$r - g < 0$: Can We Sleep More Soundly?

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PRELIMINARY—WORK-IN-PROGRESS

Abstract

Contrary to the traditional assumption of interest rates on government debt exceeding economic growth, negative interest-growth differentials have become prevalent since the global financial crisis. As these differentials are a key determinant of public debt dynamics, can we sleep more soundly, despite high government debts? Our paper undertakes an empirical analysis of interest-growth differentials, using the largest historical database on average effective government borrowing costs for 55 countries over up to 200 years. We document that negative differentials have occurred more often than not, in both advanced and emerging economies, and have often persisted for long historical stretches. Moreover, differentials are no higher prior to sovereign defaults than in normal times. Marginal (rather than average) government borrowing costs often rise abruptly and sharply, but just prior to default. Based on these results, our answer is: not really.

1 Introduction

Standard economic models assume that the interest rate is higher than the growth rate of the economy. In applications to countries' public finances, if economic growth exceeds the cost of government borrowing, the government can just roll over its debt, and the debt-to-GDP ratio will decline without the need to increase taxes. Economists have recently started rethinking whether the assumption of a positive interest-growth differential is sufficiently grounded in empirical experience, and what the implications of relaxing such assumptions would be. In his 2019 American Economic Association presidential address, Olivier Blanchard reminded us that the interest-growth differential for government debt has often been negative in the United States. Moreover, differentials have been negative, on average, in a majority of advanced economies since the Global Financial Crisis (GFC) that began in 2008, and they have remained negative even in advanced economies whose economic

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growth has returned to a healthy pace. Policymakers need to weigh such negative differentials against the background of higher public debts than prior to the global financial crisis.[1] In this paper, we provide evidence on the prevalence of negative differentials over the past two centuries in 55 advanced and emerging economies. We also show that differentials in country-years preceding defaults on public debts are no higher than usual, suggesting that interest-growth differentials have no predictive power for government defaults—at least not until it is too late for policies to take corrective actions.

The prevalence of high debt levels and low interest-growth differentials suggests several interrelated questions. First, are the recent low interest-growth differentials unique from a historical perspective? Second, are there any prominent drivers of changes in such differentials? Third, what is the empirical association between interest-growth differentials and sovereign defaults? Can low interest-growth differentials be viewed as strengthening debt sustainability?

In this paper, we address these questions empirically. We begin by assembling data on interest-growth differentials. In previous studies, the best sources of interest-growth differentials are based on marginal borrowing rates from Jordà, Schularick and Taylor (2017) for advanced economies data or author-collected bond-specific data such as Reinhart and Sbrancia (2015). We construct a larger dataset that contains the public finances, average government borrowing costs, and economic growth for 55 advanced and emerging countries over up to 200 years, drawing primarily on Mauro et al. (2015) who had used similar data to analyze the determinants of countries' primary fiscal surpluses. These data refer to the average effective cost of servicing debt (the ratio of the interest bill to government debt), which is the appropriate measure for standard debt dynamics accounting equations.[2] For a somewhat smaller sample, we also use marginal borrowing rates. These react faster to changes in market perceptions, but are an imperfect proxy for future effective interest rates.

We document four empirical regularities. First, interest-growth differentials occur for prolonged periods in history in both advanced and emerging economies. Second, the often-held view that differentials are more likely negative in emerging than in advanced economies stems largely from the period between the first oil shock of 1973-74 and the early 1990s: during that time, the advanced economies liberalized their capital markets and sought to curb inflation by allowing interest rates

[1] Public debts have increased substantially around the world since the outset of the GFC. At end-2018, debt-to-GDP ratios exceeded 100 percent for the advanced economies (the highest since WWII), 50 percent for emerging markets (a level not seen since the early 1980s), and 45 percent for the low-income countries (compared with 30 percent pre-GFC). Rising indebtedness has engendered concerns regarding debt sustainability. Primary deficits are projected to rise in the advanced economies as a result of aging populations, and in emerging and low-income countries as a result of the need to invest in human and physical capital. Policymakers need to assess whether negative interest-growth differentials will be enough to offset such fiscal pressures and ensuing risks.

[2] Based on the government flow budget constraint $d_t - d_{t-1} = \frac{1+r_t}{1+g_t} \cdot d_{t-1} + pd_t \approx (r_t - g_t)d_{t-1} + pd_t$, where d is the public debt as share of GDP, pd is the primary deficit as share of GDP, and g is the nominal growth rate, r is the average effective interest rate on the public debt. For more details of the derivation see, for instance, Escolano (2010).

to rise faster than inflation, whereas the emerging economies continued to use financial repression against the background of high inflation. Prior to the 1980s, the advanced economies engaged in financial repression too, and by the mid-1990s, many emerging economies had also liberalized their financial markets. Third, differentials computed using the average effective interest rate on government borrowing are essentially useless to predict government defaults. Fourth, it is the marginal rate (the interest rate on new government borrowing, or the interest rate on the secondary market) that often rises sharply and abruptly ahead of sovereign defaults, but does so only a few months ahead of such defaults. When documenting these regularities, we explore the role of exchange rate depreciation in the de facto cost of borrowing in foreign currency, although this portion of the analysis is constrained by the limited availability of data on the share of foreign currency public debt in total public debt.

To sum up, can we sleep more soundly as a result of low differentials? For those who lose sleep over possible debt crises, the answer is: perhaps a little, but not really. History teaches us that many crises have occurred after years of low differentials, and that market expectations can turn quickly and abruptly, shutting countries out of financial markets in a matter of a few months.

Related Literature This paper intends to contribute to three strands of literature. First, several studies have analyzed interest-growth differentials for either limited country samples or short sample periods—for instance, Ball, Elmendorf and Mankiw (1995) and Mehrotra and Sergeyev (2019) on the U.S., Escolano, Shabunina and Woo (2017) on advanced and emerging economies, and Turner and Spinelli (2011) on OECD economies since the 1980s.[3] Some of these studies (Turner and Spinelli (2011), Escolano, Shabunina and Woo (2017)) investigate the reasons for negative interest-growth differentials, such as financial repression, global saving glut, low policy rates, etc., whereas others take negative interest-growth differentials as given and analyze their implications for debt sustainability and fiscal policies (Barrett (2018), Blanchard (2019), Mehrotra and Sergeyev (2019)). This paper extends the empirical analysis by drawing on a rich historical cross-country dataset, giving us a broader perspective on some of the factors underlying variation in interest-growth differentials.

Second, this paper is related to the studies on financial repression and debt sustainability, which gauge the effects of financial repression on debt servicing costs (Giovannini and De Melo (1991), Reinhart and Sbrancia (2015), Reinhart, Kirkegaard and Sbrancia (2011)), or establish the optimal financial repression given sovereign default risks (Chari, Dovis and Kehoe (forthcoming)). Building on these studies, our paper employs new ways to systematically date financial repression—including de jure measures of financial repression and de facto measures based on deviations from UIP or carry trade yields. Utilizing these identified country-year pairs where financial repression prevails, the paper provides better estimates of the impact of financial repression on government borrowing

[3] Our paper focuses on the interest rate for government borrowing, not on the (usually higher) return on capital, which relates to a different literature on dynamic efficiency (e.g., Abel et al. (1989)) or prospects for future inequality (e.g., Piketty (2014)).

costs.

Third, this paper is linked to the studies on debt sustainability and sovereign defaults. Previous work has documented that marginal borrowing costs (interest rates spread) often spike in the run-up to sovereign defaults (for example, Arellano (2008), Broner, Lorenzoni and Schmukler (2013), Abbas, Pienkowski and Rogoff (2019)), typically drawing on data beginning in the 1980s. Our new long time series based on average effective rates allow us to go back to the mid-1800s. We find that differentials can be negative for prolonged periods followed by sudden spikes in marginal borrowing costs that often result in defaults.

The remainder of the paper is organized as follows. Section 2 describes the data. Section 3 reports stylized facts on the prevalence of negative interest-growth differentials in long-run historical data and notes the divergence between advanced and emerging countries is largely confined to 1975 – 90. Motivated by that episode, Section 4 shows that financial repression and inflation account for the difference between advanced and emerging economies' differentials in 1975 – 90. Section 5 explores the potential association between sovereign defaults and the differences between effective (or marginal) interest rates and economic growth. Section 6 concludes.

2 The Data

This paper draws on a dataset consisting of fiscal variables for 55 countries over up to 200 years (Mauro et al. (2015), updated to 2018)—to our knowledge, the most comprehensive dataset currently available for both fiscal flows (including the interest bill) and stocks. We augment these data with information on money market rates, sovereign defaults, and financial market reforms. Our final dataset consists of a cross-country panel over long time periods for interest payments, public debt stocks, gross domestic products, external public debts, money market rates, exchange rates, sovereign default indicators, and policy-based variables on the level of liberalization in financial markets.

2.1 Fiscal Variables

The centerpiece of our data consists of fiscal variables and, in particular, the interest bill from which we compute the effective interest rate on government debt, covering an unbalanced panel of 55 countries (24 advanced economies and 31 emerging economies, using the present-day classification from the IMF's World Economic Outlook classification) over 1800-2018.[4]

An important issue in the construction of long-term fiscal data series relates to the choice of government sector coverage. In order to refer to the most comprehensive sector of government for which they were available, the data at the general government level are collected wherever available. In most cases, general government data are unavailable before 1960—not surprisingly, given that for most countries the share of spending by sub-national governments has risen significantly only since then. As a result, the sector reported switches (in most cases, simultaneously for all variables—including the interest bill and the debt stock—for a given country) from central government to general government in nearly all final spliced series, and this switch generally happens in the 1960s or 70s. Breaks in series are recorded in the database.

The average effective interest rate on debt is computed as the ratio of the interest bill in year t to the stock of government debt (average of debt stocks of year-end t and $t-1$) from the sources above. The marginal cost of borrowing (in most cases, yield to maturity on the secondary market) is compiled from Mauro, Sussman and Yafeh (2002, 2006) for 1870-1914 and Datastream—updated to June 2019.

External public debt comes from a dataset assembled by the IMF staff using the WB-IMF Quarterly Public Sector Debt, OECD Central Government Debt, WEO, Guscina and Jeanne (2006), Morsy et al. (2007), Abbas and Christensen (2010), Abbas et al. (2010), and Abbas et al. (2014). We extend it back to 1970 using the World Bank's International Debt Statistics when possible.

2.2 GDP

For nominal GDP data from the distant past, the main sources are Mitchell and MOXLAD. For most countries, GDP data do not exist before World War I: in these years, GDP is proxied by variables such as Gross National Product or Net National Product from Mitchell's International Historical Statistics. In a few cases, UN statistical yearbooks are used to fill in gaps in coverage between 1940 and 1975. GDP data are drawn from the OECD database for a few member countries beginning as early as 1960. For some countries, such as the United States, the United Kingdom, Italy, the Netherlands, Japan, Canada, and India, GDP is based on government publications or

[4] Half of the observations for the fiscal variables in the dataset are drawn from various cross-country sources, including the IMF's World Economic Outlook (WEO) and International Financial Statistics (IFS) and the OECD Analytical Database for the past 20 to 50 years (subject to availability); the Statistical Yearbooks of the League of Nations and the United Nations (as well as their Public Debt Supplements) for the period between World War I and the 1970s; and Flandreau and Zumer (2004) for the pre-World War I era; in addition, long-run historical series are drawn from Mitchell's International Historical Statistics and the Montevideo-Oxford Latin American Database (MOXLAD). The other half of the data is hand-collected from country-specific sources, such as official government publications or economic histories that included public finance statistics. Examples of such data sources include Fregert and Gustafsson (2005) for Sweden over 1800-2004; Fernandez and Acha (1976) for Spain over 1850 – 1975; and Junguito and Rincon (2004) for Colombia over 1923-2003.

other country-specific sources. Starting in the mid 1990s, GDP data for almost all countries are taken from the WEO. Many sources, both cross-country and country-specific, provided fiscal data already expressed in terms of GDP as well. To ensure the quality of our fiscal and GDP data, we crosscheck with Jordà, Schularick and Taylor (2017) for 17 advanced economies from 1870 to 2016.

Based on the fiscal variables and GDP data, the interest-growth differentials are calculated as the differences between average effective interest rates on debt and nominal growth rates. To take account of the revaluation impact of exchange rate depreciation on public debt denominated in foreign currency, we later allow for depreciation adjustment, and more details can be found in Section 3.3.

2.3 Other Financial Variables

Money market rates, exchange rate. Drawn from Global Financial Data. Money market rate is the 3-month treasury yield in the secondary market, and 3-month interbank overnight borrowing rate is used if 3-month treasury yield not available.

Sovereign defaults. Years of default are drawn from Reinhart and Rogoff (2009) and, for 2009 to 2018, Moody's "Sovereign Default and Recovery Rates, 1983-2018" over 2009 to 2018.

Financial repression. Based on a dataset of financial reforms from Abiad, Detragiache and Tressel (2008), covering 91 countries since 1973. The database recognizes the multi-faceted nature of financial reform and records financial policy changes along seven different dimensions: credit controls and reserve requirements, interest rate controls, entry barriers, state ownership, policies on securities markets, banking regulations, and restrictions on the capital account. Liberalization scores for each category are combined in a graded index that is normalized between zero and one.

3 Interest-Growth Differentials: Empirical Regularities

We begin by exploring the stylized facts of interest-growth differentials, considering the evolution of interest-growth differentials in different time periods and country groups. Given our interest in long-run horizons, our baseline statistics do not include the effect of exchange rate depreciation in the presence of foreign currency debt. At the end of this section, we report the key results using corrected data for the post-1970 period, for which sufficient data on external debt are available.

3.1 The Prevalence of Negative Interest-Growth Differentials in History

Negative interest-growth differentials have occurred more frequently than not over the past two centuries for both advanced and emerging economies.[5] Figure 1 presents the share of years in which the differential was negative, for each of the 55 countries in our sample. Negative interest-growth differentials are the norm, occurring more than half of the time for both advanced and emerging economies. The second feature is the difference across countries groups. Emerging economies are more likely to experience negative differentials: the average likelihood is more than 20 percentage points larger than advanced economies, although as will be shown below this difference stems largely from 1975 to 1995. The differentials are not corrected by depreciation in our baseline presentation. At the end of this section, we note that the key results hold, although the differentials are less negative after depreciation adjustment.

The higher frequency of negative differentials is not offset by the larger size of positive differentials when/where they do occur. As shown in Figure 2, the average and median interest-growth differentials are below zero for both advanced and emerging economies. The interest-growth differentials are about negative 2.5 percentage points for advanced economies on average, and negative 10 percentage points for emerging economies. The medians for both country groups are smaller than the mean, indicating that tail events are frequent.

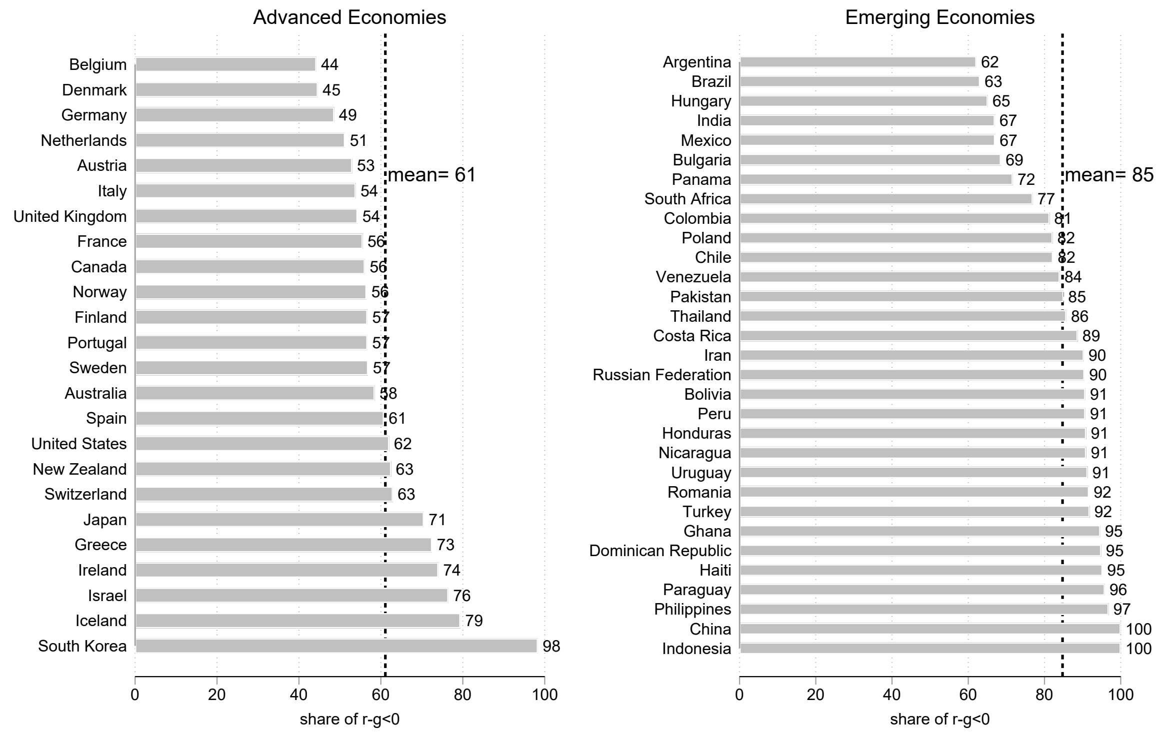
3.2 The Divergence between Advanced and Emerging Economies (1975 – 90)

Interest-growth differentials for country groups vary considerably over time. Average differentials are strongly negative during the two world wars and in the period between WWII and the first oil shock. Indeed, advanced and emerging economy average differentials move closely with each other until around 1975 (Figure 3, 4). From 1975 to 1990, the differentials diverge between the two country groups, and the average gap widens to 20 percentage points at its peak. The gap narrows in the late 1990s, as emerging economies' differentials shrink, and it remains small until the GFC, becoming insignificant thereafter.

This divergence is jointly driven by the gap in inflation rates between the two country groups and the different responses of their nominal interest rates to inflation. As an accounting identity, interest-growth differentials can be decomposed into nominal interest rate, inflation, and real growth differentials. Assessing each component separately, the gap across country groups is largely accounted for by differences in inflation during 1975 – 90, whereas differences in interest rates or real growth are small (Figure 3).

[5] We use these country groups for illustration as customary, fully recognizing that the distinction between advanced and emerging economies is not static throughout: for instance, Australia and Canada were clearly emerging economies in the pre-WWI period.

Figure 1: Share of Years (in percent) with Negative Interest-Growth Differentials, by Country



Note: This chart plots the share of years with negative interest-growth differentials for each country. The sample period with available data depends on the country. The full sample is from 1800 to 2018 for advanced economies and 1865 to 2018 for emerging economies. The dashed vertical line indicates the mean share across countries in each group.

Table 1: Summary Statistics: Interest-Growth Differentials by Time Periods

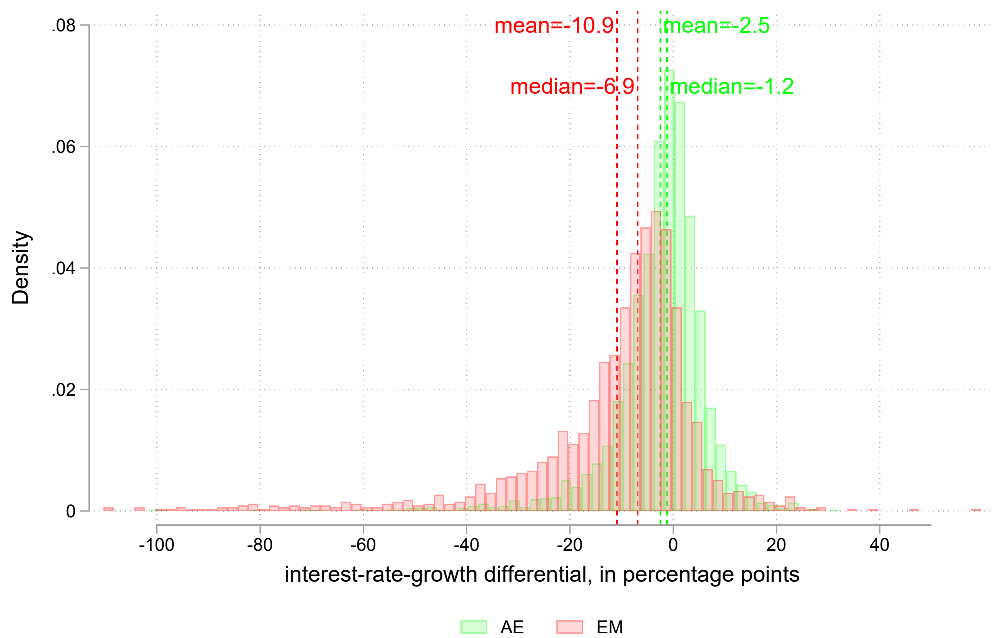
	Full sample		Pre-WWII		Post-WWII		Post-1980		Post-GFC	
	AE	EM	AE	EM	AE	EM	AE	EM		
Mean	-2.5	-10.9	0.7	1.8	-3.3	-12.5	0.0	-11.8	0.6	-5.0
Median	-1.2	-6.9	0.8	2.4	-1.6	-7.5	0.5	-7.0	-0.0	-3.3
StDev	9.5	17.6	7.3	10.6	8.1	17.9	6.1	17.1	3.9	7.9
N	2879	1671	1164	198	1651	1460	901	1013	234	306

Note: This table presents the summary statistics of interest-growth differentials by time periods. AE and EM refer to advanced economies and emerging economies, respectively. Pre-WWII period is from 1800 to 1938, excluding WWI and hyperinflation (top 1 percentile) observations. Post-WWII period is from 1950 to 2018.

3.3 Depreciation Adjustment

For countries that issue public debt in foreign currencies, one important factor driving changes in public debt is exchange rate depreciation, as emphasized by studies on "original sin" (Eichengreen, Hausmann and Panizza (2003)). To incorporate the impact of depreciation where data permit,

Figure 2: Distribution of Interest-Growth Differentials



Note: This chart plots the whole distribution of interest-growth differentials for advanced economies and emerging economies for all the observations (2879 for advanced economies, and 1671 for emerging economies. The vertical lines indicate means and medians, as denoted in the chart.

we calculate the depreciation-adjusted interest-growth differentials in the same way as Escolano, Shabunina and Woo (2017),[6] and check the validity of the previously documented empirical regularities. Although depreciation adjustment provides an additional perspective on debt dynamics, the data on foreign-currency public debt for emerging economies is only available from the 1970s.

The depreciation adjustment increases the level of interest-growth differentials, but it does not overturn the prevalence of negative differentials. For emerging economies, depreciation reduces the share of years with negative differentials, on average, from 85 percent to 73 percent of years (Figure 5). The share of years with negative differentials still lies above 50 percent most emerging economies. Depreciation adjustment also narrows the gap between advanced and emerging economies, but the divergence between the two country groups from 1975 to 1990 remains significant.

[6] The adjusted differentials are obtained by $\widetilde{r_t} - g_t = r_t + \alpha_{t-1} \cdot s_t - g_t$, where α_{t-1} denotes the last period's share of external debt and s_t is the depreciation compared with the last period.

4 The Role of Financial Repression and Inflation in Interest-Growth Differentials

Considering the full historical range, advanced economies experience three major episodes of clustered negative interest-growth differentials: (i) WWI, (ii) WWII and post-WWII until the 1970s, and (iii) the post-GFC period characterized by weak nominal growth but even lower interest rates (Figure 3). Understanding the post-WWII episode and the divergence in differentials between advanced and emerging economies during 1975 to 1990 requires analyzing inflation as well as financial repression, which creates and maintains a captive domestic audience that facilitated directing credit to the government (such as interest rate controls, capital controls, reserve requirements, and government ownership of banks, etc.). In this section, we focus on that 1975 – 90 divergence episode because many policymakers seem to view emerging economies as more prone to negative differentials than advanced economies. Understanding this episode helps to reconfirm that negative differentials are not the sole confine of emerging economies.

Financial repression, in combination with inflation, reduces the cost of debt in significant periods in history. In their study on 12 advanced economies, Reinhart and Sbrancia (2015) find that the savings of annual debt interest payments amounted to up to 5 percent. On a sample of 24 countries, Giovannini and De Melo (1991) estimate that the annual revenue gain from financial repression can be as large as 5 percent of GDP in several countries. This effect is also supported by a comparison of the interest-growth differentials between advanced economies and emerging economies. As shown in Figure 3, before the early 1970s, the two country groups move along with each other, and the gap between their interest-growth differentials is virtually nil. The more negative differentials in emerging than in advanced economies is a phenomenon of 1975 – 90, a period in which the advanced economies liberalized their capital markets, allowing interest rates to rise faster than inflation, whereas the emerging economies continued to use financial repression against the background of high inflation. Prior to the mid-1970s, the advanced economies engaged in financial repression too. By the mid-1990s, many emerging economies had also liberalized their financial markets.

4.1 Interest-Growth Differentials Before and After Financial Liberalization

To assess the role of financial repression more systematically, we begin by identifying the financial repression and liberalization years, based on both de jure measures from Abiad, Detragiache and Tressel (2008) and de facto measures as the structural breaks in the UIP deviations (see Appendix A for more details). Utilizing the identified liberalization years, as a first look, we examine whether financial repression has constrained interest-growth differentials. Essentially, we estimate the gap between the interest-growth differentials before and after financial market liberalization using the following specification:

$$y_{it} = \sum_{j=1}^{5} \beta_j D_{it}^{j} + \gamma D_{it}^{>5} + \lambda_t + \alpha_i + \epsilon_{it} \quad (1)$$

where D^j denote dummies for j years after the liberalization, and y_{it} is the interest-growth differential in country i in year t, λ and α denote country and year fixed effects.

Financial repression years are indeed associated with significantly lower differentials, by 6 to 10 percentage points. As presented in Table 3, several features stand out. First, the liberalization's effect takes time to be reflected in an increase in interest-growth differentials. For instance, interest-growth differentials will not increase until one year after the interest rate controls liberalization. Second, the effects are not transitory. Even five years after the liberalization, the effects are still significantly positive. Third, the de jure and the de facto measures arrive at similar results, not only in the dynamic patterns but also in the estimates' magnitudes.

Table 2: Impact of Financial Liberalization on Interest-Growth Differentials

	interest rate controls	capital controls	UIP dev. actual	UIP dev. PPP based	UIP dev. last 3-period average	UIP dev. last period
1 year	3.699	7.574**	5.562**	5.748**	5.562**	5.748**
	(2.61)	(2.16)	(2.47)	(2.34)	(2.47)	(2.34)
2 years	6.316**	7.710**	7.609**	7.628**	7.609**	7.628**
	(2.68)	(2.59)	(2.72)	(2.52)	(2.72)	(2.52)
3 years	8.142**	5.943	8.249**	7.261**	8.249**	7.261**
	(2.69)	(3.89)	(2.45)	(2.50)	(2.45)	(2.50)
4 years	8.916**	6.595*	8.403***	8.672***	8.403***	8.672***
	(2.82)	(3.53)	(2.34)	(2.24)	(2.34)	(2.24)
5 years	10.094**	8.372**	9.117***	9.020***	9.117***	9.020***
	(3.43)	(3.19)	(2.34)	(2.33)	(2.34)	(2.33)
N	4383	4081	3672	3672	3672	3672
R^2	0.264	0.256	0.274	0.272	0.274	0.272

Note: This table presents the relative level of interest-growth differentials in the subsequent years after financial liberalization, compared with those in the financial repression years. The financial repression years are identified using both de jure (column (1) and (2)) and de facto measures (column (3) to (6)). The de jure measures are based on (Abiad, Detragiache and Tressel, 2008), and the de facto measures are the structural breaks (identified by using Bai and Perron (1998)) in the monthly UIP deviation again U.S. dollars. Different ways to calculate expected future exchange rates are employed when constructing UIP deviations: actual future exchange rate, future exchange rate based on PPP, average over the last three months, and the last month's exchange rate are presented in column (3) to (6), respectively. Country and year fixed effects are included, and the sample is the post-WWII sample. Standard errors are clustered at country level.

4.2 The Impact of Financial Repression Controlling for Other Factors

We augment the previous specification by adding controls on macro variables and common global variables, and focus on financial repression, inflation, and their interaction term.

$$y_{it} = \beta_1 F_{it}^{\text{repression}} + \beta_2 \pi_{it} + \beta_3 \pi_{it} F_{it}^{\text{repression}} + \Gamma \mathbb{X}_{it-1} + \Phi \mathbb{G}_t + \alpha_i + \epsilon_{it} \quad (2)$$

where y denotes the interest-growth differential, or the nominal rate, or the nominal growth rate in different regressions, F_{it} indicates the level of financial repression of country i in year t, and π is inflation. We control for lagged real interest rate and real growth, and contemporaneous global risk factor proxied by Moody's BAA spread. As contemporaneous inflation is a mismeasured proxy for expected inflation, we use lagged inflation as its instrument.[7]

Financial repression significantly suppresses nominal interest rate and constrains its response to inflation, leading to low differentials. On one hand, by de facto restricting the cost of public debt, financial repression by itself reduces nominal interest rates and differentials. The magnitude is sizable—a one standard deviation deterioration in the financial regulation index can lead to about 3 percentage points decrease in nominal interest rates and differentials (see Table 3). On the other hand, in combination with expected inflation, financial repression contains the extent to which the nominal interest rate responds to inflation. In absence of financial repression, inflation would have generated larger increases in nominal interest rates. The significantly negative estimates of the interaction term between inflation and financial repression shows that the impact of inflation on nominal interest rate is partially muted by financial repression.

Another way to identify the effects of financial repression is to employ the long-difference approach. By comparing states that are distant from each other, the long-difference reduces the endogeneity concerns associated with short-term cyclical effects.[8] Our long-difference specification is as follows:

$$y_{i,t,t+5} = \beta_1 FR_{it} + \Gamma \mathbb{X}_{i,t,t+5} + \alpha_i + \epsilon_{it} \tag{3}$$

More specifically, we draw observations every five years and use the five year average interest-growth differentials as dependent variable, and we apply the same procedures for the control variables. For the key variable financial repression, we include its value at the beginning of each five-year window as the initial state. The long lag between the dependent variable and financial repression status helps to address reverse causality concerns that favorable interest-growth differentials is what allows countries to implement financial liberalization policy. As the sample size shrinks significantly in the long-difference setting, we include the significant variables (real interest rate and real growth) in the control set. To include as much variation in financial repression measures with the smaller size sample, we use continuous type indexes of financial liberalization instead of financial liberalization indicator variables. The capital control index is the Chinn-Ito index, and the financial repression

[7]The interaction between financial repression and inflation works largely by the expected inflation. By the Fisher equation, nominal interest rate is the sum of real interest rate and expected inflation. In the absence of financial repression, expected inflation would significantly affect nominal rate. Lagged inflation can serve as a valid instrument for expected inflation (McCallum (1976)): under the assumption of rational expectations, realized inflation π_t is equal to the sum of expected inflation $\mathbb{E}_{t-1}\pi_t$ and a white noise u_t. Therefore, π_{t-1} is correlated with $\mathbb{E}_{t-1}\pi_t$ and uncorrelated with u_t.

[8]This approach has been employed to assess the impact of financial development on growth—for instance, see Chinn and Ito (2006) among many others.

Table 3: Impact of Financial Liberalization on Interest-Growth Differentials

	financial regulations			capital controls		
	$r-g$	nominal r	nominal g	$r-g$	nominal r	nominal g
financial_repression	-8.206*	-7.494*	0.712	-6.322**	-6.133**	0.188
	(4.19)	(3.87)	(0.72)	(2.65)	(2.58)	(0.51)
inflation	0.369	1.249***	0.880***	0.461**	1.404***	0.943***
	(0.31)	(0.28)	(0.04)	(0.18)	(0.17)	(0.02)
repression ×	-0.438*	-0.487**	-0.048	-0.314*	-0.323*	-0.009
inflation	(0.25)	(0.23)	(0.03)	(0.18)	(0.17)	(0.03)
lag_interest_rate	0.968***	0.882***	-0.086***	1.086***	1.047***	-0.038**
	(0.14)	(0.13)	(0.02)	(0.11)	(0.11)	(0.01)
lag_growth	-0.241	0.054	0.294***	-0.381**	-0.065	0.316***
	(0.16)	(0.14)	(0.04)	(0.14)	(0.13)	(0.03)
global risk	3.093***	1.727**	-1.367***	3.390***	1.935***	-1.456***
	(0.73)	(0.67)	(0.18)	(0.52)	(0.53)	(0.11)
N	1387	1387	1387	2235	2235	2235

Note: This table presents panel regressions of financial repression, inflation, and their interaction term while controlling for macro, fiscal, and global variables. Financial repression is measured by the financial regulation index and Chinn-Ito index, see text for more details. Inflation outliers (top 1 percentile) are dropped. Standard errors are clustered at country level.

index is from Abiad, Detragiache and Tressel (2008). The higher the values of the indexes, the larger the extent of financial repressions.

The long-difference results in Table 4 confirms the significant effects of financial repression in constraining interest-growth differentials. A one standard deviation increase in the capital controls index or financial repression index is associated with a decrease by about 3 percentage points in interest-growth differentials. Inflation still shows a significant negative impact on interest-growth differentials, whereas the effect of economic growth is insignificant.

Overall, our estimates of financial repression, from both local projection and long-difference, align well with the literature. For instance, using a dynamic panel setting, Escolano, Shabunina and Woo (2017) estimate the coefficient on the Chinn-Ito capital control index to be around 4. Using individual bond yields, Reinhart and Sbrancia (2015) estimate that advanced economies have negative real interest rates between 3 – 6 percentage points during financial repression years.

To sum up, negative interest-growth differentials are a common occurrence in countries at all levels of economic development. The presumption that negative differentials are a phenomenon associated with emerging economies—a presumption common in policy circles—seems to be driven by the experience of 1975 – 95 and does not stand up to scrutiny when considering longer historical periods.

Table 4: Contributors to Interest-Growth Differentials - Long Difference

	real interest rate		r-g	
inflation	-0.522***	-0.158*	-0.499**	-0.373**
	(0.15)	(0.10)	(0.24)	(0.14)
capital controls	-3.252***		-3.149**	
	(0.94)		(1.47)	
financial repression		-0.526**		-0.509**
		(0.18)		(0.25)
inflation ×	0.251***		0.193	
capital controls	(0.07)		(0.12)	
inflation ×		-0.020		-0.043
financial repression		(0.02)		(0.03)
real growth	-0.101	1.463	-1.344	0.958
	(0.59)	(0.77)	(0.84)	(0.81)
N	445	312	445	312
R^2	0.276	0.199	0.305	0.156

Note: This table presents the contributions to real interest rate and interest-growth differentials. The financial repression years are identified using de jure measures, see the text for more details. In this long-difference specification, we only draw observation from the data every five years. Country fixed effects are included, and the sample is 1973 to 2015 based on the availability of de jure measures. Standard errors are clustered at country level.

5 Interest-Growth Differentials and Sovereign Defaults

Public debt ratio dynamics are jointly determined by interest-growth differentials and the primary fiscal balance, and large primary deficits can in principle more than offset the variation in debt servicing cost, driving up debt despite negative differentials. Therefore, in this section, we explore the empirical association between interest-growth differentials as well as other fiscal variables through the lens of sovereign default episodes.

5.1 Interest-Growth Differentials in the Run-up to Default Episodes

We focus on whether interest-growth differentials are higher in the run-up to defaults than in "normal times", using an approach similar to Gourinchas and Obstfeld (2012). We define "normal times" as all years except: (i) those when the country is in default, (ii) the three years after the completion of debt restructuring, or (iii) the five years prior to default. Besides the country fixed effects as in the Gourinchas and Obstfeld (2012) setting, we also include year fixed effects to control for any global factors that may affect interest-growth differentials, such as shocks to global risk aversion. The estimated equation is as follows:

$$y_{it} = \sum_{j=1}^{5} \beta_j D_{it}^{j} + \lambda_t + \alpha_i + \epsilon_{it} \tag{4}$$

where D_{it}^{j} denotes j years before default. The estimates of $\beta_1, ..., \beta_5$ are presented in Figure 6.

Interest-growth differentials during the run-up to default do not significantly differ from those in normal times. Although there is an increase toward the onset of default, it is not significant. This pattern holds in all of the full sample, the post-war, advanced economies, and emerging economies subsamples. Further decomposition of interest-growth differentials into components shows that neither real interest rates nor inflation rates in the years preceding defaults differ significantly from normal times.[9] As a result, although real growth is significantly lower in the years prior to default, we cannot reject that interest-growth differentials are the same as in normal times. Turning to the fiscal policy variables, both primary deficits and public debts are larger than usual in the year before default. These results suggest that interest-growth differentials do not help to predict defaults, whereas primary deficits and public debt ratios do. These results are confirmed by Badia et al. (2019), who reach the same conclusion using a machine learning method in the context of an early warning system for fiscal crises, based on a large sample of countries and more than 100 variables over a shorter sample period.

Sovereign defaults in emerging countries are often accompanied by large depreciation, which could increase interest-growth differentials and deteriorate debt trajectory. To take account of this effect, we assess the differences between depreciation-adjusted differentials in the run-up to default and normal times in the same specification as before. The results (Figure 7) show that depreciations are, on average, 24 percent larger in the year prior to default compared with normal times. This substantial depreciation leads to visibly higher interest-growth differentials, 9 percentage points one year prior to default, but still not statistically different from zero. Depreciations also do not give policy makers much lead time to prepare.

5.2 Marginal Rates in the Run-up to Default

A better predictor of default is the marginal interest rate, which responds faster than the average effective rate to changes in market participants' sentiments. There is abundant evidence documenting the increase of marginal rates in the run-up to defaults. For instance, in the cases of Greece, Argentina, Dominican Republic, etc. (Figure 8), marginal rates skyrocketed in the run-up to default.[10] A

[9] Inflation is calculated using the GDP deflator, and the (ex-post) real interest rate is the nominal rate adjusted for this period's inflation.

[10] The marginal rates are calculated as 10-year treasury bond yields for Greece and EMBI spread plus the U.S. 10-year treasury yields for emerging markets.

similar pattern is observed in more distant default episodes such as Uruguay in 1876 and Greece in 1894 (Figure 9).

Averaging across all default episodes, marginal rates in the run-up to defaults exceed those in normal times by about 2 percentage points, and the differences are statistically significant (Figure 10). This pattern holds for marginal rates measured on both domestic currency borrowing and foreign currency borrowing, and it is slightly more pronounced on the foreign currency portion.

Although the marginal rate increases significantly preceding sovereign defaults, it does not give much time for policy makers to react. Unpacking the year before default into months (Figure 11), sizable gaps emerge about six months before default, and they keep growing as default approaches. However, he increases are not robustly significant until two months prior to default. Therefore, marginal rates do not buy much time for corrective policy measures to take place.

To recall, the average effective interest rate is the relevant rate to determine debt dynamics. The marginal rate, which measures the borrowing cost for new issuance, reflects market sentiments more quickly but is an imperfect proxy for future developments in the average effective interest rate. The marginal rates are only relevant for debt dynamics when changes in sentiments are sustained for a long time and changes affect the whole maturity structure of the debt. The marginal rate is, more importantly, a reflection of whether investors are willing to roll over the debt. Increases in the marginal rate are the mirror image of a default triggered by a change in market sentiment, which is in turn hard to predict. Fiscal variables such as debts and deficits have some predictive power, but effective interest-growth differentials do not.

6 Conclusion

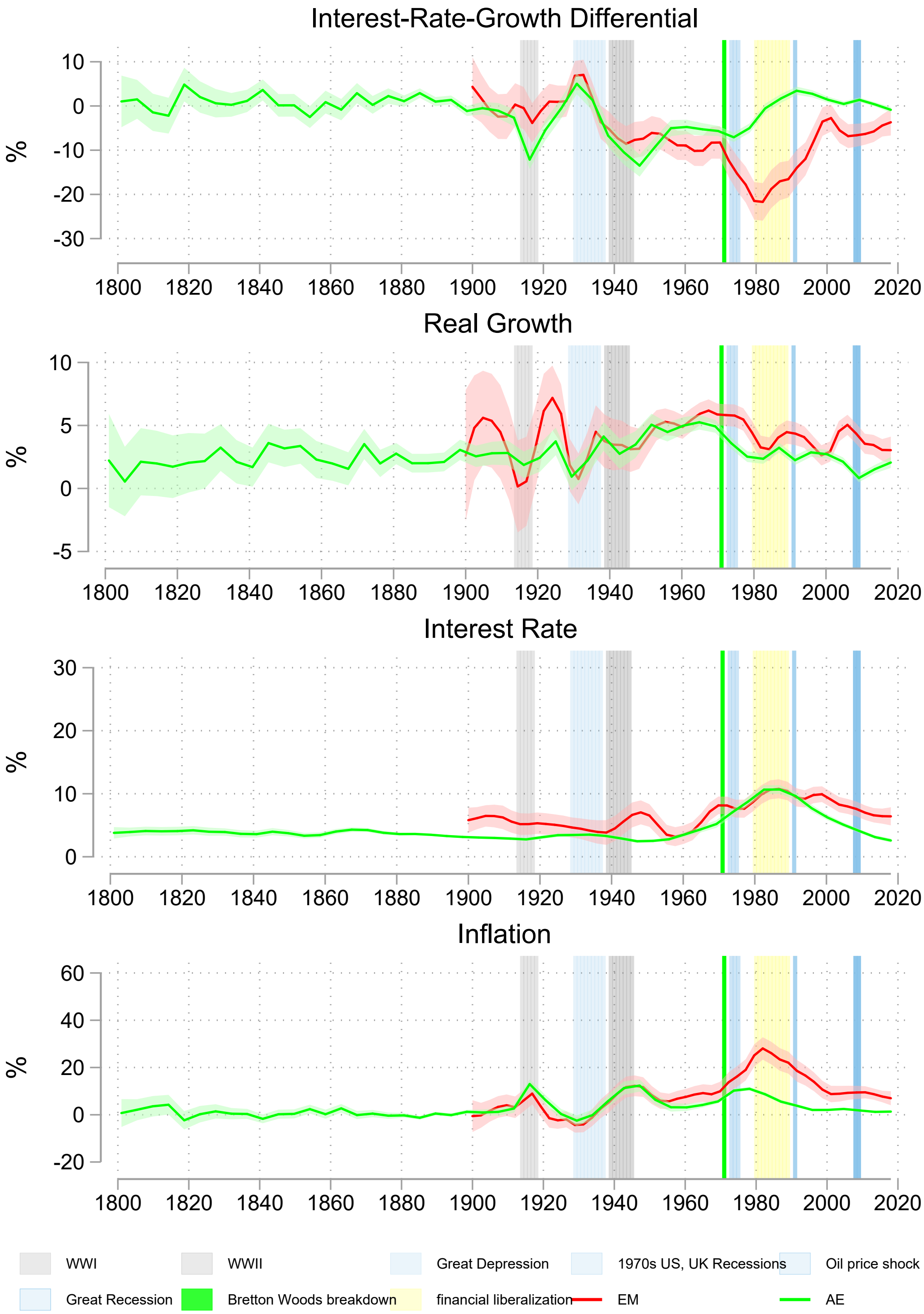
Our empirical analysis of interest-growth differentials and their role in public finance is motivated by two features of the post-GFC setting: the prevalence of low and often negative interest-growth differentials and high public debt ratios. We find that the negative differentials experienced today are not unprecedented—on the contrary, they prevail in the history of both advanced and emerging economies. Moreover, low differentials are not associated with lower frequency of sovereign defaults.

Can we sleep more soundly given low differentials? Based on the findings reported in this paper, our answer is: not really. Sovereign default histories demonstrate that after prolonged periods of low differentials, marginal rates can rise suddenly and sharply, shutting countries out of financial markets at short notice.

Our paper has abstracted from analyzing a full set of exogenous contributors to interest-growth differentials. A more complete analysis would require taking into consideration the reasons why interest-growth differentials are currently so low, as pointed out, for example, by Garín et al. (2019).

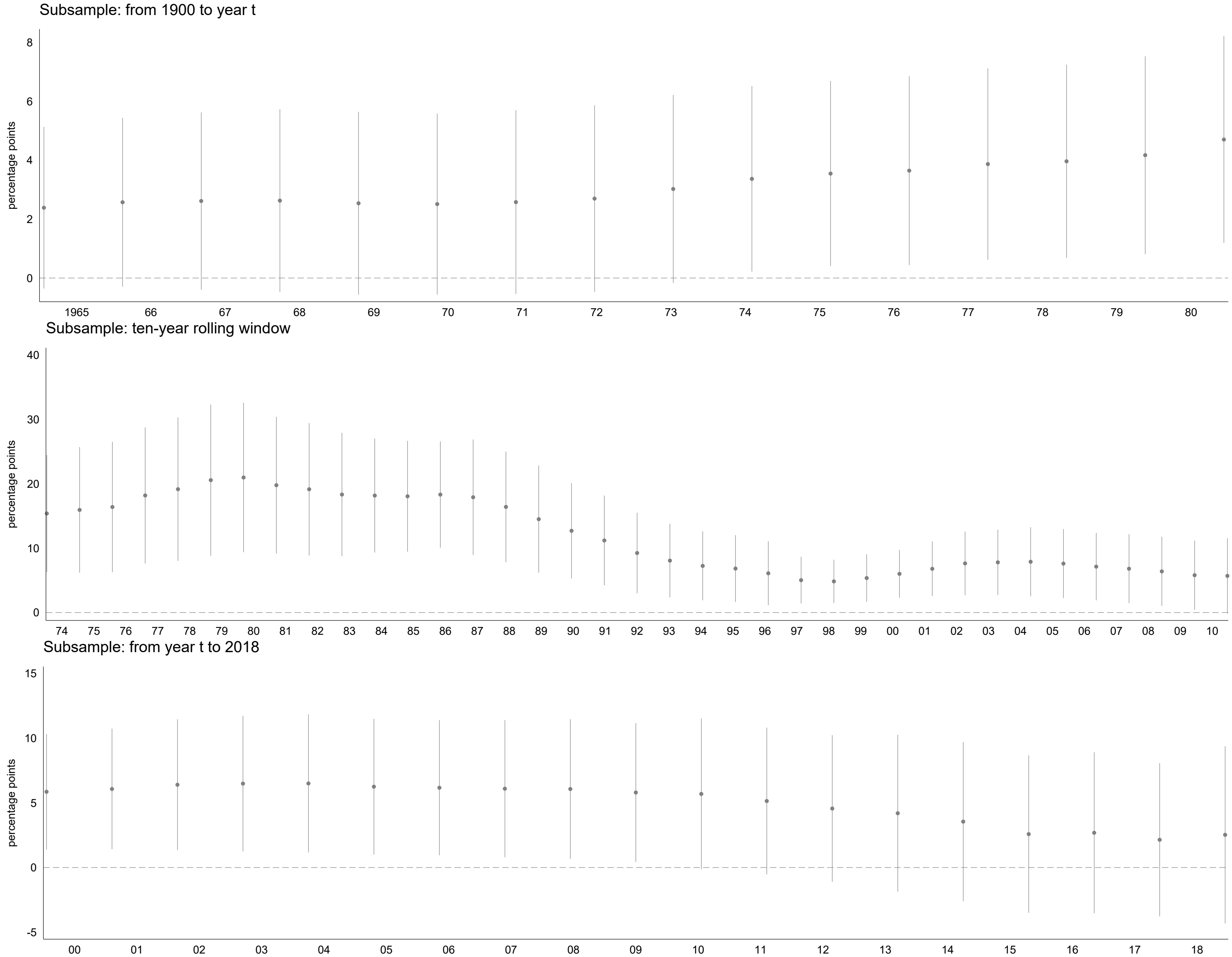
Our objective has been to caution that negative differentials do not necessarily reduce the likelihood of government defaults in the years ahead. Only with further reflection on the factors underlying the low differentials, as well as prospects for the primary fiscal balance, will we be able to make fully informed judgments on an appropriate stance of policies.

Figure 3: The Divergence Between Advanced and Emerging Economies



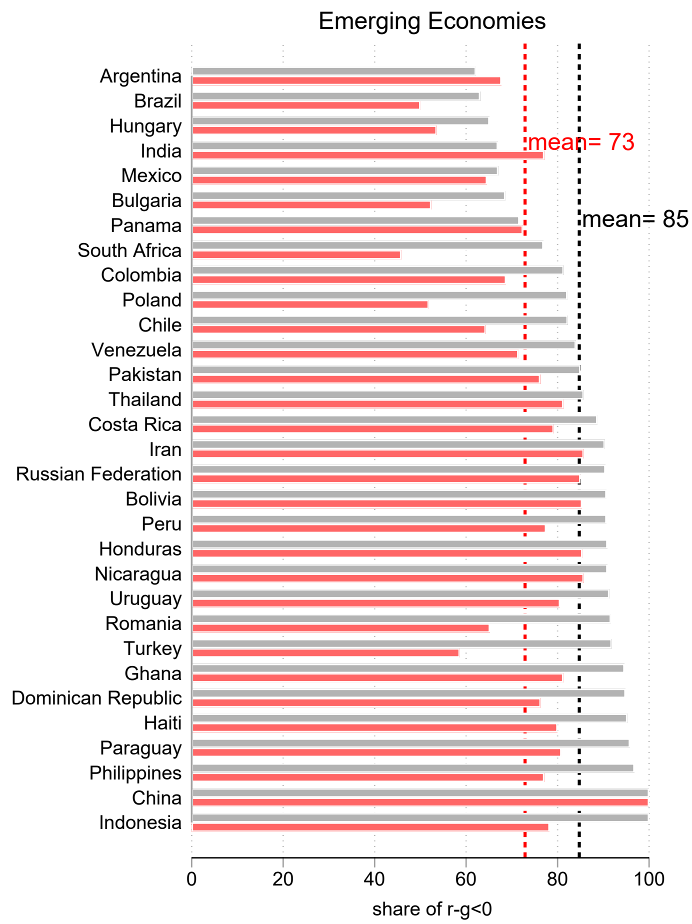
Note: This chart plots the average of interest-growth differential, real growth, effective interest rate, and inflation of advanced economies and emerging countries, respectively. The confidence band is calculated with normal kernel smoothing. The advanced economies include AUS, BEL, CAN, DEU, DNK, ESP, FRA, GBR, ITA, JPN, NLD, NOR, NZL, PRT, SWE, and USA, which have at least 100 observations. The emerging countries included are ARG, BRA, COL, CRI, IND, MEX, PAK, PHL, THA, VEN, and ZAF, which have at least 60 observations.

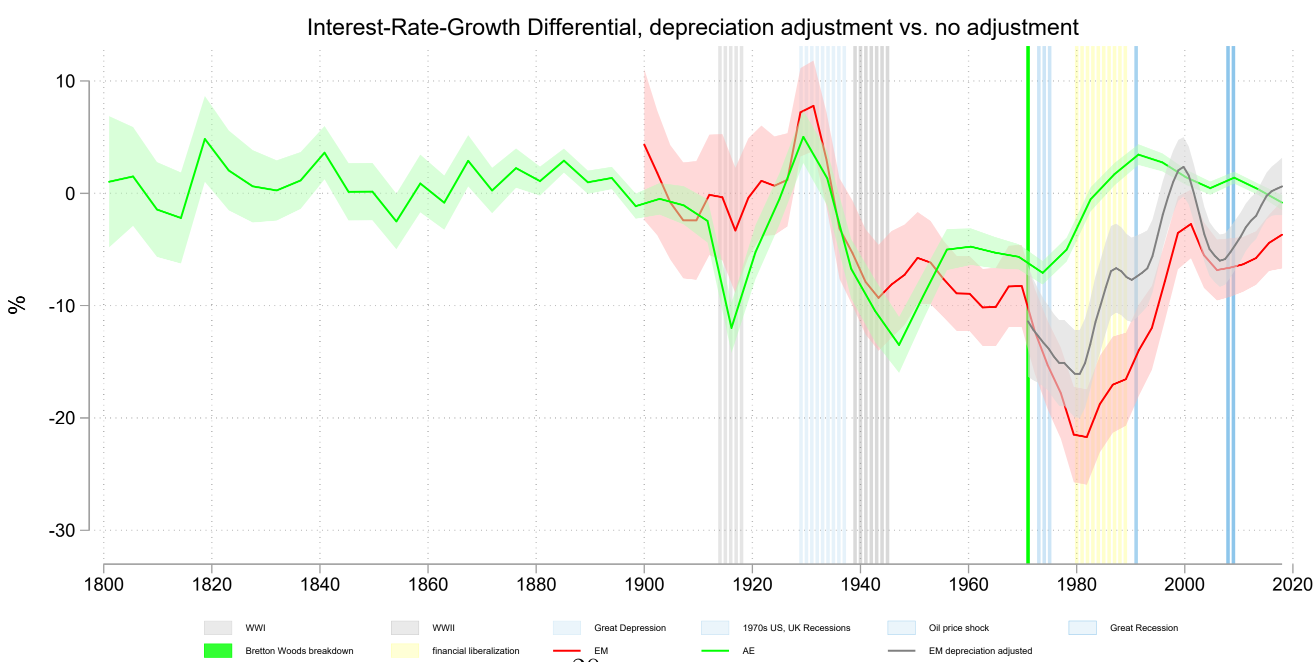
Figure 4: The Divergence Between Advanced and Emerging Economies



Note: This chart plots the difference between the average differentials between advanced and emerging economies based on different time horizons. The first panel is based on early years, from 1900 to year t, the second panel is based on ten-year rolling windows, from 1974 to 2010, and the last panel is based on recent years, from year t to 2018. The advanced economies include AUS, BEL, CAN, DEU, DNK, ESP, FRA, GBR, ITA, JPN, NLD, NOR, NZL, PRT, SWE, and USA, which have at least 100 observations. The emerging countries included are ARG, BRA, COL, CRI, IND, MEX, PAK, PHL, THA, VEN, and ZAF, which have at least 60 observations. The band indicates the 95% confidence interval.

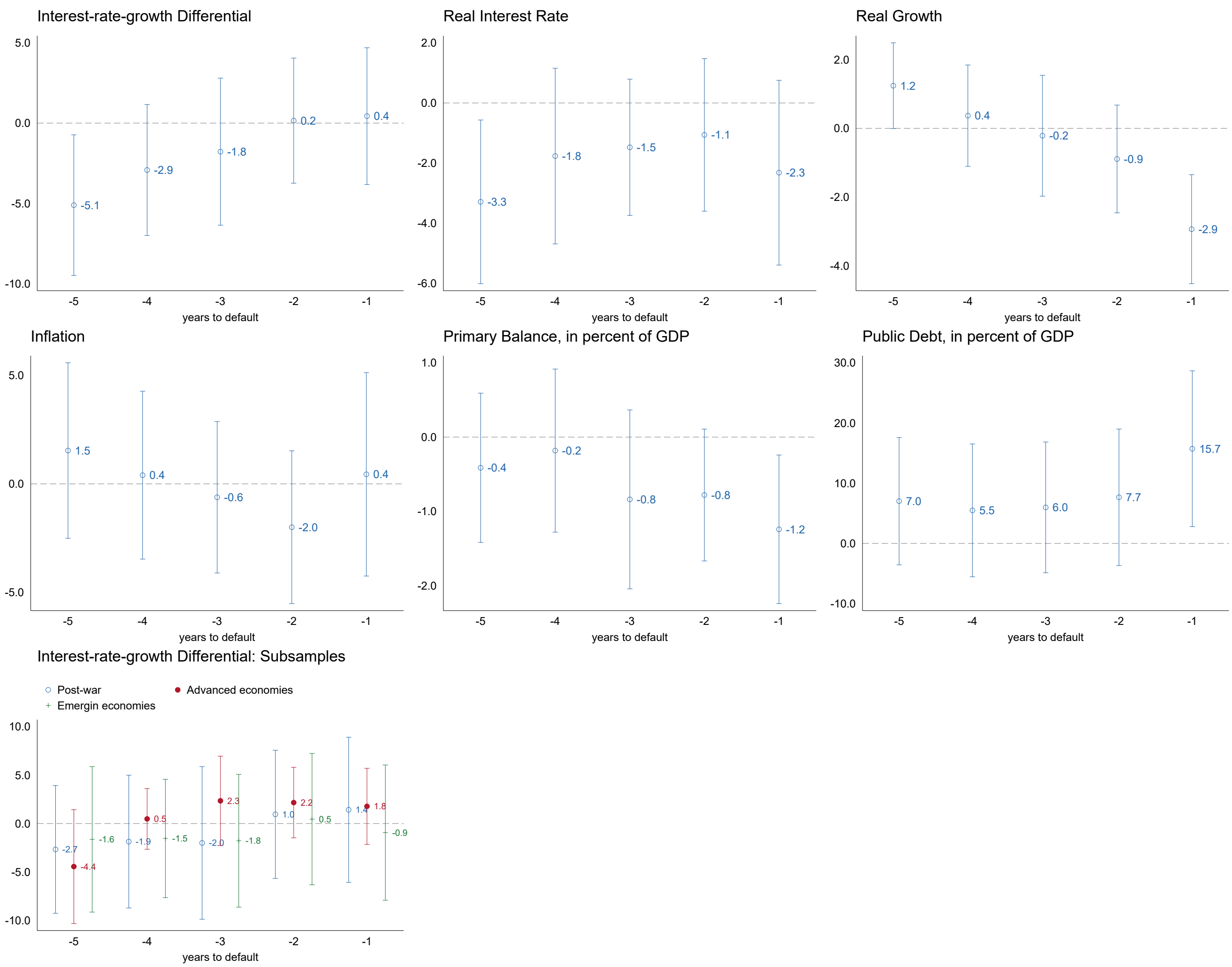
Figure 5: Depreciation-Adjusted interest-growth Differentials





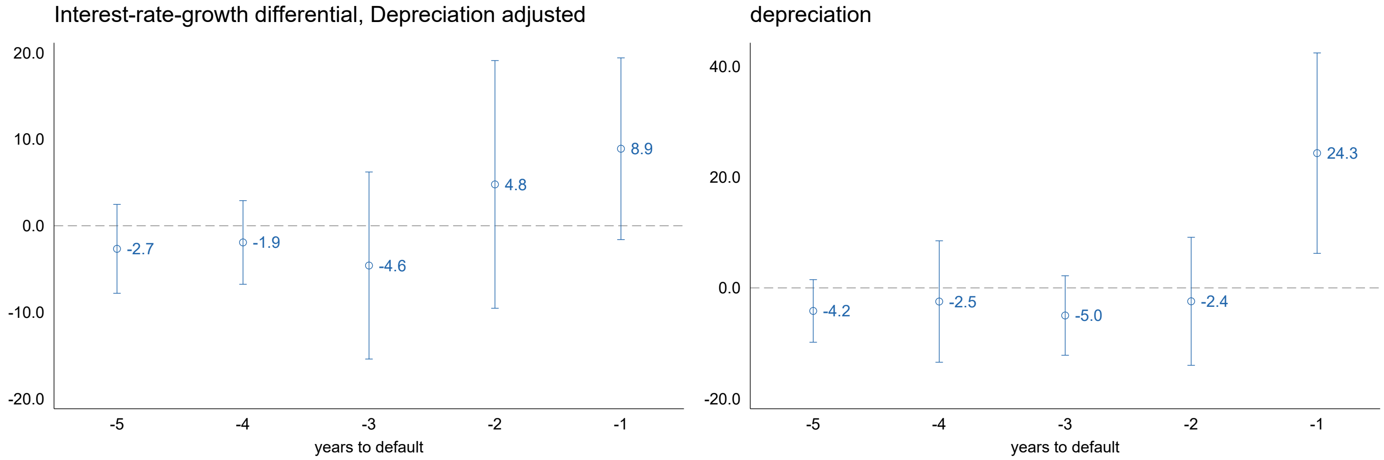
Note: This chart plots the comparisons between depreciation-adjusted interest-growth differentials versus non-adjusted ones. The upper panel is the share of years with negative differentials, and the lower panel is the average differentials across years.

Figure 6: Interest-Growth Differentials and Fiscal Variables in the Run-up to Sovereign Default



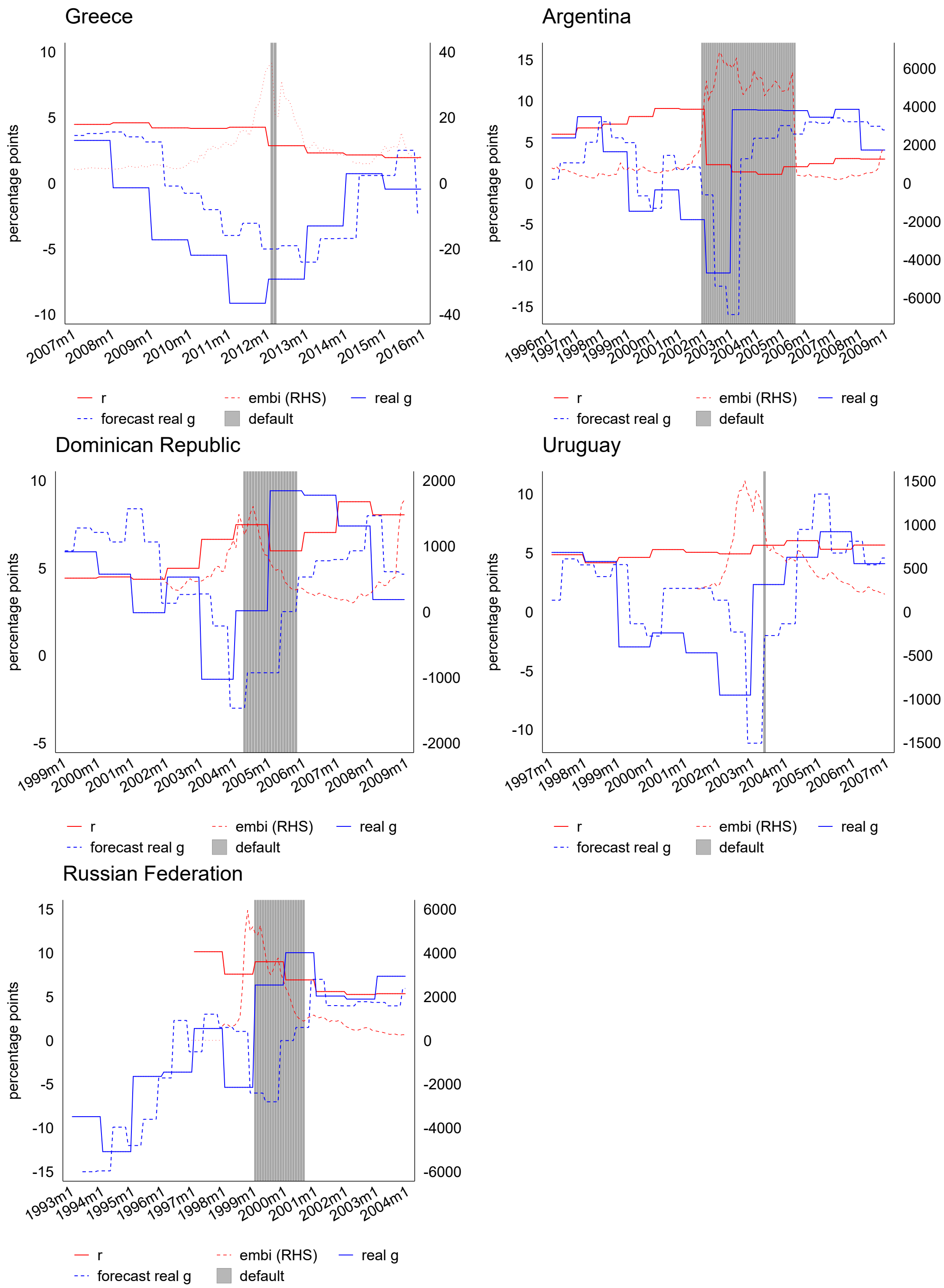
Note: This chart plots the interest-growth differential, real interest rate, inflation, real growth, primary balance, and public debt as share of GDP in the run-up to sovereign default. The point estimate is the value in years before the onset of sovereign default compared with normal years, controlling for country and year fixed effects. Debt restructuring years and (three years) post debt restructuring years are dropped from the sample. The band indicates the 95% confidence interval.

Figure 7: interest-growth Differentials and Depreciation Adjustment in the Run-up to Sovereign Default



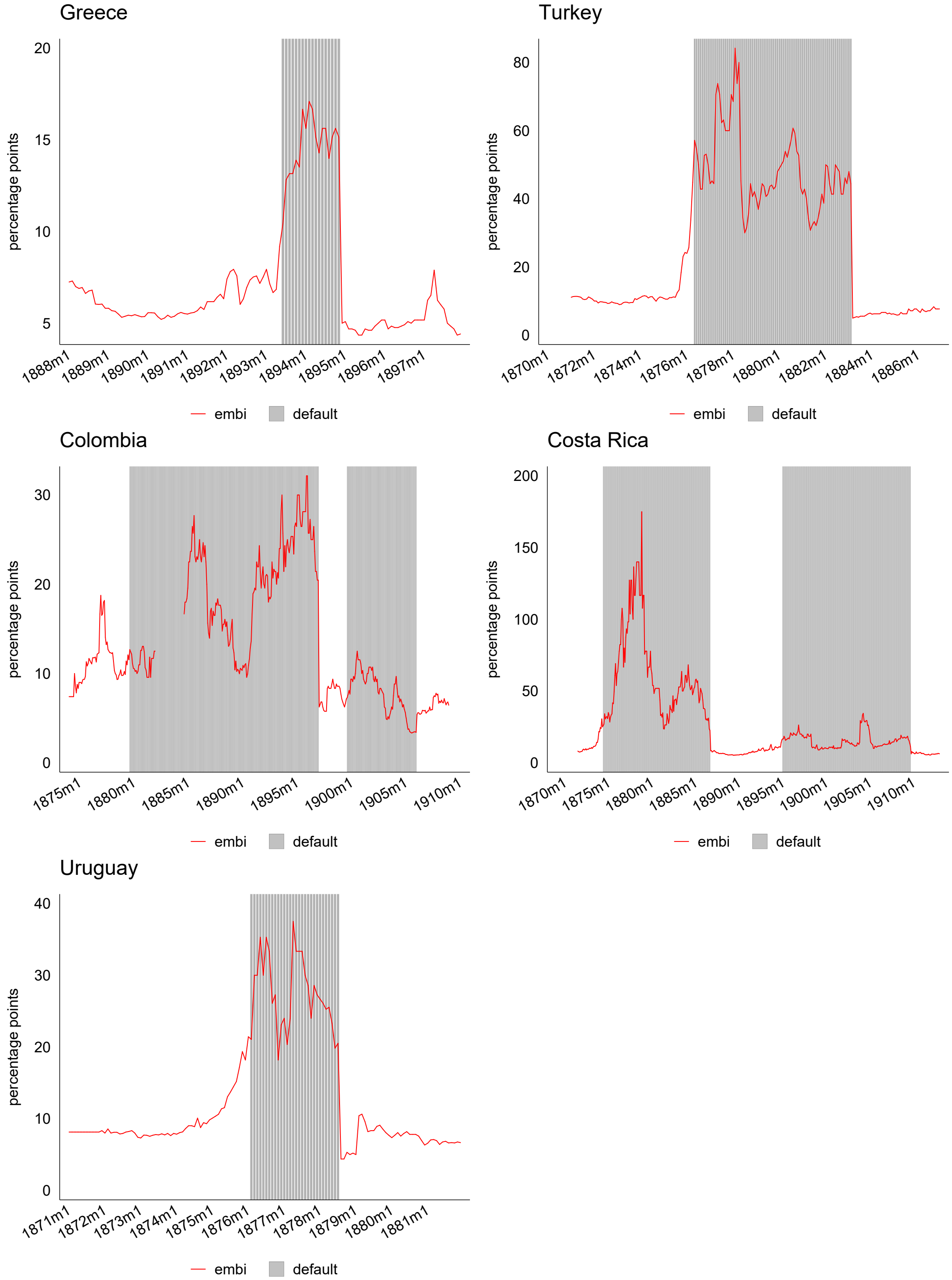
Note: This chart plots the depreciation-adjusted interest-growth differentials and depreciation in the run-up to sovereign default. The point estimate is the value in years before the onset of sovereign default compared with normal years, controlling for country and year fixed effects. Debt restructuring years and (three years) post debt restructuring years are dropped from the sample. The band indicates the 95% confidence interval.

Figure 8: Dynamics of Marginal Interest Rate during Recent Sovereign Default Episodes



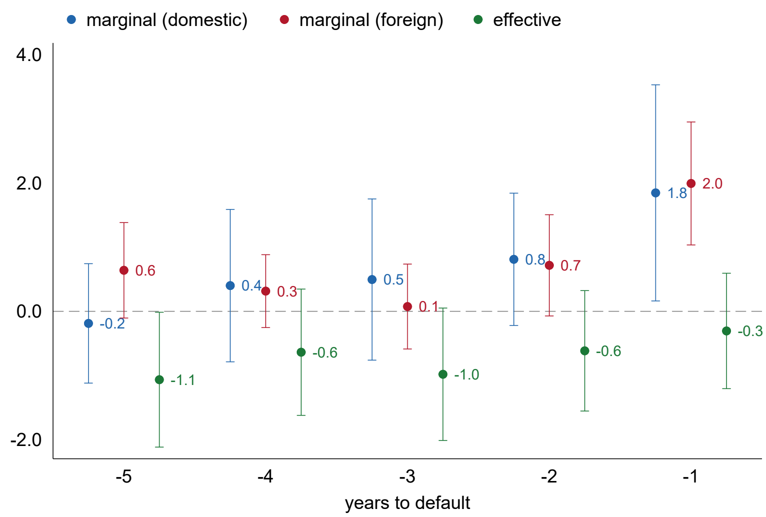
Note: This chart plots the evolution of marginal interest rate during recent sovereign default episodes. The margin interest rate is the sum of sovereign bond EMBI spread and the U.S. 10-year treasury bond yield.

Figure 9: Dynamics of Marginal Interest Rate during Historical Sovereign Default Episodes



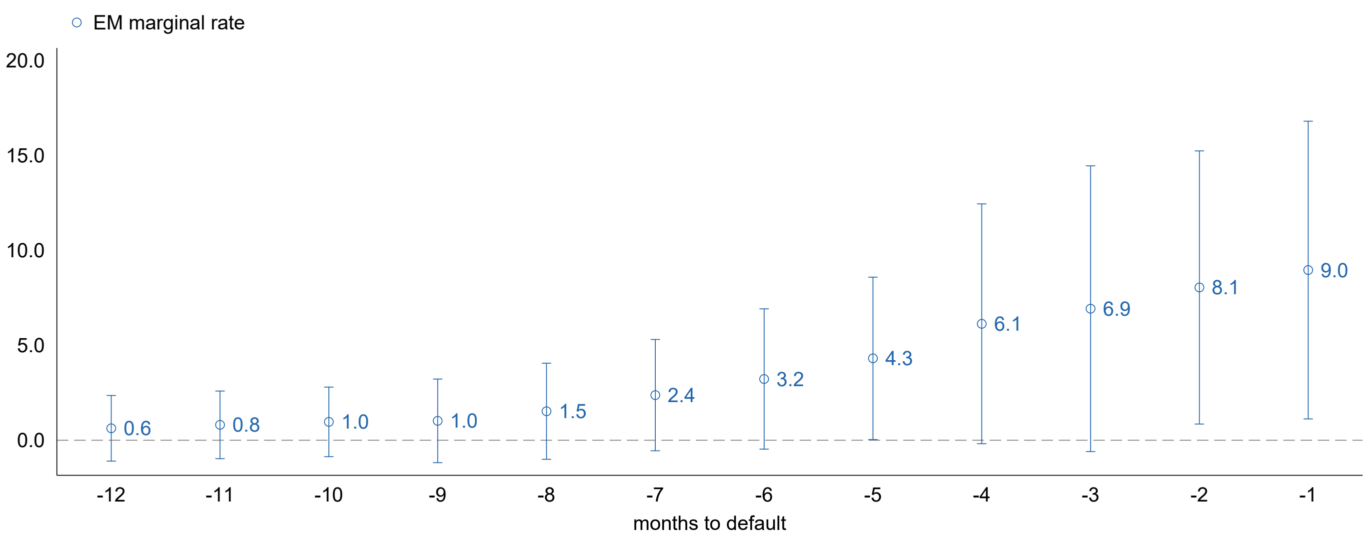
Note: This chart plots the evolution of marginal interest rate during historical sovereign default episodes before 1930s. The margin interest rate is the sum of sovereign bond spread and the consol bond.

Figure 10: Marginal Interest Rates in the Run-up to Sovereign Default



Note: This chart plots the marginal interest rates in the run-up to sovereign default. Domestic marginal rates are the 10-year treasury bond yields, and foreign marginal rates are the sum of EMBI spreads and 10-year U.S. treasury bond yields. The point estimate is the value in years before the onset of sovereign default compared with normal years, controlling for country and year fixed effects. Debt restructuring years and (three years) post debt restructuring years are dropped from the sample. The band indicates the 95% confidence interval.

Figure 11: interest-growth Differentials in the Run-up to Sovereign Default, by Month



Note: This chart plots the interest-growth differentials in the twelve months preceding sovereign default. The sample covers 16 default episodes, 8 cases in the late 1800s and early 1900s, and the rest in the post-1985 years. The point is the value in months before the onset of sovereign default compared with normal months, controlling for country and year fixed effects. In-default months and three years post debt restructuring are dropped out from the sample. The band indicates the 95% confidence interval.

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Appendix

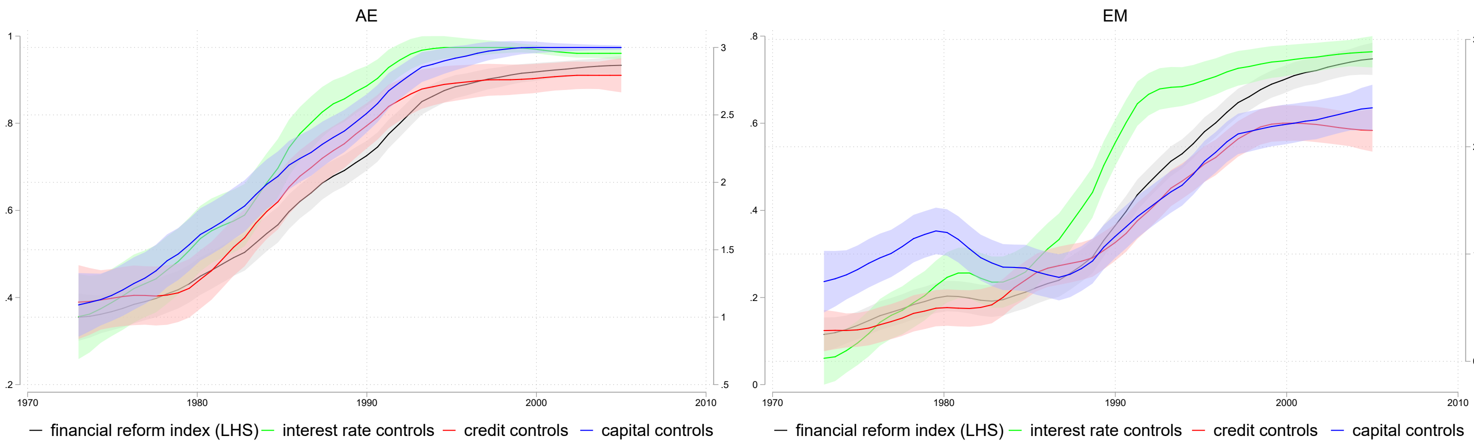
A Identify Financial Repression Years

To analyze the role of financial repression in reducing debt cost, we being with identifying the financial repression years for each country. We employ both de jure and de facto measures. The de jure measures come from Abiad, Detragiache and Tressel (2008), as illustrated before, they cover inclusive aspects of financial sector policy such as interest rate controls and capital controls. We define the liberalization year as the first year that the index of interest rate controls and capital controls reach the highest category, meaning free market. For the case the index decreases after reaching the highest category, we set the most recent year when the highest value is first reached. Therefore, our estimates can be viewed as a lower bound. The de facto measures are the structural breaks in the UIP deviations, which we identify by applying Bai and Perron (1998). The motivation comes from that frictions in the financial market imposed by finance repression can lead to UIP deviations. We calculate the 3-month horizon UIP deviation using the second market yields of the sovereign bonds. We set the 3-month horizon as the 3-month interest rates provide the largest country and year coverage, and the 3-month provides sufficient frequency to identify structure breaks. Note that as we use the 3-month interest rates, their structure breaks are neither automatically nor substantially lead to structure breaks on the effective interest rate which is used in interest-growth differentials.

The de jure and the de facto measures complement each other and provide ways for cross-validation. The advantage of the de jure measures is that they are objectively defined by the change in the policy regulations. However, the available policy measures still miss certain types of financial repression. For instance, financial repression can take the non-legislated form, such as moral suasion by putting pressure on banks to extend material support to the government. For instance, in the late 1940s, the Bank of England can make recommendations to bankers to take actions in the public interest and if these recommendations were not followed, with the approval of the Treasury, to issue directions to any banker. The de facto measures are market-based, which are able to capture the changes in interest rate resulted from all explicit and implicit regulations. That said, there are a couple of challenges. First, the UIP deviation suffer from measurement errors because the expected exchange rate is unobservable. To minimize measurement errors in using the UIP deviations and work around the benchmark, we employ various approaches to calculate expected future exchange rates, namely, the actual exchange rate, last period's exchange rate, the average of last three periods, and the expected future exchange rate backed from the Purchasing Power Parity. Second, as UIP usually does not hold, it is difficult to benchmark a counterfactual for no financial repression. Therefore, we only focus on the structure breaks rather than all deviations from UIP. The liberalization years identified by de facto measures are considerably close to those by the de jure. For instance, the median difference of the liberalization years between the UIP deviation and the capital controls abolishment is 2-year. Also, different measures of UIP deviation result in very similar liberalization years, with the largest difference of 2-year.

As presented in Figure 12, the de jure measures show that there is a significant wave of financial liberalization starting from the early 1980s for advanced economies (earliest as 1963, latest as 1988) and from the late 1980s for emerging countries (earliest as 1974, latest as 2004). For instance, the Bank of England stopped publishing the Minimum Lending Rate in 1981, interest rates ceilings were abolished om 1967 in Canada, deposit rates were liberalized in 1988-89 in Mexico, and restrictions on capital movements were lifted after August 1989 in Turkey. By the end of 1990s, the majority of advanced economies have abolished interest controls and capital controls. The liberalization process in emerging economies is still ongoing.

Figure 12: De jure measures of Financial Repression



Note: This chart plots the average of financial repression indexes across years. The financial indexes include interest rate controls, credit controls, capital controls, and an overall financial reform index. The shaded area is the 95% confidence band calculated by normal kernal smoothing. For all the indexes, the higher the value, the less regulated.

B The Persistence of Negative Interest-Growth Differentials

The previous section suggests that negative interest-growth differentials prevail in the history. Building on this, we further explore how persistent the negative interest-growth differentials, by analyzing the transition probabilities in both conditional and unconditional cases. To eliminate the effects of wars, we work on the post-war sample in this section.

Unconditionally, negative interest-growth differentials are less persistent than the positive counterparts. Table 5 shows that in general, positive interest-growth differentials are more likely to remain than the negative ones, especially for the most recent and distant periods of advanced economies and all the time for emerging economies. For advanced economies, on average, the probability of staying positive is about 86 percent compared with 76 percent of staying negative. Particularly, in the early decades (1950s and 1960s), positive interest-growth-rate is the absorbing state, because regardless of the current states, the probability of turning to positive is more than 85 percent. The persistence of negative state has increased drastically since the 1970s, however, it decreases much since the 2000s. As of the maximal level in the 1990s, the probability of remaining in negative is over 90 percent for advanced economies, while it drops to 70 percent in the current decade.

Advanced economies tend to be more persistent in the negative state than emerging economies. As shown in the next section, the negative interest-growth differential periods are usually associated with lower interest rate, higher growth and inflation, compared with the positive ones. The persistence of negative interest-growth differentials depends crucially on how sensitive is low interest, high growth, or high inflation to shocks. Given that emerging economies are prone to downside risks which push up interest rate and drag growth, the negative interest-growth differentials are less likely to sustain.

As much useful as the unconditional transition probabilities shed light on the big picture of interest-growth differentials' persistence, they do not show whether being in the current state contributes significantly to remaining in the same state. To answer this question, we employ a parsimonious panel Logit regression in the following specification.

$$D_{it} = \beta D_{it-1} + \eta D_{it-1} \cdot Decade_t + \Gamma \mathbb{X}_{it} + \lambda_t + \alpha_i + \epsilon_{it} \tag{5}$$

where D is the dummy variable of in the negative state. We include the lagged debt-to-GDP ratio and primary balance to control for fiscal stance, and the lagged output gap to control for business cycle position, and the year dummies for any global factors. We also add decade dummies interacting with the lagged negative-state dummy, in order to allow for time-varying persistence as in the unconditional case.

Table 5 highlights that the persistence of negative state is significant, and that being in the negative state is associated with an increase of more than or about 3 increase in odds ratio of remaining negative in the next period. Moreover, the persistence is higher in the 1970s and 1980s, aligning with the increases in the persistence of the negative state under the unconditional transition probabilities. In terms of domestic variables, favorable business cycle conditions increases the persistence in advanced economies, and the underlying channel could be that the strong growth may continue to bring down interest-growth differentials.

Table 5: Unconditional and Conditional Transition Probabilities Over Time

	Unconditional				Conditional			
	AE		EM		AE		EM	
	$-to-$	$+to+$	$-to-$	$+to+$	odds ratio of $r-g<0$			
lag r-g<0					1.656**	1.842**	1.441**	1.165**
					(0.57)	(0.60)	(0.57)	(0.51)
1950s	0.06	0.92	0.33	0.82				
1960s	0.15	0.95	0.40	0.92	-0.485	-0.271	0.355	0.489
					(0.68)	(0.69)	(0.92)	(0.89)
1970s	0.80	0.95	0.29	0.97	3.113**	3.099**	2.313	2.419
					(1.27)	(1.31)	(1.53)	(1.63)
1980s	0.85	0.84	0.57	0.95	1.769**	1.640**	2.476**	3.145***
					(0.79)	(0.74)	(1.05)	(0.86)
1990s	0.92	0.71	0.63	0.92	1.055*	0.994	1.642*	1.947**
					(0.64)	(0.65)	(1.00)	(0.91)
2000s	0.78	0.61	0.56	0.87	0.144	-0.135	0.478	0.694
					(0.88)	(0.79)	(0.99)	(0.89)
2010s	0.70	0.79	0.41	0.88	0.709	0.609	-0.235	0.257
					(0.68)	(0.69)	(0.75)	(0.67)
lagged debt						-0.004		0.032**
						(0.01)		(0.01)
lagged primary balance						0.019		-0.030
						(0.05)		(0.04)
lagged output gap						-0.092		-0.002
						(0.06)		(0.00)
Observations					1482	1446	1165	1161

Note: This table presents the unconditional and conditional one-year transition probabilities of switching to negative interest-growth differentials. The columns (1) to (4) are the unconditional transition probabilities over different decades. The columns (5) to (8) are the conditional probabilities estimated by panel Logit model. The columns (5) and (7) include country, year, and decade fixed effects as well as the interaction between decade dummies with lagged negative interest-growth differentials dummy to capture the decade-dependent transitional probabilities, and columns (6) and (8) further include lagged debt-to-GDP ratio, primary balance, and output gap. The Logit regressions are run on the post-war sample, and the 1950s is set as the base decade. Standard errors are clustered at country level.

C The Negative, the Positive, and the Sign Reversion

From the accounting perspective, interest-growth differentials can be decomposed to three components: interest rate, real growth, and inflation (measured by GDP deflator). Based on this accounting identity, we explore which component mostly drives negative interest-growth differentials is and which component triggers the transition from negative to positive. In doing so, we conduct the component-by-component difference between negative and positive observations and when the sign switches to positive. Note that we include both country and year fixed effects in the accounting, therefore the estimates are interpreted as the comparison within country, controlling for global factors.

As shown in Table 6, except for the post-GFC periods, inflation is the most important component that distinguishes the negative interest-growth differentials from the positive. Compared with the positive states, inflation is about 3 to 4 percentage points higher in the negative states for advanced economies, while growth is about 3 percentage points higher and interest rate 1 to 1.5 percentage points lower. These differences are almost doubled in emerging countries. Across years, the differences between the negative and the positive narrow have narrowed towards those more recent periods, in terms of interest rate and inflation. However, the growth difference barely change.

For the post-GFC periods, growth and inflation are equally crucial, while interest rate is much less relevant. Especially in advanced economies, the interest rate in the negative states becomes not significantly different from that in the positive states. This diminishing role of interest rate in the post-GFC episodes is mainly due to the low rate prevailing in advanced economies, which by nature constrains the margin that interest rates can differ from each. Similarly, for inflation, its fading also relates to the sluggish inflation in the most advanced economies.

Zooming into the transitions from negative to positive, growth slow-down and inflation decline triggers the transition, while interest rate does not play any significant role. The magnitude of the change in inflation during the transitions doubles that of growth for advanced economies, while it is almost the same as that of growth for emerging economies. Also, the changes in the transitions are smaller than the average difference between the negative and the positive states, indicating that the transitions are often mild increase rather than drastic hike.

During the post-GFC periods, the transitions from negative to positive in advanced economies involve only marginal and insignificant change in the level of interest-growth differentials. Relative to the transitions in the previous periods, the post-GFC ones do not cause large swing but marginal moves towards the positive territory. However, in emerging countries, the crucial roles of growth and inflation continue to work, despite declining magnitudes.

D Interest-Growth Differentials and Fiscal Stance

The standard inter-temporal government budget constraint shows that debt dynamics is determined jointly by primary balance and debt servicing cost. Conditional on primary balance, low interest-growth differentials reduce debt servicing cost, but this may not be true when the two are considered jointly.

In general, interest-growth differentials are negatively correlated with primary balance. As shown in Table 7, in general, the correlation between interest-growth differentials and primary balance is dominantly negative. This pattern is driven by cyclical dynamics—when growth is low, interest-growth differentials are high while primary balance is low. As such, when debt servicing cost is low (indicated by low interest-growth differentials), primary balance is high, both of which tend to help

Table 6: Interest-Growth Differentials: Negative versus Positive, and Sign Reversion

	Negative vs. Positive						**Sign reversion: negative to positive**					
	Advanced Economies			Emerging Markets			Advanced Economies			Emerging Markets		
	i	growth	π	i	growth	π	i	growth	π	i	growth	π
Full sample												
r-g<0	-1.234**	2.621***	4.394***	-3.099**	3.178***	7.551***	-0.207**	2.324***	4.513***	-2.285	3.516***	3.691**
	(0.37)	(0.29)	(0.49)	(0.92)	(0.45)	(1.22)	(0.08)	(0.42)	(0.57)	(1.78)	(0.74)	(1.03)
N	2874	2874	2874	1628	1628	1628	704	704	704	291	291	291
Post-war												
r-g<0	-1.474**	1.889***	3.035***	-3.348**	2.726***	7.885***	-0.091	1.422***	2.733***	-3.014	2.630***	2.209**
	(0.57)	(0.28)	(0.58)	(1.01)	(0.45)	(1.31)	(0.19)	(0.23)	(0.44)	(2.04)	(0.64)	(0.78)
N	1594	1594	1594	1400	1400	1400	274	274	274	213	213	213
Post-1980												
r-g<0	-1.095**	1.763***	3.341***	-2.146*	2.746***	6.943***	-0.056	1.109***	2.427***	-1.909	2.513***	2.674**
	(0.44)	(0.26)	(0.53)	(1.13)	(0.43)	(1.44)	(0.20)	(0.20)	(0.57)	(2.25)	(0.62)	(0.76)
N	923	923	923	1000	1000	1000	202	202	202	163	163	163
Post-GFC												
r-g<0	-0.145	1.592**	1.372***	-0.438**	2.711***	2.666***	-0.582	0.526	0.964	-0.151	1.524**	1.670**
	(0.13)	(0.43)	(0.36)	(0.15)	(0.55)	(0.68)	(0.54)	(0.61)	(0.81)	(0.17)	(0.51)	(0.65)
N	234	234	234	306	306	306	47	47	47	66	66	66

Note: This table presents interest rate, real growth, and inflation in the negative interest-growth differential periods compared with those in the positive periods, and also the change in those variables when interest-growth differentials revert their sign from negative to positive.Country and year fixed effects are included, and standard errors are clustered at country level.

reducing debt. Besides the sign being negative, the magnitude of the negative correlation has become more and more substantial, suggesting a growing extent of comovement between interest-growth differentials and primary balance.

Low interest-growth differentials are often associated with small change in debt position. As shown before, low interest-growth, usually coupled with low primary deficit, helps to contain debt. While the correlation has been modest around 0.2 for advanced economies during the post-war period, it has declined remarkably for emerging economies until a reverse in the last decade. The relatively small correlation for emerging economies indicates that primary deficit is likely to be too high to be fully offset by low interest-growth differentials, resulting in debt increase or marginal decrease.

While positively correlated with changes in debt, low interest-growth differentials do not necessarily link to low debt level. Low interest-growth differentials are associated with low debt in advanced economies, while the opposite holds for emerging economies. Also, for advanced economies after 2012, low interest-growth differentials tend to associate with higher than debt. This is because the debt level depends not only on the change but also the initial level. If starting with an initial level high enough, low interest-growth may fall short to bring down debt level.

Table 7: Correlation between Interest-Growth Differentials and Fiscal Stance

	$r-g$	interest rate	growth	inflation	primary balance	change in debt
$r-g$	1					
interest rate	0.2	1				
growth	-0.4	-0.1	1			
inflation	-0.8	0.3	-0.1	1		
primary balance	-0.1	0.1	0.2	0.1	1	
change in debt	0.3	0.1	-0.4	-0.0	-0.3	1

Note: This table presents the correlations between interest-growth differentials and fiscal variables, and the median of the country-specific correlations are reported.