WP/13/5

IMF Working Paper

A Modern History of Fiscal Prudence and Profligacy

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INTERNATIONAL MONETARY FUND

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IMF Working Paper

Fiscal Affairs Department

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Prepared by Paolo Mauro, Rafael Romeu, Ariel Binder, Asad Zaman[1]

January 2013

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Abstract

We draw on a newly collected historical dataset of fiscal variables for a large panel of countries—to our knowledge, the most comprehensive database currently available—to gauge the degree of fiscal prudence or profligacy for each country over the past several decades. Specifically, our dataset consists of fiscal revenues, primary expenditures, the interest bill (and thus both the primary and the overall fiscal deficit), the government debt, and gross domestic product, for 55 countries for up to two hundred years. For the first time, a large cross country historical data set covers both fiscal stocks and flows. Using Bohn's (1998) approach and other tests for fiscal sustainability, we document how the degree of prudence or profligacy varies significantly over time within individual countries. We find that such variation is driven in part by unexpected changes in potential economic growth and sovereign borrowing costs.

JEL Classification Numbers: H62, H63

Keywords: Fiscal policy, public debt, budget deficits, economic growth, debt sustainability

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[1] We thank Olivier Blanchard, Carlo Cottarelli, Mark De Broeck, Jonathan Ostry, and participants in seminars in the IMF's Fiscal Affairs and Research Departments for helpful suggestions, as well as Verena Grass and Juliana Peña for help with some of the archival and data research.

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I. INTRODUCTION

The terms "fiscal prudence" and "fiscal profligacy" are often used, somewhat loosely, to denote whether fiscal policies tend to lead to a sustainable or unsustainable fiscal position. The latter would correspond, in more academic terms, to whether the government's intertemporal budget constraint is met—that is, whether the expected present discounted value of all future fiscal surpluses matches the existing stock of public debt.

Although a precise definition of prudence or profligacy has not been established, policymakers, investors, and voters need to take a view all the time, in real time, on whether a country's fiscal policies are appropriate to support economic growth and achieve other social objectives without causing a fiscal crisis. The focus is on the fiscal stance within the control of the government—usually proxied by the primary fiscal balance (i.e., the fiscal balance net of interest payments).

In practice, prudence and profligacy are medium-term concepts. Neither prudence nor profligacy is built up overnight: one or even a few years of expansionary fiscal policies do not necessarily cause a fiscal crisis, if a government's initial position is sufficiently strong. Conversely, one cannot expect that, in real life, people will wait until infinity to check whether the intertemporal budget constraint is met. A few years of sustained deficits could well suggest that the intertemporal budget constraint is at risk. Thus, judgments regarding whether prudence or profligacy prevails are necessarily made over the course of a few years. Moreover, we believe (and show empirically below) that a country's degree of prudence or profligacy is not constant forever; rather, it will change over time, as governments, citizens' attitudes, and economic circumstances change.

This paper draws on a newly collected historical dataset of fiscal variables for a large panel of countries—to our knowledge, the most comprehensive database currently available—to gauge the degree of fiscal prudence or profligacy for each country over the past several decades. Specifically, our dataset consists of fiscal revenues, primary expenditures, the interest bill (and thus both the primary and the overall fiscal deficit), the government debt, and gross domestic product, for 55 countries for up to two hundred years. For the first time, a large cross country historical data set covers both fiscal stocks and flows.

Unfortunately, the economics profession has not yet developed a universally accepted indicator of fiscal sustainability. We rely heavily on the work of Bohn (1998, 2008), which we consider to be the "state of the art" in this area. Bohn's sustainability criterion is based upon a time series regression of the primary fiscal surplus on the public debt and other controls.[2] Thus far, empirical application of the Bohn test has been constrained by data limitations. Bohn's own work analyzed long run historical time series data for the United

[2] Other tests based on the univariate time-series behavior of the debt-to-GDP ratio have fallen by the wayside, because of the difficulties in detecting mean-reversion as the debt-to-GDP ratio is bounced around by various shocks (see Bohn, 1998, 2007, and citations therein). Again, the weaknesses of tests based upon a univariate analysis of the debt-to-GDP ratio point to the value added of our dataset which, in addition to the stock of debt, also reports data on flows.

States. A more recent study by Mendoza and Ostry (2008) analyzed panel data for 34 emerging markets and 22 advanced economies over the period 1990–2005, but the relatively short time period for which data were available required constraining the estimated fiscal policy response coefficient to be the same across the advanced economies and across the emerging markets. Our data collection effort makes it possible for the first time to run this test for individual countries, for a large number of countries.

A possible drawback of Bohn's test is that it estimates the policy response over a long time frame of many years. Because our purpose is to explore variation in the fiscal policy response function across countries but also over time within a given country, we relax Bohn's assumption of a constant long term fiscal policy response. Specifically, for each country, we employ three variations of the standard Bohn regression, including structural break tests, recursive searches for particularly influential observations, and iterations of the standard regression over rolling subsamples. We also complement these exercises with a simpler "policymakers' criterion" widely used among practitioners, which consists of comparing the actual primary surplus to the primary surplus that would be required to stabilize the debt-to-GDP ratio.[3] By algorithmically combining these criteria, we believe we provide a reasonable gauge of the degree of fiscal prudence or profligacy for each country at various points in time.

More generally, our paper follows a well established tradition in drawing lessons relevant to modern themes from long-run historical panel data sets (recent examples include Reinhart-Rogoff, 2009 and 2011 for public debt; and Schularick and Taylor, forthcoming, for credit aggregates).

While we use the terms "prudence" and "profligacy" for presentational simplicity, we attribute to them specific, positive, technical meaning as described in the body of the paper, rather than necessarily normative meaning. In other words, "profligate" fiscal policy responses may sometimes be justified from a normative standpoint—for example, to avoid plunging the economy into a deep and prolonged recession. The analysis in this paper is primarily positive.

Our main findings are the following:

- For most advanced countries, particularly prior to the global economic and financial crisis that began in 2008, we find evidence that the response of the primary fiscal surplus to variation in government debt is consistent with meeting the intertemporal budget constraint, as well as stationarity of the debt.

- Nevertheless, the evidence suggests that a given country's fiscal policy response to changes in debt is by no means constant throughout its history (a working assumption that previous studies had made owing to data limitations). On the contrary, we document

[3] The policymakers' criterion checks whether fiscal policy is consistent with stability of the debt ratio, a special case of the stationarity that is assessed through the Bohn test.

significant variation in such response, not only across countries, but also over time within a given country. Periods of a few or more years are distinguishable as clearly "prudent" or "profligate," often with all techniques giving consistent messages. Indeed, one of the paper's contributions is to document how individual countries fare with respect to fiscal prudence and profligacy, using each of the methods outlined above. Individual country results are reported in detail in this working paper's tables and charts, with further information reported in the country pages in the accompanying Chartbook.

- For example, the results suggest widespread fiscal prudence in most advanced economies during the mid-1990s until at least the mid-2000s; for the emerging economies, prudence becomes more widespread after the year 2000. Strong prudence is evident in the United States in the late 1990s (recalling contemporary discussion of a possible disappearance of the public debt); in Canada since the mid-1990s (beginning with an ambitious and successful fiscal adjustment plan); in several Euro area countries during the mid-1990s (coinciding with the Maastricht Euro entry process); in Ireland in the late 1980s and early 1990s (a well known fiscal adjustment episode); in Japan in the mid-1980s to early 1990s (as it sought to stabilize the debt); and in Turkey in the mid-1990s and at several points in the 2000s (as it improved its primary balance significantly). Conversely, notable episodes of fiscal stimulus are also evident, including the United States in 2009–11 and Spain in 2010. And Japan is found not to sufficiently improve its primary balance despite rising debts for several years starting in the late 1990s.

- Finally, we show that a stronger response of the primary fiscal balance to changes in government debt is significantly associated with changes in long-run real GDP growth rates and long-term sovereign borrowing costs (measured by secondary market interest rates on long-term government debt). Declines in "potential" (or long-run) economic growth may not be fully apparent in real time to contemporary policymakers, who therefore often fail to respond to such declines through sufficient improvements in the primary balance. Conversely, increases in the cost of sovereign borrowing prompt policymakers to tighten fiscal policy in response.

The remainder of the paper is organized as follows. Section II outlines the data collection process and reports the summary statistics. Section III presents our empirical approach and its underpinnings. Section IV reports the empirical results. Section V concludes.

II. Data Sources and Basic Statistics

A. Data Sources for Fiscal and Other Macroeconomic Variables

The database covers an unbalanced panel of 55 countries (24 advanced economies—by present day definition from the IMF's *World Economic Outlook* classification—and 31 non-advanced) over 1800–2011. The data consist of government revenue, non-interest government expenditure, and the interest bill (and thus also the overall fiscal balance and the primary balance), as well as gross public debt, all expressed as a share of GDP. Table 1 reports the list of countries and the corresponding period for which we have data for all the variables mentioned above.

This database covers not only public debt stocks, but crucially, the corresponding fiscal balance flows and their subcomponents. The availability of data on the primary balance to accompany the corresponding public debt observations makes it possible to apply well established tests or criteria that seek to gauge the degree of sustainability of a country's fiscal policies and public debt position.

About half of the observations for the fiscal variables in our 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 20–50 years (subject to availability)[4]; 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 (we collected these data by hand from various yearly reports); 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).

We hand-collected the other half of the data 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. The list of all sources, with complete bibliographical and coverage information, is provided in Appendix Table 1 (see electronic chartbook).

In collecting nominal GDP data for the distant past, we relied heavily on Mitchell and MOXLAD. For most countries, GDP data do not exist before World War I (indeed, the concept was not used by contemporaries), and in these cases we used proxy variables such as Gross National Product or Net National Product from Mitchell's *International Historical Statistics*. In a few cases we used UN statistical yearbooks to fill in gaps in coverage between 1940 and 1975. GDP data were 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, we used government publications or 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.

Given the availability of multiple sources with significant overlaps for each country, we report in detail the "decision tree" (see Appendix Figure 1 in electronic chartbook) we used to splice together different sources to create continuous historical series. Within each country, we sought to preserve source continuity across time, to minimize jumps in the series that would have stemmed solely as a result of changes in sources. Whenever possible, we also sought to draw all variables (particularly the fiscal variables) for each given year from a single data source, to preserve consistency across concepts. The splicing process was straightforward for countries without much source overlap or source disagreement, and for

[4] We used the most recent published editions as of October 2011.

countries for which we found a source offering long, nearly uninterrupted coverage for all concepts of interest. When these conditions did not hold, preserving source continuity across time sometimes became at odds with preserving source consistency across concepts. In such cases, because the primary balance usually had to be computed as the difference between the overall fiscal balance and interest payments, and because the response of the primary balance to changes in public debt is a key object of interest in this paper, we generally preferred source consistency across concepts over continuity across time. For instance, even though Mitchell provides fairly comprehensive data on revenue and expenditure, we often took revenue and expenditure data from UN statistical yearbooks where they were available, because these yearbooks also provide data on interest payments and debt. This said, we sought to use a given data source for continuous stretches of at least ten years, unless shorter stretches were the only way to fill a gap. Appendix Table 2 (see electronic chartbook) reports, by country, the data source used for each concept at each point in time.

An important issue in the construction of long term public finance data series relates to the choice of government sector coverage. We sought to use data referring to the most comprehensive sector of government for which they were available. Accordingly, we report data at the general government level where these are available. In most cases, general government data are impossible to come by 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 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. For countries with large and active subnational governments, such as most advanced countries, this change in sector coverage resulted in significant breaks in the revenue and primary expenditure series; the breaks in the debt and fiscal balance series were smaller. Breaks in series are recorded in the database through dummy variables.

B. Summary Statistics for Main Fiscal Aggregates

Figure 1 reports the simple and GDP-weighted averages and the median of the public debt stock (top panel) and the primary balance (middle panel), in percent of GDP, from 1850 to the present. The shaded areas represent the range between the 15th and 85th percentiles. The number of countries in each year for which both debt and primary balance data are available is also reported (bottom panel). We observe sharp decreases (increases) in the average primary balances (debts) during the World Wars. The range of both variables widens substantially during times of war, e.g. the U.S. Civil War. The primary deficits reverse quickly once the war episodes end, whereas postwar debts decline more gradually and over longer periods.

Focusing on the post-WWII era, debt declines continuously until the 1970s, through a combination of negative interest-growth differentials together with stable and slightly positive average primary balances. From the 1970s, debts generally increased and the primary balances improved somewhat further. Strong improvements in the primary balance occurred in the second half of the 1990s, largely reflecting Maastricht-related fiscal consolidations. Noticeable worsenings in the primary balance occurred in the late 1970s, early 1980s, early 1990s, and early 2000s. The global economic and financial crisis of the

late 2000s resulted in the most pronounced and pervasive peacetime worsening of the primary fiscal balance experienced during our long term historical investigation: the average and GDP-weighted average primary deficits in 2008−09 were larger than at any other point in history aside from the World Wars. By way of comparison, the Great Depression is hardly noticeable in the chart.

Table 2 provides summary statistics for the full sample period (1800−2011, subject to data availability) for the major budgetary line items, including revenues, expenditures, the public debt interest bill, the overall fiscal balance, the primary balance, gross public debt, and the interest-growth differential.[5] The dataset consists of about 5,700 observations for each of revenue, expenditure, overall fiscal balance, and debt. Interest expenditure data, however, are limited to approximately 4,800 observations (and consequently primary expenditure and primary balance as well). Both debt and primary balance data are available for about 4,500 country-years.

The revenue and expenditure ratios to GDP averaged 19 percent of GDP and 21 percent of GDP, respectively, while the public sector interest bill averaged 2½ percent of GDP. The primary surplus over the sample averaged ½ percent of GDP, debt averaged 50 percent of GDP, and countries generally faced a negative interest-growth differential. While both advanced and non-advanced countries maintain fiscal balances of similar magnitude, non-advanced economies report both lower revenues and expenditures. Advanced economies also report larger debt ratios, primary balances, and interest-growth differentials compared with the non-advanced. Primary surpluses in the top percentile are in excess of 9½ percent of GDP, though these largely correspond to commodity producers or countries with large government assets.[6] Those in the top five percent of the distribution are above 5½ percent of GDP, and include several advanced economies with a well diversified production structure and relatively small government assets.

Table 3 reports the summary statistics for the post-World War II period, 1950-2011. Significant differences are again observed between advanced and non-advanced economies, notably: (i) size of the public sector nearly twice as large in the advanced economies compared with the non-advanced; (ii) slightly larger debt ratios in the advanced economies (based on the median across countries); (iii) larger primary balances in the advanced economies; and (iv) more negative interest rate-growth differentials in non-advanced economies.

Table 4 compares the post-war period with the period up to 1950 but excluding wars, for the advanced economies. The table shows the tripling of public sector revenues and expenditures

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[5] The interest-growth differential is the difference between the implied nominal interest rate (current year interest payments divided by the average of current and past year debt stock) and this year's nominal GDP growth rate.

[6] Gross debt is used throughout, and the primary balance is defined as the fiscal balance plus gross interest payments. Thus we do not subtract interest revenues, which would be appropriate if we used the net public debt.

relative to the pre-1950 period. Despite worsening primary balances and primary expenditure increasing fourfold after 1950, debt declined, consistent with the negative interest rate-growth differential observed after World War II. The broader increase in primary expenditure could also be interpreted as consistent with government size increasing with economic development and over time ("Wagner's law").

To make the case that our main object of interest, the primary fiscal balance, is a key driver of variation in the debt-to-GDP ratio, we recall identity (2.1), which decomposes the change in the debt-to-GDP ratio (Δd_t) into the contributions from the primary fiscal balance (s_t), the interest rate-growth differential $\left(\frac{r_t - g_t}{1+g_t}\right) d_{t-1}$, and the stock-flow residual (SFR_t).

$$\Delta d_t = s_t + \left(\frac{r_t - g_t}{1+g_t}\right) d_{t-1} + SFR_t \tag{2.1}$$

As the variance of a sum can be expressed as the sum of the variances plus twice the sum of the covariances, we decompose the variance of the changes in the debt ratio into the sum of the variances and pairwise covariances of the primary deficit, the contribution from the interest-growth component, and the stock-flow residual.

Table 5 and Table 6 show the variance decomposition results for advanced and non-advanced economies with more than 30 observations for 1950-2011, and excluding changes corresponding to shifts in government sector coverage. For advanced economies, high stock-flow residual variances broadly correspond to countries with sizable asset accumulation (e.g. Norway, Sweden, Finland, and Japan), and to Greece, which experienced high inflation and defaults at various points in the 1950s and 1960s, and again debt restructuring in 2011. The average and median values for advanced economies suggest that fluctuations in the primary balance, interest rate-growth differentials, and stock-flow changes each explain roughly one-third of the variance of changes in the debt ratio. For non-advanced economies, more volatile debt changes are in most cases explained largely by the volatility in the stock-flow residual and interest-growth differential, consistent with greater prominence of defaults, episodes of high inflation, and more frequent exchange rate crises. Nevertheless, there is great heterogeneity among the non-advanced economies. The factors underlying variation in debt for macroeconomically stable non-advanced economies, such as Colombia and India, are similar to those for advanced economies, whereas debt changes in several other non-advanced economies are driven almost entirely by the stock-flow residual.

C. Data Sources for Other Variables

Wars

Years in which major wars led to extraordinary, temporarily high expenditures are excluded in Table 4 and the tests below. This is consistent with Barro's (1979) "tax-smoothing" reasoning and with Bohn's (1998) empirical analysis of United States data, which reported specifications excluding World War II and its immediate aftermath. In the multinational context, we identified a list of country-years involving participation in major wars (from various encyclopedias) and then excluded from the sample those country-years where war

participation led to an increase in the expenditure-to-GDP ratio by at least six percentage points in one year. We also excluded up to two years after the war period, to allow for expenditures linked to demilitarization and reconstruction. Based on this criterion, we excluded country-years involving the Danish-Swedish War of 1808-1809, the United States Civil War, the Greco-Turkish War, World War I, World War II and the Indo-Pakistani War of 1971.[7]

Defaults

Years of default are drawn from Reinhart and Rogoff (2010) and are excluded from most empirical exercises.[8] Many Latin American economies in our sample experienced defaults, as did several European economies prior to and during World War II.

Output and expenditure gaps

We compute output and expenditure gaps as percent deviations of real output and expenditure series from their Hodrick-Prescott-filtered trends.[9] For nearly all countries in the sample, real output series are computed from Maddison data for the early period, and the World Development Indicators (WDI) database for real GDP data for later years.[10] For most countries, WDI real GDP data begin in the 1960s or 1970s. From 2009 through 2016, real GDP data and projections are drawn from the WEO.[11] Real expenditure series result from the product of expenditure-to-nominal GDP and real GDP. For expenditure data gaps of three years or fewer, interpolated real expenditure values are used. For countries with blocks of at least 25 years of continuous expenditure data separated by a gap of at least 4 years, the HP-filter was applied to the separate sample periods. In cases where the expenditure data unnaturally changed as a result of a shift in coverage of the levels of government, all general government real expenditure figures were multiplied by the ratio of central government expenditure to general government expenditure in the year of the sector switch.

Commodity price indices

To control for the effects of commodity price swings on the primary balance of commodity producing countries, we include two world commodity price indices as additional

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[7] Specifically, beyond the many country-years for which data were already missing during war episodes, we excluded the following country-years: United States (1917-1919), United Kingdom (1914-1919), Italy (1914-1919), Sweden (1918), Finland (1918-1919), South Africa (1914-1915); United States (1942-1947), United Kingdom (1940-1947), Belgium (1943), Italy (1940-1946), Sweden (1940-1945), Switzerland (1940-1945), Canada (1940-1945), Finland (1939-1945), Australia (1943-1946), South Africa (1940-1945); United States (1862-1866); Sweden (1810); Greece (1897-1898); and Pakistan (1971).

[8] Default years available at http://www.reinhartandrogoff.com/data/browse-by-topic/topics/7/.

[9] This approach follows Mendoza and Ostry (2008).

[10] Maddison does not cover Iceland, so Penn World Table data are used for years preceding WDI data.

[11] For the United States, Sweden, Greece, and Argentina, fiscal data extend back further than Maddison, and in these cases real GDP data from national sources is used prior to Maddison, WDI, or WEO.

regressors—one index includes petroleum prices and the other does not. The source is MOXLAD for 1900−1957 and the IMF Research Department thereafter. The list of countries dependent on commodity exports and those dependent on energy exports more specifically are drawn from the WEO (which in turn derived its country groupings from export composition data for 1962−2010).

Real long term interest rates

An objective of this paper is to explore potential determinants of variation—across countries and over time—in the fiscal policy response to increasing debt. To that end, in section V, we test the hypothesis that a higher marginal cost of sovereign borrowing (interest rates on government bonds observed on secondary markets) is associated with greater responsiveness of primary fiscal surpluses to government debt. Our real long term interest data consist of 2,270 observations and are mainly drawn from Bordo and others (2001), Dincecco (2011), and the IMF's *International Financial Statistics* (IFS). Generally, Bordo and Dincecco cover the time period 1860−1947, whereas the IFS cover 1948−2011. In order to fill the gaps in our series we use several other cross-country databases as well as national sources (OECD; WEO; Mauro and others, 2006; IMF databases). Altogether, we have data for 27 countries with the series going back to the 1880s for the majority of the advanced economies.

III. Measuring Fiscal Prudence/Profligacy

We now outline how the degree of fiscal prudence or profligacy can be measured, both across countries and at different points in time, and how "fiscal reaction" regression analysis needs to be extended to explore how fundamental economic variables shape the degree of responsiveness of fiscal policy.

A. Bohn's Fiscal Reaction Function and Policymakers' Criterion

The literature on debt sustainability has identified a limited set of somewhat crude indicators of what may be labeled as fiscal prudence. In what follows, we rely heavily on an approach developed by Bohn (1998), which is based on estimating the following "fiscal reaction" regression on time series data for a given country:

$$s_t = \rho d_t + \alpha Z_t + \varepsilon_t, \tag{3.1}$$

where s_t and d_t are the primary surplus and the beginning-of-period public debt, respectively, both in percent of GDP; Z_t captures other determinants of the primary balance, such as the business cycle or war expenditure shocks; ε_t is an error term.

Bohn (1998) shows that if ρ is estimated to be positive and significant, then fiscal policy is consistent with the intertemporal budget constraint under uncertainty, and that the test is robust to changes in interest rates, debt structure, and growth rates. Moreover, he shows that if $\rho > \left({}^{r-g}\!/_{1+r} \right)$ then the debt ratio is stationary: in the event of a shock to the debt ratio, the

fiscal policy response would be sufficiently strong to bring the debt ratio gradually back to its initial level. In our empirical applications, we will use medium run averages of *r* and *g*, as detailed in the next sections.

Despite its many strengths, Bohn's (1998) approach also has limitations. First, configurations of the debt ratio and ρ may emerge in which the primary fiscal surplus implied by the estimated fiscal policy reaction function is too high to be politically feasible or realistic. In the empirical applications, this limitation becomes relevant, as we show below. Second, the test was conceived against the background of a generally rising debt ratio. However, many countries experienced declining debt ratios for several decades: we would argue that, in that context, failure to obtain a positive and significant Bohn coefficient (which would require a worsening primary deficit) would indeed indicate an inconsistency with the intertemporal budget constraint but should be labeled as over-accumulation of assets rather than lack of fiscal prudence.[12] We note such instances below when they occur.

Third, many years of data are necessary for a regression to be estimated, but policymakers and others often need to come to a judgment on whether fiscal policy is appropriate over a shorter horizon. Thus, policymakers and analysts in international financial institutions and the private sector often rely on comparisons between the actual primary surplus and the primary surplus that would be needed to stabilize the debt ratio—we label this the *policymakers' criterion*.[13] From the well known debt motion equation, the debt-stabilizing primary surplus is $s_t = d_{t-1}\left({}^{r_t - g_t}\!/_{1+g_t}\right)$. Note the close correspondence between the policymakers' criterion and Bohn's criterion for stationarity of the debt ratio, as a stable debt ratio is a special case of a stationary debt ratio.[14] [15]

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[12] In practice, the case in which the primary surplus is increased in response to a decline in public debt does not need to result in accumulation of assets during the sample period. More simply, the primary surplus increase would further accelerate the decline in the debt to the point where, *if such behavior persisted*, the country would eventually accumulate so many assets that some would be left over at infinity.

[13] This simple approach has been widely used for several decades. In reviewing approaches to assessing fiscal sustainability, Blanchard (1990) refers to a "primary gap" defined as the difference between the primary fiscal surplus and the product of the debt ratio times the difference between the interest rate and the growth rate.

[14] The careful reader will note that the policymakers' criterion contains *g* in the denominator and a lagged debt, whereas Bohn's condition for stationarity (which we present as in the original article) contains *r* in the denominator. This difference simply reflects different notation conventions in writing the debt motion expression. Bohn's (1998) debt motion expression, based on beginning of period debt, assumes that interest is paid on the difference between this year's debt stock and this year's primary surplus, whereas in (2.1) and thus the policymakers' criterion we use the more standard assumption that interest is paid on last year's debt stock.

[15] A fourth limitation, which admittedly is not addressed by the policymakers' criterion either, relates to the fact that the Bohn coefficient could signal lack of prudence in case the primary balance failed to respond to a rising but very small debt ratio. In practice, this situation does not seem to be relevant for our sample.

B. Methods to Gauge Variation in Prudence/Profligacy Over Time

Although Bohn's original application of his test considered the longest available time series, in principle the response of the primary fiscal balance to changes in the public debt level (i.e., the slope coefficient in a Bohn regression) is unlikely to have remained the same throughout a country's history.[16] Rather, variation in the slope coefficient is a testable hypothesis and we deliberately chose to explore it here through various methods, given that each method carries both advantages and disadvantages, and answers slightly different questions.

1) *Structural break tests*. We perform Bai and Perron (1998) structural break tests, which partition each country's history into discrete sub-periods, varying in their degrees of fiscal policy response to debt changes. These tests allow the historical fiscal record to determine the dates *and* number of potentially unknown structural changes in the degree of policy response, within the constraints of the available data and minimum subsample size. This well established method will allow us to show that in many cases the fiscal policy response to an increase in debt changes significantly over time within a given country. However, it is not sufficiently flexible to capture outliers or important changes in behavior that may occur for a few specific years and in the proximity of the beginning or the end of the sample.

2) *Search for influential observation*s. This approach assumes a country's response is largely the same throughout its history, but searches for "influential observation" years in which the response of the primary surplus to changes in debt is especially weak or negative (years which cause an otherwise prudent country to become imprudent) or especially strong and positive (the years that matter the most in rendering a country's behavior prudent).

   For a country in which the estimated debt coefficient in the full sample regression is not positive and significant, the regression is recursively run excluding one observation at a time, searching for the observation whose omission leads to the largest decline in the *p*-value. Having dropped that observation, the procedure is run again on the remaining observations, iterating until the coefficient becomes positive and significant. Hence, the "most profligate" years, those whose omission is sufficient to restore the country to a finding of prudence, are identified. For example, in the case of the United States from 1950-2011, this procedure finds that dropping the years 2008-2011 is sufficient to return to a positive and significant slope coefficient.

   For a country in which the estimated debt coefficient is initially positive and significant, the regression is recursively run excluding one observation at a time, searching for the observation whose omission leads to the largest increase in the *p*-value. The process can alternate between designating "influentially profligate" and

[16] Indeed, Bohn (1998) explores non-linearities, changes in the response coefficient, and interaction terms (e.g., with the interest rate) in some of his specifications.

"influentially prudent" years, based on one's choices of confidence levels to establish "threshold" *p*-values.

While this procedure is somewhat less standard, it has greater flexibility to capture sudden changes in behavior and influential observations in opposite directions in close proximity to each other.

3) *Iterative estimation of Bohn regressions to rolling windows or an expanding sample*. Bohn (1998) regressions are estimated over rolling windows of predetermined length (e.g., 25 years) or over an expanding sample period (beginning from, say, 1950). The rationale in this case is to gauge fiscal prudence or profligacy based only on information for specific periods (say, comparing 1955–80 with 1980–2005, in the case of windows of predetermined length) or on all information available to contemporaries as time progresses (in the case of expanding sample periods). Although this procedure imposes the constraint that the fiscal response coefficient is the same throughout a window of predetermined length, it is well established and makes for easy comparison across such windows.

C. The Drivers of Changes in Fiscal Prudence/Profligacy

Having established—as we do in Section IV—that the fiscal response coefficient to changes in debt varies significantly across countries and over time, we will turn to exploring the economic factors underlying such variation.[17] We will thus relax the assumption of a simple linear relationship in which the single parameter ρ fully captures a country's fiscal policy response and does not change over time. In particular, we consider the case where the fiscal policy response depends on unexpected changes in the real long-term growth rate, and on the marginal public sector borrowing rate. The economic rationale is that policymakers may fail to improve the primary balance in response to increases in the debt-to-GDP ratio if they fail to perceive that economic growth has slowed down in a permanent manner. Additionally, an increase in the marginal cost of borrowing will cause policymakers to improve the primary balance as a means of lowering debt. For this exercise, we work with the marginal cost of borrowing (yields on newly issued debt), because we expect this to have a much quicker impact on policymakers' behavior than would be the case for the average cost of borrowing on all outstanding debt, which responds slowly to changes in market conditions. Specifically, we estimate:

$$s_t = \underbrace{\left[\rho\left(1+\beta_1 g'_t + \beta_2 r_t\right)\right]}_{Varying\ fiscal\ response\ to\ debt} d_t + \alpha Z_t + \varepsilon = \rho d_t + \rho\beta_1 g'_t\, d_t + \rho\beta_2 r_t d_t + \alpha Z_t + \varepsilon. \qquad (3.2)$$

[17] In the original Bohn (1998) study, equation (3.1) is tested for nonlinearities in the fiscal policy response to changes in debt.

Equation (3.2) includes two interaction terms that capture potential changes in the fiscal policy reaction function to growth surprises and marginal borrowing costs. The first term interacts debt with g_t', which is the unexpected change in long-term real GDP growth. For a given country, if both estimates of $\hat{\rho} > 0$ and $\hat{\rho}\hat{\beta}_1 > 0$ are positive and significant, a country lowers its primary surplus as long-term growth unexpectedly slows. (In this case, imposing a linear functional form on countries where long-term growth slows over time would lead to lower estimates of $\hat{\rho} > 0$ and, potentially, structural breaks.) The second term interacts debt with r_t, the real long-term borrowing costs on new debt (proxied by secondary market yields). If estimates of both $\hat{\rho} > 0$ and $\hat{\rho}\hat{\beta}_2 > 0$ are positive and significant, a country increases its primary surplus as real long-term borrowing costs increase for a given level of debt. In this case, imposing a linear functional form on countries where long-term borrowing costs increase over time would lead to higher estimates of $\hat{\rho}$ and, again, possible structural breaks.)

IV. Estimates of Fiscal Prudence/Profligacy

A. Bohn (1998) Tests for Whole Sample Periods and Long Sub-Samples, Individual Countries

We begin by estimating Bohn (1998) equations for each country, excluding periods of default or major wars. Table 7 reports the estimated coefficient for the response of the primary fiscal balance to variation in debt (the Bohn coefficient) and its *p*-value. Separate tests are reported for large sub-sample periods: post-WWI (1920–2011), post-WWII (1950–2011); and post-WWII excluding the global financial crisis (1950–2007).

Using the full sample period, the Bohn coefficient is positive and significant (and thus meets the intertemporal budget constraint under uncertainty) for three fourths of the advanced economies covered here. In most of these cases, the estimated coefficient also exceeds the necessary level for stationarity of the public debt ratio. The output gap control enters positively and significantly for most countries; and the expenditure gap control often enters negatively and significantly. (Results for the control variables are available upon request).

For the United States, using data up to 2007, the Bohn coefficient is positive and significant in the post-WWI and post-WWII samples—similar to the results in Bohn's (1998) study. However, the addition of the crisis years is sufficient for the postwar Bohn coefficient to both lose its significance and change signs. Indeed, the years 2008–2011 have a sizable impact on the estimates for many countries.

Generally, advanced economies' behavior has satisfied the government's intertemporal budget constraint and has been consistent with the stationarity of the debt ratio during the

period 1950–2007.[18] Notable exceptions among the larger advanced economies include France and Japan, whose Bohn coefficients are *negative* and significant. In the case of France, this result stems in part from the combination of declining debt and a rising primary balance between 1950 and 1977, which might be labeled over-accumulation of assets; but it also stems from the weak primary balance response to the rise in debt from the late 1970s until the present.

The case of Greece, a country that has recently experienced severe repayment difficulties, also deserves comment, as its estimated debt coefficient is positive and significant in the postwar regression. Further analysis reveals that this in large part results from the sizable primary surpluses attained by Greece in the early to mid 1990s against the background of rapidly rising debt. A possible interpretation is that repayment difficulties emerged when the primary surplus did not improve to the high levels that would have been required for the past empirical association to continue with an unchanged coefficient.

B. Structural Breaks

Moving to systematic analysis of subperiods using methods that "let the data speak" on the number and location of such subperiods, we undertake Bai and Perron (1998) break tests for an unknown potential number as well as unknown location of structural breaks.[19] The subsample size over which a break is allowed is an important consideration for these tests (particularly because of the annual frequency of our data). Smaller sized subsamples trade-off estimate uncertainty with the ability to test closer to the endpoints. Thus we consider countries with a full sample of at least fifty observations and with gaps of no more than five years (for 1800-2011, excluding war and default years). If the number of observations for a given country does not exceed 100, a minimum sub-sample size of 25 percent of the subsample is imposed; otherwise, we allow for a minimum subsample of 25 observations. To address the data limitations inherent in the post-WWII sample (1950-2007; we exclude the recent global economic and financial crisis because we already know that it affects the estimates in an important manner), tests were run with minimum sub-sample sizes of both 20 observations and 25 percent of the available observations. Reassuringly, the break dates found with the 20 observation limit were usually also found using the 25 percent minimum window size in the majority of cases.

Table 10 reports the results of the break tests for the post-war period for each country. It includes the number of breaks, the break dates, and the debt coefficients corresponding to estimates of the fiscal reaction function for each partitioned subsample. We see that the fiscal policy response to debt is non-constant over time for nearly every country tested. For the United States, for example, structural breaks are found in 1974 and 1993, giving rise to three distinct sub-periods: 1950-1973, 1974-1992, and 1993-2007. Looking at the debt response

[18] Indeed, in a panel regression for the advanced economies over 1950–2007, performed with individual country fixed effects, the debt coefficient is positive and significant, confirming the result obtained by Mendoza and Ostry (2008) for 1990–2005.

[19] Bai and Perron (1998) tests build on earlier work by Andrews (1993).

coefficients, the middle subperiod has the lowest reaction, while the most recent period has the highest.

More broadly, structural changes are found, for the most part, in the mid 1970s and 1990s. In a number of both advanced and non-advanced cases, the estimated Bohn coefficients are negative in the first half of the postwar period, which may reflect slight improvements in countries' primary surpluses combined with debt ratios steadily decreasing from their elevated WWII levels. Alternatively, we might infer that sustained negative interest-growth differentials, which did most of the work in bringing down high postwar debts, may be indicative of long-term unsustainable rates of debt repayment. A generalized first round of structural breaks are found in the mid 1970s, as the policy response to debt becomes positive and significant in a majority of countries tested. The coincidence of oil shocks and slowing global growth alongside higher real rates later in that subperiod is suggestive of a fiscal policy subsequently needing to actively respond to increasing debt. A widespread second set of breaks is found during the 1990s. For two-thirds of advanced economies, the break in the 1990s represents a relaxation of fiscal restraint and an apparent switch to greater profligacy. Table 11 reports the analogous results for the entire sample. The results, which allow testing for breaks from 1800 onwards, give a long-term perspective on the stability of fiscal policy and point out noteworthy changes. First, the structural break found for the 1970s for most countries in the post-WWII sample is robust to including the entire sample. Given that the post-WWII subsample finds breaks in the 1970s and again in the 1990s, the longer-sample test may be picking up one or both of these potential breaks. It confirms, however, that fiscal policy has changed significantly in the last three decades. In addition, countries changed their fiscal policy reaction around the first decade of the 1900s and in the 1930s (the sample excludes wars). Countries were largely more fiscally prudent prior to these early breaks.

C. Search for Influential Observations

To further explore the timing of changes in the degree of fiscal prudence, the Bohn (1998) regressions are recursively run to identify influential observations based on the *p*-value of the resulting subsamples. This procedure is iterated four times per country. For countries in which the estimated debt coefficient over the entire sample period (exclusive of war and default years) is positive and significant at the 1 percent level, the "most prudent" observations (those whose removal would increase the *p*-value the most when excluded from the regression) are removed until the estimated coefficient is no longer significant at the 10 percent level. Then the "most profligate" observations are removed until the estimated coefficient is once again significant at the 1 percent level, and the procedure is repeated for another two rounds. For countries with initially insignificant or negative estimates of the policy response coefficient, the procedure is run in an analogous manner, by first dropping the "most profligate" observations until the estimated coefficient becomes positive and significant at the 1 percent level, and then proceeding similarly for another 3 rounds.

Table 12 reports the initial (secondary) designations in bold (non-bold), and designations of prudence (profligacy) in blue (tan). The results appear consistent with broad economic historical narratives and the structural break results. Several years during 1880-1913 are influentially prudent for most of the countries for which data extend back that far. Few influentially profligate observations are found for advanced economies in the 1950s and

1960s, mostly because debts were broadly declining during the first two postwar decades. Several advanced economies are deemed "influentially prudent" during some years in the mid- or late 1990s, reflective of strong growth and consolidation efforts to combat rising debts. Notwithstanding the lack of available data and prevalence of defaults in non-advanced economies, a general trend toward prudence in most Latin American countries is present in the mid 1990s and early 2000s.

As with prudence, the designations of profligacy also seem to correspond to the narrative, notwithstanding the necessary exclusion of recorded defaults from estimates of fiscal prudence. For example, there is no evidence of profligacy in Latin American countries in the later 1970s and 1980s, due mostly to the exclusion of many observations with defaults. Nonetheless, the impact of the global financial crisis on fiscal behavior is observed in many countries. Nearly half of the countries in the sample, and all but a few advanced economies, have been influentially profligate in at least one year since 2008. The early to mid 1970s also enter as profligate in a fairly large number of countries, consistent with the oil shocks and global growth slowdown.

D. Rolling (Fixed-Length) Windows and Increasing Sample Periods

In these exercises, we search for variation in the policy response to debt changes over time, for each country, by iterating estimations of Bohn's fiscal reaction function over sequential subsamples. Specifically, we apply this iterative estimation procedure to rolling, fixed-length windows of 25 years, which is the shortest time span over which we feel regression estimates are reliable; and also to all windows (of gradually increasing length) starting with 1950−74. The procedure is illustrated for the case of Japan. The bottom chart of Figure 2 (see electronic chartbook for more such figures) illustrates the results of the rolling windows exercise. The years in this chart refer to the last year of the corresponding 25 year window. Hence the value of the blue line in the year 1974 is equal to the debt response coefficient given by the estimate of the Bohn fiscal reaction function over the 25 year period starting in 1950 and ending in 1974. The value of the red line in 1974 is equal to the significance of this estimated debt coefficient. Whenever the blue line is above zero *and* the red line is below .05, the debt coefficient for the corresponding 25 year window is positive and significant, and therefore fiscal policy satisfies the government's intertemporal budget constraint.

Focusing on the postwar period, Japan's policy response to changing debt has not at all been constant throughout history. Indeed, there are clear, statistically significant changes in the estimated Bohn coefficient, even though the length of the windows, at 25 years, might ex-ante have been considered relatively too short to detect statistically significant changes across windows. Looking at the top chart of Figure 2 for reference, Japan's primary balance deteriorated from the late 1950s through the late 1970s, while debt steadily increased (albeit modestly). As expected based on these dynamics, the bottom chart indicates that windows ending in the late 1970s through 1980s have a negative and significant response coefficient. As Japan then steadily improved its primary balance through the 1990s to combat rising debts, the observed policy response coefficient rises substantially, from negative and significant to positive and significant. Since the early 1990s, Japan's primary balance has again experienced a pronounced downward trend while debt has continuously

increased. Accordingly, the bottom chart shows a descent from "prudence" to "profligacy" from 1995 through the present. Note that the postwar structural break results presented in Table 10 partition Japan's postwar public finance dynamics almost identically to our observations here.

A possible hypothesis to explain these pronounced changes in Japan's fiscal policy behavior in recent decades, against a background of broad political and social stability, is that unexpected changes in long-run economic growth played an important role. In particular, economic growth slowed down significantly in the mid-1970s, after a prolonged period of rapid economic growth. To the extent that policymakers based their fiscal policy decisions on contemporary perceptions of long-run economic growth prospects, an unexpected growth slowdown may underlie a fiscal behavior that, in hindsight, looks "profligate," with rising debts and primary deficits in the late 1970s and early 1980s. The same seems to apply to the period since the late 1990s. In Section V we explore this hypothesis more formally, through cross-country panel regressions.

Table 8 displays the results of the rolling window exercise for each country with at least 25 consecutive non-war, non-default observations. It lists the ending dates of all prudent windows (windows in which the debt response coefficient is positive and significant) and all profligate windows (windows in which the debt response coefficient is negative and significant), as well as the percentage of windows observed to be prudent or profligate for each country. Additionally, it reports all years in which fiscal policy became prudent after not being prudent (for instance, as also evident in Figure 2, the year 1988 is a change to prudence in postwar Japan), as well as years in which fiscal policy became no longer prudent (e.g., 1997 for postwar Japan).

The trends gleaned from Table 8 reflect the historical narrative and are broadly consistent with the other methods' findings. Once again, the period from 1880 to 1913 appears prudent for most countries for which data exist. By and large, countries are measured as prudent far more often than profligate, with most of the observations of profligacy occurring within the last four decades. The global financial crisis had a pronounced impact on the estimated coefficients: whereas most advanced economies exhibit sustained prudence through the late 2000s, after 2007 several episodes of profligacy and many departures from prudence are observed. Many changes to prudence appear throughout the 1990s, consistent with widespread fiscal consolidation efforts. The oil shocks of the 1970s speak less loudly in this exercise, probably because it considers long time periods; several countries are measured to be profligate for windows ending in the mid and late 1970s, but many are prudent or insignificant throughout the 1970s and 80s.

In the second iterative estimation procedure, we fixed the starting year of the window at 1950 and estimated the fiscal reaction function for each sub-period ending in 1974, 1975, … through 2011. In this manner, we get an evolving picture of the sustainability of postwar fiscal policy that policymakers would have observed, in real time. Table 9 displays the results of this procedure, performed for each country with continuous non-default postwar data. Once again, years listed in the prudent (profligate) column correspond to windows ending in the year listed for which the estimated debt coefficient is positive (negative) and significant.

With this estimation procedure, most of the observed profligacy occurs in the mid and late 1970s, indicating that fiscal policy was not as sustainable in the first half of the postwar period. By the 2000s, most countries are measured to be prudent. Indeed, most countries and retain such prudence throughout the crisis that began in 2008—particularly those that had little choice other than to adjust, given that they faced sharp increases in sovereign borrowing costs. Noteworthy exceptions include the United States, Spain, Portugal, and Iceland.

E. Summarizing the Historical Assessment of Prudence and Profligacy

In this section, we seek to summarize the results for each country by identifying periods in which a country's fiscal policy demonstrated strong evidence of prudence, or lack thereof. To do so, we combine the evidence from the structural break tests, the search for influential observations, and the rolling regressions over different subsamples as described above, together with application of the policymakers' criterion.

We will define a given country-year as "strongly prudent" (i.e., providing strong evidence of prudence) if it is a non-war, non-default year that is (i) part of at least one 25-year window with a positive and significant debt response coefficient, (ii) influentially prudent according to the influential observations routine, and (iii) in which the actual primary balance is higher than the forward-looking debt-stabilizing primary balance. Conversely, we will define a country-year as "profligate" if it is a non-war, non-default year that is (i) not part of any 25-year window with a positive and significant debt coefficient, (ii) in which the actual primary balance is lower than the forward-looking debt-stabilizing primary balance, and (iii) in which at least one of the following is true: a) the year in question is part of at least one 25-year window with a negative and significant debt response coefficient, or b) the year is influentially profligate according to the influential observations routine.

Applying these definitions to the data, Table 13 reports the list of "strongly prudent" or "profligate" years for each country in the sample, according to the procedure outlined above. For these years, the various techniques we use yield consistent messages. For other years, some but not all techniques suggest prudence (or profligacy). The individual country results for all techniques are also reported in greater detail in Figure 3 through Figure 11.

Although the purpose of this exercise is to bring new perspectives grounded in systematic data analysis, it is also reassuring that the results are often consistent with "common wisdom" on past performance in several cases. For example, the results suggest widespread fiscal prudence in most advanced economies during the mid-1990s until at least the mid-2000s. For the emerging economies, prudence becomes more widespread after the year 2000.[20] Strong prudence is evident in the United States in the late 1990s (the time when concerns emerged about a possible disappearance of the public debt); in Canada since the mid-1990s (beginning with an ambitious and successful fiscal adjustment plan); in several

[20] Increased fiscal prudence among the emerging economies after 2000 is unlikely to stem solely from improved terms of trade, because our regressions control for real commodity price developments.

Euro area countries during the mid-1990s coinciding with the Maastricht Euro entry process (Italy, Belgium, Netherlands; and even Greece as it improved its fiscal balance against the background of rising public debts); in Ireland in the late 1980s and early 1990s (a well known fiscal adjustment episode); in Japan in the mid-1980s to early 1990s (as it sought to stabilize the debt); and in Turkey in the mid-1990s and at several points in the 2000s as it improved its primary balance significantly. Conversely, notable episodes of fiscal stimulus are also evident, including the United States in 2009–11 and Spain in 2010, and several years since the late 1990s during which Japan has not sufficiently improved its primary balance despite rising debts.

V. THE DRIVERS OF CHANGES IN FISCAL PRUDENCE/PROFLIGACY

Having documented that the degree of prudence or profligacy in fiscal policy varies significantly across countries and over time, we now turn to exploring the factors underlying such variation. In order to do so, we relax Bohn's (1998) assumption that the point estimate ρ fully captures the fiscal policy response to changes in public debt, after controlling for cyclical and expenditure shocks. Indeed, we allow the fiscal policy response to changes in debt to depend on unexpected changes in real long-term GDP growth and real long-term sovereign borrowing costs. Specifically, we interact these variables with the debt level:

$$s_{it} = \alpha_{i0} + \alpha_1 d_{it} + \alpha_2 g'_{it} d_{it} + \alpha_3 g'_{it} + \alpha_4 r_{it} d_{it} + \alpha_5 r_{it} + \alpha_6 Z_{it} + \alpha_{i7} I_{it}^{War} + \varepsilon \qquad (4.1)$$

The long-term growth surprise, g'_{it}, is the difference between the full-information (full sample) long-term growth rate for each country *i*, and the long-term growth rate which could have been estimated for that country based on the available information in a given year. More precisely, for each country-year, an auto-regressive forecast of real GDP growth was constructed using that country's historical growth rate up to the given year. The real level of GDP was then projected five years forward, and that real GDP series (the known history up to the year, plus the forecast) was detrended using a Hodrick-Prescott (HP) filter. Separately, for each country, the historical (full-sample, full information) real GDP series was detrended using an HP filter. The growth surprise variable was computed as the difference between the two long-term growth rate series—full-information potential growth minus limited-information forecast—calculated for each country-year. In this manner, we capture the difference between what potential growth (based on information up through 2011) *actually* was at time *t* and what policymakers *thought* potential growth was at time *t* (based on information available through time *t*).The long-term borrowing cost for each country, r_{it}, is the 10-year domestic currency sovereign borrowing rate net of the GDP deflator.

We estimate (4.1) using panel regressions with individual country fixed effects and present the results in Table 14 (top panel, full sample; bottom panel, post-WWII). For each panel regression, six distinct model specifications are presented and labeled (1) through (6). The estimate $\hat{\alpha}_1$ is the direct response of the primary balance to changes in debt; $\hat{\alpha}_2$ captures the impact of growth surprises (g'_{it}) interacted with debt; and $\hat{\alpha}_4$ reflects the impact of changes in sovereign borrowing costs interacted with debt. Although (3.2) specifies only interaction terms (i.e. debt interacted with long-term growth and debt interacted with long-term

borrowing costs), regression equation (4.1) also includes the direct impact of long-term real GDP growth surprises, $\hat{\alpha}_3$, and long-term real interest rates, $\hat{\alpha}_5$.

In Table 14, Model (1) allows only the interaction term of debt with surprises in long-term real GDP growth (i.e., $\alpha_3 = \alpha_4 = \alpha_5 = 0$). Model (2) augments (1) with the individual surprise in the HP growth rate alongside its interaction term with debt (i.e. $\alpha_4 = \alpha_5 = 0$). Analogously, Model (3) allows only the debt-real interest rate interaction term (i.e., $\alpha_3 = \alpha_2 = \alpha_5 = 0$). Model (4) then augments (3) with the direct impact of the interest rate (i.e., $\alpha_3 = \alpha_2 = 0$) on the choice of primary balance. Model (5) includes both the interest rate and the surprise change in the growth rate (i.e., $\alpha_3 = \alpha_5 = 0$), and (6) augments (5) with the interest rate and change in the surprise GDP growth rate.

The estimates for the full sample (upper panel) yield a Bohn coefficient of about 0.03 for all specifications, consistent with meeting the intertemporal budget constraint. In other words, focusing on the simplest model (1), if a country's debt-to-GDP ratio were 100 percent, the predicted primary surplus would be 3 percent of GDP in the absence of output or expenditure gaps or growth surprises. For the post-WWII period (lower panel), the Bohn coefficient is unambiguously lower in magnitude and is statistically insignificant in some specifications, suggesting that the degree of prudence may have become weaker after WWII compared with the pre-WWII era.

The Impact of Long-term Growth Surprises on Prudence and Profligacy

Considering the effect of growth surprises on fiscal policy, $\hat{\alpha}_2 = \hat{\rho}\hat{\beta}_1 > 0$ would suggest that an unexpected decline in the long-term real GDP growth rate is associated with a weaker response of the primary balance to increases in debt. The direct effect of growth surprises, estimated at $\hat{\alpha}_3$, is independent of the level of debt, whereas the effect estimated in $\hat{\alpha}_2$ is the impact of growth surprises to be interacted with the level of public debt. The point estimates of $\hat{\alpha}_2$ range from 0.1−0.9 across models, and are statistically significant when controlling for growth surprises, as in (2) and (6). Hence, growth surprises interacted with debt have an economically significant association with the magnitude of the fiscal policy response to changing debt. To illustrate the size of the effects, consider model (6) for a country with a debt-to-GDP ratio of, say, 100 percent: if real long-term growth were to unexpectedly decline by 1 percent, the interaction term $\hat{\alpha}_2 = 0.86$ suggests that the primary surplus would be reduced by 0.86 percent of GDP (resulting from 100*0.86*-.01). However, the direct effect of the negative growth surprise, estimated by $\hat{\alpha}_3 = -51.6$, would imply a direct upward correction in the primary balance by 0.52 percent of GDP (resulting from -.01*-51.6). The net effect would be a decrease by 0.34 percent of GDP.

Thus for countries with debt above $\hat{d}' = \hat{\alpha}_3 / \hat{\alpha}_2$, the change in the fiscal policy response from a negative long-term growth surprise will be dominated by the interaction term, $\hat{\alpha}_2$, and hence will lead to an overall worsening of the primary balance in response to higher debt. Insofar as

the fiscal policy response to unexpected lower growth depends on the debt level through the interaction term, countries with higher debt will reduce their primary balances by more in response to negative growth surprises, and the direct effect will not offset this decline. For the full sample estimation, $\hat{d}' = 0.60$. Thus, the evidence suggests that countries with debt above 60 percent of GDP will usually reduce their primary balances when hit with an unexpected negative growth shock.

Turning to the post-WWII sample period, the point estimates for the interaction term, $\hat{\alpha}_2$, increase, while estimates of the direct impact, $\hat{\alpha}_3$, decline. Using model (6), the estimates now suggest a much lower threshold debt level, of about 20 percent of GDP. Thus, since 1950, for the vast majority of countries (those with debt above 20 percent of GDP) negative shocks in long-term growth have led to greater fiscal profligacy; and the higher the debt, the more adverse the response.

The Impact of Sovereign Borrowing Costs on Prudence and Profligacy

The analogous estimates for the impact of real long term interest rates on fiscal policy are given by $\hat{\alpha}_4$ and $\hat{\alpha}_5$. Using model (6) again, the point estimate for borrowing costs interacted with debt, $\hat{\alpha}_4$, is around 0.05 for the full sample and 0.35 for the post-WWII period. It suggests that an increase in the real long-term borrowing costs for governments leads to a mild increase in fiscal prudence. Returning to our example, for a country with a debt of 100 percent of GDP and facing a 100 basis point increase in real long-term borrowing rates, the interaction term would suggest an increase in the primary balance by 0.045 percent of GDP based on the full sample estimate, or 0.35 percent of GDP based on the post-WWII estimate. The point estimate of the direct impact is a positive 0.02 percent of GDP for the full sample and a negative (though insignificantly so) 0.05 percent of GDP for the post-WWII sample period.[21] The net overall impact is thus 0.07 percent of GDP for the full sample and 0.30 percent of GDP for the post-WWII period. Because both the interaction term and the direct impact are positive for the full sample, and because the direct impact is insignificant in the postwar sample, higher sovereign borrowing costs translate into greater fiscal discipline for all levels debt, and especially in the post WWII period.[22]

VI. CONCLUSIONS

This study assembles a historical record of the degree of fiscal prudence or profligacy for 55 countries over the past two centuries. To do so, it applies various fiscal sustainability tests to the most comprehensive database available to date on fiscal flows and stocks. The paper

[21] As in Bohn (1998—see his Footnote 5), we do not find the real long term interest rate level to have a significant direct impact on the estimated primary balance.

[22] If one were to consider the fact that $\hat{\alpha}_5 < 0$ (despite its lack of statistical significance), then the net overall impact would be positive as long as the debt is above $\hat{\alpha}_5/\hat{\alpha}_4$, which equals 16 percent in the post-WWII sample, i.e., a relatively low debt-to-GDP ratio.

finds evidence of significant variation across countries, over time, and within individual countries' histories, in the extent to which fiscal policy behavior is consistent with sustainability.

Although the advanced economies are measured to be generally fiscally prudent during most of their histories, the first era of global finance (pre-WWI) and the 1990s are found to be especially prudent times, whereas the mid-1970s represents a departure from prudence. The global financial crisis that began in the late 2000s posed special challenges: policy responses in some cases signaled increased prudence, in others profligacy, possibly reflecting differences in market conditions and sovereign borrowing costs. How these varying responses are eventually assessed will likely depend on whether the slowdown in economic growth proves long-lasting or long-run economic growth returns to pre-crisis levels. Latin American economies are found to exhibit a broad trend toward greater prudence in the 1990s and 2000s, after adjustment that followed widespread defaults in the 1970s and 1980s. The paper provides detailed histories using various criteria for each country in the sample, and is accompanied by an electronic chartbook.

In searching for the root causes of changes in prudence and profligacy, we estimate panel regressions of the primary fiscal balance response to changes in government debt, allowing the response to vary depending on other economic factors such as sovereign borrowing costs and changes in the long-run economic growth rate. We find that when a country has a public debt stock above an estimated threshold (65 percent of GDP for the whole sample period and as low as 20 percent of GDP for the pre-WWII period), unexpected declines in long-term growth lead to weaker increases of the primary fiscal balance in response to rising debt, whereas increases in sovereign borrowing costs lead to a stronger policy response to rising debt.

Table 1. Country Coverage of Main Variables in this Study

Country	Observations with All Variables	Coverage	Country-Specific Sources (percent)	Other Hand-Collected Sources (percent)
Argentina	148	1864-2011	89	0
Australia	99	1913-2011	0	46
Austria	111	1880-1912, 1924-1937, 1948-2011	0	25
Belgium	103	1880-1913, 1933-1939, 1950-2011	3	22
Bolivia	57	1955-2011	0	25
Brazil	73	1880-1913, 1965-1986, 1995-2011	35	0
Bulgaria	29	1929-1940, 1995-2011	0	0
Canada	142	1870-2011	66	0
Chile	39	1940-1943, 1977-2011	25	1
China	25	1987-2011	0	0
Colombia	89	1923-2011	87	0
Costa Rica	56	1956-2011	8	40
Denmark	124	1880-1945, 1954-2011	0	41
Dominican Republic	32	1980-2011	0	18
Finland	92	1918-1945, 1948-2011	0	61
France	113	1880-1913, 1925-1937, 1946-2011	4	33
Germany	106	1880-1913, 1925-1934, 1950-2011	26	14
Ghana	50	1962-2011	0	20
Greece	111	1880-1913, 1927-1939, 1948-2011	0	36
Haiti	33	1924-1929, 1931-1937, 1939-1941, 1945-1949, 20	0	0
Honduras	60	1952-2011	0	52
Hungary	42	1928-1941, 1984-2011	0	0
Iceland	66	1946-2011	37	0
India	130	1861-1891, 1913-2011	29	49
Indonesia	40	1972-2011	0	31
Iran	36	1962-1965, 1980-2011	0	0
Ireland	74	1938-2011	0	30
Israel	49	1954-1970, 1980-2011	0	20
Italy	150	1862-2011	74	0
Japan	134	1875-1943, 1947-2011	56	7
Korea	54	1958-2011	0	25
Mexico	95	1917-2011	13	35
Netherlands	123	1880-1939, 1949-2011	35	12
New Zealand	97	1913-1944, 1947-2011	63	8
Nicaragua	21	1988-2001, 2005-2011	0	0
Norway	126	1880-1939, 1946-2011	0	35
Pakistan	58	1951-1967, 1971-2011	0	37
Panama	52	1956-1977, 1982-2011	0	24
Paraguay	45	1967-2011	0	11
Peru	42	1970-2011	0	20
Philippines	58	1954-2011	0	46
Poland	28	1984-2011	0	0
Portugal	127	1880-1913, 1919-2011	60	0
Romania	32	1980-2011	0	0
Russia	47	1880-1907,1928-1931, 1933, 1998-2011	0	0
South Africa	96	1913-1976, 1980-2011	0	78
Spain	158	1850-1935, 1940-2011	89	0
Sweden	212	1800-2011	91	0
Switzerland	98	1899-1913, 1929-2011	6	42
Thailand	55	1957-2011	0	45
Turkey	42	1970-2011	0	75
United Kingdom	182	1830-2011	42	13
United States	212	1800-2011	75	3
Uruguay	40	1972-2011	0	29
Venezuela	72	1921-1937, 1949-1979, 1988-2011	0	35

Notes: This table provides the number of observations for which all key variables are available (Debt, Primary Balance and macro variables). It also contains the share of observations that were drawn from country-specific and other hand-collected sources.

Table 2. Summary Statistics for Full Sample (1800 – 2011)

	Mean	Std. Dev.	Min	25%	Median	75%	95%	99%	Max	No. Obs
All countries										
Revenue	19.0	13.6	0.5	8.5	14.7	26.5	47.4	55.2	60.5	5721
Expenditure	20.9	14.4	0.7	9.6	16.9	29.9	50.1	56.6	71.8	5742
Interest Expenditure	2.4	2.3	0.0	0.8	1.7	3.3	6.5	10.3	24.6	4862
Overall Balance	-1.8	4.0	-39.1	-3.1	-1.0	0.1	2.2	5.4	19.1	5739
Primary Balance	0.4	3.9	-35.5	-1.0	0.5	2.2	5.5	9.5	20.6	4834
Primary Expenditure	20.2	13.8	0.6	8.7	16.6	30.2	46.8	52.6	66.0	4803
Debt	49.7	42.7	0.0	19.2	37.9	66.2	133.2	215.5	289.6	5670
Interest-Growth Differential	-3.9	9.1	-34.9	-8.4	-2.8	1.5	9.0	18.0	34.2	4266
Advanced economies										
	Mean	Std. Dev.	Min	25%	Median	75%	95%	99%	Max	No. Obs
Revenue	21.9	15.6	0.5	8.6	17.3	34.6	50.5	56.5	60.5	3181
Expenditure	23.8	16.7	0.7	9.2	19.0	38.4	53.0	59.4	71.8	3173
Interest Expenditure	2.4	2.3	0.0	0.8	1.8	3.4	7.0	9.9	24.6	3007
Overall Balance	-1.9	4.5	-39.1	-3.0	-0.7	0.3	2.4	6.0	19.1	3173
Primary Balance	0.5	4.3	-35.5	-0.6	0.8	2.4	5.7	10.0	20.6	2964
Primary Expenditure	22.2	15.7	0.6	7.9	19.0	35.7	49.1	54.1	66.0	2964
Debt	57.7	47.3	0.0	22.2	46.2	76.8	158.3	223.7	284.0	3335
Interest-Growth Differential	-2.0	7.7	-34.7	-5.6	-1.1	2.3	8.9	17.0	32.5	2721
Non-advanced economies										
	Mean	Std. Dev.	Min	25%	Median	75%	95%	99%	Max	No. Obs
Revenue	15.5	9.3	2.1	8.4	13.5	20.4	34.8	42.3	52.7	2540
Expenditure	17.5	10.0	1.7	10.1	15.6	23.0	37.9	45.5	55.8	2569
Interest Expenditure	2.2	2.3	0.0	0.7	1.5	3.1	5.8	11.6	23.5	1855
Overall Balance	-1.8	3.1	-25.4	-3.2	-1.3	0.0	2.0	5.1	15.2	2566
Primary Balance	0.1	3.1	-22.6	-1.5	0.1	1.7	4.9	8.5	18.2	1870
Primary Expenditure	16.9	9.3	1.2	10.2	14.8	22.2	35.1	42.4	48.2	1839
Debt	38.2	31.7	0.0	16.6	30.3	51.8	92.5	159.8	289.6	2335
Interest-Growth Differential	-7.3	10.3	-34.9	-13.1	-6.5	-1.3	9.1	20.1	34.2	1545

Source: Authors' estimates; Full data sources reported in text and appendices.

Notes: Summary statistics are presented for the unbalanced sample for the countries and years with available data, from 1800 to 2011, for up to 55 countries. The interest-growth differential is the difference between the implied nominal interest rate (this year's interest payments divided by the average of this year and last year's debt stock) and this year's nominal GDP growth rate. All primary concepts are net of the public sector debt interest expenditure.

Table 3. Summary Statistics for Post-WWII (1950-2011)

All countries

	Mean	Std. Dev.	Min	25%	Median	75%	95%	99%	Max	No. Obs
Revenue	25.1	13.4	2.1	13.9	21.9	34.7	49.8	56.4	60.5	3126
Expenditure	27.3	13.8	1.7	16.1	24.0	37.5	52.6	58.6	71.8	3153
Interest Expenditure	2.6	2.6	0.0	0.8	1.9	3.6	7.4	12.0	24.6	2788
Overall Balance	-2.2	3.9	-31.3	-4.0	-1.8	0.0	2.8	7.0	19.1	3152
Primary Balance	0.3	3.5	-28.2	-1.5	0.3	2.2	5.9	9.6	20.6	2803
Primary Expenditure	25.8	12.8	1.7	15.0	23.3	35.4	48.8	53.8	66.0	2770
Debt	45.1	34.3	0.1	19.7	37.8	60.6	106.7	169.9	289.6	2983
Interest-Growth Differential	-5.9	9.0	-34.9	-10.4	-4.5	0.0	5.7	13.5	34.2	2471

Advanced economies

	Mean	Std. Dev.	Min	25%	Median	75%	95%	99%	Max	No. Obs
Revenue	33.3	12.8	7.6	22.6	33.1	44.0	54.0	57.6	60.5	1481
Expenditure	35.4	13.6	6.8	23.8	35.9	46.3	55.6	62.4	71.8	1479
Interest Expenditure	2.8	2.5	0.0	1.1	2.3	3.7	8.2	11.4	24.6	1467
Overall Balance	-2.2	4.3	-31.3	-4.3	-1.7	0.2	3.3	7.4	19.1	1481
Primary Balance	0.7	3.5	-28.2	-1.1	0.6	2.5	6.0	10.1	20.6	1467
Primary Expenditure	32.6	12.0	5.9	22.8	33.1	42.1	50.8	56.0	66.0	1465
Debt	49.4	34.0	1.6	22.9	44.3	64.6	113.2	166.2	284.0	1458
Interest-Growth Differential	-3.1	7.0	-34.7	-6.8	-2.2	1.4	6.5	12.3	20.2	1360

Non-advanced economies

	Mean	Std. Dev.	Min	25%	Median	75%	95%	99%	Max	No. Obs
Revenue	17.7	8.7	2.1	11.4	15.2	22.1	36.3	43.7	52.7	1645
Expenditure	20.1	9.3	1.7	13.1	18.2	25.2	39.3	48.8	55.8	1674
Interest Expenditure	2.4	2.6	0.0	0.7	1.5	3.4	6.2	13.2	23.5	1321
Overall Balance	-2.2	3.5	-25.4	-3.8	-1.8	-0.2	2.5	6.7	15.2	1671
Primary Balance	0.0	3.4	-22.6	-1.9	-0.1	1.7	5.7	9.0	18.2	1336
Primary Expenditure	18.2	8.6	1.7	11.8	16.2	22.7	36.0	44.0	48.2	1305
Debt	41.0	34.2	0.1	17.6	33.1	54.7	99.8	188.8	289.6	1525
Interest-Growth Differential	-9.3	9.8	-34.9	-15.1	-7.9	-3.1	4.1	16.1	34.2	1111

Source: Authors' estimates; Full data sources reported in text and appendices.

Notes: Summary statistics are presented for the unbalanced sample for the countries and years with available data, from 1950 to 2011, for up to 55 countries. The interest-growth differential is the difference between the implied nominal interest rate (this year's interest payments divided by the average of this year and last year's debt stock) and this year's nominal GDP growth rate. All primary concepts are net of the public sector debt interest expenditure.

Table 4. Summary Statistics for Advanced Economies

	Pre-1950, Excluding Wars									
	Mean	Std. Dev.	Min	25%	Median	75%	95%	99%	Max	No. Obs
Revenue	9.3	5.4	0.5	5.6	8.2	12.3	19.3	24.6	37.7	1374
Expenditure	10.1	6.3	0.7	6.2	8.9	13.2	21.2	31.8	56.2	1369
Interest Expenditure	2.1	1.9	0.0	0.6	1.5	3.0	6.0	9.1	9.7	1236
Overall Balance	-0.8	2.8	-39.1	-1.1	-0.2	0.3	1.3	3.7	12.5	1369
Primary Balance	1.1	3.2	-34.4	0.1	1.1	2.5	5.5	9.8	13.5	1201
Primary Expenditure	8.2	5.7	0.6	4.9	7.0	10.3	18.4	28.2	51.5	1201
Debt	63.2	55.6	0.0	20.4	45.1	90.3	189.2	235.9	264.1	1540
Interest-Growth Differential	0.4	7.6	-31.3	-3.6	0.4	4.6	12.5	22.6	32.5	1077

	Postwar Period									
	Mean	Std. Dev.	Min	25%	Median	75%	95%	99%	Max	No. Obs
Revenue	33.3	12.8	7.6	22.6	33.1	44.0	54.0	57.6	60.5	1481
Expenditure	35.4	13.6	6.8	23.8	35.9	46.3	55.6	62.4	71.8	1479
Interest Expenditure	2.8	2.5	0.0	1.1	2.3	3.7	8.2	11.4	24.6	1467
Overall Balance	-2.2	4.3	-31.3	-4.3	-1.7	0.2	3.3	7.4	19.1	1481
Primary Balance	0.7	3.5	-28.2	-1.1	0.6	2.5	6.0	10.1	20.6	1467
Primary Expenditure	32.6	12.0	5.9	22.8	33.1	42.1	50.8	56.0	66.0	1465
Debt	49.4	34.0	1.6	22.9	44.3	64.6	113.2	166.2	284.0	1458
Interest-Growth Differential	-3.1	7.0	-34.7	-6.8	-2.2	1.4	6.5	12.3	20.2	1360

Source: Authors' estimates; Full data sources reported in text and appendices.
Notes: Summary statistics are presented for the unbalanced sample for the countries and years with available data, from 1800 to 2011, for up to 24 advanced countries. The interest-growth differential is the difference between the implied nominal interest rate (this year's interest payments divided by the average of this year and last year's debt stock) and this year's nominal GDP growth rate. All primary concepts are net of the public sector debt interest expenditure. Wars with increases in the expenditure-to-GDP of at least 6 percentage points are excluded: Danish-Swedish, 1808-1809; United States Civil War, Greco-Turkish War, World War I, and World War II.

Table 5. Decomposition of Variance of Debt Changes, Advanced Economies (1950-2011)

Country	Obs.	ΔDebt	Prim.Bal.	(r-g)d	Residual	C(PB,(r-g)d)	C(PB,Resid)	C((r-g)d,Resid)
Ireland	55	58.2	28.6	9.8	8.2	10.7	1.2	-0.2
New Zealand	62	42.9	6.1	28.0	25.9	-2.3	2.0	-16.9
Israel	26	42.3	8.5	145.0	98.1	-11.3	-2.1	-195.9
Japan	61	41.8	10.1	7.9	11.8	10.5	0.9	0.6
United Kingdom	62	31.5	10.2	14.4	5.0	9.9	-2.9	-5.1
Netherlands	62	31.4	3.7	18.2	8.9	3.2	-1.1	-1.5
Greece	61	29.0	9.6	10.1	18.8	-1.0	-8.1	-0.3
Canada	62	20.3	7.0	16.2	3.2	-0.3	-1.6	-4.2
Denmark	57	20.1	8.8	4.3	15.1	-5.9	-2.1	-0.2
Sweden	61	18.9	9.3	2.6	8.5	-1.3	-0.1	-0.1
Belgium	61	17.9	10.0	9.6	4.5	-5.1	0.4	-1.5
Spain	59	16.8	6.2	5.5	6.8	5.1	-2.3	-4.5
Norway	61	16.7	24.5	4.7	52.4	3.8	-59.1	-9.5
Finland	59	16.2	11.8	1.9	12.1	0.4	-13.4	3.3
United States	61	15.7	6.6	5.1	1.2	3.4	-0.3	-0.4
Portugal	62	12.6	6.8	5.8	10.7	-1.1	-3.2	-6.3
Italy	62	10.2	9.4	16.0	4.5	-16.8	5.4	-8.3
Australia	62	8.5	5.2	10.1	10.6	3.4	-7.1	-13.8
France	60	8.2	3.6	3.6	3.8	-0.2	-3.4	0.9
Switzerland	61	8.0	1.2	1.7	3.9	1.0	0.3	-0.3
Austria	61	6.6	2.9	2.7	4.8	-1.5	-3.3	1.2
Germany	61	5.2	2.6	2.6	2.6	0.2	-1.2	-1.4
Korea	49	4.7	11.3	2.0	13.5	-3.0	-19.6	0.4
Average	*1348*	*21.0*	*8.9*	*14.3*	*14.6*	*0.1*	*-5.3*	*-11.5*
Median	*1348*	*17.3*	*8.7*	*6.9*	*8.7*	*-0.1*	*-2.1*	*-1.5*

Source: Authors' estimates; Full data sources reported in text and appendices.
Notes: This table reports the results of the variance decomposition of debt changes for advanced countries over 1950-2011, excluding debt changes corresponding to shifts in government sector coverage. We used the following identity to perform this decomposition exercise, derived from equation (2.1): $Var(\Delta d_t) = Var(s_t) + Var\left[\left(\frac{r_t-g_t}{1+g_t}\right)d_{t-1}\right] + Var(SFR_t) + 2\left[CoVar\left(s_t, \left(\frac{r_t-g_t}{1+g_t}\right)d_{t-1}\right) + CoVar(s_t, SFR_t) + CoVar\left(\left(\frac{r_t-g_t}{1+g_t}\right)d_{t-1}, SFR_t\right)\right]$, where Δd is the one-year difference in the debt to GDP ratio, s is the primary surplus to GDP ratio, r-g is the implied nominal interest rate-GDP growth differential, and SFR is the stock-flow residual. In the table, we label the interest-growth times outstanding debt component as "(r-g)d" and the stock-flow residual as "Residual". Furthermore, C() indicates twice the covariance of the variables in parenthesis. Hence each column to the right of ΔDebt expresses a component of the variance of one-year debt changes; note that the values in the component columns sum to the values in the ΔDebt column.

Table 6. Decomposition of Variance of Debt Changes, Emerging Economies (1950-2011)

Country	Obs.	ΔDebt	ΔPrim.Bal.	(r-g)d	Residual	C(PB,(r-g)d)	C(PB,Resid)	C((r-g)d,Resid)
Argentina	38	423.5	5.9	39.9	346.8	11.7	-3.5	22.6
Uruguay	20	269.5	6.8	19.8	248.7	7.6	20.1	-33.6
Nicaragua	12	231.2	6.0	105.6	281.8	-87.5	26.1	-181.9
Ghana	35	161.9	3.9	66.1	158.1	4.5	12.2	-82.9
Bolivia	34	115.2	18.9	62.1	100.8	-27.3	37.0	-76.3
Dominican Republic	27	113.0	2.6	17.3	136.8	4.2	3.1	-51.0
Hungary	22	92.6	11.2	48.6	124.0	5.5	-38.4	-58.2
Paraguay	38	80.1	3.4	28.6	80.8	5.2	4.4	-42.3
Honduras	58	74.3	9.7	51.1	116.6	21.0	-30.3	-93.8
Turkey	21	68.4	21.2	23.4	118.0	-2.0	-58.4	-33.9
Russia	12	66.8	25.3	10.7	30.8	14.5	-12.1	-2.4
Chile	30	56.6	15.7	48.8	74.1	13.5	-4.8	-90.8
Pakistan	53	52.7	9.6	25.2	41.2	-4.0	-10.5	-8.8
Bulgaria	14	49.4	7.8	54.8	18.1	20.9	-12.1	-40.1
Indonesia	34	49.3	2.8	7.6	46.8	-0.1	0.4	-8.2
Haiti	12	45.5	3.3	18.0	65.9	-7.7	10.2	-44.1
Costa Rica	50	45.2	3.5	84.6	68.1	10.0	-4.7	-116.3
Panama	52	35.0	18.1	24.6	44.8	9.4	-30.5	-31.5
Brazil	28	31.7	2.7	10.8	35.8	1.0	-5.3	-13.3
Philippines	52	31.7	3.5	2.2	31.0	2.0	-6.3	-0.7
Mexico	53	31.4	4.4	12.0	39.9	9.4	-9.9	-24.4
Peru	24	17.0	8.6	7.0	13.8	-7.1	7.5	-12.9
China	23	16.5	1.0	1.2	16.6	1.4	-1.5	-2.1
Romania	15	16.4	6.3	5.8	14.7	9.1	-8.7	-10.9
Venezuela	44	15.2	9.7	24.2	37.0	1.7	-18.7	-38.6
Thailand	55	14.9	6.0	2.2	6.2	2.0	-2.8	1.3
Poland	18	14.4	3.3	37.8	26.4	12.2	-8.6	-56.7
Iran	19	13.7	22.4	12.5	20.1	-15.5	-23.2	-2.6
South Africa	57	12.6	5.4	7.9	5.7	-2.9	-2.7	-0.9
India	61	5.5	2.4	9.1	6.7	0.8	-3.0	-10.4
Colombia	60	5.5	2.5	2.6	3.1	-0.9	-0.2	-1.6
Average	*1071*	*72.8*	*8.2*	*28.1*	*76.1*	*0.4*	*-5.6*	*-37.0*
Median	*1071*	*45.5*	*6.0*	*19.8*	*41.2*	*2.0*	*-4.7*	*-31.5*

Source: Authors' estimates; Full data sources reported in text and appendices.

Notes: This table reports the results of the variance decomposition of debt changes for emerging countries over 1950-2011, excluding debt changes corresponding to shifts in government sector coverage. We used the following identity to perform this decomposition exercise, derived from equation (2.1):

$$Var(\Delta d_t) = Var(s_t) + Var\left[\left(\frac{r_t-g_t}{1+g_t}\right)d_{t-1}\right] + Var(SFR_t) + 2\left[CoVar\left(s_t, \left(\frac{r_t-g_t}{1+g_t}\right)d_{t-1}\right) + CoVar(s_t, SFR_t) + CoVar\left(\left(\frac{r_t-g_t}{1+g_t}\right)d_{t-1}, SFR_t\right)\right],$$

where Δd is the one-year difference in the debt to GDP ratio, s is the primary surplus to GDP ratio, r-g is the implied nominal interest rate-GDP growth differential, and SFR is the stock-flow residual. In the table, we label the interest-growth times outstanding debt component as "(r-g)d" and the stock-flow residual as "Residual". Furthermore, C() indicates twice the covariance of the variables in parenthesis. Hence each column to the right of ΔDebt expresses a component of the variance of one-year debt changes; note that the values in the component columns sum to the values in the ΔDebt column.

Table 7. Bohn (1998) Test for Fiscal Policy Sustainability

Country	Full Sample	1919-2011	1950-2011	1950-2007	N
Sweden	0.038***	0.010	0.085***	0.084***	202
United States	- 0.006	0.042***	- 0.012	0.064***	177
United Kingdom	0.043***	0.005	0.016***	0.017***	160
Canada	0.056***	0.077***	0.077***	0.087***	134
Spain	0.038***	0.069***	0.032*	0.054***	133
Japan	- 0.026***	- 0.055***	- 0.03***	- 0.027***	125
Norway	0.268***	0.028***	0.308***	0.283***	124
Denmark	0.077***	0.035***	0.055***	0.056***	123
Italy	0.056***	0.019***	0.055***	0.057***	118
Portugal	0.031**	0.194***	0.020	0.047***	117
India	0.024	0.072***	0.041***	0.047***	99
France	0.037***	0.017**	- 0.042***	- 0.036***	98
Belgium	0.035***	0.056***	0.074***	0.074***	97
Netherlands	0.027***	- 0.03***	0.023***	0.022***	97
New Zealand	0.016***	0.049*	0.005	- 0.014	96
Australia	0.026**	0.035***	0.033*	0.023	95
Germany	0.023*	0.012	0.028***	0.03***	91
Finland	0.049*		0.031	0.035	82
Argentina	0.021	0.010	- 0.006	- 0.011	80
Switzerland	0.017**		0.003	- 0.002	76
Ireland	0.062***		0.069***	0.056***	75
Colombia	0.032	0.026**	0.036	0.042	75
Greece	0.037***	0.016***	0.035***	0.05***	70
Venezuela	0.008		0.007	0.033	67
Mexico	0.035***		0.038***	0.047***	63
Iceland	0.012			0.034**	62
Austria	0.005			0.009	59
Philippines	0.092***			0.093***	57
Thailand	0.003			0.005	56
South Africa	0.040			0.041	54
Korea	0.149***			0.148***	53
Pakistan	0.031**			0.029*	53
Panama	0.022			0.025	52
Costa Rica	- 0.001			- 0.002	45
Ghana	0.008			0.006	42
Paraguay	0.019			0.029**	41
Turkey	0.19***			0.193***	38
Indonesia	0.021			0.018	35
Uruguay	0.035***			0.035***	33
Israel	- 0.009			- 0.011	32
Honduras	- 0.028**			- 0.025*	29
Brazil	0.001			0.002	28

Source: Authors' estimates; Full data sources reported in text and appendices.

Notes: OLS estimation, robust standard errors. Debt coefficients reported; output gap and temporary spending controls included for all countries. Commodity price controls included for relevant countries based on latest WEO list of historical commodity exporters (index which includes oil prices applied to countries dependent on oil revenues). Default years and significant war years excluded; we report results for all countries with at least 25 non-default, non-war observations The number of observations reported refers to the full sample estimation.

Table 8. Bohn Regression Results Iterated Over Twenty-Five Year Rolling Windows

Country	Significantly Positive Response Coefficient	Significantly Negative Response Coefficient	Change to Positive	Change from Positive	Percent Positive	Percent Negative	Number of Windows	First Window
Sweden	1838, 1841-8, 1853, 1878-1913, 1989-2008	1862-9, 1966, 1982-3	1838, 1841, 1853, 1878, 1989	1839, 1849, 1854, 1914, 2009	49	8	134	1832
United Kingdom	1854-64, 1866-70, 1872-7, 1880-1913, 1978-86, 1990-94, 2003-10	none	1866, 1872, 1880, 1978, 1990, 2003	1865, 1871, 1878, 1987, 1995, 2011	75	0	104	1854
Canada	1926-34, 1966-70, 1994-2011	1973-5	1909, 1926, 1994	1901, 1917,1971	54	3	87	1894
Denmark	1904-1911, 1986-2011	1974, 1982	1986	1912	40	2	84	1904
Norway	1914-6, 1930-43, 1984-90, 2004-11	1905-6, 1967-70	1914, 1930, 1984, 2004	1917, 1991	38	7	84	1905
Spain	1903-35, 1975-86, 1996-2009	1961-9	1975, 1996	1987, 2010	70	11	84	1903
Japan	1906-33, 1988-96	1902-3, 1939-41, 1976-81, 2002-11	1906, 1988	1934, 1997	45	26	82	1899
United States	1825-6, 1829, 1904-14, 1968-85, 1996-2008	1990	1829, 1840, 1996	1827, 1830, 1915, 1986, 2009	63	1	73	1825
Portugal	1952-61, 1987-2005	1939-44, 2010	1952, 1987	1962, 2006	40	10	73	1939
New Zealand	1952-68, 1979-93	none	1979	1969, 1994	53	0	60	1952
France	1904-17	1967-98, 2007-10	none	none	24	61	59	1904
Belgium	1977-8, 1985-2007, 2009-11	none	1977, 1985, 2009	1979, 2008	49	0	57	1904
Netherlands	1904-17, 1969-72, 1975-6, 2000-11	1984	1975, 2000	1973, 1977	56	2	57	1904
Italy	1906-13, 1993-2011	1973-88	1906, 1993	none	49	29	55	1904
Ireland	1989-2011	none	1989	none	42	0	55	1957
Germany	1904-6, 1917, 1987-90, 1999-2011	none	1917, 1987, 1999	1907, 1991	40	0	52	1904
Australia	1937-42, 1983-7, 1996-2002, 2004-2011	none	1983, 1996, 2004	1988, 2003	50	0	52	1937
Colombia	1985-9, 1992-97, 1999-2010	1965-80	1985, 1992, 1999	1990, 1998, 2011	49	34	47	1965
Switzerland	1966-74, 1985-91	1995-9	1985	1975, 1992	35	11	46	1966
Finland	none	1976-84, 1993-2002	none	none	0	44	43	1969
Austria	1973-5	1983-6, 1988-91	none	1976	8	21	39	1973
India	1934-45, 1948-57, 1997-1999, 2002-9	none	1948, 2002	1946, 2000, 2010	85	0	39	1934
Iceland	1985, 1992	1976-9	1985, 1992	1986, 1993	5	11	38	1974
Thailand	1989-90	1978-82	1989	1991	6	14	35	1977
Philippines	1979-05, 2011	none	1979, 2011	2006	82	0	34	1978
Panama	1989-90	1982	1989	1991	6	3	32	1980
Argentina	1920-8, 1933-5	1942-9	1933	1923, 1936	39	26	31	1920
Korea	1985-91	1996-2000	1985	1992	23	17	30	1982
Greece	1994-2010	1985-6, 1988-90	1994	none	65	19	26	1985
Mexico	1963-5, 1971-2, 1978-81, 2011	none	1971, 1978	1966, 1973	50	0	20	1963
Paraguay	none	none	none	none	0	0	18	1994
Pakistan	1996-08	none	1996	2009	72	0	18	1991
Venezuela	none	1981	none	none	0	7	14	1969
South Africa	none	none	none	none	0	0	11	1974
Israel	none	none	none	none	0	0	10	2002
Ghana	2011	none	2011	none	20	0	5	2007
Honduras	none	1978-80	none	none	0	75	4	1977
Chile	none	none	none	none	0	0	1	2011
Costa Rica	none	none	none	none	0	0	1	2011
Indonesia	none	none	none	none	0	0	1	1996
Average					35	11	45	
Median					40	3	41	

Source: Authors' estimates; Full data sources reported in text and appendices.

Notes: OLS estimations of equation (3.1), with robust standard errors: $s_t = \rho d_t + \alpha Z_t + \varepsilon_t$. We include in Z_t output and expenditure gap controls, and, where applicable, a world commodity price index that includes or excludes oil as appropriate. We consider only 25 year periods that are complete with data, and do not include significant war or default episodes. Dates listed refer to the final year of the corresponding 25 year window: hence 1990-1 refers to the 1966-1990 and 1967-1991 windows. The first column thus reports all 25-year windows for which ρ is positive and significant (at the 5 percent level), and the second column reports all windows in which ρ is *negative* and significant. The "change to positive" column reports 25-year windows in which ρ becomes significantly positive after not being so in the window immediately prior; the "change from positive" column reports windows in which ρ is no longer significantly positive after being so in the window immediately prior.

Table 9. Bohn (1998) Fiscal Reaction Function with Expanding Sample

Country	Significantly Positive	Significantly Negative	Postwar Obs.
Australia	1976-2002	none	62
Belgium	1988-2011	none	62
Canada	1996-2011	1974-5	62
Colombia	none	1974-2000	62
Finland	none	1979-85, 1993-5	62
France	none	1974-2011	62
Iceland	2007-8	1978-9	62
Ireland	1988-2011	none	62
Italy	1974-91, 1997-2011	none	62
Netherlands	1983-2011	none	62
New Zealand	1980-95	none	62
Norway	1983, 1992-2011	none	62
Portugal	1990-2008	1981	62
Spain	1977-2010	none	62
Sweden	1989-91, 1996-2011	none	62
Switzerland	1974-5	none	62
United Kingdom	1981-2011	none	62
United States	1974-2008	none	62
Austria	1974-5	none	59
Japan	1990-4	1976-83, 2002-11	59
Denmark	1986-2011	1974, 1982	58
Germany	1989-90, 1994, 2000-11	1981	58
Philippines	1979-2011	none	57
Thailand	none	1978-83	56
Korea	1986-1992, 2005-11	none	53
Pakistan	1976-94	2005-11	53
Greece	1994-2010	1985-6, 1988-90	46
India	2003-11	none	35
Israel	none	none	32

Source: Authors' estimates; Full data sources reported in text and appendices.

Notes: Iterative Bohn (1998) OLS regressions of $s_t = \rho d_t + \alpha Z_t + \varepsilon_t$, with d_t the beginning of period debt ratio, s_t the primary balance, and Z_t controls for cyclical and other factors, beginning 1950 with twenty-five observations, expanding by one observation, and excluding countries with postwar defaults. The dates listed correspond to the final year of the subsample. The India window starts in 1978, the year after its last default.

Table 10. Structural Breaks in Bohn (1998) Sustainability Test, Post-War

	Min. Obs. 20		Min. Observations 25% of Sample								
Country	Break	Breaks	Years			Estimated Debt Coefficients				N	Sample
Australia	1985	2	1965	1985	--	0.078*	0.097***	0.082**		58	1950-2007
Belgium	1970	2	1963	1989	--	- 0.249*	0.029***	0.052		58	1950-2007
Canada	1975	2	1974	1993	--	- 0.06**	0.035*	0.247***		58	1950-2007
Colombia	1975	1	1975	--	--	- 0.169***	0.102***			58	1950-2007
Finland	1974	2	1974	1990	--	0.000	0.064	0.012		58	1950-2007
France	1977	1	1977	--	--	- 0.157***	- 0.032**			58	1950-2007
Iceland	1987	3	1965	1979	1993	0.044	- 0.143**	- 0.051	- 0.163***	58	1950-2007
Ireland	1987	2	1973	1989	--	- 0.012	0.11***	0.045***		58	1950-2007
Italy	1974	2	1970	1990	--	0.118	0.023	0.217***		58	1950-2007
Netherlands	--	1	1990	--	--	0.016**	0.143***			58	1950-2007
New Zealand	1987	2	1973	1988	--	0.013*	- 0.069	0.044		58	1950-2007
Norway	1979	3	1963	1979	1993	- 0.069**	0.058*	0.027	0.088	58	1950-2007
Portugal	1971	2	1971	1993	--	0.047	0.177***	- 0.026		58	1950-2007
Spain	1977	2	1977	1993	--	0.024*	0.059***	- 0.006		58	1950-2007
Sweden	1977	2	1977	1993	--	0.025	0.171***	0.069		58	1950-2007
Switzerland	1977	2	1964	1978	--	0.018	0.018*	- 0.020		58	1950-2007
United Kingdom	1980	2	1968	1985	--	0.016	0.133***	0.267***		58	1950-2007
United States	1974	2	1974	1993	--	0.062***	0.021	0.117***		58	1950-2007
Austria	1974	1	1974	--	--	0.474***	0.017			54	1954-2007
Denmark	1974	2	1974	1989	--	- 0.151**	0.083*	0.030		54	1954-2007
Japan	1981	2	1975	1992	--	- 0.072	0.098***	- 0.036***		54	1954-2007
Germany	1974	1	1967	--	--	- 0.919**	0.038***			53	1955-2007
Phillipines	1974	2	1974	1990	--	- 0.152	0.027	0.080		53	1955-2007
Thailand	--	2	1980	1993	--	- 0.088*	- 0.053	- 0.010		52	1953-2007
Korea	1978	2	1975	1987	--	- 0.322***	0.322	0.035		49	1959-2007
India	--	2	1980	1995	--	0.017	0.031***	0.158**		48	1950-2007
Mexico	--	0	--	--	--	0.048***				48	1950-2007
Pakistan	1977	2	1964	1988		- 0.409***	- 0.031*	0.058		48	1952-2007
Panama	--	1	1989	--	--	0.037***	- 0.032			48	1956-2007
South Africa	1976	1	1992	--	--	0.002	- 0.056			47	1950-2007
Greece	1986	1	1990	--	--	- 0.055***	0.044			42	1966-2007
Venezuela	--	0	--	--	--	0.019				42	1950-2007
Argentina	--	2	1968	1976	--	- 0.544*	- 0.093	0.05***		25	1950-2000

Source: Authors' estimates; Full data sources reported in text and appendices.
Notes: The table presents Bai and Perron (1998) tests for unknown number and location of potential structural breaks, in the post WWII period, on the Bohn (1998) test, $s_t = \rho d_t + \mu_t = \rho d_t + \alpha Z_t + \varepsilon_t$, for up to three potential structural breaks. The country, number and years of breaks are reported in the first four columns, and estimates for $\hat{\rho}$ across the subsamples are reported in the next three, with the number of observations and sample years in the last two columns. Venezuela's sample excludes 1980-87.

Table 11. Structural Breaks in Bohn (1998) Sustainability Test, Full Sample

Country	Breaks	Years			Estimated Debt Coefficients				Obs.	Sample
Sweden	2	1852	1972	--	0.072	0.016**	0.141***		198	1801-2011
United States	3	1830	1931	1984	0.157***	0.076***	0.09***	- 0.073	171	1801-2011
United Kingdom	3	1867	1931	1986	0.046***	0.065***	0.031***	0.055	158	1830-2011
Canada	3	1908	1933	1984	0.042**	0.12***	0.057***	0.164***	132	1871-2011
Spain	2	1935	1972	--	0.027***	- 0.053***	0.071***		131	1869-2011
Norway	3	1913	1939	1979	0.009	0.189***	- 0.056	0.266***	124	1881-2011
Japan	2	1938	1981	--	0.024***	- 0.068***	- 0.055***		124	1876-2011
Denmark	1	1970	--	--	0.025	0.047***			123	1881-2011
Portugal	2	1921	1967	--	0.111	- 0.016	0.076***		116	1880-2011
Italy	3	1904	1936	1971	0.009	0.004	- 0.041	0.121***	115	1880-2011
France	2	1913	1977	--	0.044***	- 0.165***	- 0.032**		98	1881-2011
Belgium	2	1957	1989	--	- 0.006	0.026***	0.074***		97	1880-2011
Netherlands	3	1950	1970	1990	0.04***	0.031**	- 0.011	0.142***	97	1880-2011
India	3	1929	1957	1990	0.031**	0.113***	0.135	- 0.012	96	1884-2011
New Zealand	2	1969	1989	--	0.018***	0.055*	0.125***		95	1913-2011
Australia	2	1949	1982	--	0.09***	0.078**	0.138***		93	1913-2011
Germany	1	1968	--	--	0.099***	0.03***			90	1880-2011
Finland	2	1968	1988	--	0.096***	- 0.079	0.031*		81	1921-2011
Switzerland	0	--	--	--	0.017**				75	1930-2011
Ireland	1	1987	--	--	- 0.005	0.081***			75	1937-2011
Argentina	2	1931	1967	--	0.023*	0.072	- 0.014		75	1900-200
Colombia	1	1975	--	--	- 0.124***	0.097***			74	1800-2011
Greece	1	1991	--	--	0.04***	- 0.055**			69	1885-2011
Venezuela	0	--	--	--	0.007				64	1921-2011
Iceland	1	1990	--	--	0.008	- 0.024			62	1950-2011
Mexico	1	1962	--	--	0.059***	0.054***			61	1925-2011
Austria	1	1974	--	--	0.474***	0.015			58	1954-2011
Phillipines	1	1976	--	--	- 0.607*	0.06***			57	1955-2011
Korea	1	1978	--	--	- 0.134	0.010			53	1800-2011
Thailand	0	--	--	--	0.029				53	1953-2011
Panama	0	--	--	--	0.053***				52	1956-2011
Pakistan	1	1988	--	--	- 0.084***	0.063**			52	1950-2011
South Africa	1	1983	--	--	0.022	0.144**			51	1950-2011

Source: Authors' estimates; Full data sources reported in text and appendices.

Notes: The table presents Bai and Perron (1998) tests for unknown number and location of potential structural breaks, in the entire sample, on the Bohn (1998) test, $s_t = \rho d_t + \mu_t = \rho d_t + \alpha Z_t + \varepsilon_t$, for up to three potential structural breaks. The country, number and years of breaks are reported in the first four columns, and estimates for $\hat{\rho}$ across the subsamples are reported in the next three, with the number of observations and sample years in the last two columns.

Table 12. Influential Years in Recursive Bohn (1998) Test

Country	Influential Years	N	Original Estimate
Sweden	**1803,** 1981-2-**3-4, 1987**-8-9, **1993-4**-5, **1996-2000**-1, 2006-7	202	0.038***
United States	**1936**-7, 1939, **1941, 1948-49**-50-**51**, 1959, 1975, **1983-7**-8, **1990-3**, 1998-2000, **2003-4**-5, **2008-11**	177	-0.006
United Kingdom	**1830-46, 1847-8,** 1850, **1854-6,** 1860, **1900-2,** 1906-**07-13, 1923-31,** 1948-**49-50-51,** 1952-3, **1954, 1956-7**-8-9, 1963, **1981, 1992-4,** 2002-**3**-4-5, 2005, **2009**	160	0.043***
Canada	**1881**-2, 1885, **1891, 1906, 1909-15,** 1916-7, **1918-9, 1932-3,** 1937-9, **1946-8, 1994-2003, 2010**	134	0.056***
Spain	**1868-70, 1872, 1875-6,** 1883, **1894**-5, **1896-1910,** 1913, 1915, **1943**-4-5, 1976-7, **1978-85,** 2010	133	0.038***
Japan	1907, 1939-41, 1960-**1**-2, 1970, 1985-7, **1988-91**-2, 1994, **1995-2011**	125	-0.026***
Norway	1890-3, 1899, 1915-6, **1927-8**-9, **1931-5, 1947**-8-9, **1971-4,** 1975-7, **1978-82**-83, **1987,** 1994-5-**6-7, 2000-11**	124	0.268***
Denmark	**1971-2**-3-4, **1984-91,** 1994-5, **1996-2001, 2005**	123	0.077***
Italy	**1880, 1882-91**-92, 1893-6-**7,** 1898-1903, **1905, 1921-2, 1923-5, 1928,** 1935-6, 1939, **1947-9, 1975,** 1992-4, **1995-2001**-2, **2007,** 2011	118	0.056***
Portugal	1880, 1922, 1968-70, **1971-8,** 1979-81, 2009-**10**	117	0.031**
India	1921-2, 1929-**30-31**-32, 1945, **1980,** 1982, **1983-6,** 1989-90, 2007, **2010**-1	99	0.024
France	**1881-8,** 1892, **1893-1901,** 1909, 1912-3, 1947, 1973-**4**, **2009-10**-11	98	0.037***
Belgium	1950, 1980-**1-2-3**-4, 1989-**90**-91, **1994-2001**-2, 2009-11	97	0.035***
Netherlands	1880, **1886**-7, 1889-**90, 1892-6**, 1897-8, **1900,** 1903-4, **1908**-9, **1911-13, 1949, 1950, 1951-2**-3, 1976, **1978-81, 1993-4, 1996,** 2000, 2002-3, 2005, **2007-8**	97	0.027***
New Zealand	1917-**8**-9, **1921,** 1931, **1933-5,** 1976, 1982-3-**4**-5, **1995**-6, 2003, **2004-6**-7,	96	0.016***
Australia	**1931-4**-5, **1942,** 1947-49, 1950, 1960, 2003, 2005-7	95	0.026**
Germany	**1913,** 1958, 1966-**7**-8, **1975, 1995, 2000,** 2002-4, 2007-8, **2010**-11	91	0.023*
Finland	**1976-7**-8, 1994-5, 1997-**8**-9, **2000-1**-2, 2006-**7**	82	0.049*
Argentina	**1900**-1, 1903, 1967, **1969-70**-71-72, **1974**-5, **2006**	80	0.021
Switzerland	**1946-8, 1960,** 1964, 1966-8, 1997, 2003-4, 2007	76	0.017**
Ireland	1937, **1960,** 1979-83, 1985-**6**-7, **1988-91,** 1992-3, 1997, 2006, **2009-10-11**	75	0.062***
Colombia	**1906, 1931,** 1953-4-**5**-6, 1974, 2003-**4-5**-6-**7-8,** 2010-11	75	0.032
Greece	1885-**6**-7-8, **1889-1908,** 1911, 1966, **1973-4,** 1979-80-**81-82,** 1993, **1994-8,** 1999, **2000**-1-2, 2004, 2007-8-**9**-10	70	0.037***
Venezuela	1957, 1979, **1989, 1991-2**-3-**4,** 1999-2000, **2003,** 2007-8, **2009-11**	67	0.008
Mexico	**1925, 1949, 1952,** 1959, 1961-2, **1964-5, 1978-79**-80, **1991-2, 1996-7,** 2006, 2008, 2009-11	63	0.035***
Iceland	1958-60, 1968, 1974-5, 1984, 1993-**4, 1997**-8, **1999-2000,** 2006-**7, 2009-11**	62	0.012
Austria	1954-**5-6**-7-**8-9**, **1961, 1962,** 1964-**5-6**, 1970-**1-2**-3-4-5, **1995, 2004,** 2009-**10**	59	0.005
Philippines	1960, **1962,** 1967-**8-9,** 1971-**2**-3-**4**-5, **1979-80, 1984, 1987-90, 1994-6,** 1999, 2001-2, 2009	57	0.092***
Thailand	**1957-9,** 1961, 1974, 1975, 1977-8, **1988**-9, **1991**-2-**3-4, 1998, 2003, 2005-6**-7	56	0.003
South Africa	**1950-1,** 1952-6, 1964, **1974,** 1992, 2007-**08-09-10**	54	0.040
Korea	1960-1-**2, 1966-69,** 1970, **1990-5,** 1996-7, 2009, 2011	53	0.149***
Pakistan	**1952,** 1975, 1978-9, **1987**-8, 1990, 1998-9, **2000-3**-4	53	0.031**
Panama	1965, 1967-**8,** 1971-2, **1974,** 1976-**7, 1982,** 1987-8-**9, 1990-93,** 1996	52	0.022
Costa Rica	**1958-60**-61, 1968, **1974,** 1978, **1982, 1991-2**-3, **2007**-08-09-10	45	-0.001
Ghana	**1971,** 1977, 1981, **1983, 1985-6, 1992**-3, **1996**-7, **2001**-2	42	0.008
Paraguay	1973, **1974-6,** 1977, 1986-**7-8**-9, 1991, 2003, **2009,** 2011	41	0.019
Turkey	1971, 1974-5-6, **1980-1,** 1986, 1994, **1995-8, 1999-2000,** 2002, **2003-7, 2009,**	38	0.19***
Indonesia	**1972-3**-4, 1986, 1992, **2001,** 2003, **2005**	35	0.021
Uruguay	1972, 1974-5, 1977, **1982, 1988-9,** 1993, 1998-9, **2004-5**-6-7	33	0.035***
Honduras	1953, **1955-8,** 1960, 1962-**3,** 1965, **1967-74,** 1976, **1977-78-79-80, 2011**	29	-0.028**
Brazil	1981, **1991-2**-3-4-5-6, 2002-3-4, **2005-8,** 2009-**10-11**	28	0.001

Source: Authors' estimates; Full data sources reported in text and appendices.

Notes: Years resulting from searching OLS regressions of $s_t = \rho d_t + \alpha Z_t + \varepsilon_t$ —with d_t the beginning of period debt, s_t the primary balance, and Z_t controls for cyclical and other factors, from 1800-2011 and excluding war and defaults—for years that cause $\hat{\rho}$ to become insignificant when estimates yield significant $\hat{\rho} > 0$ (and analogous for $\hat{\rho} \leq 0$ /insignificant). Blue (tan) denotes influential prudence (profligacy); Bold (non-bold) indicates designation as an influential observation in the initial (secondary) stage of the program. Asterisks denote significance at the 10, 5, and 1 percent levels, respectively.

Table 13. Times of Strong Prudence and Profligacy

Country	Times of Strong Prudence	Times of Profligacy	N
Sweden	1987-9, 1996-2001, 2006-7	1915, 1920-2, 1953, 1957	202
United States	1948-51, 1998-2000	1934-6, 2009-11	177
United Kingdom	1830-6, 1841-6, 1850, 1856, 1860, 1906-13, 1954-9, 2002	none	160
Canada	1881, 1891, 1906, 1909-13, 1933, 1937-8, 1946-8, 1995-2003	none	134
Spain	1894-1910, 1913, 1915, 1976-7	1943, 2010	133
Japan	1907, 1985-92	1880, 1997-2011	125
Norway	1915-6, 1927-9, 1931-5, 1971-83, 1987, 1994-7, 2000-11	1881-4	124
Denmark	1984-91, 1994-2001, 2005	none	123
Italy	1882, 1885-6, 1890, 1895-6, 1898, 1900, 1905, 1907, 1909, 1969-80, 1995-2000	1921	118
Portugal	1968-71, 1979	1922, 2006-10	117
India	2007	none	99
France	1881, 1885-8, 1893-6, 1899-1901, 1909, 1912	1948-53, 1978, 1981-4, 1986, 1988-96, 2002-11	98
Belgium	1990, 1994-2002	none	97
Netherlands	1886, 1893-8, 1900, 1903-4, 1908-9, 1911-3, 1949, 1951-3, 1976, 1993-4, 1996, 2002, 2005, 2007-8	none	97
New Zealand	1921, 1933-5, 1976, 1982-5	none	96
Australia	1931-5	none	95
Germany	1967-8, 2000, 2007-8	none	91
Finland	none	1952, 1955-6, 1961-5, 1974, 1991-3, 1995	82
Argentina	1900-1, 1903	1937-9, 1949-50	80
Switzerland	1946-8, 1966-8	1992-5, 1997-8	76
Ireland	1987-93, 1997	none	75
Colombia	2003-8	none	75
Greece	1974, 1982, 1993-8, 2000-2	1965, 1969	70
Venezuela	none	1958-61, 1969, 1977-8, 1994, 2009	67
Mexico	1978-80, 1991-2, 1996-7, 2006, 2008	none	63
Iceland	1968, 1974-5, 1984	none	62
Austria	1954	1976-80, 1982-3, 1986, 1990-1, 1995, 2004, 2009-10	59
Philippines	1960, 1962, 1967, 1971, 1974, 1979-80, 1984, 1987-90, 1994-6, 1999, 2001-2, 2009	none	57
Thailand	1974, 1988-9	none	56
South Africa	none	1964	54
Korea	1970	none	53
Pakistan	1990, 1998-2004	1952-67	53
Panama	1965, 1968, 1971-2, 1974, 1977, 1989	1958-63, 1993	52
Costa Rica	none	1963, 1967, 1978-9	45
Ghana	1993, 2001	1983	42
Turkey	1980-1, 1995-8, 2002-7, 2009, 2011	none	38
Indonesia	1986, 2001	none	35
Uruguay	1988, 2004-7	none	33

Source: Authors' estimates; Full data sources reported in text and appendices.

Notes: Dates of strong prudence are non-war, non-default years that are part of at least one 25 year window with a positive and significant debt response coefficient, that are influentially prudent according to the influential observations routine, and in which the actual primary balance is higher than the forward-looking debt-stabilizing primary balance. Dates of profligacy are non-war, non-default years that are *not part of any* 25 year window with a positive and significant debt response coefficient, in which the actual primary balance is lower than the forward-looking debt-stabilizing primary balance, and in which *at least one of the following is true*: i) the year in question is part of at least one 25 year window with a negative and significant debt coefficient, or ii) the year is influentially profligate according to the influential observations routine. The last column reports the total number of non-war, non-default observations for each country. This table reports only countries for which we have at least 30 non-war, non-default observations.

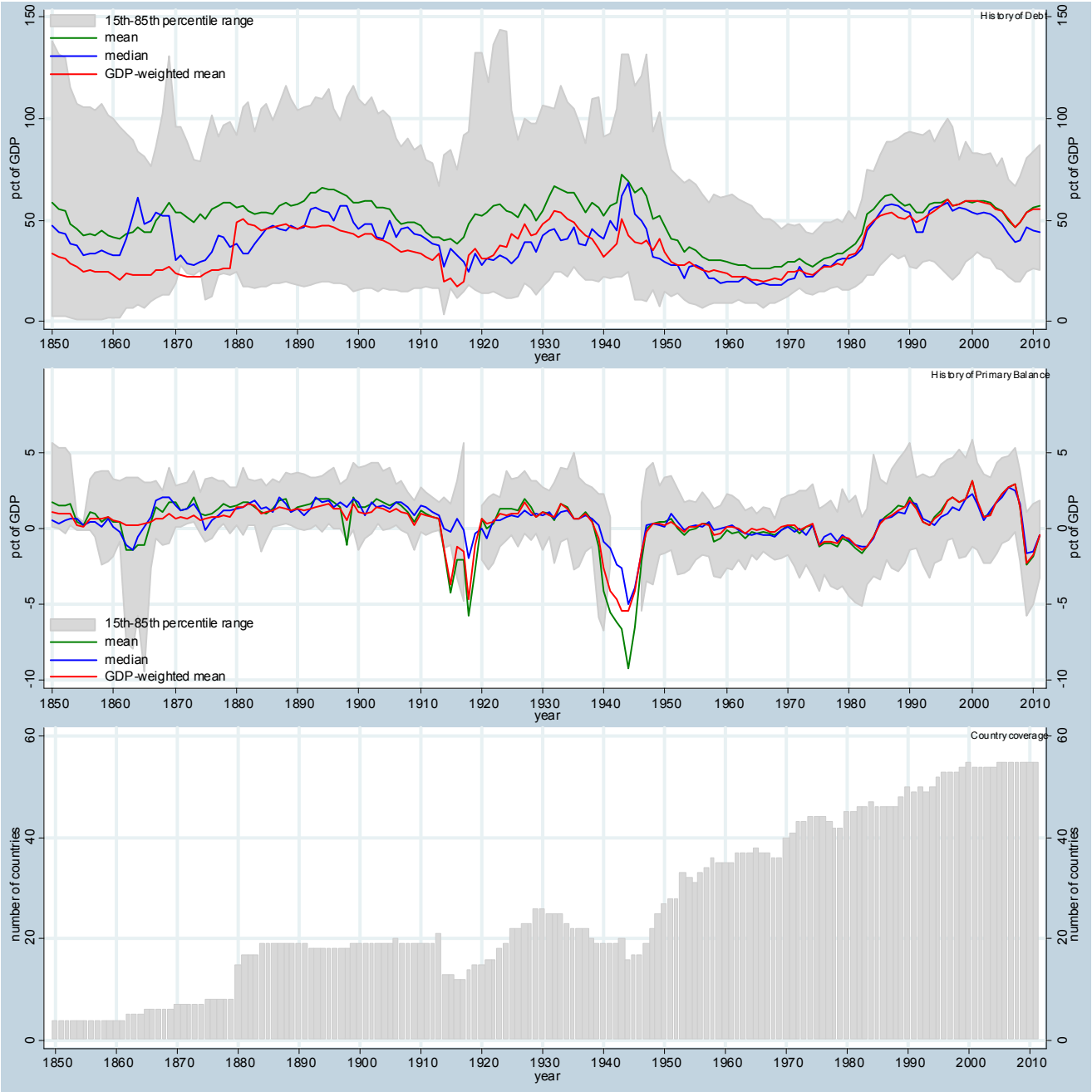
Table 14. Panel Results, Fiscal Response as a Function of Growth and Borrowing Costs

Primary Balance to GDP	R1	R2	R3	R4	R5	R6
Full Sample Results						
Lagged Debt	0.027***	0.027***	0.029***	0.030***	0.030***	0.029***
Debt*Change in HP Growth	0.063	0.179**			0.33	0.861**
Change in HP Growth		- 13.34				- 51.565*
Debt*Real LT Interest Rate			0.067***	0.049	0.067***	0.045
Real LT Interest Rate				1.859		2.403
Output Gap	0.046**	0.031	0.053	0.053	0.084*	0.043
Real Expenditure Gap	- 0.080***	- 0.081***	- 0.096***	- 0.096***	- 0.093***	- 0.093***
Non-fuel Commodity Prices	- 0.001	- 0.001	- 0.085***	- 0.088***	- 0.080***	- 0.068***
Fuel Commodity Prices	- 0.001	- 0.001	(omitted)	(omitted)	(omitted)	(omitted)
Constant	- 0.632	- 0.605	- 0.688	- 0.729	- 0.737*	- 0.720*
Number of Observations	3774	3774	1916	1916	1908	1908
Adjusted R-Squared	0.457	0.458	0.558	0.558	0.56	0.565
Postwar (1950-2011) Results						
Lagged Debt	0.022**	0.022**	0.015	0.014	0.020*	0.018
Debt*Change in HP Growth	0.35	0.359			0.872*	1.238**
Change in HP Growth		- 0.769				- 26.515
Debt*Real LT Interest Rate			0.257***	0.303***	0.273***	0.351***
Real LT Interest Rate				- 3.235		- 5.432
Output Gap	0.173***	0.172***	0.241***	0.240***	0.308***	0.291***
Real Expenditure Gap	- 0.129***	- 0.129***	- 0.273***	- 0.274***	- 0.270***	- 0.270***
Non-fuel Commodity Prices	- 0.006*	- 0.006*	- 0.343***	- 0.340***	- 0.345***	- 0.329***
Fuel Commodity Prices	- 0.002	- 0.002	(omitted)	(omitted)	(omitted)	(omitted)
Constant	- 0.206	- 0.204	- 0.145	- 0.075	- 0.37	- 0.232
Number of Observations	2394	2394	1219	1219	1212	1212
Adjusted R-Squared	0.204	0.203	0.299	0.299	0.313	0.315

Source: Authors' estimates; Full data sources reported in text and appendices.

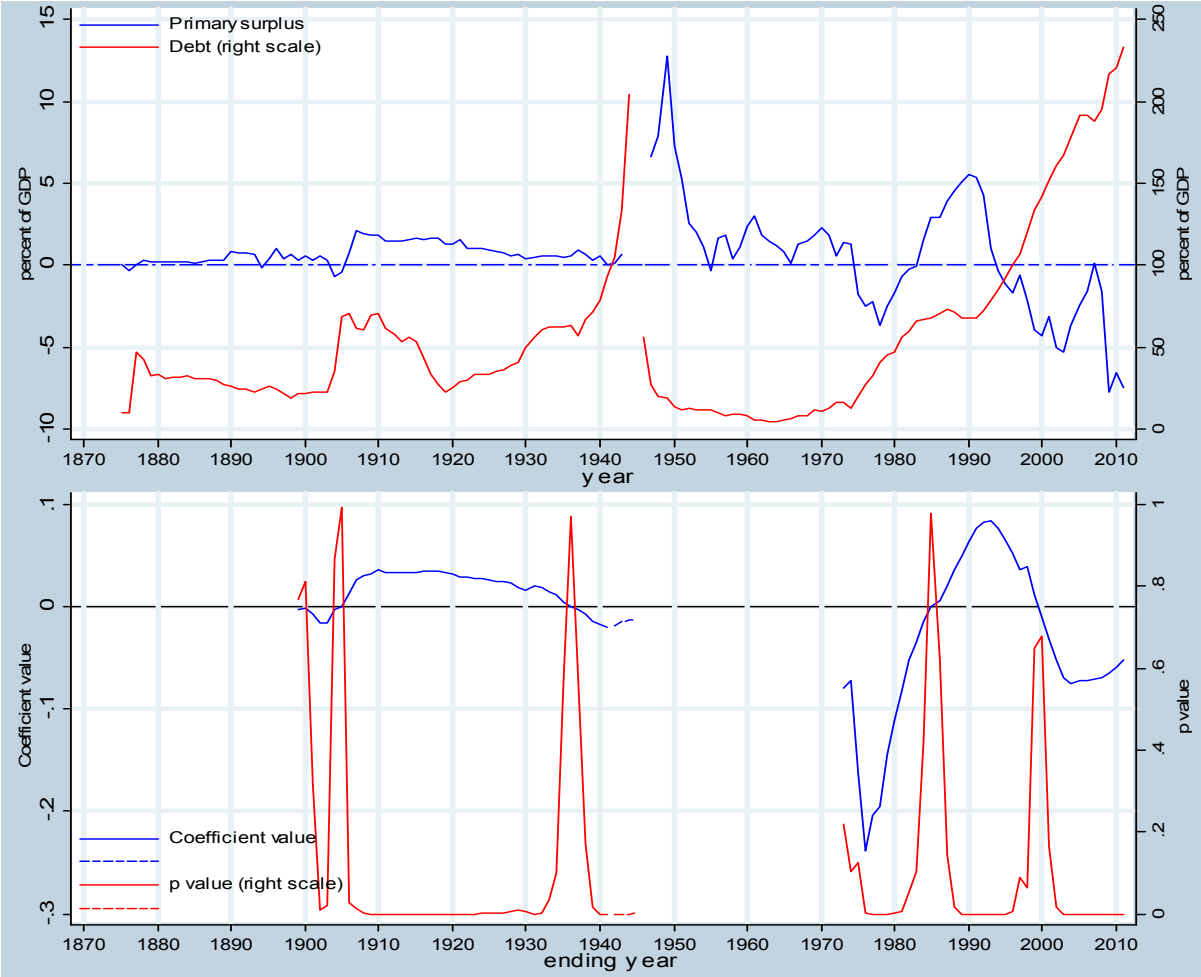
Notes: Six estimations of the primary balance reaction function: $s_t = \rho d_t + \rho\beta_1 \bar{g}_t d_t + \rho\beta_2 r_t d_t + \alpha Z_t + \varepsilon$ with d_t the beginning of period debt, s_t the primary balance, $\bar{g}_t$ the unexpected change in the long-term real GDP growth rate, r_t the real sovereign interest rate, and Z_t controls for cyclical and other factors, from 1800-2011 (top) and 1950-2011 (bottom). R1 allows only the debt-LT growth surprise interaction term, R2 augments R1 with the HP growth surprise. R3 allows only the debt-LT real interest rate interaction term, and R4 augments R3 with the real LT interest rate. R5 includes both the LT real interest rate and the LT real GDP growth surprise, and R6 augments R5 with the LT real interest rate and change in the LT real GDP growth rate. Asterisks indicate significance at the 10, 5, and 1 percent levels, respectively. The Output Gap, Expenditure Gap, and commodity price indices are abbreviated by Z_t,. Country-year indicators for wars where expenditure grew beyond six percent of GDP not shown.

Figure 1. Government Debt and Primary Fiscal Balance, 1850–2011, in percent of GDP



Sources: See Data Source Description in main text and accompanying electronic chartbook.
Note: The top (middle) panel presents the unweighted and GDP-weighted mean, as well as the median, of the government debt (primary fiscal balance) as a share of GDP for the countries in the sample, whose number at each point in time is indicated by the bars in the bottom panel. The shaded areas show the 15th and 85th percentiles (not shown in the middle panel for the years corresponding to the major wars to preserve readability of the chart).

Figure 2. Fiscal Variables (Top Chart) and Rolling Regression Results for Japan, 1875-2011



Notes: In the bottom chart, the value of the blue line in the year 1974 is equal to the debt response coefficient given by the estimate of the Bohn fiscal reaction function over the 25 year period 1950-1974. The value of the red line (right scale) in 1974 is equal to the significance of this estimated debt coefficient. Whenever the blue line is above 0 and the red line is below .05, the debt coefficient for the corresponding 25 year window is positive and significant at the 5 percent level, and hence fiscal policy satisfies the government's intertemporal budget constraint in accordance with Bohn (1998). Dotted lines indicate the presence of a war or default episode in the corresponding 25 year window.

Figure 3. Periods of Prudence and Profligacy, 1800-2011

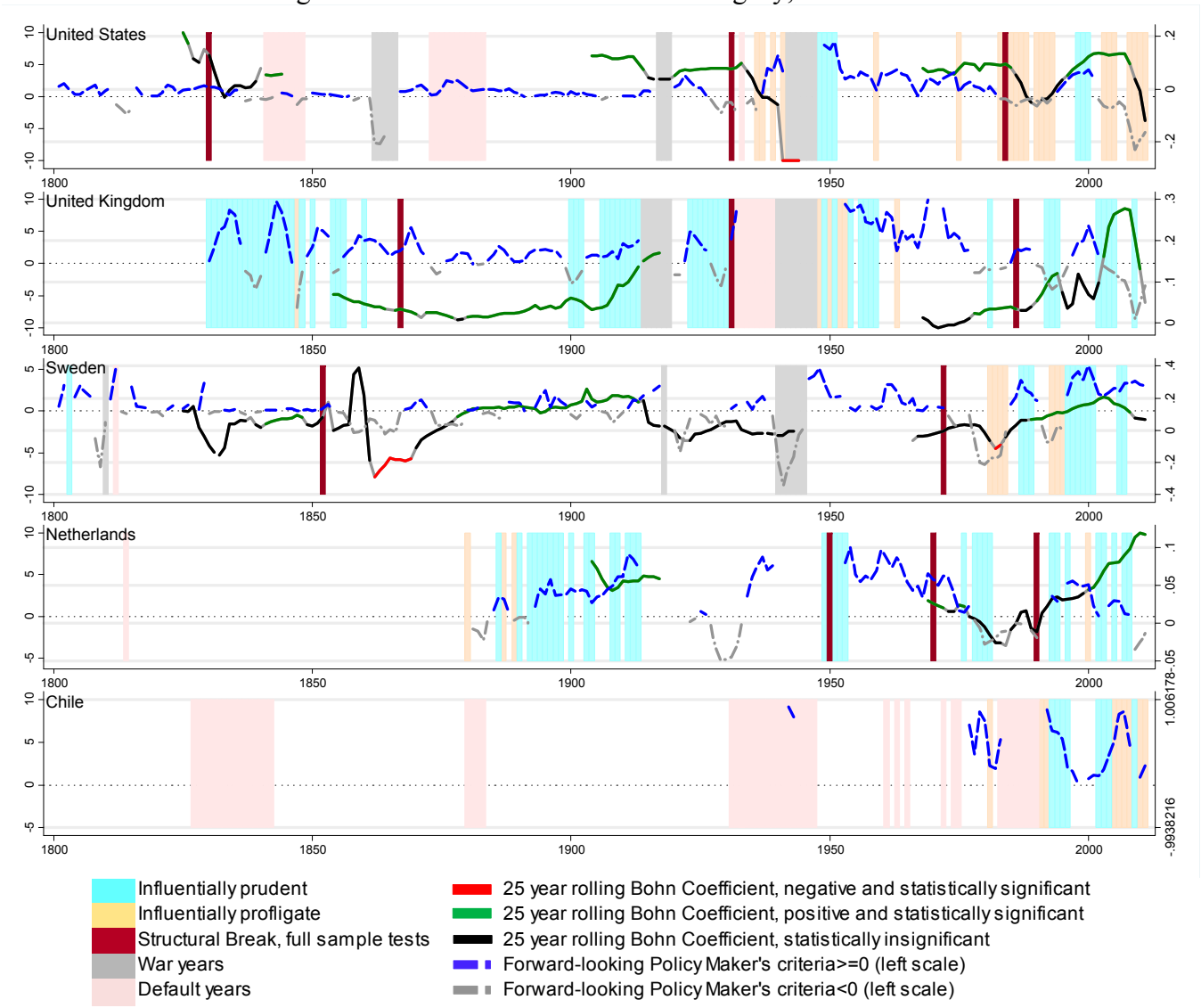


Figure 4. Periods of Prudence and Profligacy, 1850-2011

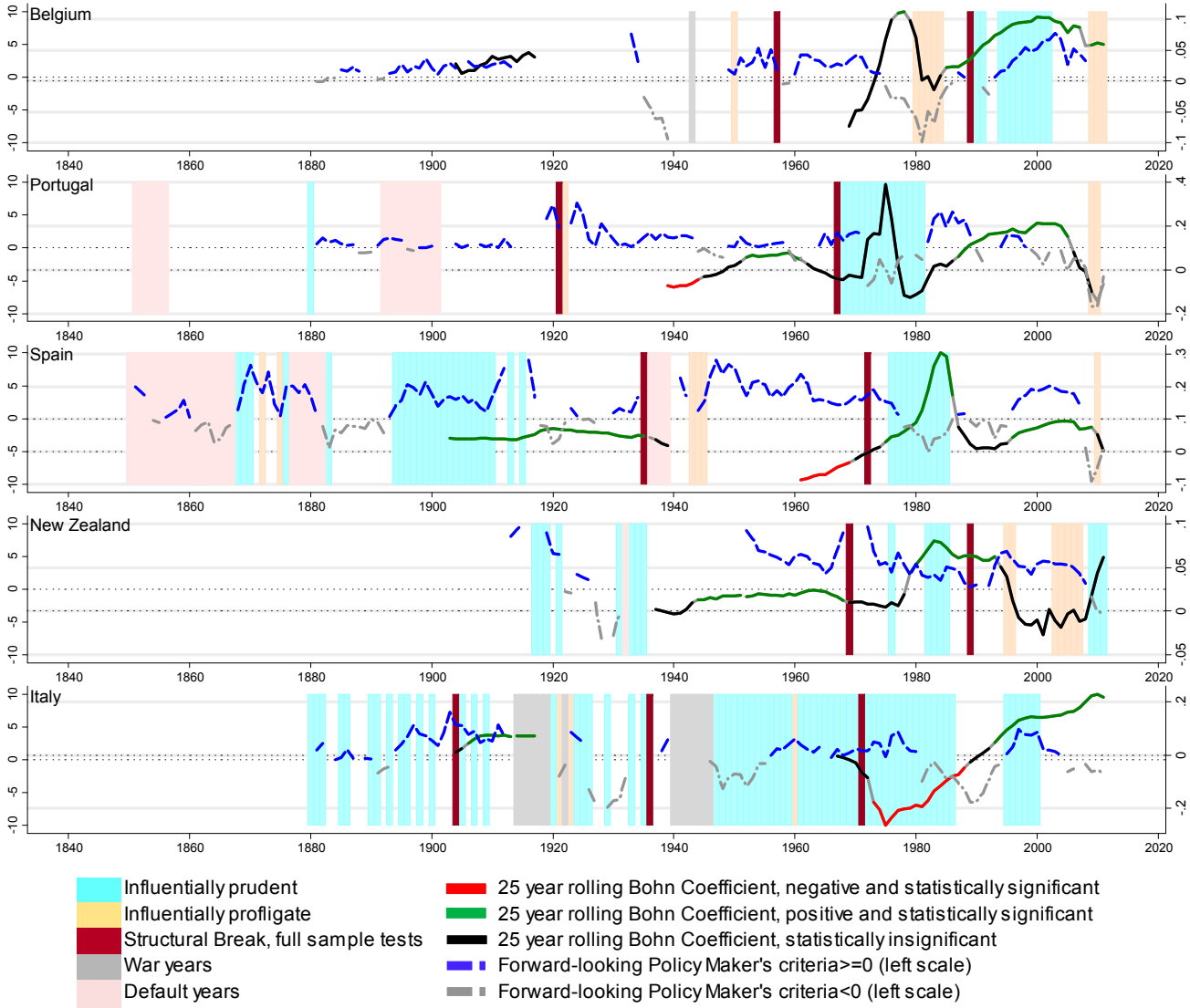


Figure 5. Periods of Prudence and Profligacy, 1850-2011

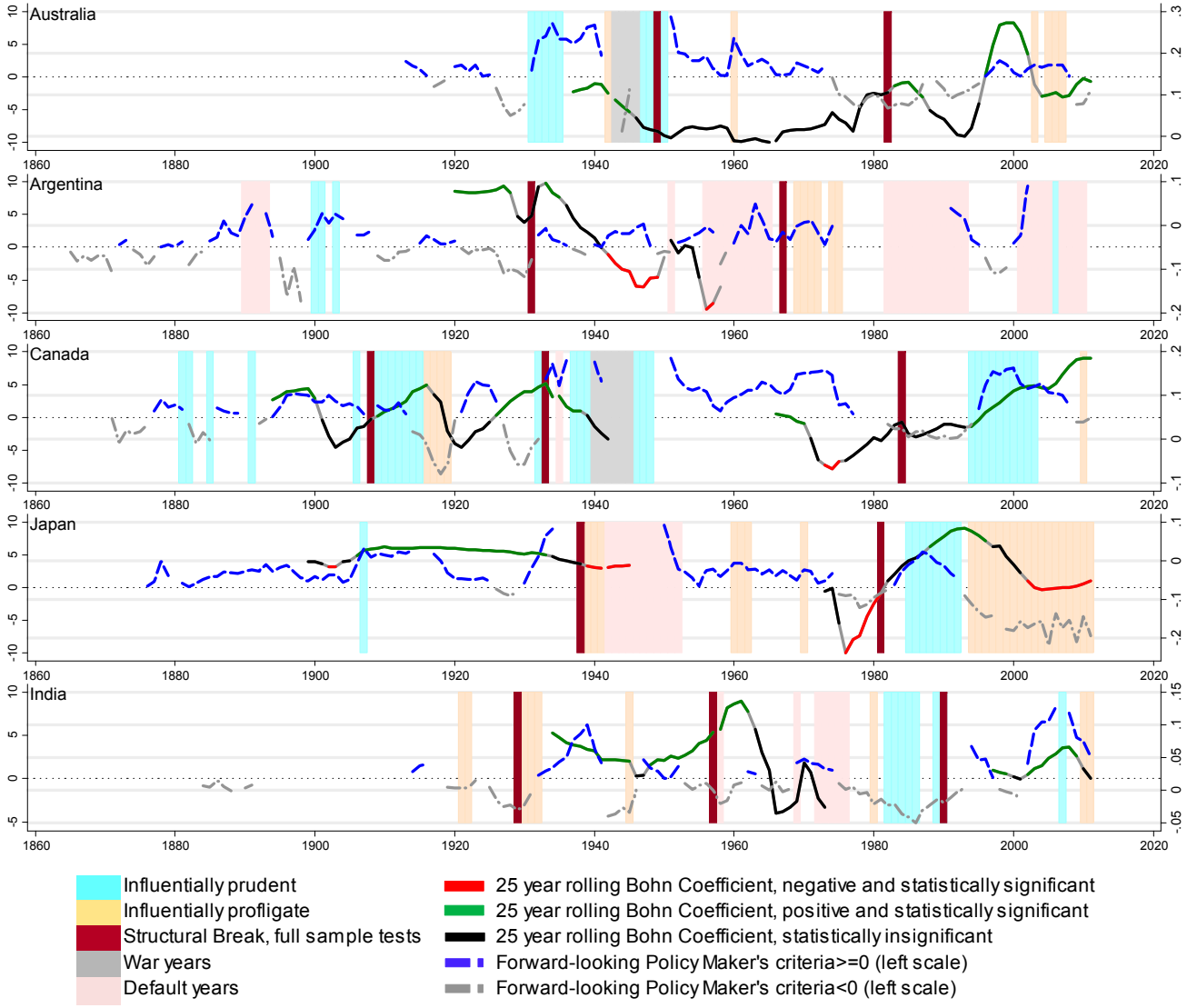


Figure 6. Periods of Prudence and Profligacy, 1880-2011

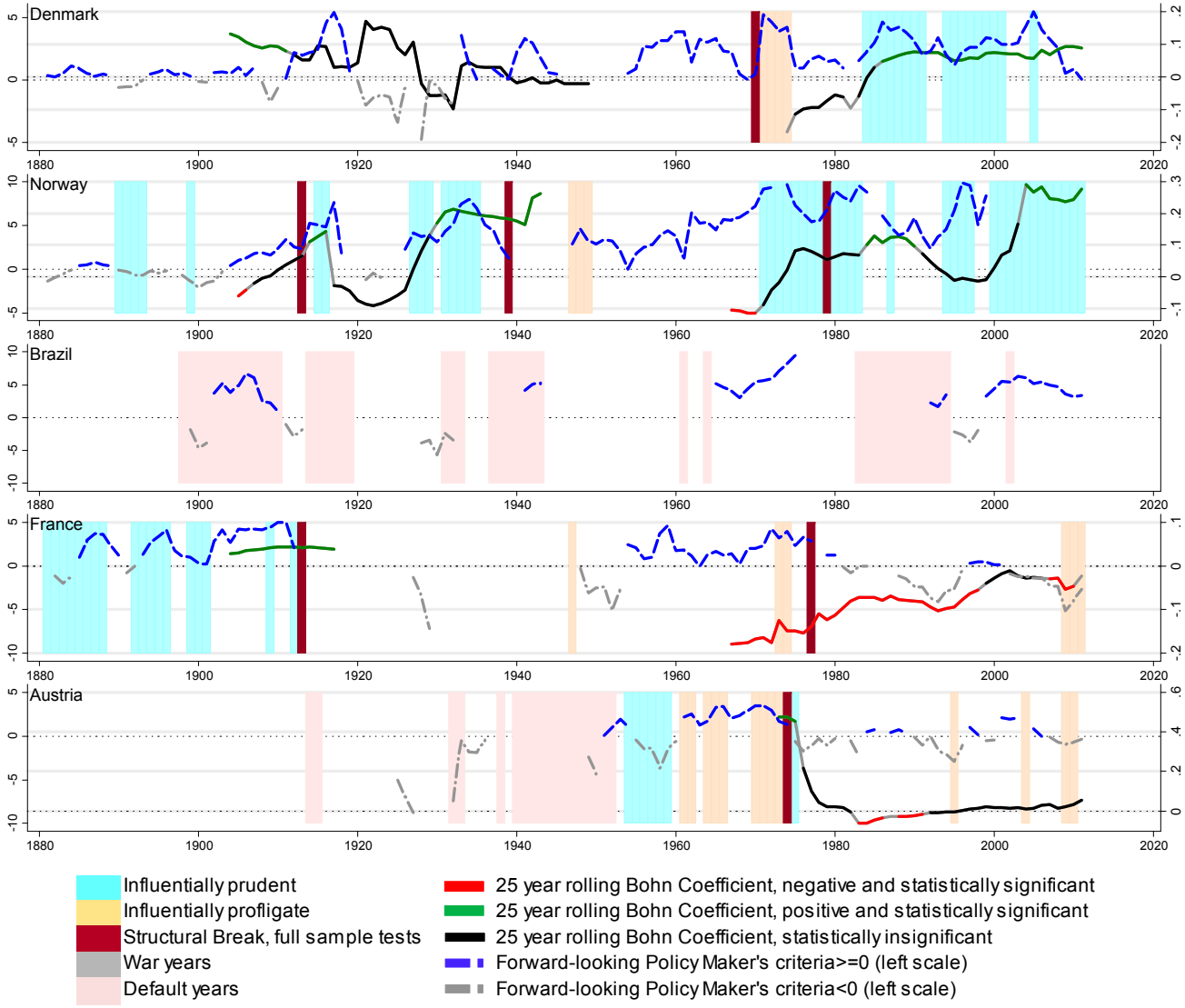


Figure 7. Periods of Prudence and Profligacy, 1880-2011

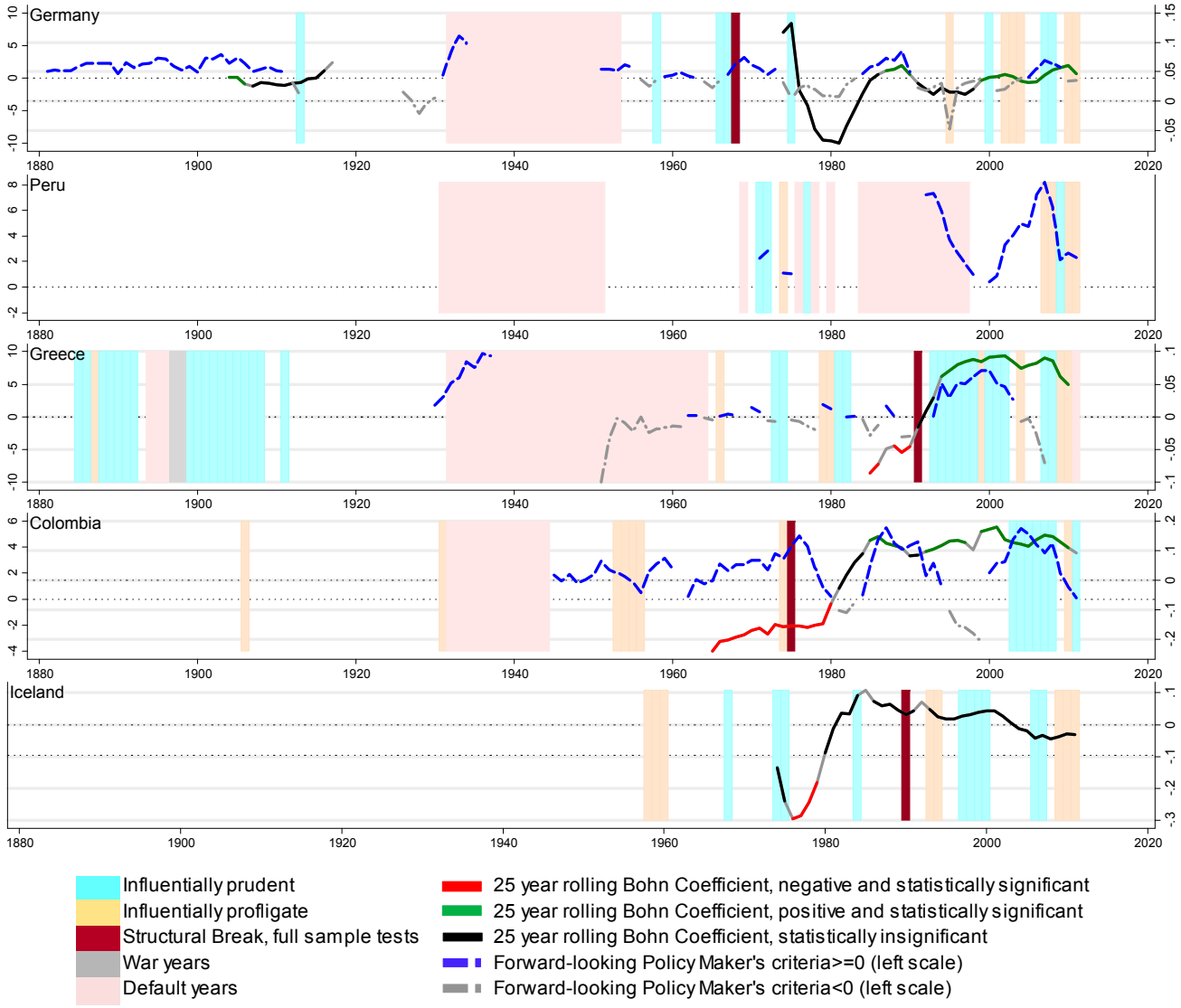


Figure 8. Periods of Prudence and Profligacy, 1900-2011

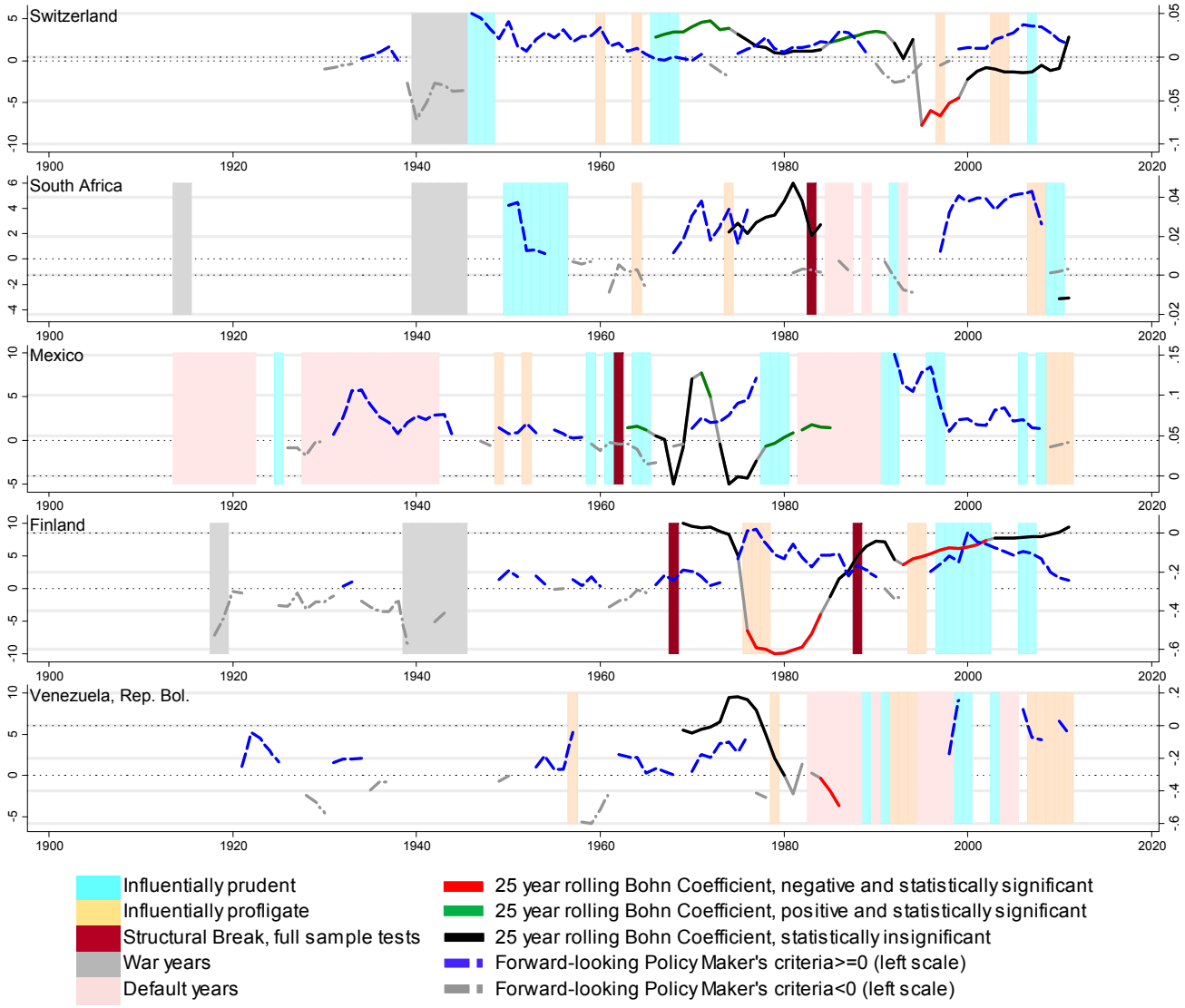


Figure 9. Periods of Prudence and Profligacy, 1900-2011

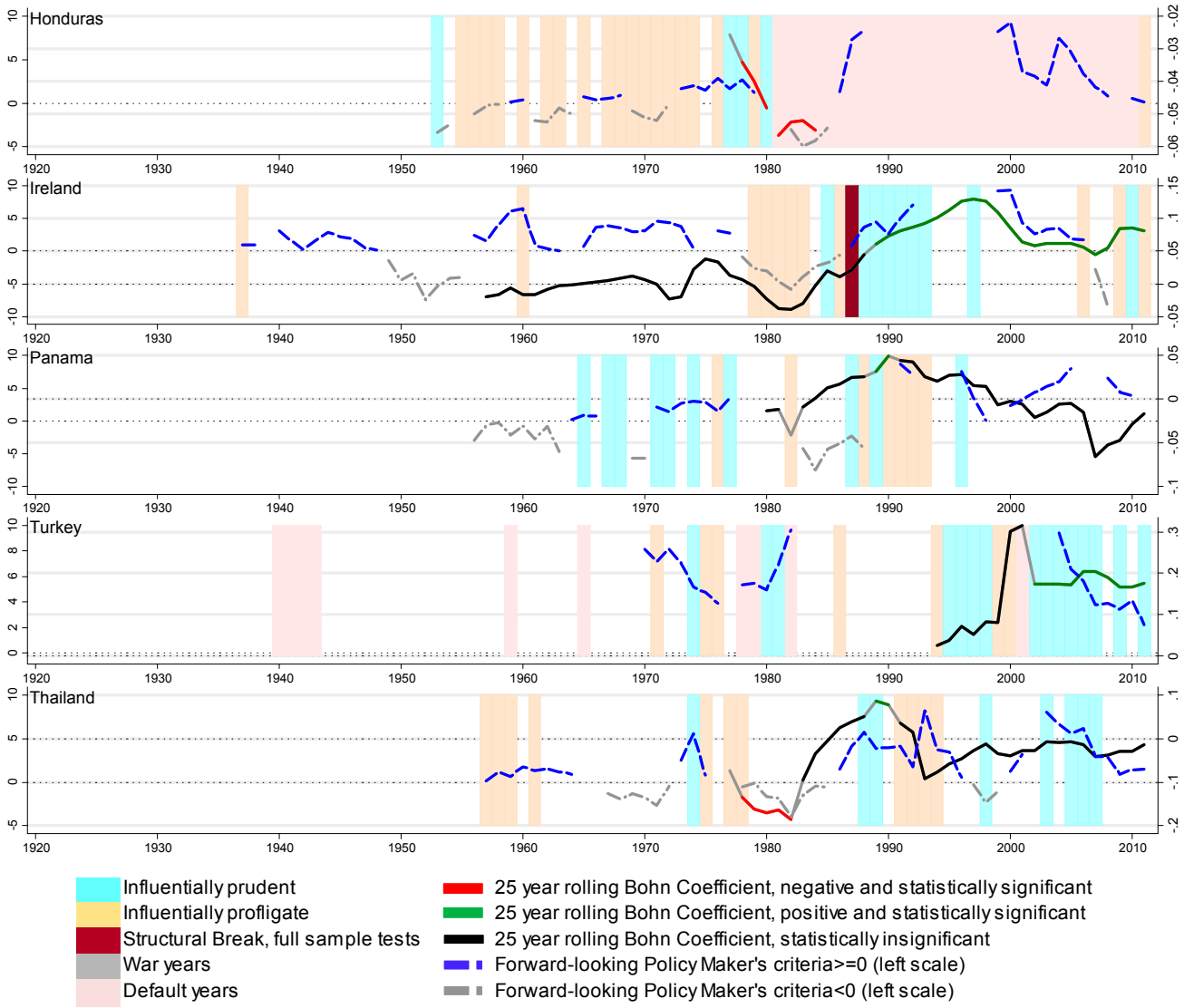


Figure 10. Periods of Prudence and Profligacy, 1950-2011

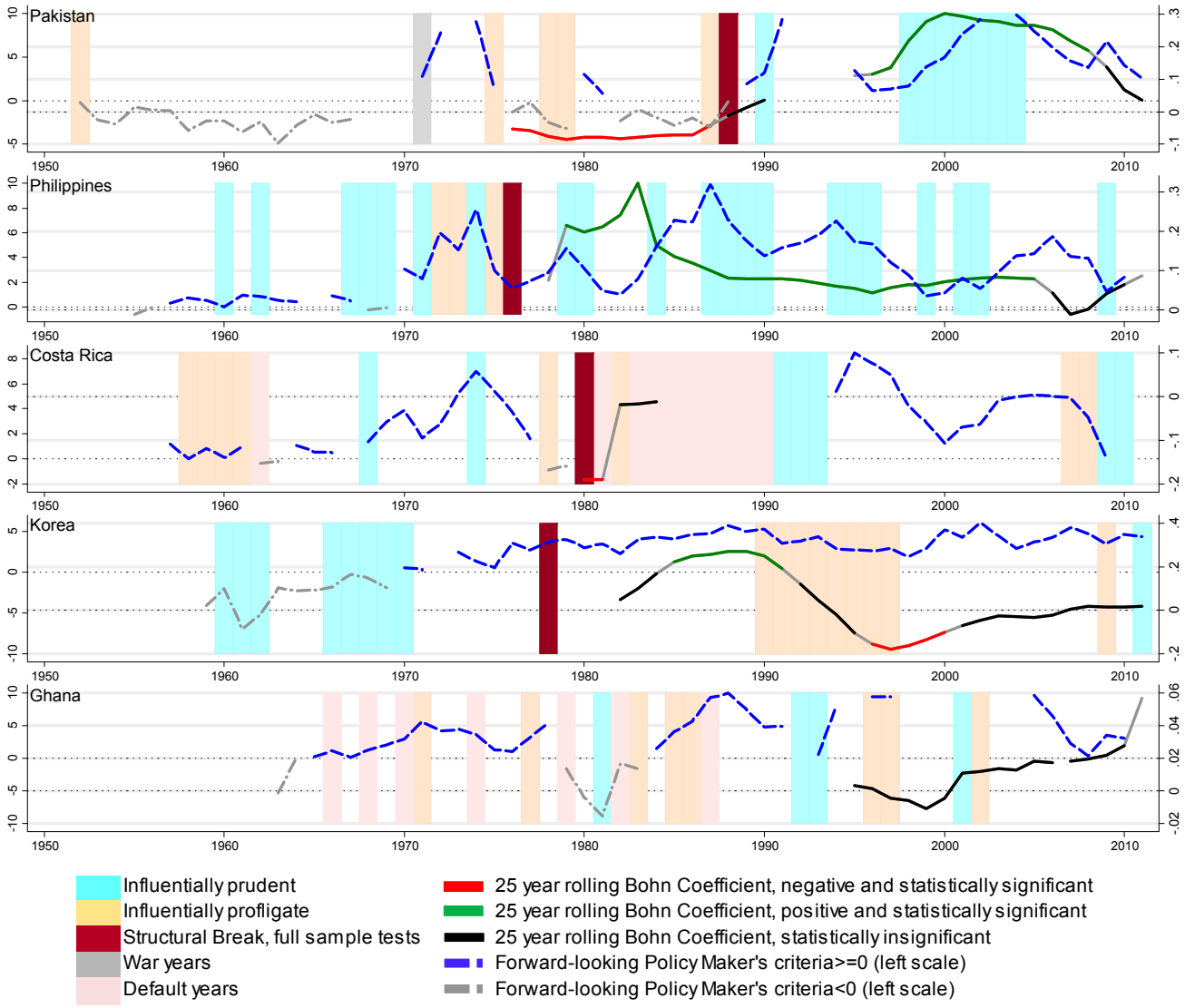
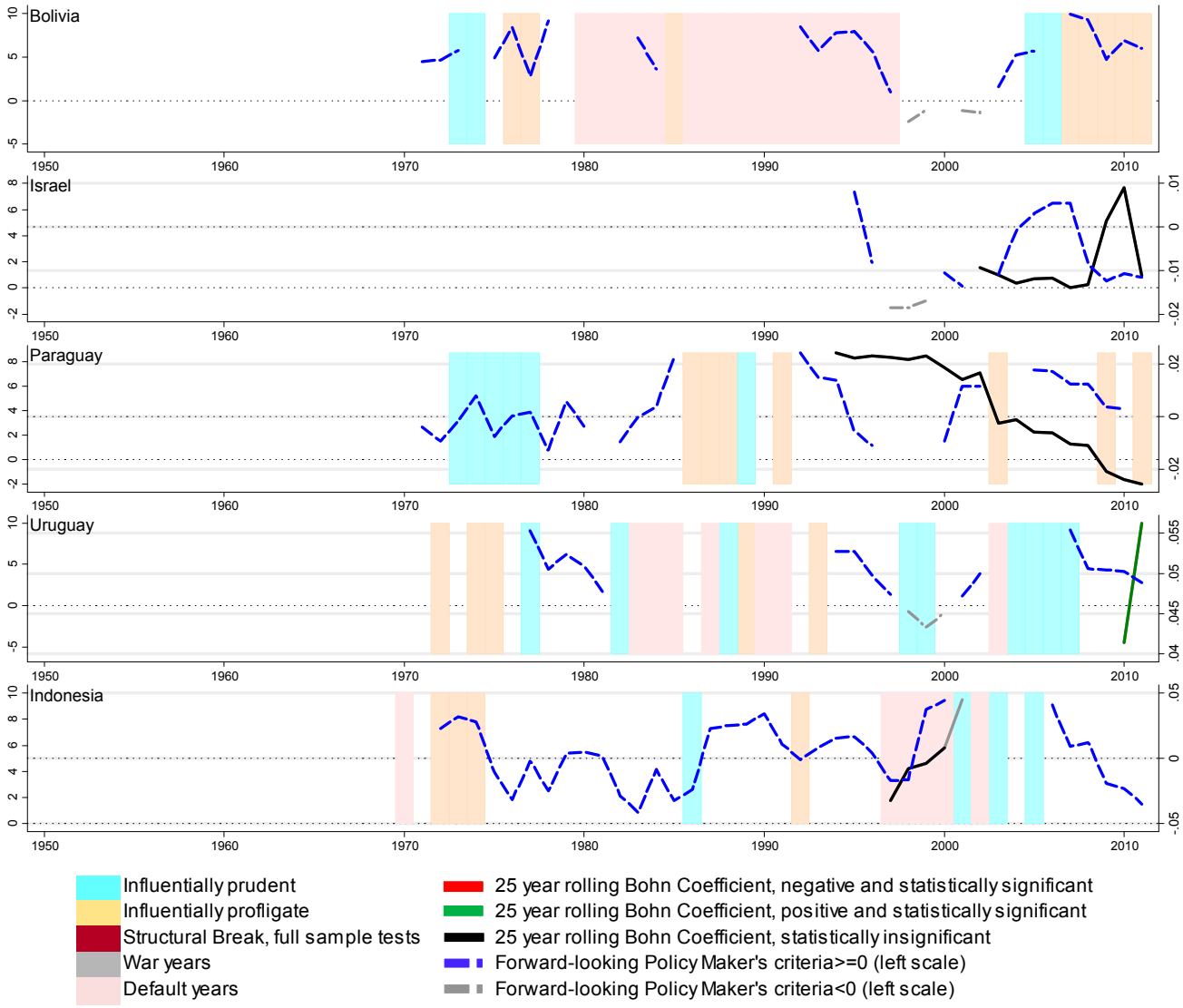


Figure 11. Periods of Prudence and Profligacy, 1960-2011



REFERENCES

Andrews, D. W. K., 1993, "Tests for Parameter Instability and Structural Change with Unknown Change Point," *Econometrica*, Vol. 61, No. 4, pp. 821-856.

Bai, Jushan and Pierre Perron, 1998, "Estimating and Testing Linear Models with Multiple Structural Changes," *Econometrica*, Vol. 66, No. 1, pp. 47-78.

Barro, Robert J., 1979, "On the Determination of Public Debt," *Journal of Political Economy*, Vol. 87, No. 5, pp. 940–971.

Blanchard, Olivier, 1990, "Suggestions for a New Set of Fiscal Indicators," OECD Department of Economics and Statistics Working Paper No. 90, Paris, France.

Bohn, Henning, 1998, "The Behavior of U.S. Public Debt and Deficits," *Quarterly Journal of Economics*, August, Vol. 113, No. 3, pp. 949–963.

Bohn, Henning, 2007, "Are Stationarity and Cointegration Restrictions Really Necessary for the Intertemporal Budget Constraint?" *Journal of Monetary Economics*, Vol. 54, pp. 1837–1847.

Bohn, Henning, 2008, "The Sustainability of Fiscal Policy in the United States," in Reinhard Neck and Jan-Egbert Sturm, eds., *Sustainability of Public Debt*, MIT Press, Cambridge MA, pp.15–49.

Bordo, Michael, Barry Eichengreen, Daniela Klingebiel, and Maria Soledad Martinez-Peria, 2001, "Is the Crisis Problem Growing More Severe?" *Economic Policy*, Vol. 16, No. 32, pp. 51-82.

Dincecco, Mark, 2011, *Political Transformations and Public Finances: Europe, 1650-1913*, Cambridge: Cambridge University Press.

Mauro, Paolo, Nathan Sussman and Yishay Yafeh, 2006, *Emerging Markets and Financial Globalization: Sovereign Bond Spreads in 1870-1913 and Today*, New York: Oxford University Press.

Mendoza, Enrique G. and Jonathan D. Ostry, 2008, "International Evidence on Fiscal Solvency: Is Fiscal Policy 'Responsible'?" *Journal of Monetary Economics*, Vol. 55, No. 6, September, pp. 1081–1093.

Reinhart, Carmen M., and Kenneth S. Rogoff, 2009, *This Time is Different: Eight Centuries of Financial Folly*, Princeton, NJ: Princeton University Press.

Reinhart, Carmen M., and Kenneth S. Rogoff, 2011, "From Financial Crash to Debt Crisis," *American Economic Review*, Vol. 101, No. 5, August, pp. 1676–1706.

Schularick, Moritz, and Alan M. Taylor, forthcoming, "Credit Booms Gone Bust: Monetary Policy, Leverage Cycles and Financial Crises, 1870–2008," *American Economic Review*.