tax revenue, an increase of provincial debts indirectly increases the level of national debt.[20] During 1996-2000, provincial public debt increased by $8.4 billions pesos, that is an expansion of 8.9% per year, 3.5 times the average annual GDP growth rate during the same period. Argentina had the largest default in history in 2001. Several factors lead to this crisis. We argue that the perverse incentives created by a system of tax centralization, spending and financing decentralization played an important role in making Argentina one of the world's leading serial defaulter in the modern history.

We build a model where powerful groups and lenders choose their actions optimally, taking the institutional quality of the country as given. We demonstrate that the default probability depends both on the institutional quality and the degree of polarization. Polarization in the model is captured by the distribution of shares of government resources allocated to the groups.[21] In countries with good institutions, even if there are many powerful groups, social optimal allocation for government consumption and borrowing is achieved because the central planner maximizes the

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[20] Saiegh & Tommasi (1999) and Argañaraz et al. (2001).

[21] Woo (2003) used income distribution to measure polarization. When we use the GINI coefficient instead of ideological difference in the governing parties for our empirical analysis, the positive relationship between polarization and default probabilities is preserved. Therefore, assuming that more unequal distribution of government resources implies more polarization is consistent with our empirical analysis.

aggregate welfare. In countries with bad institutions, powerful groups do not coordinate with each other; instead, each group optimizes independently how much to spend and borrow at a level that is suboptimal from the point of view of the country overall. The negative externality in this case is due to the fact that each group internalizes only its own cost of borrowing, which is lower than the aggregate cost. We want to emphasize that political fragmentation (i.e., having numerous political parties) is not problem; it is the interplay of having bad institutions and a polarized government that ultimately define a country's likelihood to default on its external debt.

2.3 A Simple Theory of Government Polarization and Default Probability

To study the relationship between the frequency of sovereign default, institutions and government polarization, we first build a two-period model with four assumptions: 1) there are *n* powerful groups that would like to influence government's spending and borrowing decisions. Powerful groups' income sources come from government transfers. These groups can only save and borrow through the central government. 2) We take the institutional quality of the country as exogenous. Countries with good institutions are those that there is a well-developed legal structure exist to limit the influence of powerful groups on central government fiscal and debt decisions. In this case a central planner's solution that maximizes collective welfare is achieved regardless the degree of polarization. We will call this the ***unified government case***. In countries with bad institutions, the central government is weak; powerful groups have direct influence on central government decisions. Furthermore,

groups act in a non-cooperative manner; each group maximizes its individual welfare ignoring the effect of its action on other groups.[22] We will call this the ***polarized government case***. 3) We assume that failure to repay the full amount of the debt constitutes default, and borrowers are excluded from the capital market as part of the default penalty.[23] 4) International lenders observe the number of powerful groups, the degree of polarization and how much debt the country (as a whole) demands, but they cannot match the group with the part of debt that is allocated to it. When a default decision is made, lenders are uncertain whether the decision is made by all the groups or one group and, in this last case, which group. Hence, when one group defaults, all groups are shut down from the international capital market.[24]

The two key elements of the model are i) institutional quality that can be good or bad depending if powerful groups can influence central government's policies or not; ii) the degree of group polarization that is relevant only when there is bad institutions. This is because when there is good institution, even if the powerful groups are highly polarized, they cannot affect central government's policies. These two elements are the counterparts of the two findings in section 2.2.2.

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[22] If there is a cost associated with coordination among groups that depends on the degree of polarization, $c(\eta)$, we are assuming that $c(\eta) = \infty$, that is groups never coordinate. We can also assume that the cost for the groups to coordinate with each other is increasing in the degree of polarization, same conclusions can be reached.

[23] It is true that most defaults end up being partial, not complete, although sometimes after long negotiations. We do not model the renegotiation process or how long it takes. We simply assume that during this renegotiation process, the country lives in autarky.

[24] A less extreme case is when one group (for example, a province) defaults, investors perceive a higher risk of default in other groups too; therefore, risk premium increases to all groups. This implies the behavior of one group has an effect beyond its own. The case of Brazilian state Minas Gerais constitutes a clear example. The declaration of liquidation of its debt at the end of 1998 caused not only doubts about the ability of repayment of other states, but also produced a national crisis the following year.

The model structure is based on Vegh (2010) Chapter 2. We have small open economies that take the international price as given. The saving or borrowing decision is made in period one; the repayment or default decision is made in period two. Since this is a finite horizon model, debt is sustainable if and only if default does not occur with probability one. For this reason, we assume a default cost in period two. For simplicity, we assume n=2.[25] The two groups share the tax revenue Y collected by the central government. Let's denote η group 1's and 1-η group 2's share of resources they receive from the government. Let $\eta \in (0,0.5]$; hence, group 1 receives less transfers than group 2. Similar to Alesina and Drazen (1991), we use η to measure the degree of government polarization. That is, the more unequal the shares of resources that correspond to groups are, the larger the degree of polarization is.[26] Revenue in period 2 (Y_2) is the only source of uncertainty in this model. It is a random variable drawn from a uniform distribution with support [0, Y_2^H].

2.3.1 Optimization Problem of the Unified Government

In this section, we solve the unified government case, which is the central planner solution. The objective of the planner is to maximize the sum of the two groups lifetime utility weighted by their relative power η subject to the economy-wide resource constraint. In period one, the planner chooses the aggregate spending and

[25] Results are preserved for more than 2 groups.

[26] Alesina and Drazen (1991) used the fraction of tax burden borne by groups as measure of the degree of polarization.

aggregate debt,[27] given the revenue shock and the schedule of interest rate. In period two, the planner decides to repay or default the debt. To simplify the analysis, we will assume that preferences are linear.[28] The objective function of the planner is given by

$$U^U = \max_B \{\eta g_1^1 + (1-\eta) g_1^2 + \beta E[\eta g_2^1 + (1-\eta) g_2^2]\} \quad (1)$$

where superscript denotes groups, subscript denotes period and 0<β<1 denotes the discounting factor. The government budget constraint in each period is given by

$$\begin{cases} t = 1 & g_1^1 + g_1^2 = Y_1 + B^U \\ t = 2 \text{ (default)} & g_D^1 + g_D^2 = Y_2(1-\phi) \\ t = 2 \text{ (repay)} & g_R^1 + g_R^2 = Y_2 - (1+r^U)B^U \end{cases} \quad (2)$$

where g_1^1 denotes group 1's consumption in period one; g_D^1 and g_R^1 denote group 1's consumption in period two in the event of default and repayment, respectively. Similarly g_1^2 denotes group 2's consumption in period one; g_D^2 and g_R^2 denote group 2's consumption in period two in the event of default and repayment, respectively. B^U denotes the level of debt engaged by the planner in period 1 to be repaid in period 2 in case that it chooses to; Y_1 denotes period 1's revenue, Y_2 denotes period 2's revenue, not known in the period 1; ϕ denotes share of the revenue that is lost if default is chosen; and r^U denotes the real interest rate charged by lenders to countries with a unified government.

In the second period the planner will repay the debt only if the cost of repaying it, given by $(1+r^U)B^U$, is smaller than the cost of default ϕY_2. Therefore, default is optimal for low realizations of the revenue shock in period 2, that is, if

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[27] We focus on the case of borrowing in period 1 to be optimal by assuming 1-β(1+r)>0.

[28] Results are preserved using a concave utility function, as it will be shown in the infinite horizon model.

$Y_2 < Y_2^{U*}$; and repayment is optimal otherwise. Y_2^{U*} is the threshold by which if the revenue shock is smaller than it, default will be optimal.

$$Y_2^{U*} = \frac{(1+r^U)B^U}{\phi} \tag{3}$$

Let π^U denote the probability of default in the unified government case

$$\pi^U = \Pr[Y_2 \le Y_2^{U*}] \tag{4}$$

2.3.2 Optimization Problem of the Polarized Government

In the polarized government case, in addition to having bad institutions (i.e., groups have power over central government's decisions), they do not coordinate, thus giving rise to a negative externality that harms the collective welfare. Unlike the unified government case, each group makes spending, borrowing and default decisions independently.

The objective of each group is to maximize its lifetime utility given by

$$U^{P,i} = \max_{b_1^i} \{ g_1^i + \frac{1}{1+\delta} E[g_2^i] \} \tag{5}$$

subject to the budget constraints

$$\begin{Bmatrix} t=1 & \mathrm{g}_1^i = \eta^i Y_1 + b^i \\ t=2 \text{ (default)} & \mathrm{g}_D^i = \eta^i Y_2 (1-\phi) \\ t=2 \text{ (repay)} & \mathrm{g}_R^i = \eta^i Y_2 - (1+r^P) b^i \end{Bmatrix} \tag{6}$$

where $\eta^1 = \eta, \eta^2 = 1-\eta$, b^i denotes the level of debt engaged by group *I* in period 1 to be repaid in period 2, and r^P denotes the interest rate charged by lenders to countries with bad institutions and a polarized government.

In the second period, group *i* will repay its debt only if the cost of repaying, given by $(1+r^P)b^i$, is smaller than the cost of default $\phi\eta^i Y_2$. Default is optimal for low realizations of the revenue shock, that is, if $Y_2 < Y_2^{P*}$, and repayment is optimal otherwise. Y_2^{P*} is the threshold by which if the revenue shock is smaller than it, default will be optimal for group *i*.

$$Y_2^{P*} = \frac{(1+r^P)b^i}{\eta^i \phi} \tag{7}$$

Let π^i denotes the default probability of group *i.*

$$\pi^i = \Pr[Y_2 \leq Y_2^{P*}] \tag{8}$$

2.3.3 Foreign Lenders

Lenders are international investors with a funding cost of *r*, the risk-free interest rate. They are competitive and risk neutral. They know the quality of institutions, whether the country has a unified government or a polarized government. In the case of having a polarized government, they also know the degree of polarization, captured by η, and the distribution of revenue shock in period two. However, investors cannot identify the groups nor which portion of the total debt lent to the country corresponds to each group. Therefore investors do not lend directly to each group, but to the country as a whole. In this case, whenever investors do not collect the full amount of the contracted debt; that is, if at least one group fails to repay or both groups decide not to repay; it constitutes a default. Similarly, when the country demands one unit more of debt, lenders will charge the same interest rate regardless of the group that is actually receiving that unit.

When facing a country with a unified government, lenders know the default probability in period two is given by π^U. Using the zero profit condition we can pin down the equilibrium real interest rate charged by lenders to a unified government

$$(1+r^U)(1-\pi^U)=1+r \tag{9}$$

where π^U is given by (4) and r is the risk-free interest rate.

When the borrowing country has a polarized government with η degree of polarization, the equilibrium real interest rate charged by lenders is given by

$$(1+r^P)(1-\pi^P)=1+r \tag{10}$$

where

$$\pi^P=\max\{\pi^i\}_{i=1}^2 \tag{11}$$

Equation (11) means that the probability of default used by lenders to determine the interest rate they charge to the country with a polarized government is that of the group with the highest default probability. This is because failure to repay the full amount constitutes default in our model.[29] As long as one group decides not to repay its portion of the total debt, the country will not be able to repay the full amount even if the other group chooses to repay.[30] Hence, the relevant default probability for investors is the highest probability of the two groups. This is a negative externality in the case of countries with a polarized government. Assume that group *i* has the highest default probability. When it chooses to increase the amount of debt it borrows,

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[29] Reinhart & Rogoff (2010) define as external default crisis the failure of a government to meet a principal or interest payment on the due date. These episodes include instances in which rescheduled debt is ultimately extinguished in terms less favorable than the original obligation.

[30] In equilibrium, if one group chooses to default, the other group will find it optimal to default as well. This is because it has to incur the default cost regardless if it repays or not. Hence, the other group is better off defaulting, too.

to repay or to default, it does not take into account the effect of its action on the other group, which is to increase the borrowing cost of the other group. And in the case it chooses to default, it forces the other group to default as well. The cost of not repaying for group i is simply $\eta^i \phi Y_2$ but the full cost to the country is ϕY_2. For all values of η^i, the individual cost of default is strictly lower than the aggregate cost.

2.3.4 Timing of the Events

Unified government

t=1 Planner chooses B^U;

interest rate is determined satisfying investors zero profit condition;

planner transfers to each group debt and revenue according to its share.

t=2 Revenue shock is realized;

if $Y_2 < Y_2^{U*}$, it choose to default, if $Y_2 \geq Y_2^{U*}$ it chooses to repay;

if it defaults, each group receives its share of the revenue net of default cost

$\eta Y_2(1-\phi),\ (1-\eta)Y_2(1-\phi)$;

if it repays, each group receives its share of revenue net of repayment

$\eta[Y_2 - (1+r^U)B,\ (1-\eta)[Y_2 - (1+r^U)B]$.

Polarized government

t=1 Each group receives its share of revenue and chooses b^i;

total debt is the sum of b^i, $B^P = \sum_{i=1}^{2} b^i$. The central government goes to the

international capital market and demands B^P;

interest rate is determined satisfying investors zero profit condition.

t=2 Revenue shock is realized;

if $Y_2 < Y_2^{P*}$, groups choose to default; if $Y_2 \geq Y_2^{P*}$, groups choose to repay;

if groups default, each group receives the share of revenue net of default cost according to its share $\eta Y_2(1-\phi),\ (1-\eta)Y_2(1-\phi)$;

if both groups repay, each group receives the share of revenue net of repayment $\eta Y_2 - (1+r^P)b^i,\ (1-\eta)Y_2 - (1+r^P)b^i]$.

2.3.5 The Equilibrium

In this section we solve the equilibrium default probabilities for the unified government and polarized government separately. Note that, conditional on the country having defaulted Y_2 varies uniformly between 0 and Y_2^{U*} in the unified government case, and between 0 and Y_2^{P*} in the polarized government case. Similarly, conditional on the country having repaid, revenue varies uniformly between Y_2^{U*} and Y_2^H in the unified government case, and between Y_2^{P*} and Y_2^H in the polarized government case.

Unified Government

The expected revenue in period 2 is given by

$$E\{Y_2 / D\} = \frac{\pi^U Y_2^H}{2} \tag{12}$$

$$E\{Y_2 / R\} = \frac{(1+\pi^U)Y_2^H}{2} \tag{13}$$

where D denotes the case of default and R denotes the case of repayment.

Having linear utility function allows us to rewrite the planner's objective function (1) in the following way:

$$U^U = \max_B \{g_1^1 + g_1^2 + \beta E[g_2^1 + g_2^2]\} \tag{14}$$

using (2), (9), (12) and (13), (14) can be written as

$$U^U = \max_B \{Y_1 + \beta E[Y_2] + B^U(1-\beta(1+r)) - \frac{\phi\beta(\pi^U)^2 Y_2^H}{2}\} \tag{15}$$

The first order condition is given by:

$$1 = \beta(1+r) + \beta\phi\pi^U Y_2^H \frac{d\pi^U}{dB^U} \tag{16}$$

The above marginal condition has a straightforward economic interpretation. In (16) we see that in choosing the optimal amount of debt, the marginal benefit of today to increase an additional unit of debt equals to the marginal cost of increasing one unit of debt tomorrow discounted. The marginal cost is composed by the sum of 1+*r*, the risk-free interest rate, and the marginal increase in the default probability times the revenue loss in case of default.

Combining (3), (4), (9) and (16), we obtain:

$$\pi^U = \frac{1-\beta(1+r)}{2-\beta(1+r)} \tag{17}$$

Note that default probability is independent of the degree of polarization η. This is because there is no negative externality in the central planner case; all default costs are internalized.

The equilibrium debt and interest rate are the following:

$$B^U = \frac{[1-\beta(1+r)]\phi Y_2^H}{(1+r)[2-\beta(1+r)]^2} \tag{18}$$

$$1+r^U = (1+r)[2-\beta(1+r)] \tag{19}$$

Polarized government

In a polarized government, each group maximizes its lifetime utility subject to budget constraint taking as given the interest rate schedule the country faces. In equilibrium, the total debt that the central government borrows at the international capital market will be the sum of debts chosen by the two groups, each group contributing according its power η, 1-η. That is,

$$b^i + b^j = B^P, b^i = \eta B^P, b^j = (1-\eta)B^P \tag{20}$$

In this case, the expected revenue in period 2 is given by

$$E\{Y_2 / D\} = \frac{\pi^P Y_2^H}{2} \tag{21}$$

$$E\{Y_2 / R\} = \frac{(1+\pi^P)Y_2^H}{2} \tag{22}$$

Combining (5), (6), (10), (20) and (21), we can express group *i*'s problem as the following

$$U^{P,i} = \max_{b^i} \{\eta Y_1 + \beta\eta E[Y_2] + (1-\beta(1+r))b^i - \frac{\beta\eta\phi(\pi^P)^2 Y_2^H}{2}\} \tag{23}$$

The first order condition is given by:

$$1 = \beta(1+r) + \beta\phi\eta\pi^P Y_2^H \frac{d\pi^P}{db^i} \tag{24}$$

The economic interpretation of (24) is similar to the one given in the unified government case. However, a key difference should be noted: the second component of the marginal cost of increasing one unit of debt is only a fraction η of the total cost. This shows that group *i* when deciding the optimal level of debt ignores the additional effect that it imposes on the other group. That is a higher borrowing cost and it constitutes a negative externality. Consequently, a lower η, which means a higher

polarization, is associated with greater externality, increasing the resultant debt level and default probability.

Given that lenders charge the same interest rate to all groups, the marginal increase in interest rate is the same for an additional unit of the total debt and an additional unit of a group's debt. That is

$$\frac{dr^P}{db^i} = \frac{dr^P}{db^j} = \frac{dr^P}{dB^P} \tag{25}$$

(10) and (25) implies

$$\frac{\partial \pi^P}{\partial b^i} = \frac{\partial \pi^P}{\partial B^P} \tag{26}$$

Combining (7), (8), (10), (20), (24) and (26), we obtain group *i's* default probability,

$$\pi^i = \frac{1-\beta(1+r)}{\beta(1+r)(\eta-2)+2} \tag{27}$$

A similar optimization problem of group *j* results in

$$\pi^j = \frac{1-\beta(1+r)}{2-\beta(1+r)(\eta+1)} \tag{28}$$

Taking into account (11) and the fact that $0<\eta\leq 0.5$, the default probability of a polarized government is given by

$$\pi^P = \frac{1-\beta(1+r)}{2-\beta(1+r)(2-\eta)} \tag{29}$$

The equilibrium debt and interest rate are the following:

$$b_i = \phi Y_2^H \eta \Omega \tag{30}$$

$$b_j = \phi Y_2^H (1-\eta) \Omega \tag{31}$$

$$B^P = \phi Y_2^H \Omega \tag{32}$$

$$1+r^P = \frac{(1+r)[2-\beta(1+r)(2-\eta)]}{1-\beta(1+r)(1-\eta)} \tag{33}$$

where

$$\Omega = \frac{[1-\beta(1+r)][1-\beta(1+r)(1-\eta)]}{(1+r)[2-\beta(1+r)(2-\eta)]^2}$$

Proposition 1: $\forall$ η, *i*) the default probability, *ii*) the level of total debt, and *iii*) the equilibrium interest rate are strictly higher in the polarized government case than in the unified government case, that is $\pi^P > \pi^U, r^P > r^U, B^P > B^U$.

Proof. See appendix C.

Proposition 2: In the polarized government case, $\forall$ η, *i*) the default probability, *ii*) the level of total debt, and *iii*) the equilibrium interest rate are increasing in the degree of polarization, that is $\frac{\partial \pi^P}{\partial \eta} < 0, \frac{\partial r^P}{\partial \eta} < 0, \frac{\partial B^P}{\partial \eta} < 0$.

Proof. See appendix C.

Proposition 1 state that the quality of institution determines the likelihood of default independent of the distribution of powers. Given that the default probability is higher in the polarized government case, the equilibrium interest rate is higher to satisfy investors' zero profit condition. The lack of coordination leads to overborrowing because groups do not internalize the aggregate cost of a marginal increase of the debt. Proposition 2 asserts how the degree of government polarization affects the equilibrium default probability, debt level and risk premium. The higher the degree of polarization, the higher the default probability, the higher the total level of debt and

the higher the equilibrium interest rate. They are due to the fact that the size of the negative externality increases in the degree of polarization.

2.4 Extending the Model to Infinite Periods

In this section, we extend the two-period model into the infinite horizon framework of Eaton and Gersovitz (1981). We adopt the quantitative analysis technique developed by Aguiar and Gopinath (2006) and Arellano (2008).

There is an additional default cost in the infinite horizon setup, that is, the risk of being excluded by the international capital market for a certain periods, also known as the reputation cost.[31] This cost will dampen the incentive of the country to default because while the country is excluded from the capital market, it lives in autarky and consumption smoothing is not possible.

2.4.1 Model Setup

Preference of the group *i* in period *t* is given by

$$E_0 \sum_{t=0}^{\infty} \beta^t U(g_t^i) \tag{34}$$

where *U(.)* is strictly concave and differentiable, $\beta \in (0,1)$ is the discount factor and g_t^i is the consumption of group *i* in period t. The central government receives a stochastic stream of revenue *Y*. We assume that *Y* follows a Markov process with transition function *f(Y,Y')*. The country has access to the international capital markets, where it can buy one period discount bonds *B'* at price *q(B',Y)*. The bond price is a

[31] For discussion on cost of the exclusion, see Arellano (2008).

function of the amount of bond B' and the current revenue shock Y. When B' is a negative number, it means the country receives $-q(B',Y)B'$ units of goods and promises to repay, conditional on not defaulting, B' units of goods the following period.

The timing of events can be summarized as follows: at the beginning of the period, the country starts with a level of debt B. The revenue Y is realized and it is revealed to lenders. In the unified government case, the planner decides to repay or default on the previous period debt. If it chooses to repay, it also chooses how much to borrow. The equilibrium bond price is determined by satisfying the lender's zero profit condition. After receiving $-q(B',Y)B'$, $Y+B-q(B',Y)B'$ is split between the two groups according to their share η and $1-\eta$. If it chooses to default, from that period onward, the country will be in financial autarky until re-access. In the polarized government case, each group decides to repay or to default on its previous period debt simultaneously. If both groups repay, then each group also chooses how much to borrow. The central government then goes to the international capital market and sells sovereign bonds for the amount that is the sum of the two groups' chosen debts. The equilibrium bond price is determined. If at least one group decides to default, lenders shut down the capital market to the country since failure of full repayment constitutes default. The country will remain in financial autarky until re-access.

2.4.2 Default Decision in Unified Government

Like the two-period model, the planner's problem is to maximize the aggregate welfare of the two groups weighted by their relative power η:

$$E_0 \sum_{t=0}^{\infty} \beta^t [\eta U(g_t^1) + (1-\eta) U(g_t^2)] \tag{35}$$

The planner solves the following problem: If the country is active in the international capital market (i.e., it has not defaulted in the previous period) and has debt, it chooses to default or to repay; and in the case of repayment, how many new bonds to issue (B').[32]

We define the optimization as a recursive problem. The state variables are the level of debt inherited from the previous period B and current revenue shock Y. We denote the value function for the unified government being active at state *(B,Y)* as $V^U(B,Y)$. With option to default, $V^U(B,Y)$ satisfies

$$V^U(B,Y) = \max_{\{D,R\}} \{V_D^U(Y), V_R^U(B,Y)\} \tag{36}$$

where $V_D^U(Y)$ is the value associated with default and $V_R^U(B,Y)$ is the value associated with repayment. When the planner chooses to default, the country is in temporary financial autarky, total consumption equals to revenue net of default loss. The value of default is given by:

$$\begin{aligned} V_D^U(Y) &= \eta U(g^1) + (1-\eta) U(g^2) + \beta \int_{Y'} \mu V^U(0,Y') + (1-\mu) V_D^U(Y')] f(Y',Y)\, dY' \\ s.t. \qquad & g^1 + g^2 = Y^{def} \end{aligned} \tag{37}$$

where μ is the probability that the country will regain access to the international credit market. Following Arellano (2008) $Y^{def} = h(Y) \leq Y$, *h(.)* an increasing function. When central planner chooses to repay, the value of remaining in credit relation is given by:

---

[32] As in the two-period model, we will assume parameter values that make the agent always want to consume more in the current period relative to the next period; hence, we will only analyze the case of borrowing.

$$V_R^U(B,Y) = \max_{B'}\{\eta U(g^1) + (1-\eta)U(g^2) + \beta \int_{Y'} V_U(B',Y')f(Y',Y)dY'\}$$
$$s.t. \qquad g^1 + g^2 = Y + B - q(B',Y)B' \tag{38}$$

The decision to default or to repay is a period-by-period decision. The default probability in the unified government case is

$$\pi^U(B,Y) = \Pr[V_D^U(Y) > V_D^U(B,Y)] \tag{39}$$

2.4.3 Default Decision in the Polarized Government

Powerful groups maximize their lifetime utility given by

$$E_0 \sum_{t=0}^{\infty} \beta^t U(g_t^i) \quad i = 1,2 \tag{40}$$

Each group solves the following problem simultaneously: If the country is active in the international credit market and the group *i* has debt (b^i), it chooses to default or to repay; and in the case of repayment, it chooses how many new bonds to sell ($b^{i\prime}$). The state variables for each group are the level of debt inherited from the previous period b^i, the revenue shock Y and the aggregate bond B'. We denote the value function of interest group *i* of a country with polarized government being active at state (b^i, B, Y) as $V^{Pi}(b^i, B, Y)$. Group *i* decides whether to default or repay its debt to maximize its individual utility function. With option to default, $V^{Pi}(b^i, B, Y)$ satisfies

$$V^{Pi}(b^i, B, Y) = \max_{\{D,R\}}\{V_D^{Pi}(Y), V_R^{Pi}(b^i, B, Y)\} \tag{41}$$

When ***at least one*** group decides to default, the country is in temporary financial autarky; total expenditure equals to revenue net of default loss. The value of default is given by:

$$
\begin{aligned}
&V_D^{Pi}(Y) = U(g^i) + \beta \int_{Y'} \mu V^{Pi}(0.0, Y') + (1-\mu) V_D^{Pi}(Y')] f(Y', Y) dY' \\
&s.t. \qquad g^i = \eta^i Y^{def} \\
&i = 1,2 \\
&\eta^1 = \eta,\ \eta^2 = 1 - \eta
\end{aligned}
\tag{42}
$$

When ***both groups*** decide to repay, the value of remaining in credit relation is given by:

$$
\begin{aligned}
&V_R^{Pi}(b^i, B, Y) = \max_{b^{i'}} \{U(g^i) + + \beta \int_{Y'} V_{Pi}(b^{i'}, B', Y') f(Y', Y) dY'\} \\
&s.t. \qquad g^i = \eta^i Y + b^i - q(B', Y) b^{i'}
\end{aligned}
\tag{43}
$$

The default probability of group *i* is given by

$$\pi^{P,i}(b^i, B, Y) = \Pr[V_D^{P,i}(Y) > V_R^{P,i}(b^i, B, Y)]$$

Whenever the country fails to repay the full amount (i.e., at least one group decides to default on its debt) lenders exclude the country (i.e., all groups) from the capital market. Therefore, the default risk that is relevant to determine the equilibrium bond price is the maximum default probability of the two groups.

$$\pi^P(B, Y) = \max\{\pi^{P,i}\}_{i=1}^2$$

2.4.4 The Equilibrium Bond Price

Foreign investors are risk neutral and competitive. Given *B'*, the country's total amount of debt, the revenue *Y* and the default risk, the bond price for both unified and polarized government satisfies

$$q(B', Y) = \frac{1 - \pi(B', Y)}{1 + r} \tag{44}$$

where $\pi(B', Y)$ equals π^U and π^P, for unified and polarized government, respectively.

2.5 Quantitative Analysis

We now turn to test the success of the model in matching the stylized facts we identified in section 2 quantitatively. The numerical analysis uses parameter values that are standard in the literature.

2.5.1 Functional Forms and Parameters

The model is solved numerically using value function iteration. A CRRA utility function:

$$U(g) = \frac{g^{1-\sigma}}{1-\sigma}$$

The revenue process is assumed to be a log-normal AR(1)

$$\log(Y_t) = \rho \log(Y_{t-1}) + \varepsilon_t,\ E[\varepsilon] = 0, E[\varepsilon^2] = \sigma$$

We use the Arellano (2008) output cost structure[33] that takes the following form

$$Y^{def} = \begin{cases} (1-\phi)Y & \text{if } Y > \hat{Y} \\ Y & \text{if } Y \leq \hat{Y} \end{cases}$$

Each period refers to a quarter. The discount factor β is set to 0.95; the risk-free interest rate 1%; the coefficient of relative risk aversion 2; the probability of re-access to the capital market after default μ=0.1, which implies an average duration of 2.5 years of staying in autarky, similar to the estimate by Gelos et al. (2004) and the output loss when staying in autarky 2%. Values for parameters of the revenue process

[33] Arellano (2008) discusses the advantage of using this asymmetric default cost structure.

are: ρ=0.9 and σ_y =3.4%, which is the value used in Aguiar and Gopinath (2006), also similar to many business cycle models.

2.5.2 Simulation Results

We simulate the model for the unified government and polarized government cases separately. In the polarized government case, simulation is conducted for three degrees of polarization: high η=0.1, medium η=0.3 and low η=0.5. The computational algorithm used to solve the model can be found in the appendix D.

Figure 22 shows the bond price schedule faced by the countries a unified government as a function of assets *B'* for two revenue shocks that are one standard deviation above and below the trend. Bond prices are an increasing function of asset, making larger levels of debt to be associated with lower price. Booms are associated with higher bond price, which implies lower interest rate. This is because revenue is persistent: higher revenue in the current period predicts higher revenue in the next period, and therefore less likely to default. This endogenous countercyclical interest rate is standard in the sovereign default literature and consistent with the data. Figure 23 shows the default decision rule as a function of revenue at a given level of debt: 1 denotes default, 0 denotes repayment. Default is optimal when revenue shock is low. This is also consistent with the data, since most defaults occur in recessions. The fact that the central planner maximizes the collective welfare, the relative power of the groups, i.e., η, does not affect the optimal decision, therefore, the price schedule and default decision rule are the same using different η's.

Figure 22- Bond price schedule: Unified government

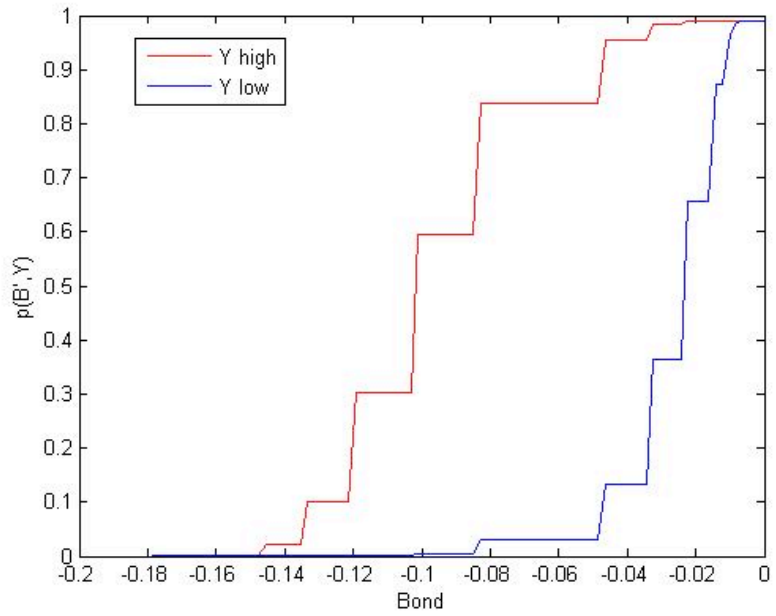
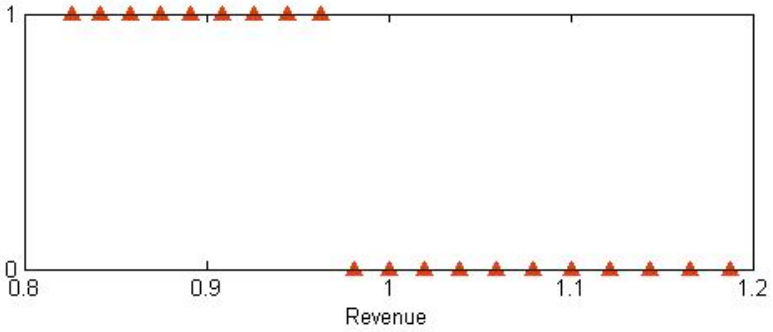


Figure 23- Default rule: Unified government



Figures 24 and 25 correspond to the case of countries with a low degree of polarization, that is η=0.5 . Compared to the unified government case, bond price is lower for any given *Y* and *B'*. This is because default probability is higher for countries with a polarized government; to compensate for the higher default risk, interest rate is higher (bond price lower). Price zero means there is no market for bonds at that level because at that level of debt, default probability is one. This is known as the default set. Comparing Figure 8 to Figure 10, the default set is larger in the case of the polarized government than the unified government.

Figure 24- Bond price schedule: Polarized government (η=0.5)

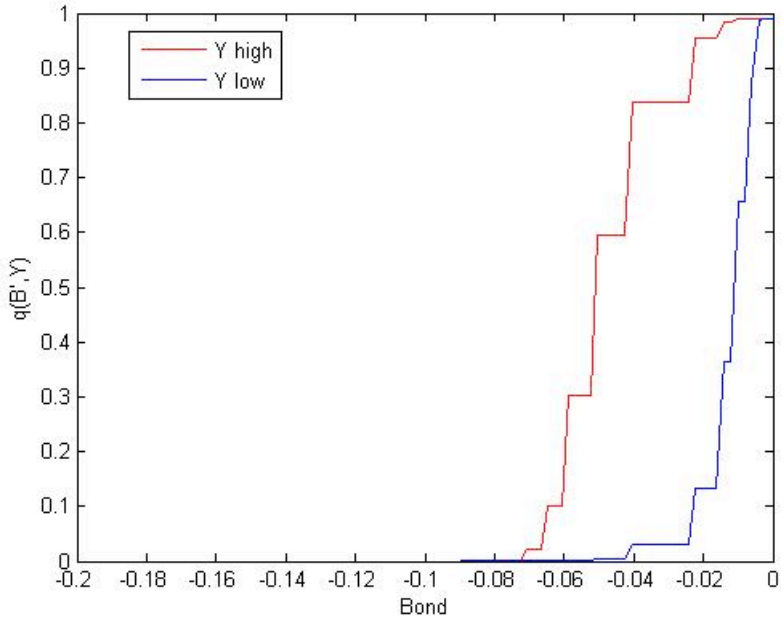
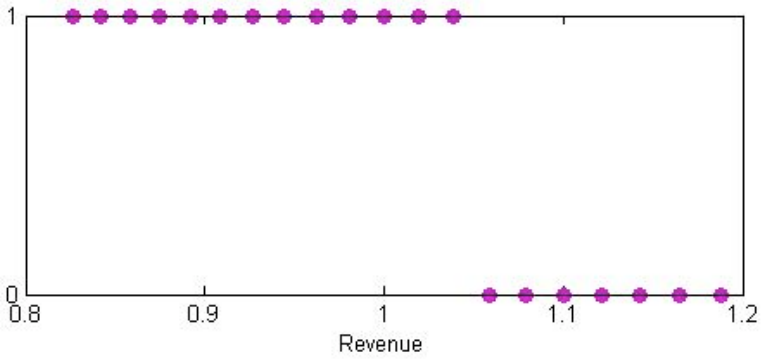


Figure 25- Default rule: Polarized government (η=0.5)



Comparing Figure 23 to Figure 25, countries with a polarized government default in more states of the revenue shock than countries with a unified government at any given level of debt. Figures 26 and 27 show the case of countries with high degree of polarization, $\eta = 0.1$. The default set becomes even larger and there are more states of revenue in which default is optimal.

Figure 26- Bond price schedule: Polarized government (η=0.1)

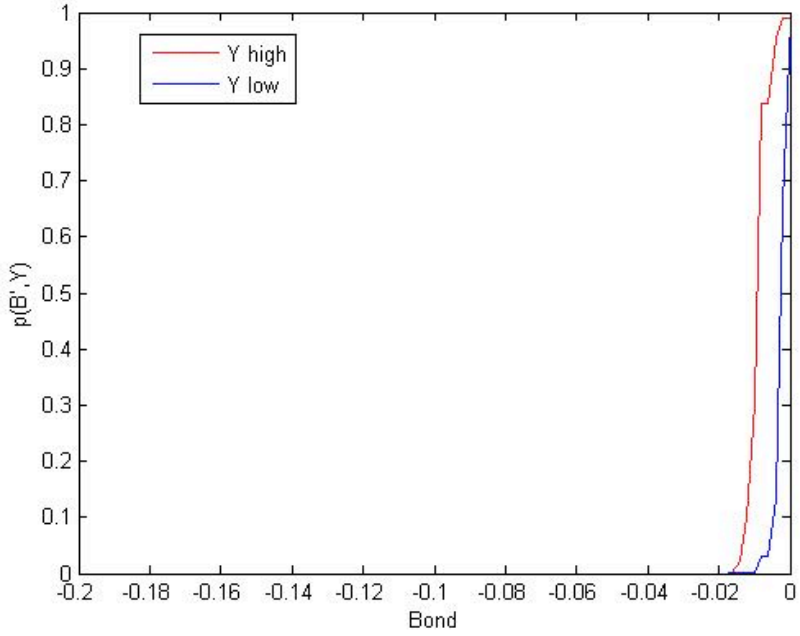
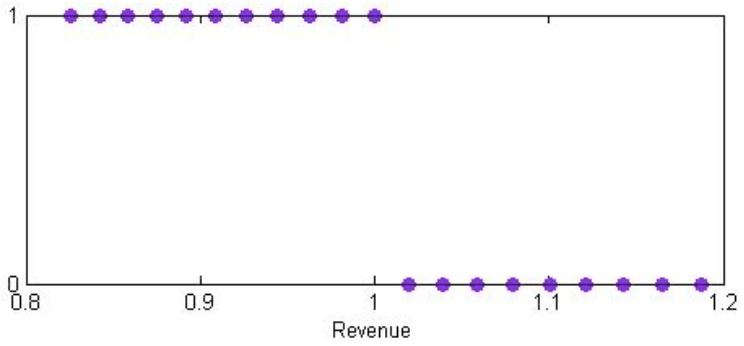


Figure 27- Default rule: Polarized government (η=0.1)



In order to study the long-run default probabilities, we simulate the model 10,000 periods 100 times for the unified government case and for the polarized government cases. We compare simulation results with the data. The average polarization in the data given that there is some degree of polarization (η≠0) is 0.34; the corresponding standard deviation is 0.28. We divide the sample into four groups:

i) countries without polarization ($\eta=0$); ii) countries with low polarization ($\eta<0.12$); iii) countries with medium polarization ($0.12\leq\eta<0.34$), and iv) countries with high polarization ($\eta\geq0.34$). We then take the average default probability of each group and compare it to the simulation result. For the simulation, default probability is calculated as number of periods that the country defaults divided to total number of periods that the country has access to the capital market. Autarky periods are excluded.

Results of the two-period model are confirmed in this infinite horizon setting. Simulation results of the model in Table 9 show that the default probability is higher for countries with a polarized government. Default probability in the unified government case is 1.78%, lower than the polarized government case, 2.64%. Furthermore, default probability is increasing in the degree of polarization. At low degree of polarization, the default probability is 2.04%, at medium degree 2.56% and at high degree 3.34%. Compared to the data, our model explains more than 70% of the observed default frequencies for each polarization group. Note that for the simulations we use are the same set of parameters values for both unified and polarized government cases; the only differences are the institutional quality and the degree of polarization. In the data, the heterogeneity among countries are more than these two, which in principle accounts for the remaining 30%.

Table 9- Summary Statistics of Default Probabilities: Simulations Results

	Default Probability (in percent)	
	Data	Simulation
Unified government	2.29	1.78
Polarized government		
Low (η=0.5)	2.45	2.04
Medium (η=0.3)	3.27	2.56
High (η=0.1)	4.76	3.34

Note: in the data, unified government are countries with zero polarization; polarized government with low degree of polarization are countries with polarization below 0.12; polarized government with medium polarized are countries with polarization between 0.12 and 0.34 and polarized government with high polarization are countries with polarization above 0.34.

2.6 Conclusion

We have provided an explanation for the cross-country differences in sovereign default frequencies. The key factor that determines the likelihood of default in this paper is the institutional setting. If institutions set clear rules to limit the influence of powerful groups in central government's spending and borrowing decisions, the central planner solution that maximizes collective welfare can be achieved. If such institutions do not work properly, individual behaviors of powerful groups lead to an inefficient equilibrium in which default occurs more often. Furthermore, given that powerful groups do not coordinate in the polarized government case, more polarization results in higher default probabilities.

In the two-period model, we showed that a country with a unified government is less likely to default than a country with a polarized government. This is because in the unified government case, there is either good institutions that limit the influence of powerful groups in the central government's decisions or that the groups can coordinate; thus, the central planner's solution that maximizes the collective welfare can be achieved. In contrast, in a polarized government, each powerful group makes

decisions ignoring the effect of its action on other groups. As a result, suboptimal choices are made and default is more likely.

Numerical simulation of the infinite horizon model succeeds in showing the cross-country difference in terms of default probability and degree of polarization. We are able to match the empirical positive relationship between degrees of polarization and default probabilities using standard values for the parameters.

One policy implication of the paper is that efforts of international organizations to help serial defaulters to prevent future sovereign debt crisis should not only provide assistance in designing better fiscal policies, but most important, should tackle the root of the problem: institutions. Chapter 1 of this thesis shows that the IMF program does not necessarily halt the ultimate crisis. In many cases, countries default within three years of an IMF bailout. The notorious example is Argentina, which received large bailout packages in 2000 and again in 2001, but nevertheless defaulted in 2002.

Our results show that if there are institutions that limit the influence of powerful groups in central government's debt and fiscal policies, the central planner's solution that maximizes the collective welfare can be reached. If such institutions are absent, individually optimal behavior by each group translates into an inefficient equilibrium in which the default risk is higher and it increases with the degree of polarization. However, how to set the framework and make it effective would be country specific. For example, in the case of Argentina, the failure of the system is that there is centralized tax collection but spending and borrowing decisions are decentralized. This fiscal asymmetry causes a spending and borrowing bias because of the negative externality in the presence of multiple decision-makers. To correct the

institutional failure and eliminate the negative externality in this case would be either to centralize financing (borrowing and tax collection) and spending decisions, or to decentralize them.

Appendix A

Table A1- Average duration of crises

	External Default		Inflation		Banking	
	Median	Average	Median	Average	Median	Average
World	8	15.1	1	2.3	1	2.5
High income	9	20.7	1	1.6	1	1.7
Middle and Low*	4	14.1	1	2.4	3	4.0
Latin America	9	14.6	1	3.2	2	2.7

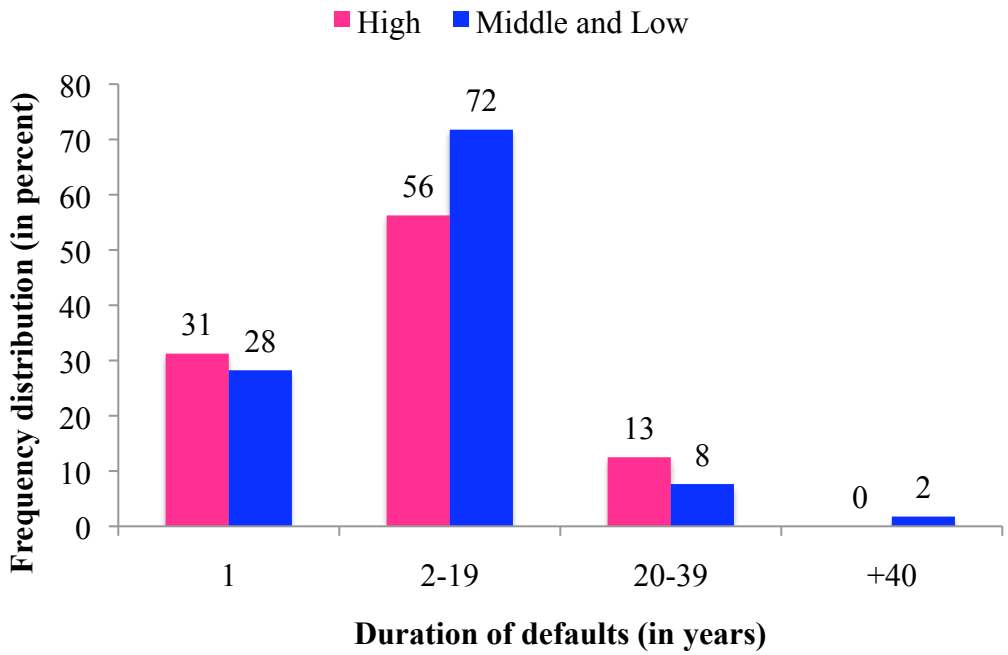
* Excluding Latin America

Note: Duration of a default crisis is calculated as number of years between the starting year and end year of the crisis. For example: Argentina had defaulted in 1982 and it didn't resolve it until 1993. In this case, the duration of this episode of default crisis is 12. Inflation crisis dating is straightforward per definition in text. As Reinhart and Rogoff (2009) note, dating the end of banking crises is very difficult, though in any event, they are typically relatively short.

Sample coverage: 198 episodes of default crisis (high income: 28, middle and low: 170); 462 episodes of inflation crisis (high income: 166, middle and low: 296); 201 episodes of banking crisis (high income: 108, middle and low: 93).

Sources: Reinhart and Rogoff (2008), sources cited therein and authors' calculations.

Figure A1
Duration of external default crises
Frequency distribution (in percent): 1800-2008
High vs. Middle and low income

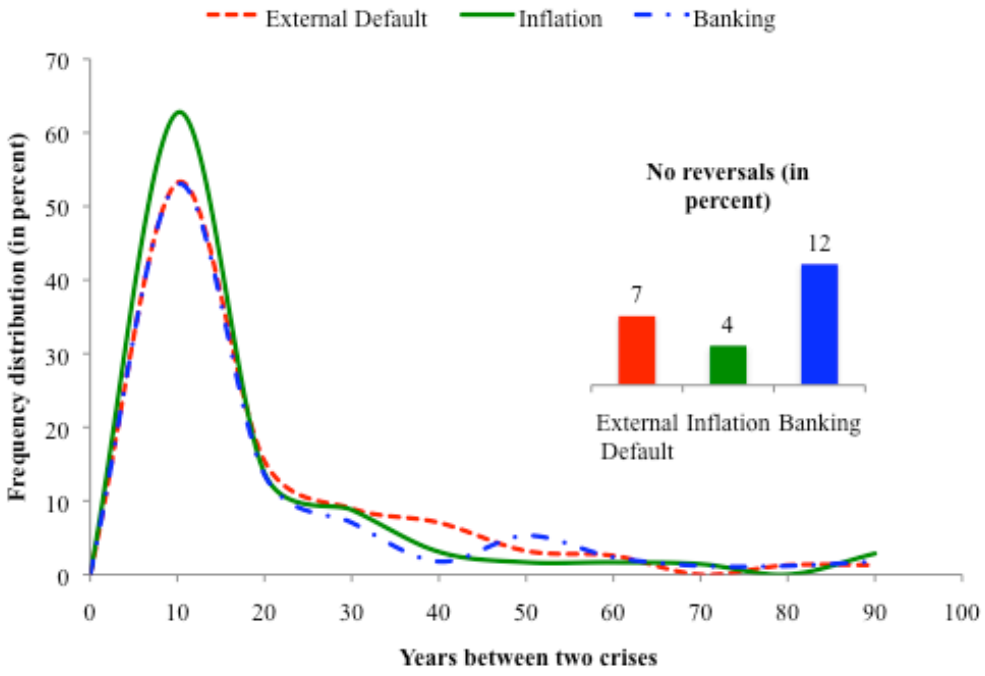


Note: Duration of defaults is calculated as number of years between start of a default crisis and the year that is resolved. The end of a default episode is considered as the year the country regains access to the capital market. In other words, as long as the country is excluded from the international capital market, it is not considered as having resolved its default crisis.
Sample coverage: 218 episodes of default crisis (high income: 32, middle and low: 186).
Sources: Reinhart and Rogoff (2008) and authors' calculations.

Table A2- Default episodes that began after and during severe wars

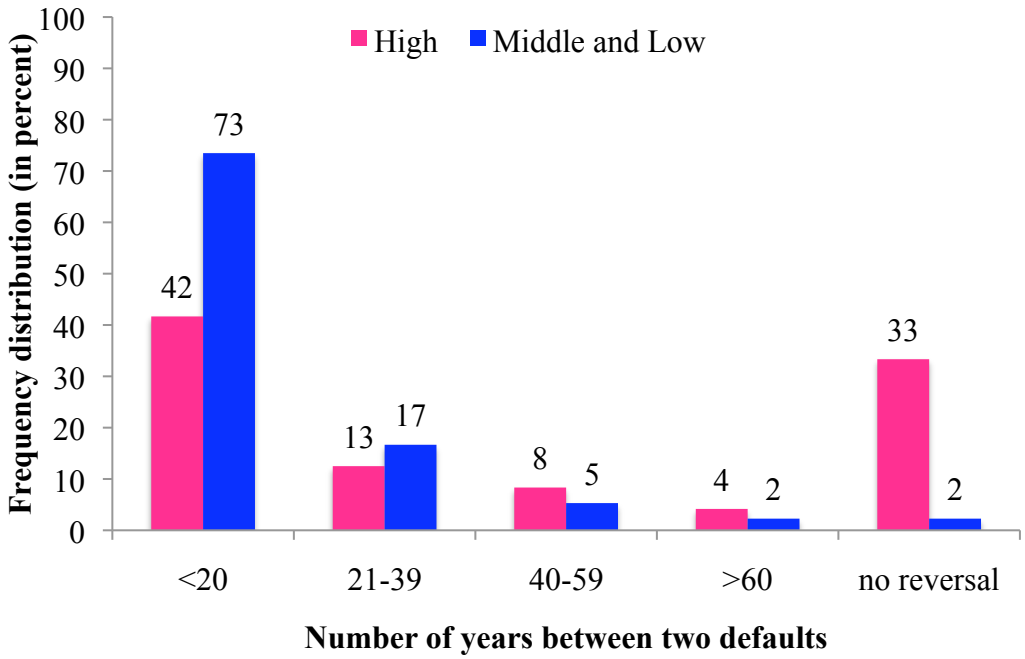
Country	War Start	War End	War name	death_pop (%)	Default 1st year
Angola	1975	1991	Angolan Civil War	5.57	1985
Colombia	1899	1903	Colombia vs. Liberals of 1899	2.60	1900
Germany	1939	1945	World War II	4.39	1939
Guatemala	1961	1996	Guatemalan Civil War	1.14	1986, 1989
Hungary	1941	1945	World War II	1.46	1941-1967
Japan	1941	1945	World War II	2.41	1942
Mexico	1910	1914	Mexico vs. Liberals &Radicals	1.65	1914
Nicaragua	1978	1979	Nicaragua vs. Sandinistas	1.45	1979
Paraguay	1932	1935	Chaco	3.91	1932
Turkey	1914	1918	World War I	1.75	1915
Venezuela	1859	1863	Venezuela vs Liberals	1.35	1860

Figure A2
Duration of "tranquil times" conditional on having had at least one crisis
Frequency distribution (in percent): 1800-2008
Excluding defaults started after and during severe wars.



Note: See figure 7 in text.

Figure A3
External default crises*: Duration of "tranquil times" conditional on having had at least one crisis
Frequency distribution (in percent): 1800-2008
High vs. Middle and Low income



* Excluding default episodes started after and during severe wars.
Note: See corresponding figure 8 in text
Sources: Reinhart and Rogoff (2009), sources cited therein and authors' calculations.

Appendix B

Default reversal: Note on hazard rate analysis

Definition

The hazard rate is the probability of a country having a crisis at time t+1 given that it has not had a crisis at time t. The hazard rate is calculated conditioned on the length of time since the last crisis. Thus we are looking at the subset of countries that had at least one crisis event (default in this particular calculation). For example: Country A had a default crisis in 2001 and it ended in 2003. The hazard rate of crisis in 2010 for country A indicates the probability of having a crisis in 2010 conditioned on it being crisis free for 7 years.

The nonparametric analysis makes no assumptions about the shape of the hazard function or about how variables affect it. Instead, the hazard function is estimated based on the data, using the Kaplan-Meier (1958) method. (KM is a descriptive procedure for time-to-event variables, commonly used when time is considered the only salient variable).

Figure B1 shows the hazard rate of default reversal for the entire sample (167 episodes). The vertical axis indicates the probability of having a default crisis and the horizontal axis indicates years since the end of the last default episode. For less than 60 years, the hazard rate declines with the length of the crisis-free spell. That is, the longer the country remains crisis-free, the lower the probability of it having another default crisis. But there is a break in year 60. After 60 years of being crisis-free, the hazard rate increases with the length of time. This suggests that there might be a

default crisis cycle every 60 years or it might be an artifact of the sparseness of the sample if countries that go 60 years without a crisis.

Figure B1
Hazard rate of default reversal: Full sample

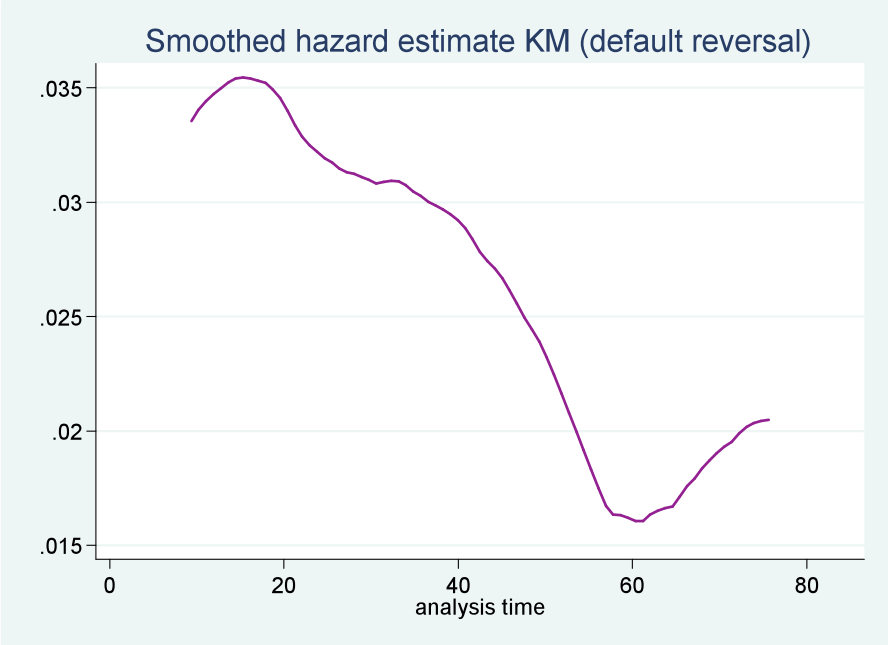
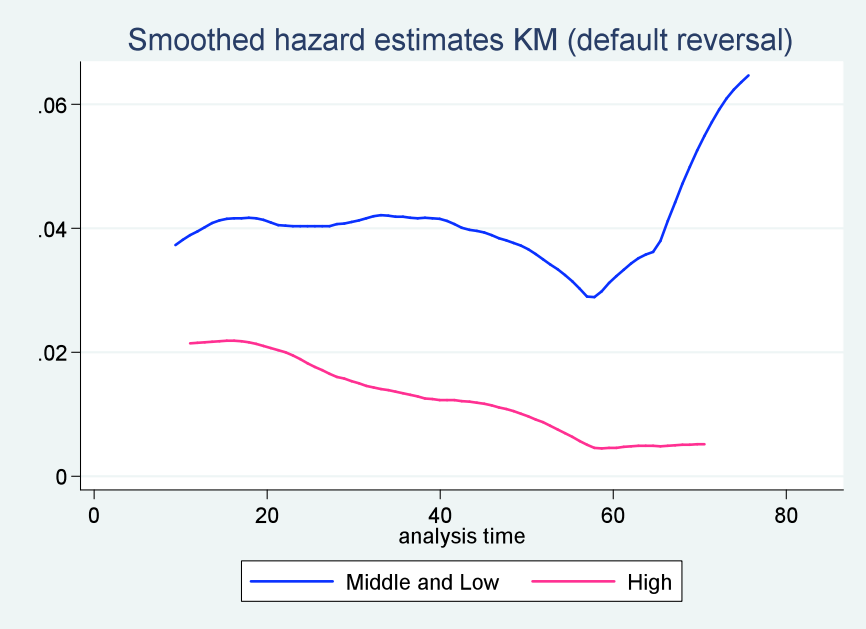


Figure B2 separates the sample by income level. For high income countries, the hazard function monotonically decreases with respect to the length of tranquil time, approaching zero when the country has been crisis-free for more than 60 years. However, for middle and low income countries, the hazard function slightly declines in the first 60 years of tranquil time, but it starts to increase after year 60. This means, for countries that had been crisis-free for more than 60 years, the hazard rate of having another crisis increases every year, indicating a default cycle is highly probable for this income group. One explanation for such a pattern in the middle and low income group is that once a long period of time has passed since the last crisis, countries become more vulnerability to a "This Time is Different Syndrome", with

policymakers and investors not paying sufficient attention to indicators of crisis vulnerability.

Figure B2
Hazard rate of default reversal: High vs. Middle and Low income



Parametric analysis specifies the shape of the baseline hazard function as well as how the covariates affect the hazard function. We assume proportional hazard models. Covariates are assumed to raise or lower the hazard function in a multiplicative way.

The baseline hazard function is Weibull, which encompasses a baseline hazard function that may be flat like exponential models, monotonically increasing or decreasing. We use as covariates: Lag world share of countries in default crisis and three dummy variables: i) being in a severe war the year of crisis reversal; ii) pre 1914 and iii) income level equals 1 for all high income countries and 0 for rest of the world.

Table B1 reports the results of the parametric analysis. The coefficients have the usual interpretation: an increase of 1 percent in share of countries in default crisis

during the previous year increases the hazard of default reversal by roughly 2 percent. Both severe war and pre-World War I have coefficients close to zero and are not significant. Being a high income country decreases the hazard of default reversal by 0.23 percent point, however, this change is too small to be significant. The hazard ratio shows the qualitative effect of covariates to hazard rates. When it is greater than 1, it increases the hazard rate, when it is less than 1, it decreases the hazard rate and when it equals 1, it does not affect the hazard rate. Alpha measures the rate of change over time of the hazard rate. In this case, alpha equals to -0.11 indicating a decline of hazard of about 11% per year. Finally p measures time dependence. For p less than 1, there is negative time dependence, meaning the longer the country stay in tranquil time (crisis-free), the lower the hazard of default reversal may occur.

Table B1- Parametric analysis: hazard rate of default reversal

Variable	**Weibull model**	
	Coefficient	Hazard ratio
Lag share of countries in default	2.04	7.68
	(0.02)	
Severe war	0.05	1.05
	(0.87)	
Pre-World War I	0.09	1.10
	(0.61)	
High income	-0.23	0.79
	(0.29)	
cons	-2.79	
alpha	-0.11	
p	0.90	

Note: Lag share of countries in default is the percentage of countries in default crisis the year before the default reversal; severe war is a dummy variable that equals to 1 if the country that had default reversal was in severe war (defined as death to population larger than 0.8%); High income is a dummy variable that equals to 1 if the country that had default reversal is a high income country. In parenthesis we report the p-value.

Appendix C

Proposition 1: $\forall\ \eta$, *i*) the default probability, *ii*) the level of total debt, and *iii*) the equilibrium interest rate are strictly higher in countries with a polarized government than those with a unified government, that is, $\pi^P > \pi^U, r^P > r^U, B^P > B^U$.

Proof:

i) Comparing (17) to (29)

$$\pi^P > \pi^U \ \textit{iff}\ \beta(1+r)(\eta-2)+2 < 2-\beta(1+r)$$
$$\beta(1+r)(\eta-1) < 0$$

ii) Comparing (18) to (30)

$$B^P > B^U \ \textit{iff}\ \frac{[1-\beta(1+r)(1-\eta)]}{[2-\beta(1+r)(2-\eta)]^2} > \frac{1}{[2-\beta(1+r)]^2}$$

First we will prove show that $\frac{\partial(B^P - B^U)}{\partial\eta} < 0$

$$\frac{\partial(B^P - B^U)}{\partial\eta} < 0 \ \textit{iff}\ \frac{\partial B^P}{\partial\eta} < 0$$
$$\frac{\partial B^P}{\partial\eta} = \frac{\phi Y_2^H [1-\beta(1+r)]\{\beta(1+r)^2[\beta(1+r)(\eta-2)+2]^2 - 2[\beta(1+r)(\eta-1)+1][\beta(1+r)(\eta-2)+2]\beta(1+r)^2\}}{(1+r)^2[\beta(1+r)(\eta-2)+2]^4}$$
$$\frac{\partial B^P}{\partial\eta} < 0 \ \textit{iff}\ [\beta(1+r)(\eta-2)+2]^2 - 2[\beta(1+r)(\eta-1)+1][\beta(1+r)(\eta-2)+2] < 0$$
$$[\beta(1+r)(\eta-2)+2]^2 - 2[\beta(1+r)(\eta-1)+1][\beta(1+r)(\eta-2)+2] =$$
$$= [\beta(1+r)(\eta-2)+2][\beta(1+r)(\eta-2)+2-\{2[\beta(1+r)(\eta-1)+1]\} = (\eta-2)-2(\eta-1) < 0$$
$$\Rightarrow \frac{\partial(B^P - B^U)}{\partial\eta} < 0$$

Since ($B^P - B^U$) is strictly increasing in η, it is suffice to show $B^P - B^U > 0\ \forall\eta$ if $B^P - B^U > 0$ at η=0 and η=0.5.

$$\begin{aligned} B^P - B^U &= [1-\beta(1+r)][2-\beta(1+r)]^2 - [2-2\beta(1+r)]^2 \\ &= 4\beta(1+r) - \beta^2(1+r)^2 - 3\beta(1+r) \\ &= 1-\beta(1+r) > 0 \end{aligned}$$

$B^P - B^U$ evaluated at $\eta = 0.5$

$$
\begin{aligned}
B^P - B^U &= [1-\beta(1+r)0.5][2-\beta(1+r)]^2 - [2-2\beta(1+r)1.5]^2 \\
&= 2\beta(1+r) - \beta(1+r)0.5[4-4\beta(1+r)+\beta^2(1+r)^2] - 1.25\beta^2(1+r)^2 \\
&= 1.5 - \beta(1+r) > 0
\end{aligned}
$$

iii) Given that $\pi^P > \pi^U$, using (9) and (10), it is easy to see that $r^P > r^U$.

Proposition 2: Given that there is polarization in the government, $\forall$ η, *i*) the default probability, *ii*) the level of total debt, and *iii*) the equilibrium interest rate are increasing in the degree of polarization, that is, $\frac{\partial \pi^P}{\partial \eta} < 0, \frac{\partial r^P}{\partial \eta} < 0, \frac{\partial B^P}{\partial \eta} < 0$.

Proof:

i) $\frac{\partial \pi^P}{\partial \eta} = -\frac{[1-\beta(1+r)]\beta(1+r)}{[2-\beta(1+r)(2-\eta)]^2} < 0$

ii) Proved in Proposition 1.

iii)

$$
\begin{aligned}
\frac{\partial r^P}{\partial \eta} &= \frac{\beta(1+r)^2[1-\beta(1+r)(1-\eta)] - (1+r)[2-\beta(1+r)(2-\eta)]\beta(1+r)}{[1-\beta(1+r)(1-\eta)]^2} \\
&= \frac{-\beta(1+r)-1}{[1-\beta(1+r)(1-\eta)]^2} < 0.
\end{aligned}
$$

Appendix D

We use the discrete state-space method. We generate the AR(1) process for revenue with a discrete Markov chain using 21 equally spaced grids. The asset space is discretized into 100 possible values. We make sure that the limits of our asset space never bind.

The computational algorithm used to solve the unified government case is the following:

1. Start with a guess for the bond price schedule such that $q^0(B,Y) = 1/(1+r)$ for all B' and Y.
2. Given the bond price schedule and an initial guess for $V_U^{D,0}$ and $V_U^{R,0}$, iterate on the Bellman equations (37) and (38) to solve the optimal value function for $\widehat{V}_D^U, \widehat{V}_R^U$, $\widehat{V}^U = \max\{\widehat{V}_D^U, \widehat{V}_R^U\}$ and the optimal policy functions.
3. We compute a new bond price schedule $q^1(B,Y)$ using default sets and repayment sets such that lenders' zero profit condition is satisfied. We then compare the new bond price schedule to the previous iteration's. If a convergence criterion is satisfied, that is, $\max\{q^0(B,Y) - q^1(B,Y)\} < \varepsilon$ then proceed to the next step. Otherwise, update the price and go back to step 2.
4. Compute default probabilities from 10,000 periods.

The computational algorithm used to solve the polarized government case is the following:

1. Start with a guess for the bond price schedule such that $q^0(B,Y) = 1/(1+r$ for all B' and Y.

2. Given the bond price schedule and an initial guess for $V_{Pi}^{D,0}$ and $V_{Pi}^{R,0}$, iterate on the Bellman equations (41) and (42) to solve the optimal value function for $\widehat{V}_D^{Pi}, \widehat{V}_R^{Pi}$, $\widehat{V}^{Pi} = \max\{\widehat{V}_D^{Pi}, \widehat{V}_R^{Pi}\}$ and the optimal policy functions for each i=1,2.
3. We compute a new bond price schedule $q^1(B,Y)$ using default sets and repayment sets such that $\pi^P = \max\{\pi^{Pi}\}_{i=1}^2$ and lenders' zero profit condition are satisfied. We then compare the new bond price schedule to the previous iteration's. If a convergence criterion is satisfied, that is, $\max\{q^0(B,Y) - q^1(B,Y)\} < \varepsilon$ then proceed to the next step. Otherwise, update the price and go back to step 2.
4. Compute default probabilities from 10,000 periods.

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