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ABSTRACT

This paper uses a data set of over two hundred years of sovereign debt, banking and inflation crises to explore the question of how long it takes a country to "graduate" from the typical pattern of serial crisis that most emerging markets experience. We find that for default and inflation crises, twenty years is a significant market, 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 paper raises the important theoretical question of why countries experience serial default, and how they might graduate.

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I. 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 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.

[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.

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

[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.

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 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

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

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 certainly increased countries' resilience to "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.

II. 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% we and others 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]

[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".

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.

III. 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

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

"peripheral" advanced countries such as Spain and 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	
WWI begins 1913			frequent in advanced and emerging
WWII ends 1945		rare in advanced **and** emerging	
post-1945			
1964			rare
1973			frequent in advanced and emerging
early 1980s		more frequent in advanced/serial in emerging	
early 1990s			frequent in emerging
2000	Serial in some emerging markets		rare
2009			
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	**9**
	1770, 1788, 1812	
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, 1845**	**5**
Russia	**1839**	**1**
Spain	**1557, 1575, 1596,**	**10**
	1607, 1627, 1647	
	1809, 1820, 1831, 1843	
Sweden	**1812**	**1**

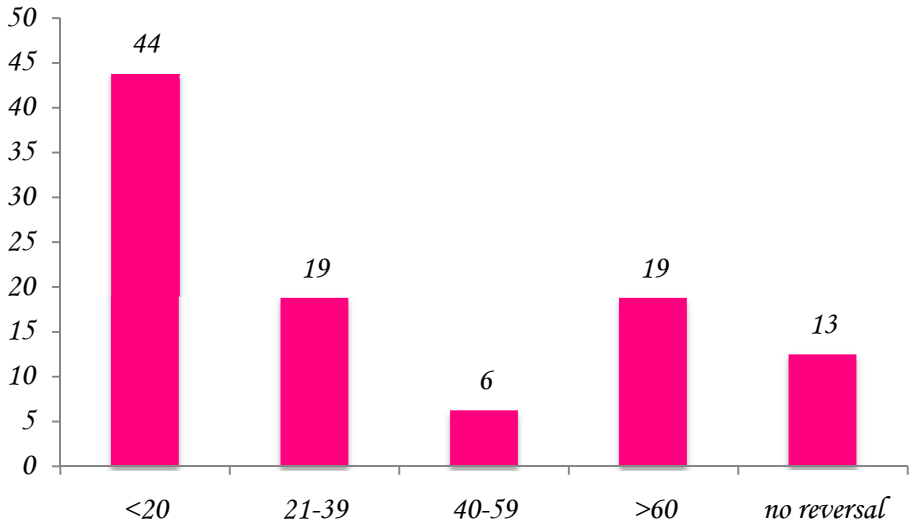
Sources: Reinhart, Rogoff and Savastano (2003), Reinhart and Rogoff (2009) and sources cited therein. The "*" for England denotes our uncertainty at this time about whether its default involved external (as opposed to purely domestic) debt. The table excludes Greece (which gained independence in 1829). 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.

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.

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.

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.

IV. 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.

[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.

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]

Appendix 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 on 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.

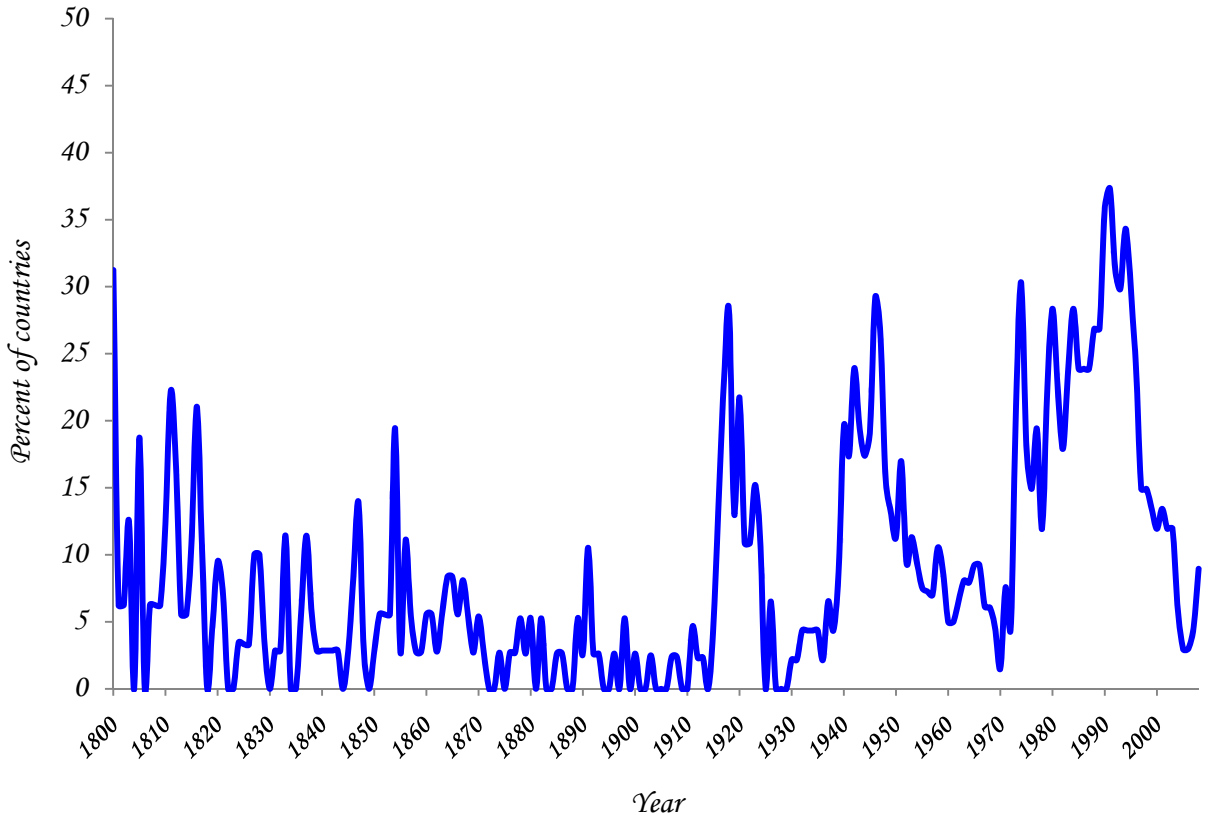
Figure 2 gives the share of countries in inflation crisis over the same period. Note the huge rise in inflation crises starting after World Wars I and II, again in the 1980s and early 1990s. The very recent history of low inflation throughout most of the world indeed represents a major shift from the preceding 80 years. It remains to be seen whether inflation is a scourge

[8] Interestingly, as we showed in the appendix to the conference version of this paper, 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.

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.

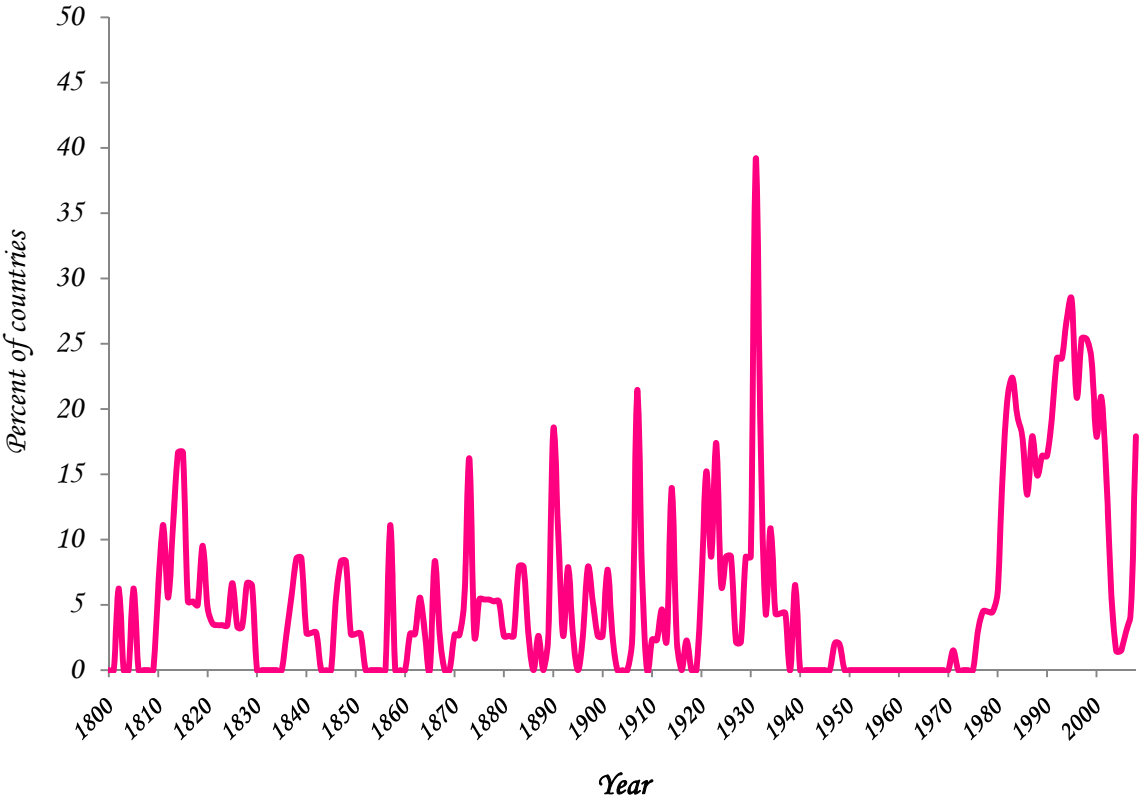
Figure 2
Share of countries in inflation crisis: 1800-2008
World



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

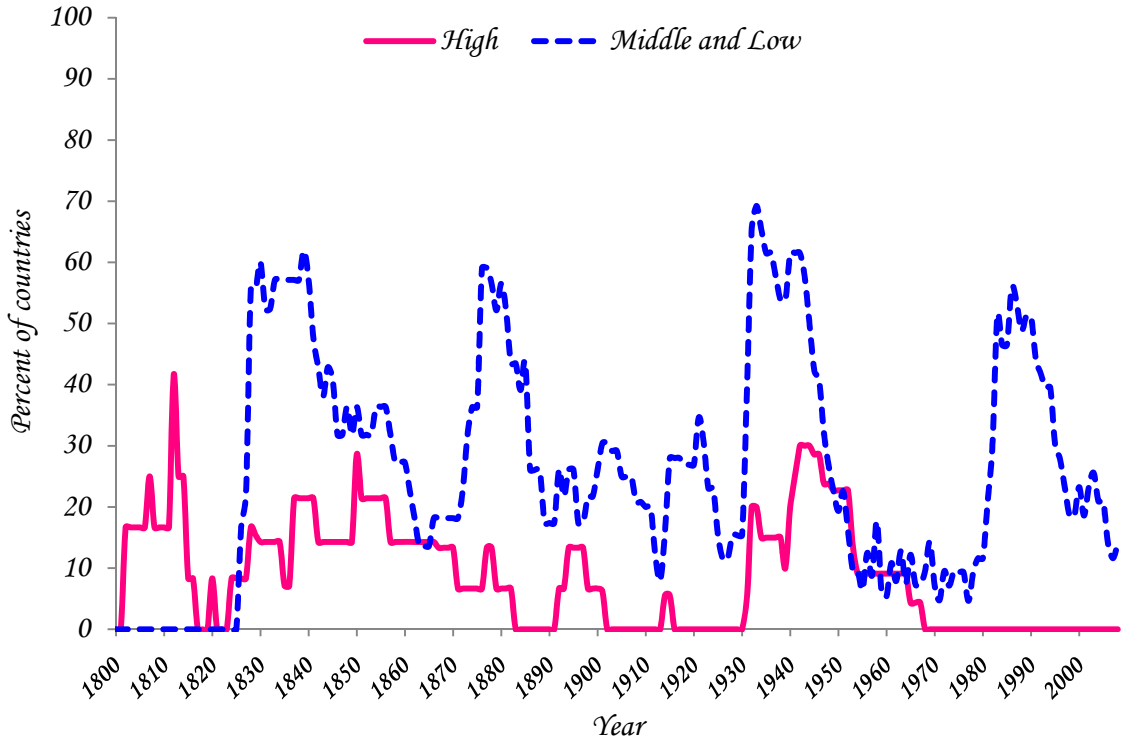


Sample coverage: 66 countries that were independent in the given year.
Sources: Reinhart and Rogoff (2009), sources cited therein and authors' calculations.

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



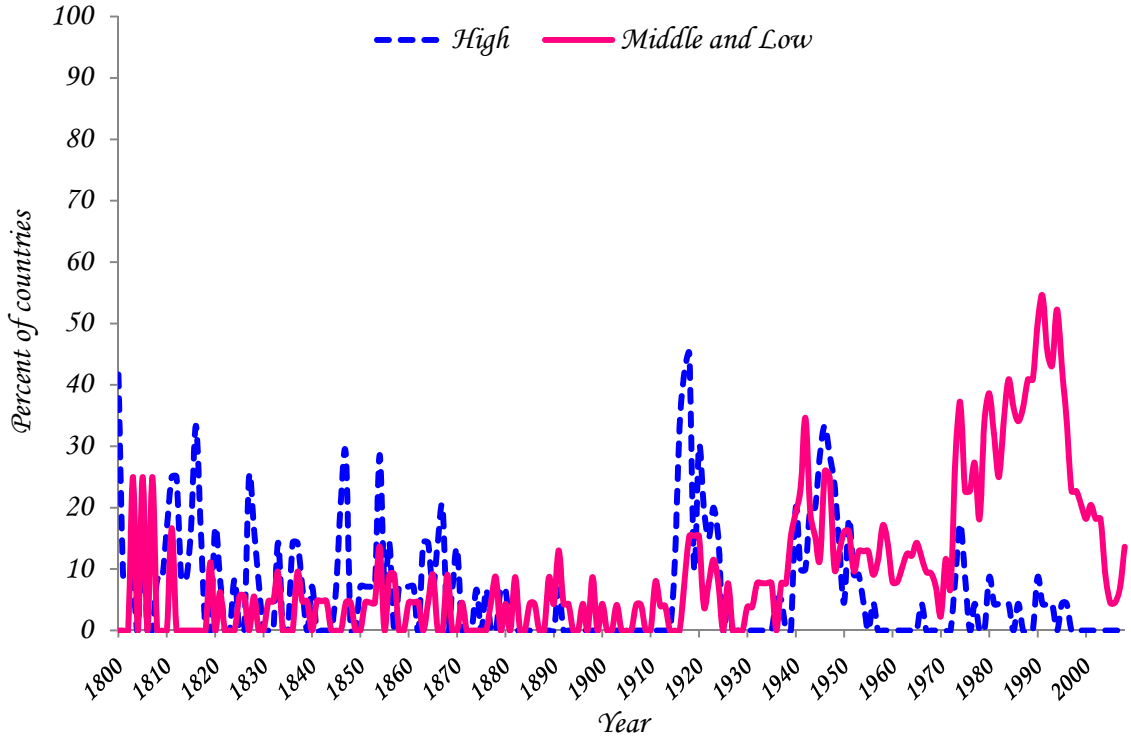
Sample coverage: 66 countries (23 high income and 43 middle and low income countries) that were independent in the given year.
Sources: Reinhart and Rogoff (2009), sources cited therein and authors' calculations.

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



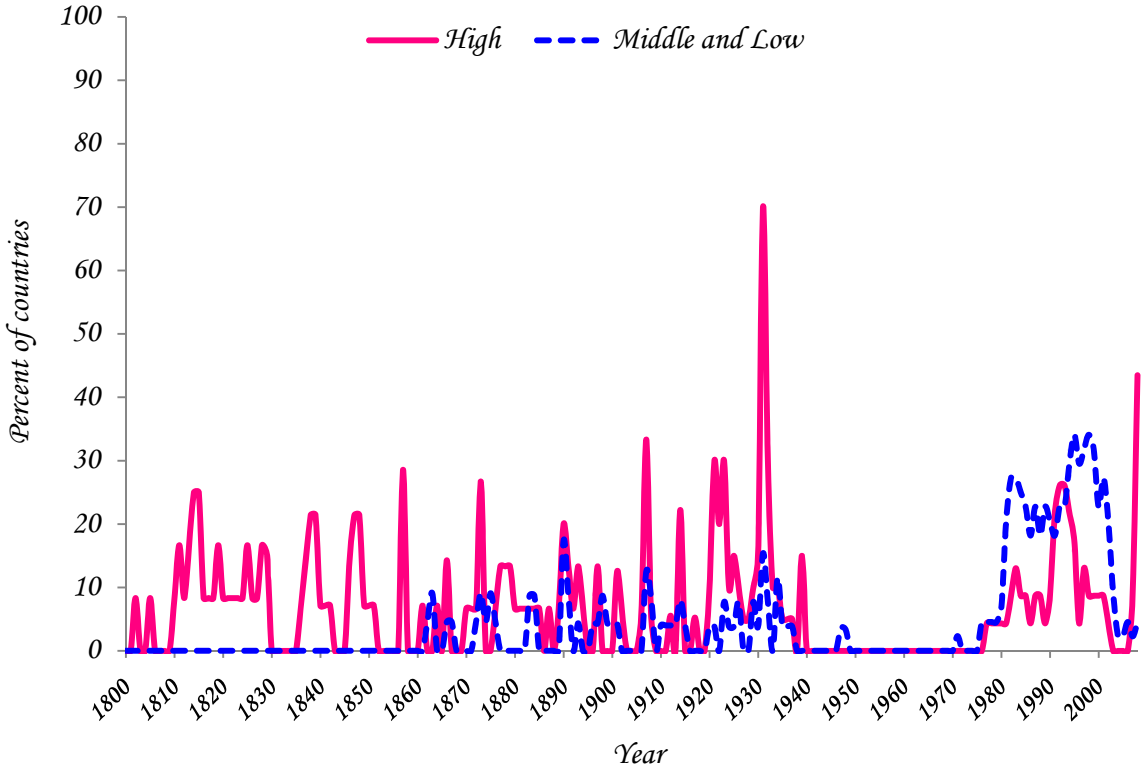
Sample coverage: 67 countries (23 high income and 44 middle and low income countries) that were independent in the given year.
Sources: Reinhart and Rogoff (2009), sources cited therein and authors' calculations.

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.

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.

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

V. 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, which in principle allow for conditioning on a broader range of variables.)

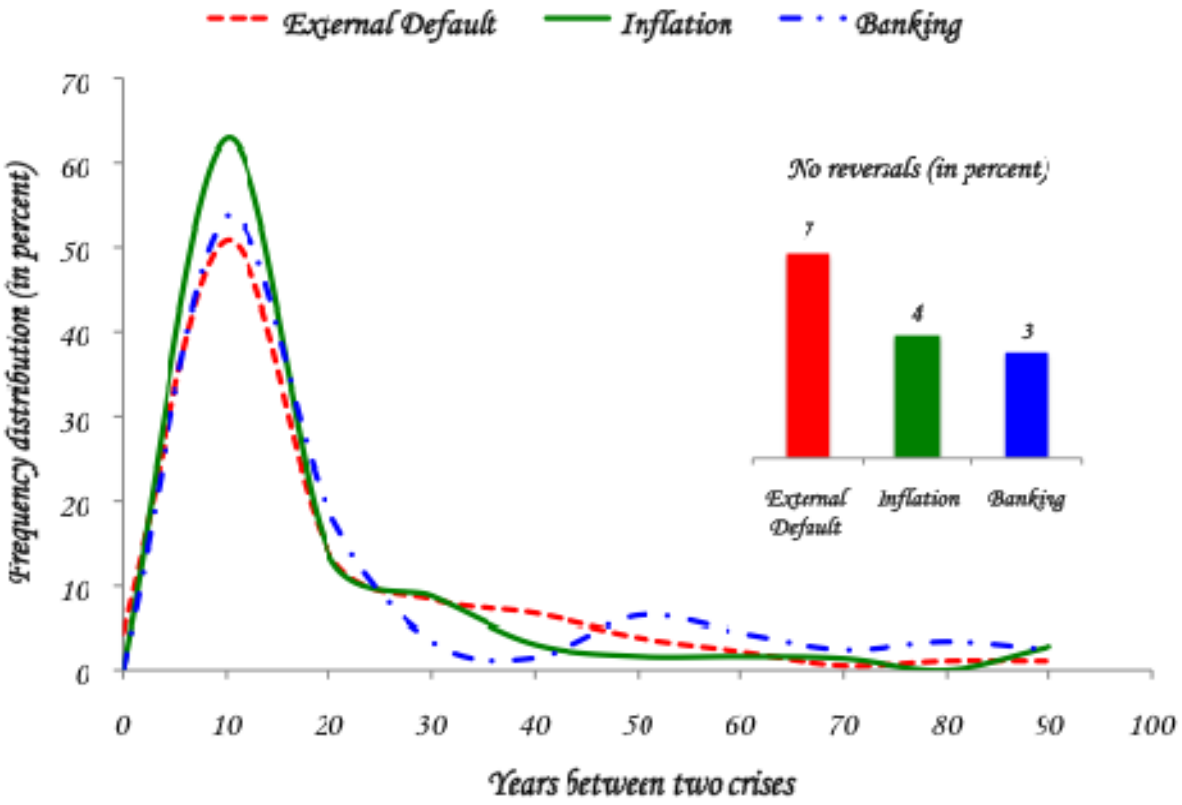
In figure 7, we look at the frequency distribution of "tranquil" periods, how long before one crisis episode stops and the next crisis starts. The figure gives the statistics separately for external default, inflation and banking crises. The frequencies shown are conditional on having had at least one 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

[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.

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

Crisis reversal and duration

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. In other words, Argentina had default reversal in 7 years.
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.

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

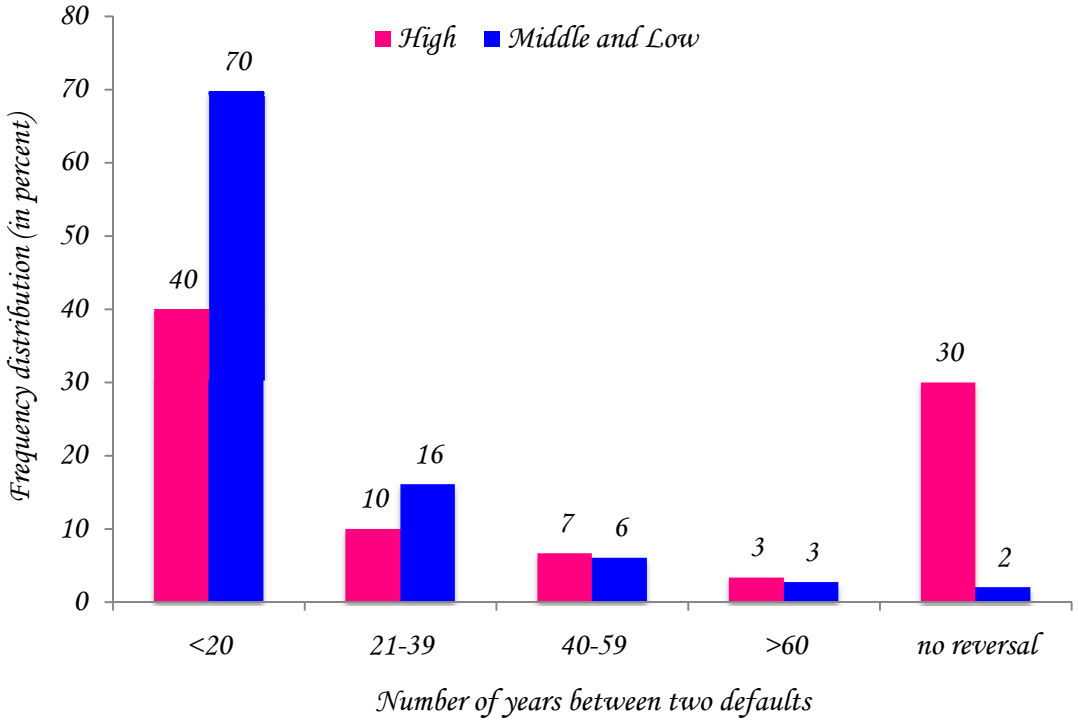
The conditional frequency of recidivism (conditional on a crisis recurring) is broadly similar across different types of crises. Twenty years without a default, banking or inflation crisis is hardly evidence of "graduation". But it does appear to be a notable break, where the odds of recidivism over 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.

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.

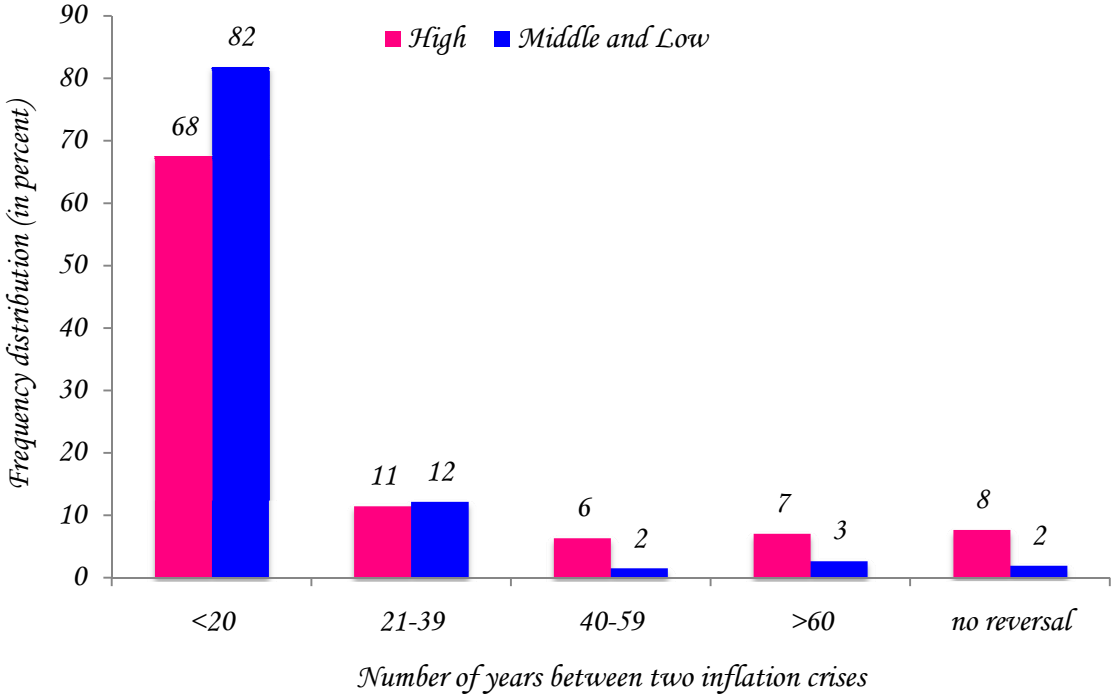
[11] The bars in figures 7-9 add to less than 100% because they excludes episodes where there has not yet been recidivism, but where the 50 year cut-off for "no reversal" has not yet been reached.

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



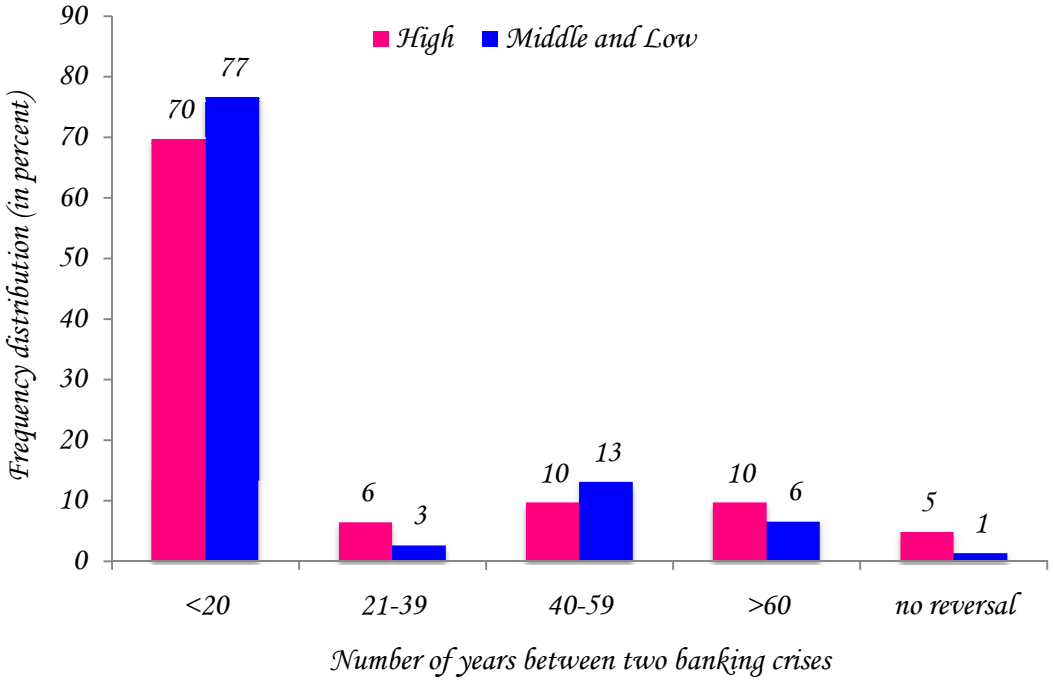
Note: Duration of tranquil time is calculated as number of years between two consecutive default episodes. The end of a default episode is considered as the year the country regains access to the capital market. In other words, as long as the country is excluded from the international capital market, 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.

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, 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

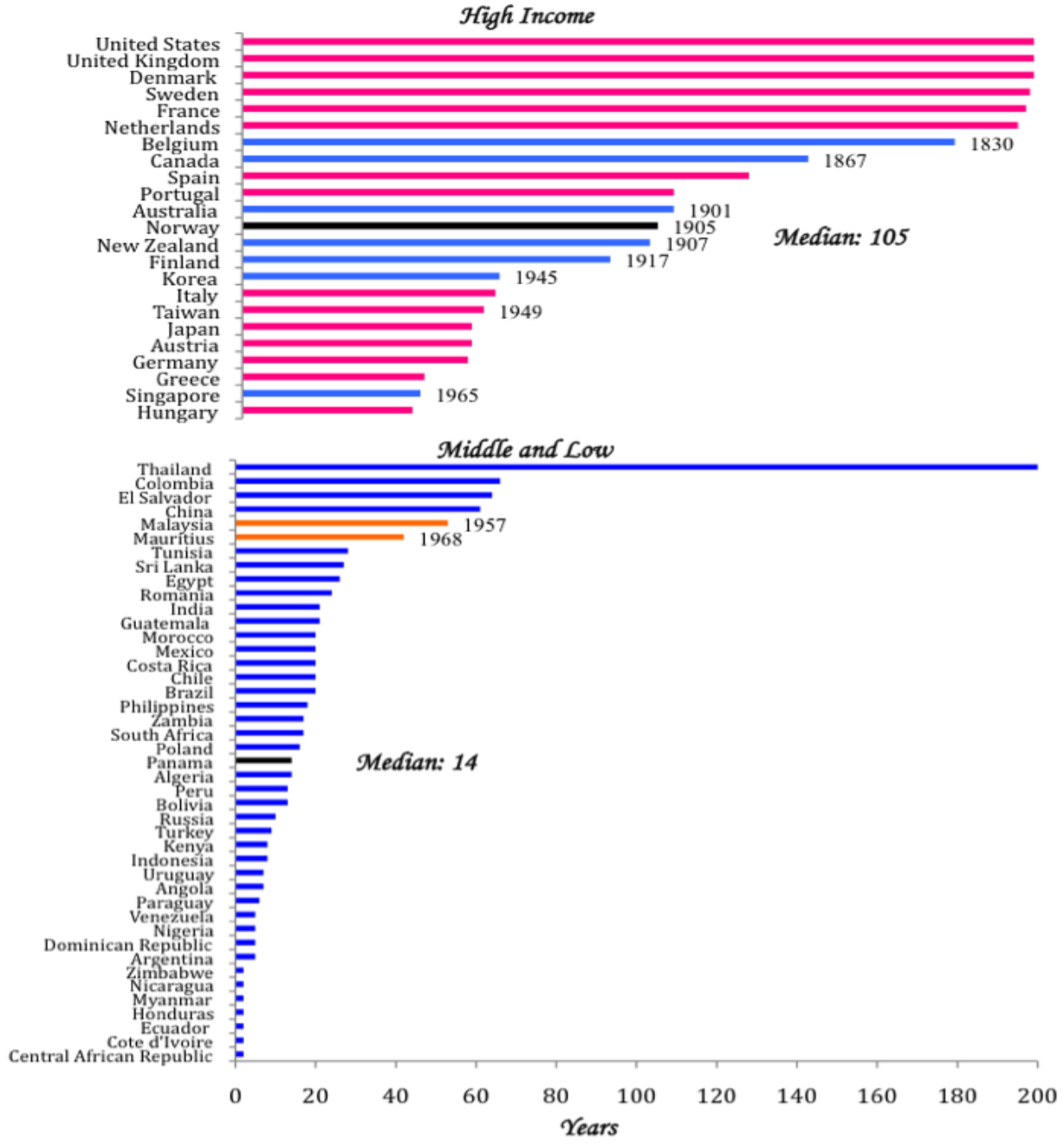
not entirely clear that this measure is more meaningful than the simpler one of the text; further study is needed.

VI. 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.

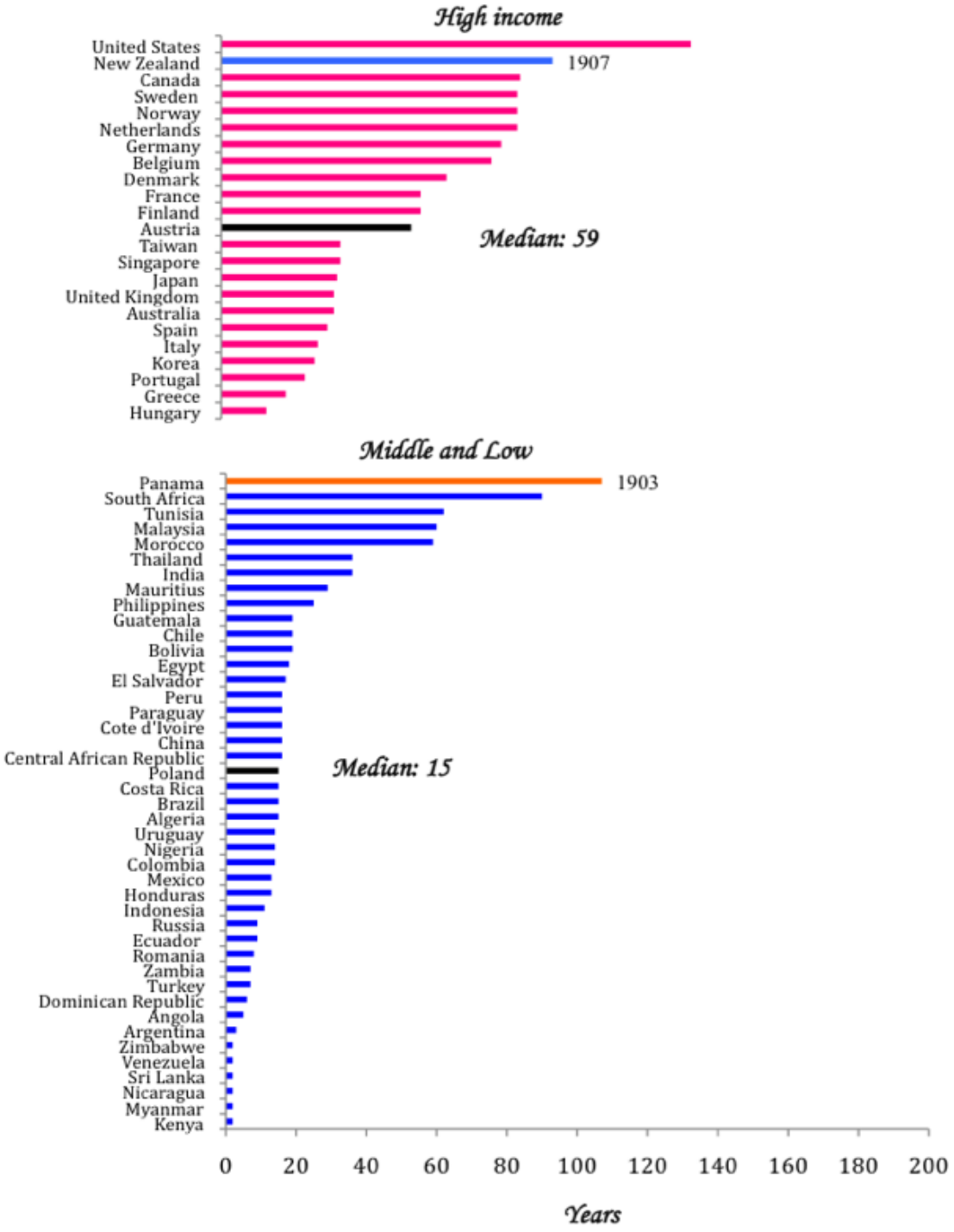
Figure 11
Time elapsed since last external default crisis, 1800 or year of independence in 2010: High vs. Middle and Low



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 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.

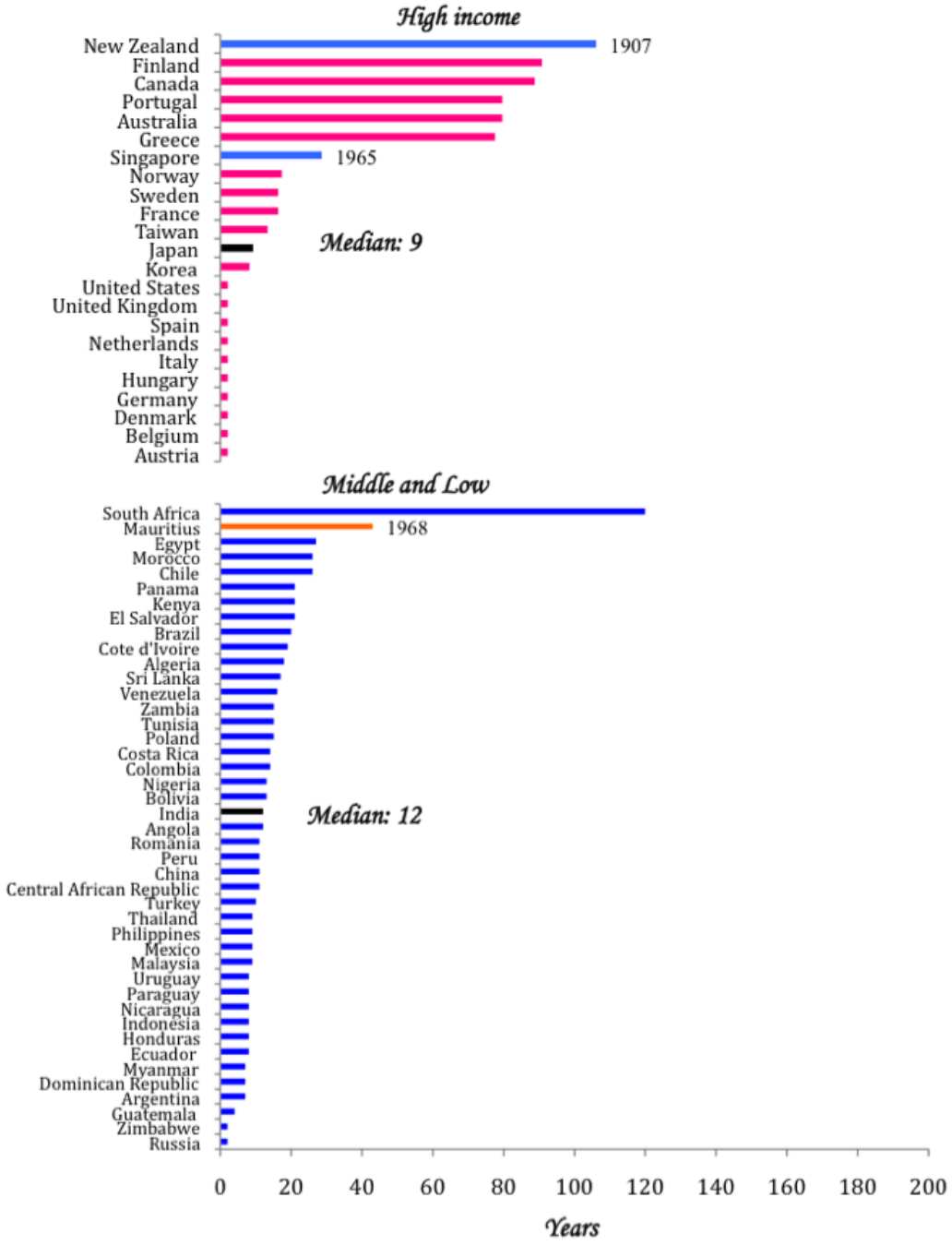
Figure 12
Time elapsed since last inflation crisis, 1800 or year of independence in 2010: High vs. Middle and Low



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.

Finally, for banking crises, the difference between income groups is even smaller. The interesting point is that even prior to the crisis, the distinction between high income countries and the rest of the world was not nearly as large as for other crises.

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



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.

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.

Memo to table 4: Asian countries' median distance to external default crisis is 24, to inflation crisis is 21, and to banking crisis is 9. Latin America countries' median distance to external default crisis is 13, to inflation crisis is 15 and to banking crisis is 10.

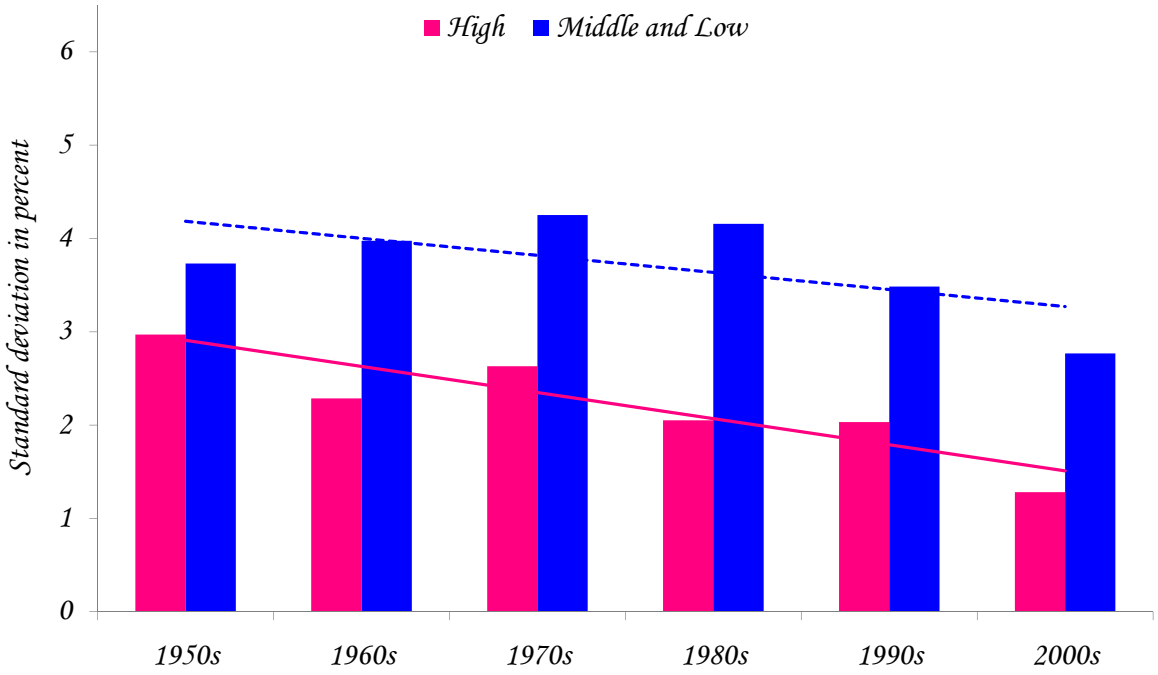
VII. Macroeconomic volatility

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,**

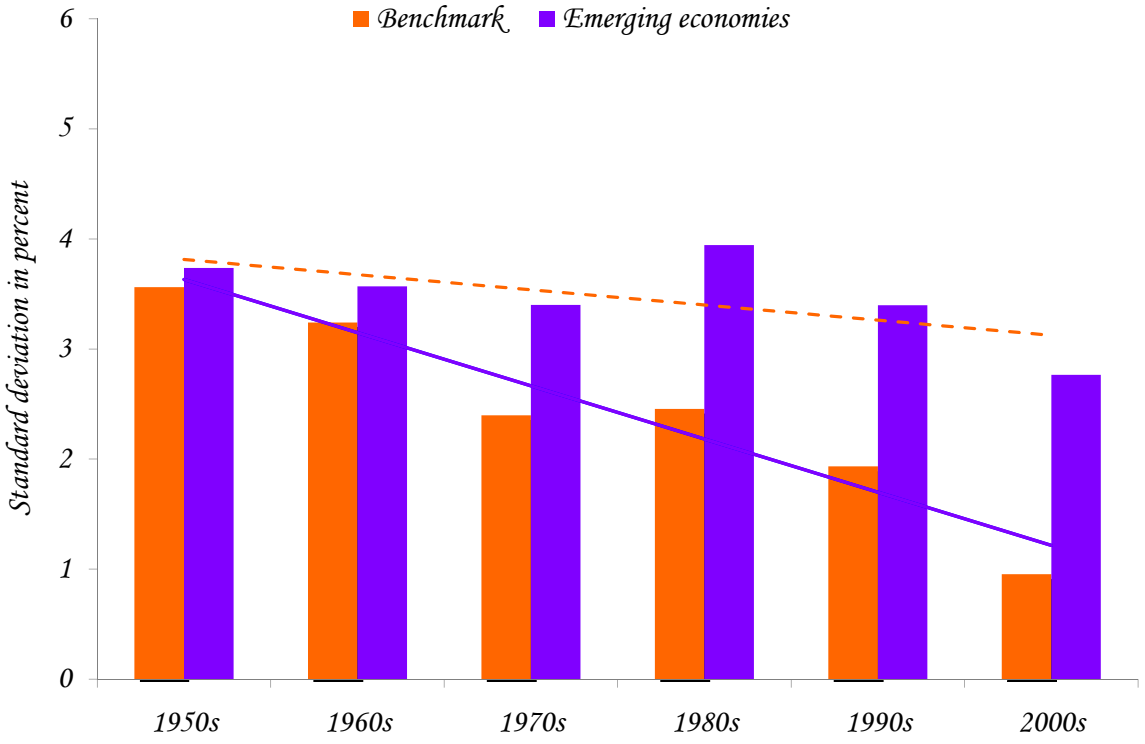
crises and growth" argue that countries that inherited more ‘‘extractive’’ institutions from their colonial past were more likely to experience high volatility, lower growth rate and more economic crises during the postwar period. This is an interesting hypothesis that merits further research, also on 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 Qian (2010). 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.

VIII. 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

[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.

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.

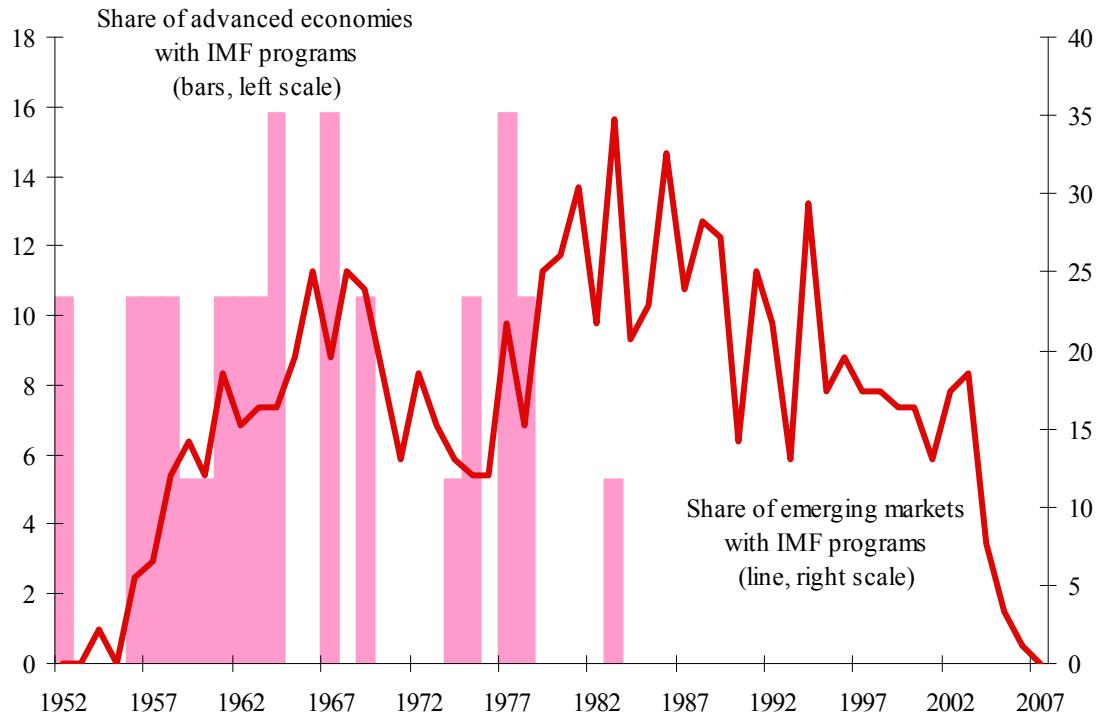
Table 5
Examples of cases where IMF programs are introduced but there is subsequent default

		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

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.

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



Source: Reinhart (2010).

IX. 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 Qian (2010). 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 less (as a percent of their income) or that they should necessarily be more 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.

X. 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.

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Appendix

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

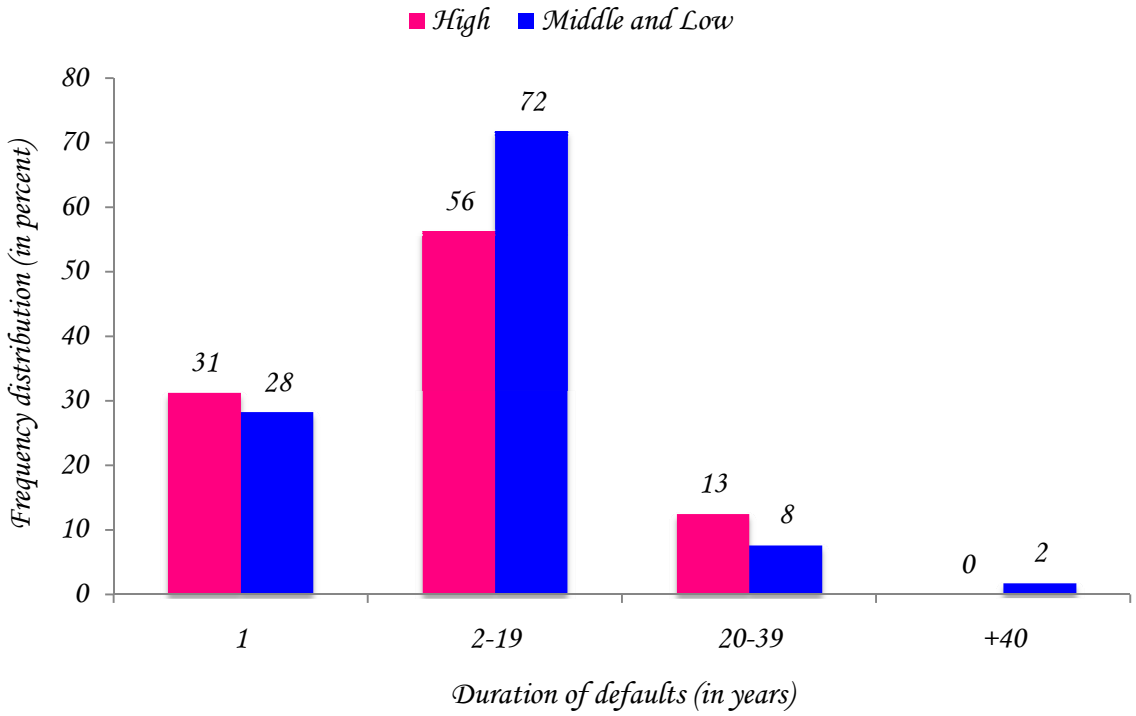
* Excluding Latin America

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

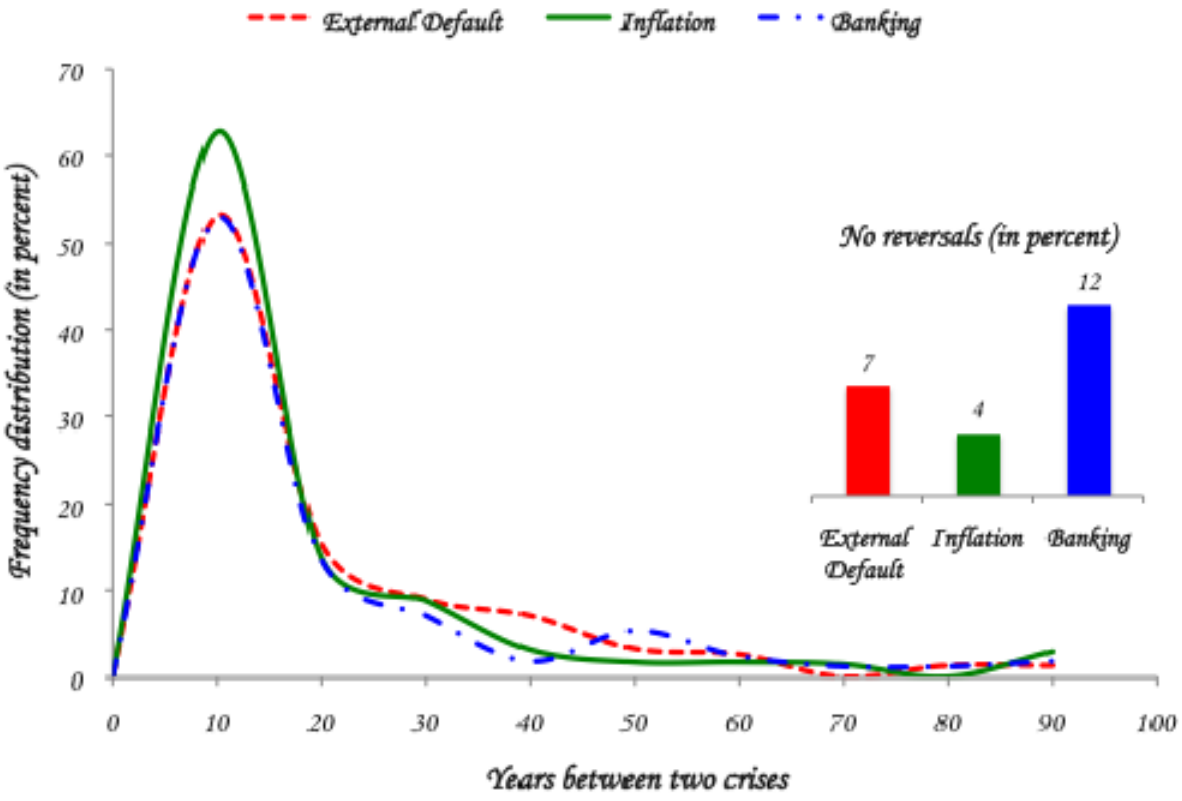


Note: Duration of defaults is calculated as number of years between start of a default crisis and the year that is resolved. The end of a default episode is considered as the year the country regains access to the capital market. In other words, as long as the country is excluded from the international 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 which began after and during severe wars

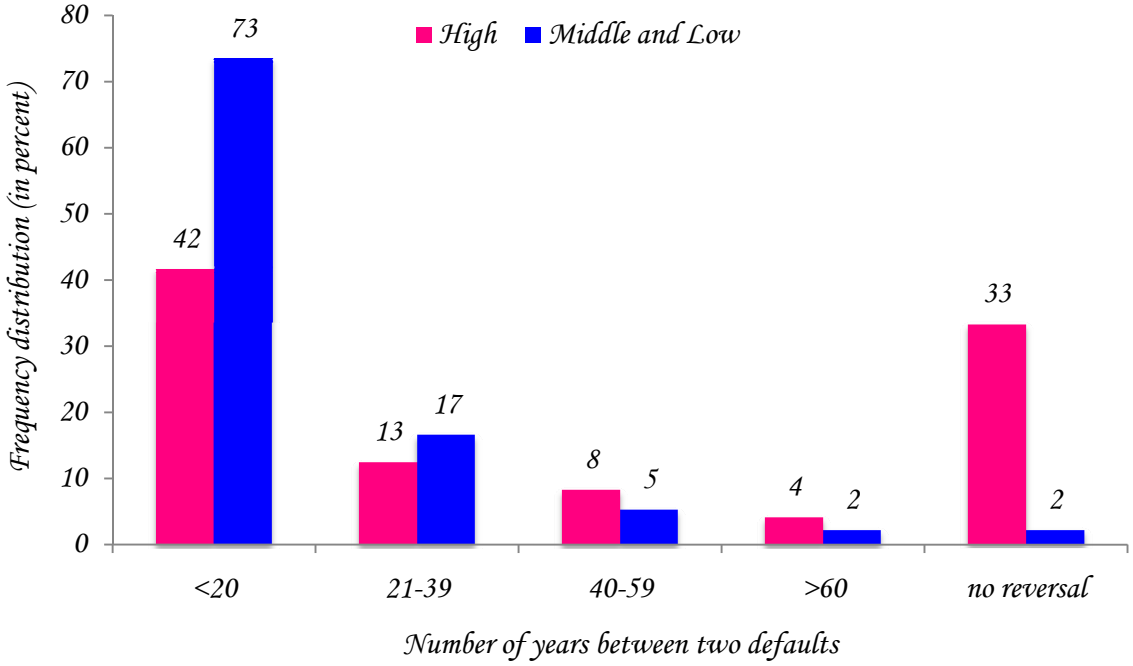
Country	War Start	War End	War name	death_pop (%)	Default 1st year
Angola	1975	1991	Angolan Civil.War	5.57	1985
Colombia	1899	1903	.Colombia.vs.Liberals.of.1899	2.60	1900
Germany	1939	1945	WorldWar II	4.39	1939
Guatemala	1961	1996	Guatemalan.Civil.War	1.14	1986, 1989
Hungary	1941	1945	WorldWar II	1.46	1941-1967
Japan	1941	1945	WorldWar 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.

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 A4
Hazard rate of default reversal: Full sample

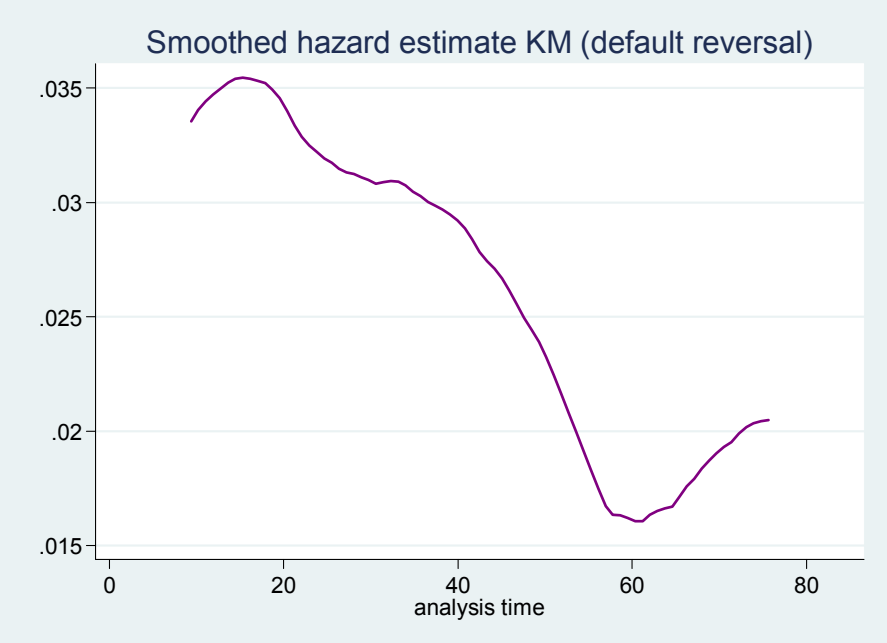
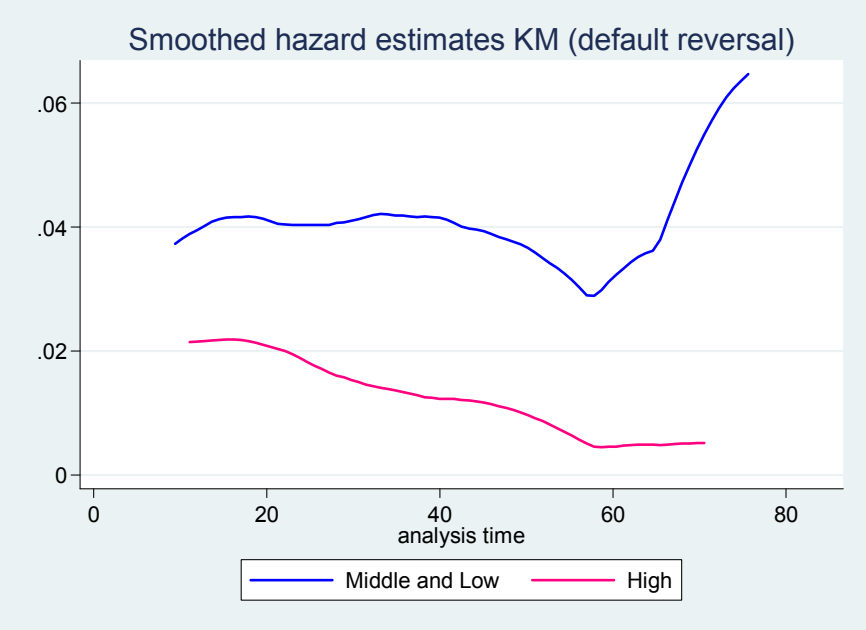


Figure A4 shows the hazard rate of default reversal for the entire sample (167 episodes). The vertical axis indicates the probability of having a default crisis and the horizontal axis indicates years since the end of the last default episode. For less than 60 years, the hazard rate declines with the 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 A5 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 A5
Hazard rate of default reversal: High vs. Middle and Low



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 A3- 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-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.

Table A3 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-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.