Debt and Inflation during a Period of Financial Repression

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[Job Market Paper, latest update: December 5, 2011]

Abstract The current debt-to-GDP ratios of many advanced economies are at historically high levels, raising questions about how they are going to be reduced. I assess whether domestic debt can be inflated away by looking at the experience of 12 countries after the end of World War II, when debt levels were also high. The countries in the sample are mainly advanced economies with histories of relatively low inflation. I find that inflation played an important role in reducing government debt, generating average revenues for the government of between two and three percent of GDP. The incidence of the effect is primarily explained by the presence of financial repression keeping interest rates at low levels, rather than unanticipated inflation or changes in the market value of debt. I also examine how financial repression affected the relative returns of financial assets over this period. The results suggest that some of the equity premium during this period, which was over eight percentage points, can be explained by the abnormally low returns in the market for government bonds.

Keywords: Government debt, financial repression, inflation, equity premium.

JEL Classification Numbers: F3, G1, H6, N2

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1 Introduction

In many countries, the current ratio of government debt to GDP is at historically high levels. The 2008 financial crisis has created a situation where several countries are at risk of defaulting on their debt, and many more are struggling with the economic and political changes needed to reduce their debt to more sustainable levels. Broadly speaking, the different alternatives available to governments to reduce their debt burdens are: (i) growth; (ii) fiscal adjustment (i.e., increases in taxes and reductions in government spending); (iii) outright default or restructuring; and (iv) inflation (via inflation surprises or a combination of financial repression and inflation). While there is some empirical evidence on the consequences of default (Reinhart and Rogoff, 2009; Sturzenegger and Zettlelmeyer, 2006; Borensztein and Panizza, 2006) and on the potential for fiscal austerity/restructuring (Alesina and Ardagna, 2010; Perotti, 2011), there is limited empirical evidence on whether inflation can reduce the real value of debt.

Revisiting similar episodes in the past can be useful for understanding the possible courses of action currently available to governments. In this paper, I explore the relationship between inflation and debt in the years after the Second World War in 12 countries with very different economic characteristics.[1] Many governments had high debt levels at the end of the Second World War, which then declined over the following decades. I construct a detailed database of government debt portfolios spanning three or more decades for each country and analyze the role of inflation in reducing real debt, examine the circumstances under which this occurs, and the implications of this for both the government and investors. The primary focus of the paper is to understand whether this is an empirically important phenomenon, rather than the desirability or optimality of using inflation to erode the real value of debt.

To understand the magnitude and nature of the effects, it is important to identify the channels through which inflation can have an effect on debt. The previous literature on how inflation may reduce debt is largely theoretical, and focused on the role of unanticipated inflation in reducing government debt. Several papers have looked at the time inconsistency problem present when debt is denominated in nominal terms, where governments may be tempted to use unanticipated inflation to reduce the real value of their debt (Barro and Gordon, 1983; Grossman and Van Huyck, 1984, 1985; Grossman, 1987, 1988). In this paper, I identify three channels through which inflation can have an effect on debt: unanticipated inflation, inflation in combination with financial repression, and via changes in the market value of debt.

[1] The countries in the sample are: Argentina, Australia, Belgium, France, India, Ireland, Italy, Japan, South Africa, Sweden, the United Kingdom, and the United States.

The term "financial repression" is used to refer to a situation characterized by: i) numerous policies and regulations which introduce frictions in financial markets, and ii) large participation of nonmarket players. The list of policies is large; some examples of financial repression are: ceilings on interest rates, directed lending, capital controls.[2] The policies that will be particularly relevant for this paper are those which create captive investors for government debt, and hence allow the government to issue debt at a rate below what the market would charge absent any restrictions. Being able to issue debt at a below market interest rate represents a saving in interest payments for the government. When combined with an inflation rate above the nominal interest rate, this leads to negative real interest rates that effectively reduce government debt. This mechanism can be present even when inflation is fully anticipated.

There are several channels through which inflation can affect debt: unanticipated inflation, financial repression combined with inflation, and via changes in the market value of debt. I develop a conceptual framework in order to understand how those channels can be measured separately and together. While it is not possible to directly observe inflation expectations and quantify the effect of financial repression on market interest rates, I show that the net effects of these channels must be large whenever real interest rates are negative; that is, when real interest payments are negative (which can be thought of as a revenue for the government). My primary empirical strategy is to focus on years where this occurs, which are labeled *liquidation years*.

On average, real interest rates on the overall portfolios of domestic government debt were negative in half of the years in the sample.[3] The predominant pattern that emerges across countries is a high incidence of liquidation years in the period immediately after the end of WWII, and again during the 1970s. In the United States, 50 percent of the years between 1945 and 1980 were liquidation years. Estimates of the implicit revenues for the governments in the 12 countries, which are labeled *liquidation revenues,* average between two and three percent of GDP in liquidation years.[4]

I show that the effects are similar whether I measure debt at face value or at market value, which suggests that changes in the market value of debt are not responsible for these large effects. I conduct several exercises to disentangle the relative contributions of the other two channels, unanticipated inflation and financial repression. First, I estimate inflation ex-

[2]For a more detailed definition, see Appendix A and Reinhart and Sbrancia (2011).

[3]Historically most of the domestic debt has been denominated in local currency. Notable exceptions are Mexican Tesobonos in the 1980's and Brazil dollar-denominated bonds a decade after.

[4]These revenues estimates do not includes the revenues from seigniorage. A comparison to seigniorage revenues is performed in section 4.

pectations to see whether inflation surprises can account for the liquidation years. Across the 12 countries, only 15 percent of liquidation years are ones where there is an inflation surprise. This suggests that, for the period under consideration, financial repression (combined with inflation) is important for explaining the high incidence of liquidation years. In a second exercise, I test whether the overall results are biased by bonds issued prior to 1945. The thinking behind doing this is that, if the overall results are primarily due to unanticipated inflation, then newly- issued bonds should reflect higher inflation expectations. For bonds issued after 1945, I find negative real interest rates were as common as in the full sample of bonds. This failure of markets to respond provides further evidence that there was financial repression during this period.

To put the magnitude of the liquidation revenues into perspective, I compare them to inflation tax revenues.[5] The liquidation effect revenues are consistently larger than inflation tax revenues at the beginning of the sample period, when debt levels were high. In some countries, such as the United Kingdom, the liquidation effect revenues are larger than inflation tax revenues throughout the whole sample period. This finding may help to explain why Reinhart and Rogoff (2009) find that the debt stock was significantly larger than the money stock in many episodes of high and hyperinflation, as the gains from inflating away debt may be larger than inflation tax revenues during these periods.

I also gain a greater understanding of the role of inflation by examining the cumulative effect of inflation on the stock of debt under plausible alternative inflation paths. I find that these cumulative effects are large. For example, if annual inflation rate had remained constant at two percent throughout the 1945-1980 period, the debt-to-GDP ratio in 1980 would have been 40 percentage points higher in the United States, 167 percentage points higher in the United Kingdom, and 81 percentage points higher in Australia.

An important finding of the paper is that inflation need not be particularly high in order to obtain a sizable reduction of the debt. Except in Argentina and Italy, median inflation during liquidation years is below 10 percent. Average inflation is four percentage points higher than median inflation rates over the 1930-2010 period.

A multivariate analysis is conducted to understand how country characteristics and different factors affect the incidence of the liquidation effect. I find that two variables strongly and positively correlated with liquidation years are interest payments (as a proportion of GDP) and the size of the deficit relative to GDP. The significance of these fiscal variables points at the presence of important links between fiscal and monetary policies. I find that neither the share of short term debt nor central bank independence have have strong relationships

[5]The term "inflation tax" refers to the component of seigniorage that would be collected in steady state.

with the incidence of liquidation years.

The last section of the paper focuses on the implication for investors. If Treasury bonds are used as a benchmark in the valuation of other assets, then it is important to understand how the presence of financial repression affected financial markets more broadly.[6] I examine returns on bonds and other financial assets for more than 100 years, and find that the returns on bonds were low during the 1945-1980 period relative to other periods. Furthermore, for all of the countries in the sample the return from investing in stocks during the 1945-1980 period was much higher than the return from investing in government bonds. These differences do not appear to be explained by stock return volatility or risk. The equity premium is shown to be relatively high during this period. For instance, the average equity premium - calculated as the excess return of stocks on T-Bills over rolling 30-year periods - in the US averaged 8.3 percent over 1945-1980, compared to an equity premium of 4.4 percent in the other years between 1870 and 2010. These patterns are consistent with the presence of financial repression keeping returns on bonds artificially low over the 1945-1980 period.

The paper contributes to several literatures. First, it extends the results of Reinhart and Sbrancia (2011) who establish the importance of financial repression as a restructuring mechanism for government debt. In their paper, the authors provide first pass estimates which show that the effects are quantitatively important. This paper complements the results of Reinhart and Sbrancia (2011) in three main ways. First, I examine the different channels through which inflation can reduce government debt and consider how to think of financial repression as a restructuring mechanism. Second, through different empirical exercises, I show that financial repression in combination with inflation is the most important channel through which debt was reduced. Finally, the paper looks at the key features of this period of financial repression and how the returns of other assets were affected.

A related literature looks at the implications of inflation on a government's reported fiscal position, and particularly how inflation affects measures of fiscal deficit (Siegel,1979; Tanzi et al., 1987; Persson et al.,1996). The results in this paper provide empirical support for the theoretical literature which has argued that government debt could not be reduced systematically by unanticipated inflation (Calvo and Guidotti, 1993). The results also point to financial repression as an important source of revenue, which could be important for rationalizing why countries seem to set inflation rates above what would be optimal if they were just maximizing seigniorage revenues (Calvo and Leiderman, 1992).

The paper also adds to the literature on financial repression, which has primarily focused

[6]For instance, Treasury bonds serve as a benchmark in the valuation of corporate bonds (Crabbe and Fabbozi, 2002).

on the economic growth implications in emerging economies (Mc Kinnon, 1973; Shaw, 1973; King and Levine, 1993; Fry, 1997). I show that financial repression can be important in advanced economies, and may generate revenues for governments by reducing their debt burdens.[7] This complements work by Giovannini and de Melo (1991), who measure the revenues from financial repression by comparing the interest paid by the government on its external and domestic debt, and Aizenman and Guidotti's (1990) theoretical work analyzing under what conditions it may be optimal to impose capital controls.

Finally, the paper contributes to growing efforts to use historical documents and government reports to understand key issues in international finance. Long time series on public debt were uncommon until the publication of Reinhart and Rogoff (2008, 2009). I construct a database on the domestic debt portfolios of 12 countries for three or more decades after the end of WWII. The database contains a detailed description of the different instruments that constitute the stock of debt in a given year together with their coupon rates, maturity date, outstanding amount and in some cases prices at different points in time.

The next section presents the conceptual framework. Section 3 describes the data and the empirical measures constructed. In Section 4, I present the results for the liquidation effect from the perspective of the government. In Section 5, a broader analysis of financial markets during the period of financial repression is provided, together with its implications for investors. Section 6 concludes.

2 Conceptual Framework

The first step is to understand the channels through which inflation can affect the value of debt. When discussing how debts may be "inflated away," researchers usually think of a higher than expected inflation rate eroding the real value of the debt. However, financial repression (by which governments issue debt at below market interest rates) is an additional and important channel through which inflation can reduce government debt. The primary objective of this section is to separate, at least conceptually, the contribution of unanticipated inflation and financial repression in the liquidation of government debt.

The consolidated budget constraint for the government is obtained by combining the budget constraints of the fiscal and monetary authorities. This budget constraint makes explicit the tight linkage that exists between monetary and fiscal policy. In real terms the consolidated budget constraint is given by:

[7]For evidence on the presence of financial repression in these countries, please see the Appendix A in this paper and Reinhart and Sbrancia (2011).

$$g_t + \frac{1+i_{t-1}}{1+\pi_t} b_{t-1} = \tau_t + b_t + \left(h_t - \frac{h_{t-1}}{1+\pi_t} \right) \tag{1}$$

On the left side are the expenditures in a given year: government spending (g_t) and the real interest payments on the real stock of debt, which depends on the nominal interest rate set in the previous period (i_{t-1}), the inflation rate in the current period (π_t), and the debt from the previous period (b_{t-1}).[8] The real interest rate paid on the stock of debt issued in the previous period is an ex post real interest rate, since it is determined by the realized rate of inflation. The right side contains the sources of income: revenues (τ_t), newly issued real debt (b_t), and the seigniorage revenues from printing money, where h_t is the real monetary base.[9] While inflation affects seigniorage revenues as well as other items of the budget constraint, I ignore those effects as the focus on the paper is on sources of revenue which have a direct impact on a government's real debt payments.[10] These effects are compared to seigniorage revenues in Section 4.

The budget constraint can be re-written in terms of the ex post real interest rate (r_t^P) as follows:

$$g_t + (1+r_t^P) b_{t-1} = \tau_t + b_t + \left(h_t - \frac{h_{t-1}}{1+\pi_t} \right) \tag{2}$$

Two additional definitions of interest rates are required to capture the role of unanticipated inflation and financial repression. The first one is the ex ante real interest rate. This is the interest rate that is expected to be earned in period t, as of period $t-1$. It is determined by the nominal interest rate i_{t-1} and the expected inflation rate π_t^e.

The second interest rate definition identifies the effect of financial repression. The free market interest rate (i_{t-1}^F) is the interest rate that would be observed in the absence of financial frictions. If the government issues debt at a below-market interest rate, then $i_{t-1}^F > i_{t-1}$.

[8] Expressing the budget in terms of a one-period bond simplifies the notation without changing the implications that would be derived from explicitly considering a richer maturity structure.

[9] Seigniorage is the change in the nominal monetary base relative to the previous period, and divided by the current price level. It arises from two sources as shown below:

$$\frac{H_t - H_{t-1}}{P_t} = (h_t - h_{t-1}) + \frac{\pi_t}{1+\pi_t} h_t$$

The first component of seigniorage comes from changes in the real stock of monetary base. The second comes from a depreciation in the outstanding stock of real balances, and is sometimes referred to as inflation tax. In steady state, only the second component will be positive.

[10] See Persson, Persson and Svensson (1996) for a study on the overall fiscal gains from an increase in the inflation rate in Sweden.

The three relevant interest rates are:

$$1 + r_t^P = \frac{1 + i_{t-1}}{1 + \pi_t} \qquad \text{Ex post real interest rate} \tag{3}$$

$$1 + r_t^A = \frac{1 + i_{t-1}}{1 + \pi_t^e} \qquad \text{Ex ante real interest rate} \tag{4}$$

$$1 + r_t^F = \frac{1 + i_{t-1}^F}{1 + \pi_t^e} \qquad \text{Ex ante free market real interest rate} \tag{5}$$

These terms can be incorporated into the government budget constraint. After some algebraic manipulations, the following equation is obtained:[11]

$$g_t + (1 + r_t^F) b_{t-1} - \underbrace{(1 + r_t^A) \frac{\pi_t - \pi_t^e}{1 + \pi_t} b_{t-1}}_{\substack{\text{Unanticipated} \\ \text{Inflation Effect (A)}}} - \underbrace{\frac{i_{t-1}^F - i_{t-1}}{1 + \pi_t^e} b_{t-1}}_{\substack{\text{Financial} \\ \text{Repression Effect (B)}}} = \tau_t + b_t + \left(h_t - \frac{h_{t-1}}{1 + \pi_t} \right) \tag{6}$$

The "unanticipated inflation effect" is the difference between realized and expected inflation multiplied by the real cost of previous period stock of debt, while the "financial repression effect" is the difference between the free market and actual nominal interest rate multiplied by the real stock of debt from the previous period. To better understand this equation, note that if there were no financial frictions that would cause i_{t-1} to be different from i_{t-1}^F, and if actual inflation was equal to expected inflation, then the last two terms on the left side would be equal to zero. In this case, $(1 + r_t^F)$ would be both the ex ante and ex post real interest rate, and there would be no savings in interest payments for the government from either source.

Whenever the actual inflation rate is above the expected inflation rate, the unanticipated inflation effect will be positive and the government will save on interest payments by the amount given by this term.[12]The opposite is true when expected inflation is higher than the actual inflation rate. The financial repression effect will be positive and represent savings for the government when the nominal interest rate does not reflect the true cost of borrowing for the government, so that the actual nominal interest rate is below the free market interest rate.

Both effects can be present at the same time. In this case, financial repression has an

[11] The term, $\frac{1+i_{t-1}+\triangle_{t-1}}{1+\pi_t^e}$ where $\triangle_{t-1} = i_{t-1}^F - i_{t-1}$, is added and subtracted from the left-hand side of equation (1).

[12] When the only friction is the difference between actual and expected inflation, it follows that $r_t^F = r_t^A$

indirect effect on the size of the unanticipated inflation effect. This indirect effect comes from the fact that the ex ante real interest rate (r_t^A) will be lower than what it would be in the absence of frictions. In other words, for a given $\frac{\pi_t - \pi_t^e}{1+\pi_t}$, the savings from unanticipated inflation will be lower in the presence of financial repression. This interaction is potentially important when modeling inflation expectations and inflation surprises, although it will not be separately estimated in this paper.

The Consolidated Budget Constraint at Market Value

Up to this point debt has been expressed at face value. Expressing the consolidated budget constraint with debt at market value allows the identification of an additional effect that comes from changes in the market value of debt. This will be important for understanding returns for investors, and the response of the market in the presence of the effects. In a well-functioning financial system, changes in inflation expectations are going to affect expected returns and should be reflected in the price of government bonds. The (real) market value consolidated budget constraint is given by:

$$g_t + i_{t-1}\frac{B_{t-1}}{P_t} + \frac{P_t^B B_{t-1}}{P_t} = \tau_t + \frac{P_t^B B_t}{P_t} + \left(h_t - \frac{h_{t-1}}{1+\pi_t}\right) \tag{7}$$

Where P_t^B stands for the price of the debt at time t, and B_t is the nominal amount outstanding of debt at time t. The real market value of debt is defined as $\hat{b}_t = \frac{P_t^B B_t}{P_t}$. Using these definitions, equation (7) can be re-written as:

$$g_t + \frac{i_{t-1}}{1+\pi_t}\frac{\hat{b}_{t-1}}{P_{t-1}^B} + \frac{\hat{b}_{t-1}}{1+\pi_t} + \frac{P_t^B - P_{t-1}^B}{P_{t-1}^B}\frac{\hat{b}_{t-1}}{1+\pi_t} = \tau_t + \hat{b}_t + \left(h_t - \frac{h_{t-1}}{1+\pi_t}\right) \tag{8}$$

Note that this equation is similar to equation (1), apart from the extra term that captures changes in the market value of debt, where $\frac{P_t^B - P_{t-1}^B}{P_{t-1}^B}$ is the rate of change in the market value of debt.[13] Following some algebraic manipulations, a version of equation (6) is obtained:

[13]Changes in the market price of debt affect only the principal and not the interest payment term $\left(\frac{\hat{b}_{t-1}}{P_{t-1}^B} = b_{t-1}\right)$.

$$g_t + i^F_{t-1} b_{t-1} - \underbrace{i_{t-1} \frac{\pi_t - \pi^e_t}{1+\pi_t} b_{t-1}}_{\substack{\text{Unanticipated} \\ \text{Inflation Effect}}} - \underbrace{\frac{i^F_{t-1} - i_{t-1}}{1+\pi^e_t} b_{t-1}}_{\substack{\text{Financial} \\ \text{Repression Effect}}} - \underbrace{\frac{P^B_{t-1} - P^B_t}{P^B_{t-1}} \frac{\hat{b}_{t-1}}{1+\pi_t}}_{\text{Valuation Effect}} = \tau_t + \left(\hat{b}_t - \frac{\hat{b}_{t-1}}{1+\pi_t}\right) + \left(h_t - \frac{h_{t-1}}{1+\pi_t}\right) \tag{9}$$

When using debt at market values it is possible to distinguish between three effects: a valuation effect, the unanticipated inflation effect, and the financial repression effect. The unanticipated inflation and financial repression effects are identical to the corresponding terms in equation (6), and can be interpreted in the same way. The valuation effect has an easy interpretation: when the prices of the government bonds go down there is an implicit capital gain for the government due to a lower value of its liabilities. On the other hand, when prices are increasing there is an implicit capital loss due to an increase in the value of the government liabilities. This does not represent a change in the cash payments the government makes, but a change in the market value of its debt.

Measurement Issues

Equation (6) identifies the different elements required to estimate the sources of interest payment savings for the government at face value. Similarly, equation (9) identifies the elements required to estimate the sources of interest payment savings for the government at market value. A central challenge is that, in both cases, it is not possible to directly observe inflation expectations and free market interest rates.

The first approach to dealing with this is to focus on instances when the net effect of inflation expectations and financial repression is so large that one or both must be present. When real interest payments are negative, they constitute a revenue rather than an expenditure for the government. In equation (2), when debt is at face value, this will be the case when $r^P_t < 0$. In these years, the sum of the unanticipated inflation effect and the financial repression effect is large enough to outweigh the free market interest payments, which is given by the second term on the left hand side of the equation. Given that government debt is liquidated in any year where real interest payments are negative, those years will be defined as *liquidation years*.[14] I will refer to the effect of inflation on debt as the *liquidation*

[14] Reinhart and Rogoff (2009) refer to the use of inflation to erode the value of government debts as *default via inflation*. I use the term "liquidation effect" to allow for the possibility that the inflation was not caused by a deliberate government action.

effect and the revenues for the government from this source as *liquidation revenues*, which will be calculated in any single year as:

Liquidation Revenues = Negative Real Interest Rate×Outstanding Stock of Domestic Debt

This definition provides a lower bound for the effect of inflation on debt, since the combined effect of unanticipated inflation and financial repression needs to outweigh free market interest payments. Additional assumptions are used in Section 4 to understand the likely frequency of instances where these effects are positive but not large enough to satisfy the definition adopted here.

The measure captures the net effect of inflation expectations and financial repression on domestic debt, when these are sufficiently large to satisfy the definition. In order to gain some understanding of the relative contribution of each, inflation expectations are estimated. This is done in Section 4 and provides a range for the contribution of inflation expectations. By considering the remainder of the total effect as due to financial repression, this approach also provides some understanding of the importance of financial repression.

Similar approaches are used when it comes measuring debt at market value. As shown in equation (8), real interest payments will be negative when $\frac{i_{t-1}+\left(P_t^B-P_{t-1}^B\right)}{P_{t-1}^B(1+\pi_t)} < 0$. The only difference is the additional term that reflects changes in the market value of government debt. This component turns out to be small, so that the face and market value measures produce similar results. To the extent that the term reflects changes in expectations for future inflation, this term provides additional information about the role of inflation expectations for the countries and periods under study.[15]

3 Empirical Measures and Data

This section presents the empirical measures constructed to measure the effect of inflation on government debt, and the data used to calculate those measures. Detailed information on the overall portfolio is necessary to obtain accurate estimates because there is no single interest rate that is going to reflect the financing cost of the government.

[15]This term could also reflect changes in the general economic environment. Siegel (1979) decomposes the changes in the real market value of debt coming from changes in the general price level and changes in the price of government bonds. He finds that bond price changes are more volatile but account for a small fraction of the total changes in the real market value of debt. An additional point made by Siegel is that changes in the general environment will affect both the liabilities and assets side of a government's balance sheet, which may leave the wealth position of the government largely unchanged.

3.1 Empirical Measures

Two measures of nominal interest rates are constructed, one corresponding to when debt is expressed at face value and the other when debt is at market value. The face value measure is the *Contractual Interest Rate* (CIR), which is the coupon rate at which the bond was issued. From the perspective of the government it represents the annual interest cost of each security. The CIR is consistent with the accounting method used by the government.

The market value measure is the *Holding Period Return* (HPR). The HPR is the nominal return for a security bought at the beginning of a year and sold at the end, where a year corresponds to the fiscal year of each country.[16] The HPR reflects changes in the market interest rate and is the proper way to measure the (before tax) return on government bonds for investors.

$$HPR_t = \frac{C_t + \left(P_t^B - P_{t-1}^B\right)}{P_{t-1}^B} \tag{10}$$

The Holding Period Return comes from two sources: the annual interest payments and any capital gains (losses) coming from increases (decreases) in the price of the bond. Apart from minor differences in notation, this expression is the same than the one obtained in the conceptual framework.

Both the CPR and HPR are nominal measures. Their real counterparts are obtained using inflation data from each country's Consumer Price Index and that corresponds to the annual inflation rate during the fiscal year. Since the rate of inflation is sometimes large, the following formula is used to obtain the real return for security i:

$$r_t^i = \frac{x_t^i - \pi_t}{1 + \pi_t} \tag{11}$$

Where x_t^i is the nominal return (either CIR, HPR) for security i at time t.

The last step consists of calculating the real interest rate for the whole portfolio of government securities. This is done by calculating the weighted average of the real interest rates of each security, where the weights represent the amount outstanding of that security relative to the total outstanding of all securities. In the case of HPR the total amount outstanding corresponds to the sum of the amounts outstanding of the securities for which the measure was calculated. This is done, in order to have the weights adding up to 1.

[16] For the US data as of end of December is used, given that monthly data was available, due to changes in the fiscal year during the sample period.

$$\text{Portfolio Real Return } (R_t) = \sum_{t=1}^{N_t} r_t^i \frac{\text{Outstanding Amount}_i}{\text{Total Outstanding Amount}} \tag{12}$$

where N_t equals the total amount of securities at each point in time.

A *liquidation year* takes place whenever the real interest rate on the overall portfolio is negative. This definition is a lower bound for the actual effect in the case of the CIR measure since only cases where the combined effect of unanticipated inflation and financial repression is large enough to make the real interest rate negative are considered. In the case of the HPR measure there exists the theoretical possibility that it may be capturing changes in the general economic environment and not the effects studied in this paper. As discussed in the previous section, empirical evidence suggests this should account at most for a small fraction of the total cases.

Finally, by saving in interest payments there is an implicit revenue for the government in years of liquidation effect which can be calculated as:

Liquidation Revenues = Negative Real Interest Rate$\times$Outstanding Stock of Domestic Debt

3.2 Data

A database was constructed from primary sources and includes 12 advanced and developing countries. The sources are usually publications by the fiscal authority or the central bank of each country; they are listed in Appendix B . The stock of domestic debt in each year consists of the full list of securities outstanding at the end of that year. For each security, I collected data on the outstanding amount, maturity date, and coupon rate. Additional information was collected, depending on its availability, including the price at which the securities were issued, and the share of marketable and non-marketable debt.

There are 12 countries in the sample: Argentina, Australia, Belgium, France, India, Ireland, Italy, Japan, South Africa, Sweden, United Kingdom and the United States. The data on securities prices required to calculate the Holding Period Return were available for Argentina, Belgium, India, Italy, Sweden, United Kingdom and the United States. The sample period in each country generally covers 1945 to 1980. The exceptions are India, which only has data after its independence in 1949, and Belgium, and France, where data is unavailable for 11, and 8 years respectively. Data is available for Ireland, Japan and Sweden that extends beyond 1980. [17]Table 1 lists the sample periods covered for all 12 countries.

[17] More recent data is also available for other countries in the sample, but has not yet been compiled.

Nine of these countries are advanced economies; the three developing countries are Argentina, India and South Africa. These countries had quite different economic outcomes during the sample period. They also differ in the degree to which they were involved in World War II, and the challenges they faced at the end of it. There are also large differences in their debt over time. Table 1 also shows the change in the debt-to-GDP ratio from 1945 to 1980 for each country. Many of these countries experienced large reductions in their debt over this period. The UK has the largest decline in the debt ratio, from 210 to 41 percentage points. In the United States, the ratio decreased from 118 to 33 percentage points. While debt ratios generally declined over time, there are several countries in which the debt ratio remained fairly constant or even increased. The diversity of the types and experiences of these countries will be important to understand how general the results are, as well as, how they vary depending on the countries' economic characteristics..

It is important that the database covers all of a country outstanding securities, as the composition of debt varies over time. For example, in the United States, Treasury Bills constituted 6.5 percent of the total domestic debt in 1946 and 25.1 percent of the total in 1976, while non-marketable securities accounted for 22.7 percent in 1946, 16.7 percent in 1966 and 35.4 percent in 1976. As another example, the share of marketable rupee loans in India went from 59 percent in 1950 to 39 percent in 1970. The composition of the debt portfolio of India and the US at different dates is shown in Table III of Appendix B.

4 The Liquidation Effect from the Perspective of the Government

In this section, I begin by describing the inflation in the 12 countries and real interest rates on their debt portfolios over the sample period. The incidence and magnitude of the liquidation effect is then outlined, together with a description of the associated revenues for the government.

Several additional exercises are presented, which are aimed at understanding what mechanisms are driving the aggregate patterns. First, inflation expectations are estimated to separate the relative contribution coming from unanticipated inflation and financial repression. Next, I focus on bonds issued within the sample period in order to understand whether returns on new bond issues responded to low real returns. This furthers our understanding of the role of financial repression during this period, as poor returns on new bond issues suggests a captive audience for those bonds. The magnitude of the revenues from the liquidation effect are then put in perspective by comparing it to those from the inflation tax, and by looking at the cumulative effect it had on the stock of debt. Finally, a multivariate

analysis is used to identify which country characteristics are particularly relevant to explain the incidence of the liquidation effect.

4.1 Inflation and Real Interest Rates on Debt Portfolios

Before getting into an examination of the liquidation effect, it is important to understand the inflation rates and the distribution of real interest rates during the period under study. The first three columns of Table 2 shows several statistics for the inflation rates in the different countries. The average inflation rate in nine of the countries is in single digits during this period, while the median inflation is in single digits in all of the countries except Argentina. In the United States the average inflation rate was 4.6 percent and the median inflation rate was 3.2 percent, while in the United Kingdom the average inflation was 6.3 percent and median inflation 4.2 percent. High inflation rates in France, Italy, and Japan in the years immediately after WWII declined significantly in the 1950s.

Table 2 also shows the arithmetic mean, the median and the standard deviation for the real interest rate on the debt of each country. Columns (4) to (6) show the results when the Contractual Interest Rate is used, and columns (7) to (9) show the results when the Holding Period Return is used to measure real returns. When the CIR is used, the average real interest rate is negative in all countries except Sweden. The real interest rate is negative in seven of the eight countries where the HPR can be calculated, with Belgium the only exception. Median real interest rates are also low: for example, using the CIR, six of the 12 countries have a median real return that is negative and the median real return is never larger than 1.2 percent. Using the CIR, the median real interest rate was -0.6 percent in the United Kingdom and 0.3 percent in the United States. In the whole sample, the fraction of the observations where the real interest rate is above three percent is, on average, 11 percent; it is 5.6 percent in the United States and 2.8 percent in the United Kingdom.

Two countries have particularly poor real returns. Argentina has the largest negative mean and median real interest rate: the median real interest was -14.1 according to CIR and -11.0 according to HPR. France has the next largest average and median negative real interest rates, which may be explained by two main facts. First, the missing years of 1953-1958 and 1960-1963 perhaps contributes to that pattern. In most countries, the real interest rate is above the average and median values in those years. Second, even if France did not lose WWII, it had been occupied by German forces during the War, which left the country and the economy in a delicate situation. The average inflation rate was 40 percent between 1945 and 1950, while the (weighted) average interest rate on the debt was 2.7 percent during the same period.

It is clear that the results that follow are not going to be driven by a small number of years in each country. The incidence of negative real interest rates during the period 1945-80 was consistently high across the countries, and the distributions of real returns were skewed towards negative values.[18]

4.2 Incidence and Magnitude of the Liquidation Effect

Liquidation years are years where the real interest rate on the debt portfolio is negative. Table 3 shows the incidence of liquidation years for each country according to the CIR measure. Column (1) contains the share of liquidation years for the full sample period of each country, and the following columns show the share of liquidation years for different subperiods. The average share of liquidation years is 56 percent for the full sample period. Excluding Argentina, which is an outlier in the sample, it is 53 percent. Liquidation years comprise 50 percent of the years in the United States and 58 percent of the years in the United Kingdom.

When looking at changes in the share of liquidation years across subperiods, two patterns can be identified. The most common one is a high incidence of liquidation years immediately after the end of WWII, a lower incidence between 1957-1968, and a higher incidence again in the 1970s. This is the case for eight countries: Australia, Belgium, France, Italy, Japan, South Africa, the UK and the US. In all of these countries, there is a higher incidence during the period 1969-1980 than during 1945-1956. These are typically countries where the debt ratios were high at the end of WWII. The low incidence period of 1957-1968 coincides with the golden era of Bretton Woods, while the high incidence during the 1970s occurs at a time when a surge in the price of commodities led to an increase in the inflation rates of most countries.

The second pattern occurs in the case of Argentina, India, Ireland and Sweden, who exhibit a reasonably constant incidence of liquidation years across the subperiods. Argentina is the most extreme case, with almost every single year satisfying the definition of liquidation year. In India, there is a lower incidence in the first subperiod and the subsequent increase in the share of liquidation years in the other two subperiods. While the debt ratio in India did not vary much during the period under study, this is explained by the average inflation rate during 1949-1956 (0.2 percent) being significantly lower than in the other subperiods (6.6 percent during 1957-1968 and 7.0 percent during 1969-1980). In the case of Ireland, the lower

[18]Reinhart and Sbrancia (2011) show the distributions of real deposit rates, discount rates and T-Bill rates in a larger groups of advanced and emerging economies. In all cases the distributions for the period 1945-1980 are to the left from those before 1945 and after 1980.

share of liquidation years during the 1980s can be attributed to a higher average nominal interest rate and a lower inflation rate. In Sweden, the average inflation rate during 1969-1980 was 8.4 percent, twice as large the average inflation for the two previous subperiods. This, combined with the fact that the nominal interest rate did not increase by the same proportion, explains the higher incidence of liquidation years during 1969-1980 relative to 1945-1968.

An interesting observation is that the incidence of liquidation years diminishes in the countries for which the sample period extends beyond 1980, when most of the controls were lifted and the era financial liberalization began. In Ireland, the incidence for 1969-1980 was 92 percent, whereas for 1981-1990 it was 30 percent. It went from 83 percent to 10 percent over the same subperiods in Sweden, while there is only one liquidation year in Japan after 1980. The period after 1980 is a period of greater financial liberalization, and the reduced incidence of negative real returns seems to be associated with higher nominal interest rates and lower inflation rates. To illustrate, in Sweden the average nominal interest rate was 6.2 percent and average inflation 8.4 percent during 1969-1980, whereas the average nominal interest rate was 10.9 percent and average inflation 7.6 percent during 1981-1990. Even if inflation did not go down by much on average the nominal interest rate increased significantly.

Table 4 shows the magnitude of the liquidation effect in these liquidation years. For any given year, the liquidation effect corresponds to the absolute value of a negative real interest rate. Column (1) shows the average liquidation effect for the full sample period, while the next five columns show the average liquidation effects for the same subperiods as in Table 3. Excluding Argentina and Japan, which have large average liquidation effects of 21.4 and 13.2 percent respectively, the average liquidation rate was 4.6 percent. The subperiods results show a similar pattern to that observed in the previous table, namely that liquidation rates were higher both after WWII and during the 1970's. Column (1) of the table shows the largest negative real interest rate for each country, together with the year in which it took place. For roughly half of the countries, the minimum real interest rate took place in the years immediately after the end of WWII, and for the other half it occurred in the early 1970s. The minimum real interest rate in the United States was -13.7 percent in 1946, while in the UK the minimum was -10.9 percent in 1975.

4.3 Liquidation Revenues for the Government

The implicit revenues for the government are calculated as a percentage of GDP and presented in Table 5. The way to interpret these estimates is that, if the average liquidation

revenues were two percent, it means that the government's deficit was, on average, two percentage points of GDP lower during liquidation years and led to savings on interest payments equivalent to two percent of GDP. Revenues are determined by the magnitude of the liquidation effect and the size of the stock of debt.

The average liquidation effect revenues during the entire sample period generally lies between 1.5 and 3.8 percent of GDP, with Sweden (0.8 percent) and Japan (5.9 percent) the only countries outside of this range. Table 5 also shows average revenues within subperiods. Initially high debt-to-GDP ratios means revenues were highest in the period immediately after WWII. In all countries, the average revenue is higher for 1945-1956 than for the full sample period. In the United States, average revenues relative to GDP were 4.3 percent during 1945-1956 and 2.3 percent for the full period, with both the liquidation rate and the debt ratio highest in that first subperiod. In the case of Australia, revenues during 1945-1956 (6.7 percent) were twice as high as the average for the full sample (3.3 percent).Debt-to-GDP ratios were relatively low in India, Ireland, South Africa and Sweden, which is reflected in lower average revenues. In India, where both the debt-to-GDP ratio and the liquidation effect rate were constant over the full sample, the revenues were reasonably constant across subperiods as well. Italy also exhibits relatively low revenues, the large reduction in the debt ratio was between 1942-1947 which explains the high value in the first subperiod.

It is helpful to also compare liquidation effect revenues to tax revenues in those years. Table 6 presents a comparison of the liquidation revenues relative to both GDP and tax revenues for the Holding Period Return measure as well as the CIR measure. Tax revenues do not include those from the inflation tax. Results for the CIR and HPR measures are similar, which suggests that the valuation effect is generally small. The revenues from the liquidation effect can be sizable when expressed in terms of tax revenues, as they average 20 percent of tax revenues. A comparison to the revenues from the inflation tax is presented later in the section.

An important finding of this paper is that the inflation rate does not need to be very high. Table 7 compares the median inflation rate -due to the presence of very high inflation in some of the countries- during liquidation years and during 1930-2010. The reason to start in 1930 is to focus on the period after the gold standard when there was a change in the way monetary policy was conducted. Two thirds of the countries in the sample have median inflation below 10 percent both during liquidation years and during 1930-2010. The difference is as low as 1.8 percentage points for South Africa. In the US, median inflation during liquidation years was 6.0 percent, in contrast to 3.0 percent during 1930-2010. In the UK median inflation was 8.3 percent, 4.5 percentage points higher than the historical

median.

Higher inflation rates led in some cases to a faster liquidation of the debt, whereas in other cases this did not happen. In Argentina, inflation rates were high during most of the period (53.4 percent on average) but no large reduction in the debt ratio is observed, possibly because the government kept running deficits which forced it to keep borrowing. In contrast, Italy and Japan had very high inflation (around 500 percent) at the end of WWII. This spike in inflation in Italy reduced the debt ratio from 118 percent in 1942 to 21 percent in 1947.[19] In the Japanese case there is no good data for GDP during the war but different estimates put the debt ratio over 110 percent, in 1951 the debt-to-GDP ratio had reached 10 percent. In both cases the sample was started in 1946 after the end of WWII, in the Italian case the spike in inflation was prior to that which is reflected in a lower incidence and liquidation rate as well as revenues.[20] If one were to include 1942-1945 to the Italian sample the revenues numbers for the first subperiod would be very similar to those of Japan.

4.4 The Role of Inflation Expectations and Financial Repression

The measures presented so far do not distinguish between the relative contributions of inflation surprises and financial repression. The goal of this section is to estimate inflation expectations, in orde to identify the relative contribution of each factor.[21]

The empirical strategy to estimate inflation expectations follows Fama (1975) and Mishkin (1981), who were interested in testing for market efficiency. An advantage of this method is that it allows standard errors to be obtained. The analysis is centered on the Fisher equation, in which the nominal interest rate at time t is equal to the real interest rate plus the rate of inflation that is expected between $t-1$ and t:

$$i_t = r_t^A + \pi_t^e \tag{13}$$

[19] Average real growth was -4 percent between 1942 and 1947

[20] The year 1945 was considered as the end of the war despite the fact that Italy surrender in September of 1943.

[21] There are several ways in which inflation expectations have been estimated. One is to estimate the anticipated component of inflation (or money supply) with an ARMA or ARIMA process and take the residuals as the unanticipated component (Barro, 1978). Other techniques include using a Kalman filter (Burmeister, Wall, and Hamilton, 1986) or indexed bond yields to recover the inflation expectations (Deacon and Derry, 1994). The latter one is not a possible alternative in this case because indexed bonds were issued after the end of the sample period. For example, they were first introduced in the United Kingdom in 1981 and in the United States in 1997. While there are surveys on inflation expectations, such as the Livingston Survey and the Thomson Reuters/University of Michigan Survey in the United States, such surveys are not widely available during this period.

Where i_t represents the nominal interest rate between $t-1$ and t, r_t^A is the real interest rate expected to be earned between $t-1$ and t, and π_t^e is the inflation rate expected by the market between $t-1$ and t.

Contrary to the ex ante real interest rate, which is determined by the expected rate of inflation, the ex post real interest rate is determined by the actual inflation between $t-1$ and t:

$$r_t^P = i_t - \pi_t \tag{14}$$
$$= r_t^A - (\pi_t - \pi_t^e) \tag{15}$$

Under the assumption of rational expectations in the bond market, the forecast error of inflation should be uncorrelated with information available at $t-1$, which implies that:

$$E\left(\pi_t - \pi_t^e | \phi_{t-1}\right) = 0 \tag{16}$$

Where ϕ_{t-1} denotes the information set at $t-1$. That is, given all of the available information at $t-1$, on average the difference between actual and expected inflation is equal to zero.

Using variables X_{t-1} that are part of the information set ϕ_{t-1}, the following equation can be written:

$$r_t^A = X_{t-1}\beta + u_t \tag{17}$$

The error term u_t is also determined at $t-1$ and is assumed to have a mean of zero, constant variance, and to be serially uncorrelated. Equation (17) can be substituted into (14) to obtain:

$$r_t^P = X_{t-1}\beta + u_t - \epsilon_t \tag{18}$$

where $\epsilon_t = \pi_t^e - \pi_t$.

Contrary to (17), equation (18) can be estimated. Mishkin shows that the OLS estimate of β from (17) and (18) are equal in expectation. The variance-covariance matrix derived from equation (18) will be larger than the one resulting from (17), and the estimates of β from equation (18) will be less precise.

The variables included in X_{t-1} are: inflation rate, money growth rate, real GDP growth, and trend variables. These variables are the variables usually used in this literature because of their high correlation with the ex ante real interest rate. The estimates are used to obtain the following series for the ex-ante real interest rate:

$$\hat{r_t^A} = X_{t-1}\hat{\beta_{r^P}} \tag{19}$$

Combining this with equation (13), estimates for inflation expectations can be obtained:

$$\hat{\pi_t^e} = i_t - \hat{r_t^A} = i_t - X_{t-1}\hat{\beta_{r^P}} \tag{20}$$

The exact standard errors for the estimates cannot be obtained, as the variance of the within-sample error depends on the relative size of the variance of u_t and the variance of ϵ_t. However, lower and upper bounds for the errors can be obtained.

I estimated this equation as follows. The first step was to run the regression with one explanatory variable at a time, varying the number of lags of that variable and selecting the lag structure with the highest adjusted R^2. Of the regressions with the different explanatory variables, the regression with the highest adjusted R^2 was chosen. In the second step, a second variable was added to this regression and the process repeated to choose the variable and lag structure that results in the highest adjusted R^2. This is done for the subsequent variables until adjusted R^2 is maximized.[22] This iterative process determined the regression to be estimated, which was tested for serial correlation in the errors and for heteroscedasticity.

Table 8 contains the results of the regressions for each country when CIR measures are used.[23] The explanatory variables are denoted as follows: inflation rate (INFL), growth of money supply (GM1), real growth in GDP (GROWTH), and a trend variable (TREND). The estimated equation varies country by country, reflecting different sets of variables that provided the best fit. All of the regressions include lagged values of inflation and/or money growth; the first lag of both measures is generally negative and statistically significant. Lagged values of growth are included in several countries, although the magnitude of the coefficients is never particularly large. These country-specific specifications generally explain around half of the variation in inflation.

These regressions provide a basis on which to bound inflation expectations.[24] When

[22]Darrat (1985) applies a similar method to calculate inflation expectations but with an autoregressive process.

[23]Similar results are obtained using the HPR, when it is available.

[24]As a robustness exercise, inflation expectations were also estimated by fitting an autoregressive process.

people form their expectations about future inflation, they are likely to have a distribution for future inflation rather than a point estimate. For this reason, an *inflation surprise year* is said to take place whenever the actual inflation rate is two standard deviations above the estimated expected rate of inflation.

Table 9 shows the share of inflation surprises relative to the total number of years in the sample for each country, as well as the overlap between inflation surprises years and liquidation years. The results are presented using both the lower and upper bound estimates for the standard errors. The average share of inflation surprises each county has is 8 percent using upper bound standard errors and 17 percent using the lower bound. The frequency of inflation surprise years in liquidation years is 15 to 28 percent, depending on which estimate for the standard errors is used. In either case, they constitute a minority of cases, which suggests that inflation surprises are not the primary cause of liquidation years.

For most countries, inflation surprises are concentrated immediately after the end of World War II and during the 1970s. It is worth noting that, after the end of World War I, most countries experienced low inflation rates as they tried to return to the gold standard. This led many people to expect low inflation rates after World War II, and many economists thought that the biggest challenge after the war would be slow growth and high unemployment (Studenski and Krooss, 1963). What actually happened is that average inflation rate in the decade after WWII was 7 percentage points higher than the average inflation rate in the decade after WWI. The other period with high incidence of inflation surprise years, in the 1970s, corresponds to a period of oil shocks and a surge in the price of commodities.

The main conclusion from this exercise is that financial repression appears to have been more important than inflation surprises in reducing government debt.

4.5 Are the Results Biased by Bonds Issued Before 1945?

Inflation rates were lower before WWII which, absent any restrictions, should be reflected in lower nominal interest rates. If a large proportion of the bonds in a country's portfolio were issued prior to 1945, then the results may be biased by the returns on these bonds.

The richness of the database allows me to look at the issuance patterns over time, to get a sense of what fraction of debt is issued before 1945 and the importance of this issue. In most countries, many new securities were issued every period and securities issued after 1945 quickly account for most of the debt. The exception is Japan, where there were not many

This generates similar estimates of inflation expectations. Also, for the United States, these estimates were found to be similar to the Livingston survey on inflation expectations.

instruments issued between the end of WWII and 1965. The maturity structure also means that most of the debt matures within the sample period; as perpetual securities, such as the consols in the UK, account for small fractions of the overall portfolios.

It may still be the case that the liquidation effects are not common for debt issued after 1945. To check this, I analyze the performance of bonds issued after 1945 in Australia, India and Ireland, which are countries for which the necessary data were available. The Yield to Maturity (YTM) is used to study the performance of the bonds. The YTM is a measure of the per-period return an investor expects to receive by holding a security until its maturity date. It is sometimes referred to as the internal rate of return. For a given bond, the YTM at time t is given by the following equation:

$$P_t = \sum_{t=1}^{T} \frac{C_t}{(1+r)^t} + \frac{Principal}{(1+r)^T} \tag{21}$$

Where C_t is the coupon payment, P_t is the price of the security at time t, and r is the YTM. The YTM is the rate of discount at which the present value of the promised future cash flows is equal to the price of the security.

As mentioned before, the YTM should reflect the investor's inflation expectations at the time the bond was issued. Investors are likely to have in mind a possible distribution for future inflation. While this is not directly observable, two extreme assumptions about the real returns and inflation expected by investors can provide lower and upper bounds on the nominal YTM. First, to calculate a lower bound, suppose investors expected a zero real return and so expected an inflation rate equal to the YTM for each period. Alternatively, suppose investors expected a real return equal to the nominal YTM, so that they expected an inflation rate equal to zero. This can be thought of an upper bound, and these extremes can be used to bound the *ex ante real YTM as of time of issuance*.

The final step in calculating the real return consists of expressing the cash flows of each security for each year until maturity in real terms. The year of issuance for each security is used to deflate the cashflows. Having obtained these real cash flows, and using equation (21), I can calculate the YTM that would deliver that stream of cashflows given the price at which the security was issued. This is the *ex post real YTM as of time of issuance*, and provides a measure of real returns within the sample period based on expectations at time of issuance.

Australian data is available for the period 1945-1968, Indian data for 1960-1978, and Irish data for 1965-1975. The data for each security issued within these years consists of

the price and date of issuance, maturity date, and coupon rate. All of the securities mature before 2010.

Figure 2 shows, at the time securities were issued, the frequency distribution for both the ex ante real YTM and ex post real YTM. When it is assumed that the expected inflation rate is equal to the YTM in each period, there is a mass concentrated at zero which is shown by the vertical solid line in each panel. It follows then that, even without knowing what inflation expectations investors had, the actual distribution for the ex ante real YTM should be somewhere between the two solid black lines. As the figures for the three countries show, the distribution for the ex post real return is always to the left of the ex ante, which suggests negative real returns were common. In the case of India and Ireland, the overlap between the two distributions is close to zero. The share of observations with negative ex post real YTM is 54 percent in Australia, 85 percent in Ireland, and 94 percent in India.

Summary information on the nominal and ex post real YTM appears in Table 10. For each country, I show the average, maximum and minimum for the nominal YTM at issuance and the ex post real YTM as of time of issuance. On average, the ex post real YTM was negative in all countries.

The findings of this exercise show that the results presented in the previous subsection are not biased by securities that were issued before 1945, and that negative real returns were common for securities issued within the sample period. The results provide further evidence that the presence of financial repression is an important factor for explaining the incidence and magnitude of the liquidation effect.

4.6 Comparison to Inflation Tax

Inflation has usually been considered as a tax on real cash balances (Friedman, 1971). It is important to compare the revenues from the liquidation effect to those from the inflation tax, in order to understand the incentives of governments to use inflation as a broader source of revenue. Calvo and Leiderman (1992) showed evidence that in some situations the observed inflation rate is above the rate at which seigniorage is maximized. The authors argued that countries were sometimes setting inflation rates in the inefficient side of the Laffer Curve. However, if debt liquidation revenues are an additional source of revenue generated by the inflation rate, then it may not be that the observed inflation rates were too high but that the tax bases were larger than previously thought. Support for this possibility comes from Reinhart and Rogoff (2008, 2009), who noted during several episodes of high inflation that the debt-to-GDP ratio was much higher than the ratio of the monetary stock to GDP.

The inflation tax can be collected every period, which is not generally the case for the "liquidation effect" tax. For this reason, instead of comparing year-on-year revenues from each source, a comparison is conducted over subperiods. The revenues from the inflation tax are calculated as:

$$\text{Inflation Tax} = \frac{\pi_t}{1+\pi_t} * \text{Money Supply}$$

Where π_t is the inflation rate. This is the component of seigniorage that would be collected in steady state (see footnote 9). The monetary aggregate used is M1, which is the most liquid monetary aggregate. This is the measure used by Rodriguez (1994) and Easterly et al. (1995) for instance. If the monetary base was used instead of M1, then the estimates for the inflation tax would be lower because the monetary base is a fraction of M1.

After calculating the revenues from each source, the sample is split into subperiods of at least 10 years so that each country (except Ireland) has three subperiods that cover the 1945-1980 period. Using the official CPI, the revenues for each year are expressed in constant terms. The base year is the first year in each subperiod. To illustrate, total revenues for the subperiod 1945-1956 are expressed in 1945 dollars. The revenues are then added up and expressed in terms of the GDP of the base year.

The results of such comparison are displayed in Table 11, with countries grouped according to the main patterns that can be observed. The first group of countries has liquidation revenues that are consistently higher or similar to those from the inflation tax across the subperiods. These countries are Belgium, India, Ireland, Sweden and the United Kingdom. In Belgium and the UK, the liquidation effect dominated the inflation tax both in the decade after 1945 and in the 1970s. For India, Ireland and Sweden, the revenues from each source are broadly similar in all subperiods.

The second group of countries have liquidation revenues which are relatively large in the first subperiod (normally 1945-1956), then have relatively larger inflation tax revenues in later periods. Countries in this group are Australia, France, Japan, and the United States. Their liquidation effect revenues are higher than those from the inflation tax in the first subperiod, when debt was very large. In the subsequent subperiods, when the debt stock had been reduced and the incidence and magnitude of the liquidation effect declined, the inflation tax revenues were relatively higher. In Australia and the United States the revenues from the liquidation effect increase again during 1969-1980 but do not surpass those from the inflation tax. The case of Japan[25] highlights the point that in some episodes of high

[25]Similar results are found (though not reported) for Italy for the period 1942-1947.

inflation the revenue from liquidating debt were higher than those from the inflation tax. For the period 1946-1956 the revenues from liquidation effect were 73.6 percent whereas the revenues from inflation tax were 15.3 percent.

In the third group of countries, which are Argentina, Italy, and South Africa, the revenues from the inflation tax are higher than those from the liquidation effect in all subperiods. Debt in Italy had been reduced before the start of the first subperiod, whereas the money supply remained higher for a longer period of time. In South Africa, the debt ratio was low and inflation averaged a relatively low 3.5 percent between 1945 and 1972.

Despite the fact that the liquidation effect may not be collected every year, during periods of high incidence of the liquidation effect the revenues obtained from this source are usually higher than the revenues from inflation tax. Liquidation revenues were relatively high when the debt stocks were large. Looking at the revenues from both sources together, this suggests that the total tax revenues generated by inflation can be significantly higher than previously thought. The effective tax base, at least during this period of high incidence of negative real interest rates, should be thought of as the stock of domestic debt in addition to the money stock.

4.7 Effect on the Stock of Debt

To this point, I have focused on the effect of inflation on the government debt on a year-on-year basis. There is also a cumulative effect on the stock of debt, as by paying lower interest on its debt the government has a lower deficit which affects its needs for new debt issuance and future interest payments. One way to capture the magnitude of this cumulative effect is by assessing what each country's debt-to-GDP ratio would have under plausible alternative inflation paths. As it will be shown, a small difference in the average inflation rate can have large effects on the stock of debt.

To capture the effect on the stock of debt, the following equation of motion for the government debt is used:

$$\frac{B_t}{P_t rGDP_t} = (1 + i_{t-1} - \pi_{t-1} - g_{t-1}) \frac{B_{t-1}}{P_{t-1} rGDP_{t-1}} + \frac{def_{t-1}}{P_t rGDP_t} \tag{22}$$

Where B_t is the stock of domestic debt, P_t is the implicit price level, $rGDP_t$ is the real GDP, i_t is the nominal interest rate, π_t is the net inflation rate, g_t is the net real growth rate and def_t is the primary deficit.

A series for the primary deficit is generated using the estimated values for the nominal interest rate, together with observed values for the real stock of debt, real growth and inflation. I assume that the primary deficit remains unchanged under the different inflation scenarios. Debt ratios are then obtained for different inflation paths.

Three alternative paths for the inflation rate are assumed: (i) the inflation rate is equal to the country's median inflation between 1930 and 2010, (ii) the inflation rate is equal to the (weighted) average nominal interest rate of the corresponding year, and (iii) the inflation rate is equal to 2 percent.[26] These different alternatives help to understand the effect that inflation can have in shaping debt dynamics. Under the first scenario, I assume that the experience in each country during the sample period is comparable to its inflation rate during a longer period of time. With the second scenario, I compare the actual debt dynamics to a situation where real interest rates are zero in every period. By assuming an inflation rate of 2 percent, which is a common inflation target nowadays in many countries, in the third scenario it is possible to explore how the debt ratios in these countries would have evolved if that inflation target had been in place.

Table 12 shows the results of the analysis. Column (1) shows the debt-to-GDP ratios at the start of the sample period (normally 1945), while Column (2) shows the debt-to-GDP ratios at the end of the sample period (normally 1980). Columns (3) to (5) show what the debt-to-GDP ratio would have been at the end of the sample period under the three alternative inflation paths.

The exercise highlights the cumulative effect of inflation on the dynamics of the debt-to-GDP ratio. Compounding means that relatively small differences in the inflation rate has large long-term effects on debt-to-GDP ratio. For example, the United States had an actual debt-to-GDP ratio in 1980 of 32 percent. Under the scenario where the inflation rate is equal to the median inflation rate over 1930-2010, which is 3.0 percent, the ratio would have been 51 percent in 1980; if the inflation rate had been a constant 2 percent the ratio would have been 72 percent in 1980. The cumulative liquidation effect implied a reduction of 40 percentage points, relative to a scenario where the annual inflation rate had been 2 percent. For the same scenario of a constant 2 percent inflation rate, the difference between the observed and estimated debt-to-GDP ratios in the United Kingdom would have been of 167 percentage points, leaving the debt ratio at 212 percent. In Argentina, where actual inflation was significantly higher than the alternatives proposed, the estimated debt-to-GDP ratios are implausible high. This is also the case for Italy and Japan if the sample is started in the final years of WWII.

[26] Under (i) and (iii), the inflation rate remains constant over time.

In the case of Japan the estimated ratios are shown until 1980 to make the results comparable to those of other countries. For the period 1947-1980 the estimated ratios are significantly higher than the actual debt ratio which should not be surprising given that median inflation was 6 percent during those years. The approach can be also used to show what the debt dynamics in Japan would have been if inflation had been higher during the period 1981-2008. The inflation rates during this period were markedly lower than the inflation rates in the previous forty years. Median inflation between 1981-2008 was 0.7 percent. If inflation had remained at 2 percent, conducting the same exercise as before for 1980-2008, the debt ratio would have been 115 percent in 2008.[27] The actual debt-to-GDP ratio in 2008 was 167 percent.

4.8 Understanding What Affects the Probability of a Liquidation Year

In order to understand under which circumstances negative real interest rates are most likely to occur, it is important to understand how different factors affect the return on the portfolio of government debt. For instance, does the share of short-term debt in the portfolio increase the probability of a liquidation year? I run a panel-data model to understand such factors. The results should be taken as identifying conditional correlations rather than causal relationships.

The estimated model is given by:

$$r_{it}^{CIR} = \alpha_i + \gamma_t + \mathbf{X'}_{it}\boldsymbol{\beta} + u_{it} \qquad i = 1, ..., N$$
$$u_{it} = \rho_i u_{i,t-1} + \epsilon_{it} \qquad t = 1, ..., T$$

Where i is the country identifier and t the time period, N is the total number of countries and T is the number of time periods. The dependent variable is the ex post real interest rate on the portfolio given by the CIR measure. The specification includes country fixed effects (α_i) to control for constant differences between countries, and time fixed effects (γ_t) to control for shocks common to all countries. The matrix $\mathbf{X}$ includes a constant and a number of explanatory variables, which are detailed in the next paragraph. The error structure allows for correlation across countries and for autocorrelation over time with country specific autocorrelation coefficients (ρ_i). The estimator is the pooled least-square estimator with an

[27] The estimated debt ratio is 87 percent under the scenario of inflation equal to historical median inflation and 70 percent under the scenario of inflation equal to average nominal interest rate.

AR(1) for the errors.[28]

The explanatory variables included in the regression are: the ratio of interest payments to GDP (intgdp); the ratio of deficit to GDP (defgdp); the ratio of tax revenues to GDP (trgdp); the share of short term debt (st); and an indicator for central bank independence (cbind). Higher interest payments could increase a government's reliance on other sources of financing and make inflation more attractive. A higher deficit and lower tax revenues could have a similar effect. One would expect that a higher share of short-term debt would be associated with a lower probability of a liquidation year, because the government will need to refinance its debt sooner in the market. The idea behind Central Bank independence is that an independent Central Bank may be less willing to finance government deficits with inflation, which could lead to a higher real interest rate. The sources for these variables are detailed in the Data Appendix.

Table 13 shows the results from estimating this equation. The variable with the greatest explanatory power is the interest payments-to-GDP (intgdp) variable, which is shown in Column (1). When either deficit-to-GDP or tax revenues-to-GDP are added, the estimated coefficients have the expected signs in each case, but tax revenues are not statistically significant. This is the case both under different error structures and different estimations. The results for both regressions are shown in Columns (2) and (3) of Table 13. The negative coefficient on the interest payments variable means that increases in the variable are associated with lower real interest rates. A higher value of the deficit variable, a less negative deficit or higher surplus, have a positive conditional correlation with real interest payments.[29]

In all of the specifications, the share of short-term debt is not statistically significant at the five percent level. This could appear at first as a surprising result given the argument that, as the government attempts to inflate away its debt, investors would seek protection from inflation through shorter maturities and indexation (Blanchard et al., 1985; Spaventa, 1986). The result provides further evidence that there were restrictions on the degree to which financial markets could respond. Further evidence of this lack of market response is provided in Figure 3, which shows the maturity structure for debt in India, Japan, and the United States. The dark gray area is short term debt maturing in less than a year and the lighter gray area is debt with a maturity period longer than one year.[30] In all three countries, the share of short-term debt represents less than 50 percent of the debt throughout

[28] The results are robust to other estimators such as Feasible Generalized Least Squares, or allowing for other types of autocorrelation, such as a common AR(1) parameter.

[29] The deficit variable is defined as the difference between revenues and spending and expressed as a share of GDP.

[30] The shares of debt remain fairly constant even when medium term debt -debt maturing in 1 to 5 years- is included.

the sample period. In the United States, the share of short-term debt was highest during the 1950s and early 1960s, and then declines to around 20 percent of total debt after 1965. In Japan, the share of short-term debt initially increases and peaks around 1960, and then steadily declines to around 10 percent of the total debt by 1980. While India exhibits the largest share of short-term debt throughout the whole sample period, after an increase in the first decade the fraction of short-term debt is reasonably stable. The fact that despite the large incidence of negative real interest rate, governments were able to issue debts at a fairly unchanged interest rate and still at long maturities can be interpreted as further evidence of financial repression during the period 1945-1980.

The last variable added, Column (5), is Central Bank Independence (cbind) which is not statistically significant at the five percent level. One possible explanation is that there are not many observations after 1980 when central banks became more independent. An alternative explanation could be related to Alesina and Summer's (1993) finding that, although a higher degree of central bank independence is associated to a lower inflation rate, there is no correlation between central bank independence and real interest rates levels or variability.

A government's fiscal position is an important determinant of the likelihood of a liquidation year. After controlling for several factors, including the share of short-term debt, worsening government finances are associated with lower real interest rates on government debt. Montiel (2003) argued that financial repression has a fiscal origin, in the sense that the inability of a government to collect revenues from traditional sources forces it to seek other sources of revenues. In the case of financial repression, this constitutes an implicit tax on the financial sector. The results of this exercise suggest that there is a high conditional correlation between fiscal variables and negative real interest rates, but the exercise cannot determine whether these are causal relationships.

5 How did Investors Fare During this Period?

In this section, I compare the relative performance of bills, bonds and stocks. In order to understand investors' options and whether financial repression policies were key to the low returns on government bonds over the 1945-1980 period, I compare the returns on bonds to other financial assets during this period as well as in the decades before 1945 and after 1980. The returns on bonds during the 1945-1980 were poor relative to the return on stocks, but higher than that on other assets during the same period.

This suggests governments were able to generate demand for their securities, and provides further evidence that the presence of financial repression during the sample period affected

the return on government bonds. During World War II, countries imposed controls on the economy in order to obtain the physical and monetary resources necessary to fight the war.[31] The objective of governments was the same across countries: to direct funds towards government bonds while keeping the interest rate on their securities at low levels. Although the War officially ended in 1945, it took several decades to dismantle the restrictions that had been imposed during the war. Direct evidence on policies implemented during the sample period can be found in Appendix sec:historyFR.

5.1 Stocks, Bills and Bonds during the Sample Period

Table 14 shows the real returns using the portfolio of government debt using the Contractual Interest Rate and Holding Period Return measures, together with real returns on bills (short-term debt) and the stock market. For each of the variables, I present the geometric return, the arithmetic return and the standard deviation of the real returns. The geometric (or compound) return is the most appropriate measure to compare investments over a longer period of time (Bodie, Kane and Marcus, 2009), but I show the results are also similar when the arithmetic return is used. This information is provided for every country except Argentina and Ireland, as they had no stock market data that included dividends.

The most accurate measure on government bonds is the HPR, since it incorporates capital gains and losses. The CIR is also presented, however, because the HPR is not available for all of the countries. The results are generally similar, although the average real returns measured by CIR are one percentage point lower than those measured by HPR. This suggests that capital gains partially compensated investors for low interest payments. As a reminder, the measures for the return on government bonds are for the portfolio of government securities, and hence contain securities of various maturities. The return for short term government securities, bills, is presented separately as well.

The stock market returns were calculated using the most comprehensive index available for each country. In all cases, the indexes include both dividends and price changes. Details on the indexes used and their sources are included in B. The results for Japan and Sweden correspond to the period 1945-1980, so that the experience in these countries can be compared to that of the other countries in the sample.

In all countries, the average real return from the stock market is positive whereas the real return from government bonds is negative (except for Belgium under the HPR measure).

[31] Oosterlinck (2010) discusses the situation in the French stock market during the war; and also refers to the situation in other countries such as Belgium, the UK and the US.

This is true for both the short term and overall portfolio of government securities. The fact that the geometric mean is negative implies that someone who invested at the beginning of the period recovered less than the initial investment at the end of the sample period. For an investor who invested $1,000 in US government bonds in 1945, he would have received $824 in 1980 (measured in 1945 dollars). An investor in the United Kingdom would have recovered 58 percent of their initial investment during the same sample period.

The standard deviation for the portfolio of debt is lower than the standard deviation for stocks, which implies that there is a trade-off between risk and return.. A simple way to look at this trade-off is to compute the percentage of the time that stocks outperformed bonds for holding periods of different lengths. In Table 15, I present these percentages for holding periods of one, two, five, ten, 20 and 30 years for both the CIR and HPR measures. The way to read the table is as follows: in Australia, stocks perform better than bonds in 71 percent of all two year holding periods, 96 percent of 10 year holding periods and 100 percent of the 20 and 30 year holding periods. In all of the countries and under both measures, stocks tend to outperform bonds regardless of the holding period. In around 60 percent of the one year holding periods, stocks perform better than bonds. This suggests that, even over short investment horizons, stocks outperform bonds and make it unlikely that risk could explain the differences in returns between bonds and stocks.

The calculations reported in this table are before-tax returns. In order to be able to calculate after-tax returns, one would need historical information on the tax codes of the different countries. Siegel (2008) calculated historical after-tax returns for the United States, and finds that stocks to have a tax advantage relative to bonds. This occurs because relatively most of the return on stocks come from capital gains rather than dividend payments, and capital gain taxes can be deferred until the assets are sold so that the investment grows at the before-tax rate. The difficulty of extending this to other countries is that, while dividend and income taxes are usually higher than capital gain taxes, government securities often receive special tax treatment. This special treatment for government bonds makes it hard to know which group of assets had a tax advantage in other countries.[32]

5.2 A Longer Historical Perspective

Dimson, Marsh, and Stauton (2002) and Siegel (2008) provide evidence that investing in the stock market is the best alternative for investors with a long time horizon, at least in

[32] For instance, in the US municipal bonds are tax-exempt. In the UK private investors in Gilts are not liable for capital taxes.

advanced economies. They do this by comparing the returns on equity, bonds and bills in samples that span more than 100 years.

The results presented by these authors are useful to put the returns during the 1945-1980 period into historical perspective. Siegel (2008), who focuses on the US economy, reports that the annual real return on long-term government bonds was 4.8 percent over 1802-1870, 3.7 percent over 1871-1925, and 2.4 percent between 1926-2006. If the last subperiod is further split into smaller subperiods, it becomes clear that the low real returns are driven by the negative average real returns between 1945-1980. This suggests that the 1945-1980 period was distinctive in terms of the poor real returns on US government bonds.

Dimson et al. (2002) reported real returns on bonds, bills and stocks for all of the countries in my sample except Argentina and India. Tables 16 and 17 show these returns over 1900 to 2000, as well as over 1900-1939, 1940-1979 and 1980-2000. The returns on bonds for both 1900-1939 and 1980-2000 periods were higher than those during the 1940-1979 period in all of the countries except Belgium. In Australia, the annual real return on bonds from 1900-2000 was 1.1 percent while the real return between 1940-1980 was -2.8 percent. In the United States, the equivalent numbers are 1.6 percent and -1.8 percent respectively.

Bills are short-term securities, which should quickly reflect changes in inflation expectations and market interest rates in a well-functioning market. The fact that the average real return on bills was negative in all countries during 1940-1979 offers supportive evidence of the presence of financial repression. Average real returns on bills are rarely negative in earlier and later periods.. Across the ten countries for which this information is available, the average real return on bills was 1.0 percent between 1900-1939, -3.6 percent between 1940-1979, and 3.5 percent between 1980-2000.

In contrast to the performance of government bonds and bills, the real return in the stock market was positive in all subperiods in all countries (with the exception of Italy between 1940-1979). There is no common pattern for stock returns across the 1900-1939 and 1940-1979 subperiods, while the return for the 1980-2000 subperiod was markedly higher. This last observation will be important next, when the equity premium is re-examined.

5.3 The Equity Premium Puzzle Revisited

The equity premium is the excess return on equities over a risk-free asset, such as US T-bills, and is a key variable in many asset pricing models. Mehra and Prescott published a paper titled The Equity Premium: A Puzzle?" in 1985, where they found that the historical equity premium was far higher than the premium that could be rationalize by a standard

neoclassical model. Specifically, the observed equity premium over a 100 year period was more than 6 percent, whereas the premium predicted by the model was 1.4 percent. An additional finding at odds with the empirical evidence was that the risk free rate predicted by the model was 13.2 percent, whereas the average risk free rate observed in the data was less than 1 percent.

A large literature has attempted to explain this puzzle. Mehra (2006) summarizes the different explanations that have been provided, dividing the explanations into those that are risk-based and those that are not. Under the first category, Mehra groups explanations that have been successful at obtaining a risk free rate in line with the empirical evidence but have failed to explain the equity premium. Examples of this are models which propose alternative preferences (e.g., habit formation), different probability distributions (e.g., adding a disaster state), and behavioral models where agents are not fully rational. Mehra concludes that: "The difficulty that several model classes have collectively had in explaining the equity premium as a compensation for bearing risk leads us to conclude that perhaps it is *not* a "risk premium" but rather due to other factors." Papers that explore explanations that are not risk- ased use models which take into account market frictions or allow for incomplete markets, by adding characteristics like borrowing constraints, transaction costs and taxes.[33]

The particularly low bond returns during the 1945-1980 period may account for some of the equity premium. To examine this, I calculate the equity premium for rolling 30-year periods over time spans in the United States and the United Kingdom.[34] These are plotted in Figure 4, with the US results shown in Panel A and the UK results in Panel B. The shaded areas correspond to the period of financial repression (1945-1980). The data for the UK is available for the 1800-2010 period and for the US it is available for the 1870-2010 period, so that the first 30-year period is 1829 and 1899 respectively.

The first observation is that the equity premium has varied significantly over time, and it has even been negative at times in the United Kingdom. The second, more important observation is that the peak in the equity premium in both countries coincides with the period of financial repression. Excluding 1945-1980, the average equity premium for the period 1900-2010 is 2.1 percent in the UK and 4.4 percent in the US. This compares with the average equity premia for the 1945-1980 period of 6.7 percent in the UK and 8.3 percent in the US.

McGrattan and Prescott (2003) argue that one should take into account the role of taxes, diversification costs and regulatory constraints as determinants of the equity premium.

[33] In addition to Mehra (2006), Kocherlakota (1996), Cochrane (1997) and Campbell (1999, 2001) also offer surveys of the literature on the equity premium.

[34] Each observation is the geometric mean for the equity premium over the preceding 30 years

Although some of their results are encouraging, further work should be done to try to measure the effect of financial regulations, including taxes and other restrictions, in shaping the equity premium.

The observations of this section have potentially important implications for understanding the equity premium and the equity premium puzzle. First, a successful model of the equity premium should take into account the effect of regulations and institutional background. Trying to explain the average equity premium without acknowledging its large variations over time may not be particularly helpful to model prospective risk. In addition, if one believes that *to some extent* it is possible a return to a more tightly regulated financial system, then one should expect to observe a larger equity premium.

6 Conclusion

As a result of the recent financial crisis, the public debt ratios of advanced economies have increased to levels not seen since World War II. This raises questions as to how governments will reduce their debt burden. Studying how countries coped with similar situations in the past can shed light on the effectiveness and implications of the different alternatives. In this paper, I provide empirical evidence that inflation reduced post-World War II debts. I show the conditions under which inflation was effective and the implications for both governments and investors.

In combination with financial repression, inflation was an effective mechanism to reduce large debt burdens. Negative real interest rates were common and large in magnitude across the 12 countries under study. On average, the real interest rates on the portfolio of domestic government securities were negative in half of the observations in my sample. Implicit government revenues averaged two to three percent of GDP. When the sample is broken into smaller subperiods, it becomes apparent that there was a high incidence of the effect both in the years after the end of World War II and during the 1970s. In France, Italy and Japan, the countries which experienced the highest inflation rates after the war, the revenues as a proportion of GDP averaged 12 to 17 percent between 1945 and1956.

A conceptual framework was developed to identify the channels through which inflation can have an effect in reducing government debt, and to show how to think of financial repression as a restructuring mechanism. Several exercises were conducted to separate their relative contribution. The results consistently point to the importance of financial repression, rather than unanticipated inflation, in explaining the high incidence of negative real interest

rates. For instance, when inflation expectations are measured I find that inflation surprises occur in only 15 percent of liquidation years.

Of the various exercises focused on governments, two are worth emphasizing. First, when compared to other sources of government revenue, liquidation revenues are large. On average, liquidation revenues are equivalent to one fifth of tax revenues, and they are sometimes significantly larger than those from the inflation tax. Second, the results of a multivariate analysis point at an important connection between fiscal variables and the presence of the liquidation effect. While this is consistent with the argument by Montiel (2003) about financial repression having a fiscal origin, further work is required to understand whether the links between the variables are causal.

Most of the sample period coincides with the Bretton Woods era, which was characterized by the presence of tightly regulated capital flows. This appears to have facilitated domestic policies that kept interest rates on government debt artificially low. Further evidence of the presence of financial repression and its effect is provided by looking at the return of government bonds for the period 1900-2000. The real returns on bonds were significantly higher both in the period before and after 1940-1980. The presence of frictions in financial markets during this period is also apparent when looking at the average real returns on Treasury Bills, which were negative in all of the countries in the sample between 1940 and 1980.

The abnormally low real return for bonds during the period of financial repression is also reflected in the equity premium. The equity premium, calculated over 30-year rolling periods, was the highest during the decades after World War II that are studied in this paper. In the United States, the average equity premium from 1870 to the present is 4.4 percent while the average equity premium during 1945-1980 is almost twice as large at 8.3 percent. These findings may be relevant for understanding the equity premium puzzle, and suggest that studies trying to assess prospective risk should take into account the significant effect that government intervention can have on the return of different assets.

Real growth is unlikely to play a major role in reducing debt burdens at least in the next few years. Moreover, conditional on being able to implement fiscal austerity measures, the evidence on their success is limited to a few countries (Perotti, 2011). The options left are explicit defaults and restructurings, or the mechanisms studied in this paper. In the last three decades, the world has moved towards a more financially liberalized environment, which means that the magnitudes found here may not be representative of what could happen in the future. There have been some recent regulatory changes, however, that suggest governments may still be able to pay low real returns on their debt in difficult times. That, together

with the scale and breadth of how inflation was used to liquidate government debt in the period under study, suggests we should pay more attention to the use and implications of this debt-reduction mechanism.

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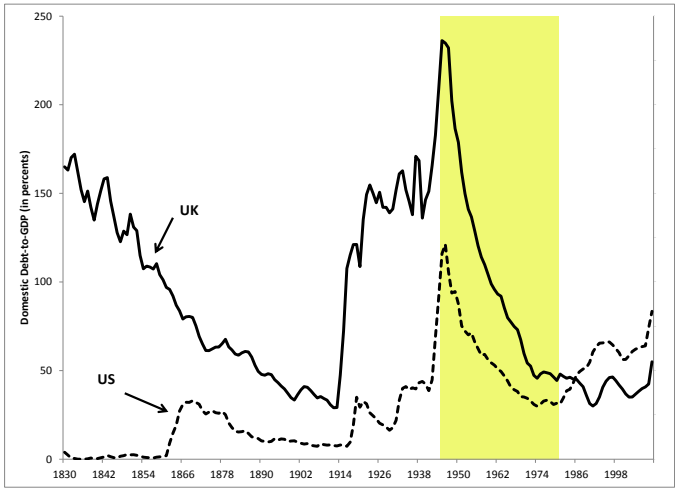
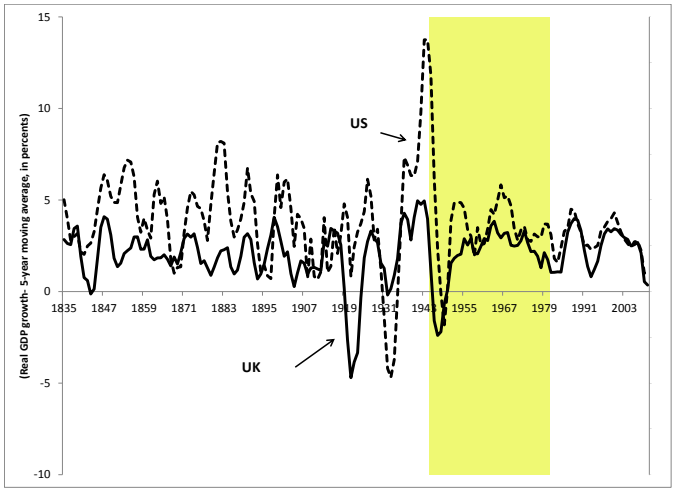
Figure 1: Debt-to-GDP, Real Growth Rate and Distribution of Real Returns

Panel A: Debt-to-GDP Ratios



Panel B: Real Growth Rate (5-year moving average)



Panel C: Distribution of Real Interest Rates

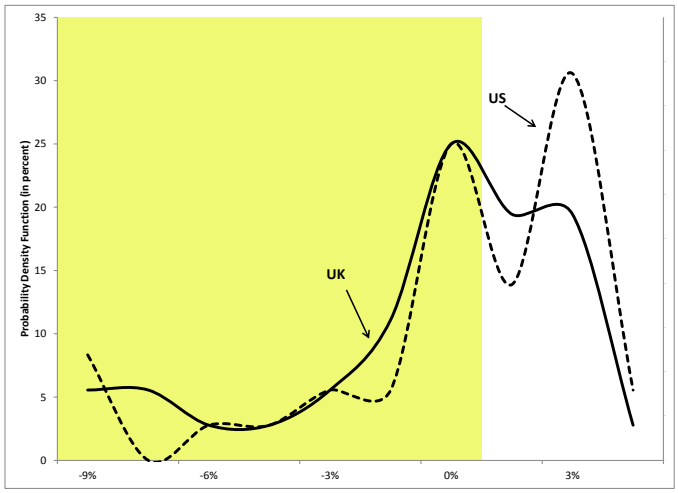
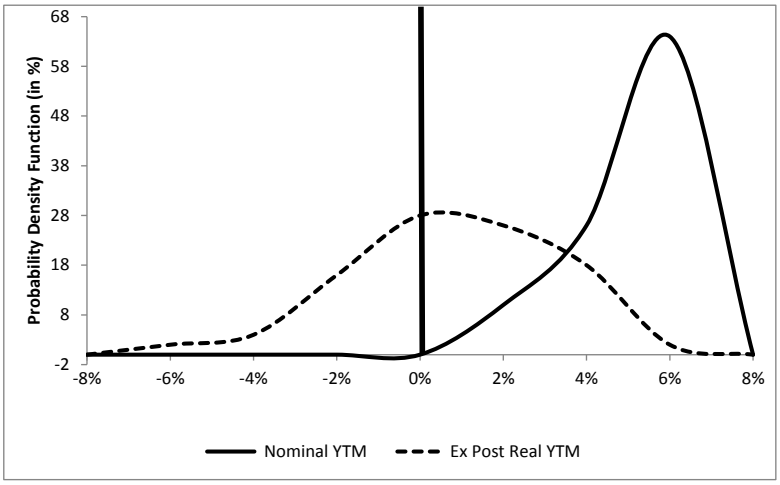
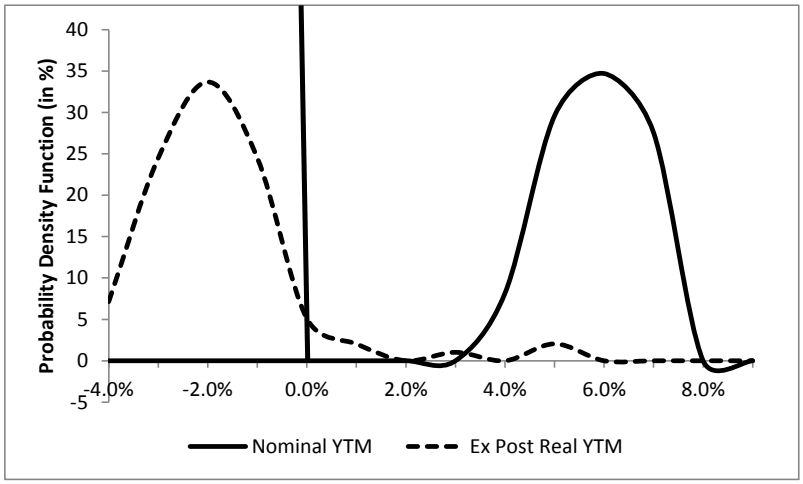


Figure 2: Frequency Distributions of Nominal and Ex Post Real Yield to Maturity (YTM)

AUSTRALIA



INDIA



IRELAND

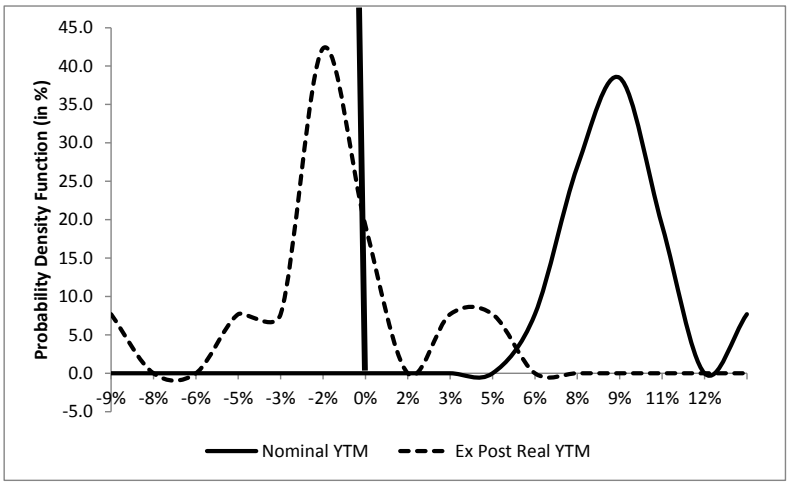
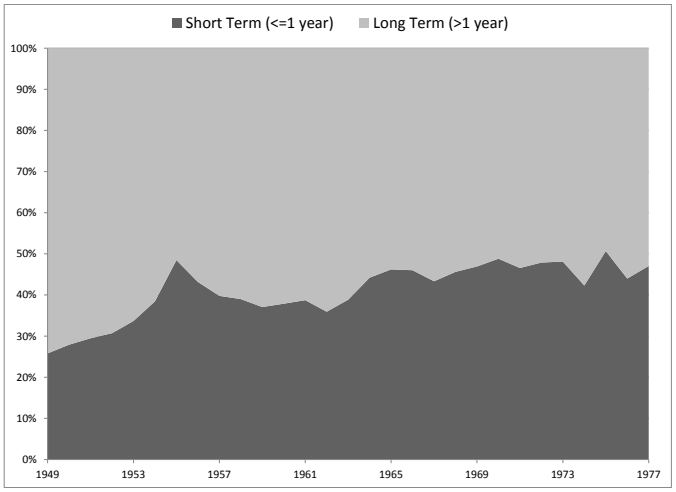
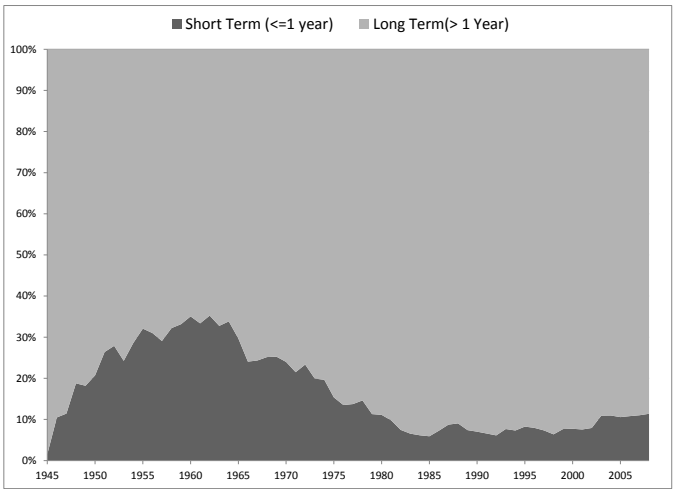


Figure 3: Maturity Structure

INDIA



JAPAN



UNITED STATES

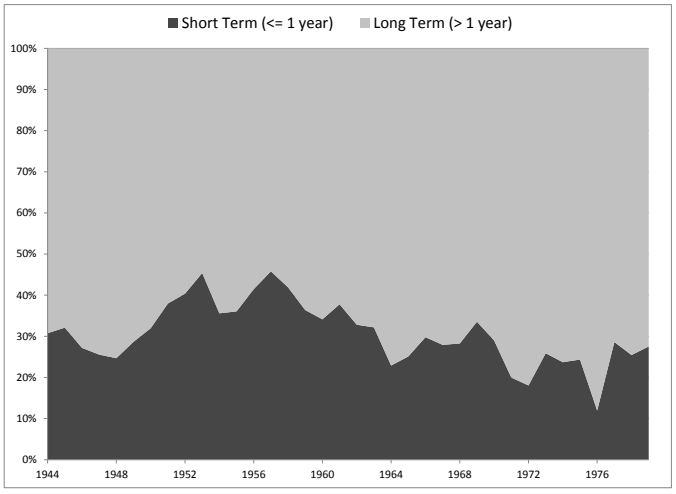
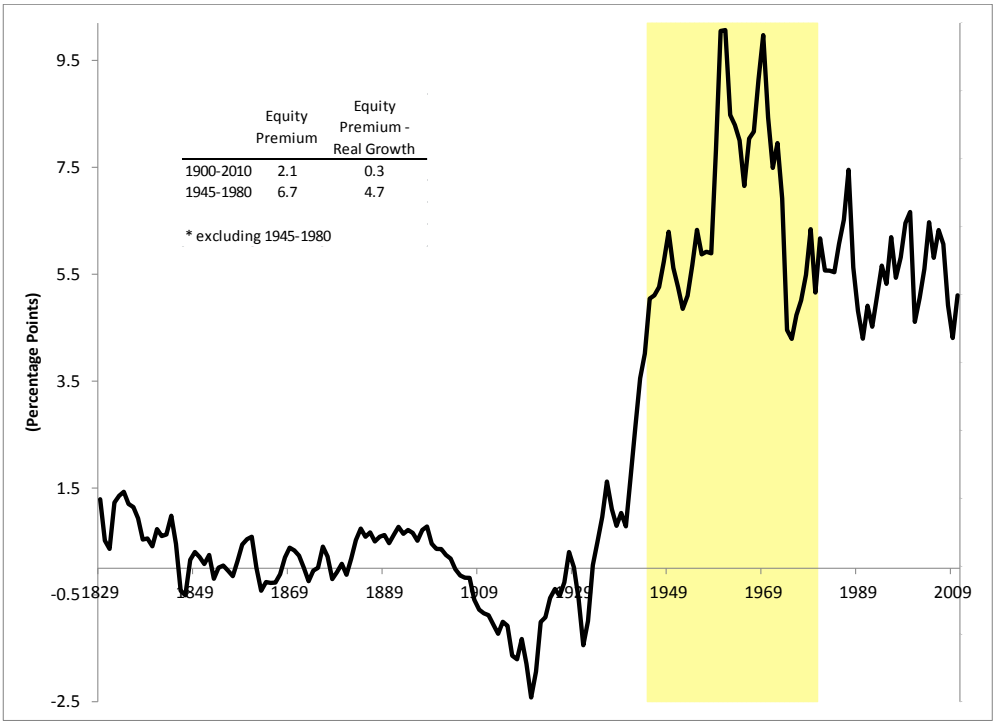


Figure 4: Rolling 30-year Equity Premium

UNITED KINGDOM



UNITED STATES

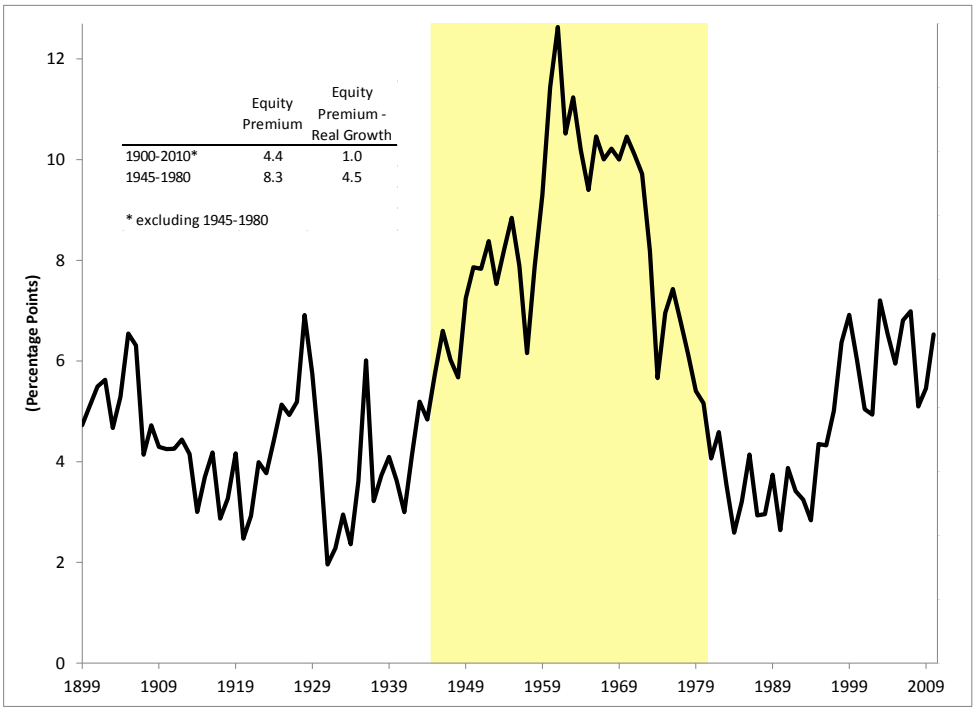


Table 1: Countries in the Sample and Sample Periods

Country	Period	Change in debt-to-GDP in percentage points (p.p.)	
Argentina	1942-1980	15.2 p.p.	(from 42.2 to 27.0)
Australia	1945-1980	124.6 p.p	(from 143.8 to 19.3)
Belgium[a]	1945-1974	74.4 p.p.	(from 112.8 to 38.4)
France[b]	1945-1980*	97.9 p.p.	(from 104.1 to 6.2)
India	1949-1980	(1.4) p.p.	(from 27.5 to 28.9)
Ireland	1960-1990	1.8 p.p.	(from 54.7 to 52.8)
Italy[c]	1946-1980	11.6 p.p.	(from 37.2 to 25.6)
Japan	1946-2008	(82.6) p.p.	(from 82.6 to 164.2)
South Africa	1945-1980	40.6 p.p.	(from 73.0 to 32.4)
Sweden	1945-1990	13.9 p.p.	(from 52.0 to 38.1)
United Kingdom	1945-1980	169.1 p.p.	(from 210.0 to 40.9)
United States	1945-1980	85.0 p.p.	(from 118.4 to 33.4)

[a] Missing data for 1964-1968
[b] Missing data 1953-1958 and 1960-1963
[c] The debt ratio in 1942 was 118 percent of GDP.

Table 2: Summary of Inflation and Real Interest Rate (in percent)

Country	Inflation			CIR			HPR		
	Average	Median	St. Dev.	Average	Median	St. Dev.	Average	Median	St. Dev.
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Argentina	53.4	21.7	81.0	-19.4	-14.1	18.3	-14.1	-11.0	15.9
Australia	6.4	4.3	5.4	-1.7	-0.3	4.5	n.a.	n.a.	n.a.
Belgium	3.9	3.2	4.0	-0.6	0.2	4.3	1.0	2.0	5.8
France	12.2	6.0	17.7	-7.3	-2.4	12.7	n.a.	n.a.	n.a.
India	5.2	4.4	7.5	-0.7	-0.4	6.8	-1.3	-0.7	6.9
Ireland	8.5	6.7	6.2	-1.3	-0.8	4.3	n.a.	n.a.	n.a.
Italy	8.3	4.6	10.1	-1.6	0.4	6.8	-0.6	0.7	5.7
Japan	27.2	5.6	73.7	-1.5	1.2	12.3	n.a.	n.a.	n.a.
South Africa	5.2	4.1	3.8	-0.5	0.2	2.7	n.a.	n.a.	n.a.
Sweden	5.9	5.7	3.9	0.2	0.5	3.4	-0.9	-0.2	4.7
UK	6.3	4.2	5.8	-1.4	-0.6	3.7	-1.2	-0.1	7.3
US	4.6	3.2	4.4	-0.8	0.3	4.1	-0.4	0.0	4.2
Average	12.3	6.1	18.6	-3.1	-1.3	7.0	-2.5	-1.3	7.2

Notes: See Table 1 for sample period.
[a] Missing data for 1964-1968
[b] Missing data 1953-1958 and 1960-1963

Table 3: Incidence of Liquidation Years

Country	Period	Share of Liquidation Years for different subperiod					
		Full Sample	1945-1956	1957-1968	1969-1980	1981-1993	1994-2008
		(1)	(2)	(3)	(4)	(5)	(6)
Argentina	1942-1980	92	80	100	100	-	-
Australia	1945-1980	53	67	8	83	-	
Belgium[a]	1945-1974	48	42	14	100	-	-
France[b]	1945-1980	77	75	50	92	-	-
India	1949-1980	53	25	67	58	-	-
Ireland	1960-1990	68	-	78	92	30	-
Italy	1946-1980	49	36	25	83	-	-
Japan	1946-2008	35[c]	64	42	75	0	7
South Africa	1945-1980	47	58	8	75	-	-
Sweden	1945-1990	48	42	50	83	10	-
United Kingdom	1945-1980	58	67	25	83	-	-
United States	1945-1980	50	58	17	75	-	-
Average		56	56	40	83	13	7

Notes: Share of liquidation years is calculated as the ratio between number of years in which the real return was negative and the total number of years in the corresponding subperiod. The measure of real interest rate is the Contractual Interest Rate (CIR).
- Subperiods not included in the sample of the country
[a] Missing data for 1964-1968
[b] Missing data 1953-1958 and 1960-1963
[c] The share of liquidation years for the period 1946-1980 is 60 percent

Table 4: Liquidation Rate

Country	Average Liquidation Effect						Minimum
	Full Sample	1945-1956	1957-1968	1969-1980	1981-1993	1994-2008	(Year)
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Argentina	21.4	13.0	17.0	34.2	-	-	72.3 (1976)
Australia	4.6	6.8	0.9	3.2	-	-	15.1 (1952)
Belgium	4.2	6.0	1.0	3.1	-	-	9.6 (1974)
France	9.8	26.8	1.4	2.9	-	-	41.2 (1946)
India	5.4	6.0	4.8	5.8	-	-	17.4 (1974)
Ireland	3.4	-	1.0	4.4	5.7	-	12.7 (1975)
Italy	6.0	13.3	2.1	4.2	-	-	27.6 (1947)
Japan	13.2	35.0	2.2	3.7	*	0.1	78.5 (1946)
South Africa	3.0	2.7	0.5	3.3	-	-	6.8 (1975)
Sweden	2.6	4.7	1.2	2.4	2.9	-	11.9 (1951)
United Kingdom	3.5	2.7	0.5	5.1	-	-	10.9 (1975)
United States	3.5	4.1	0.1	3.7	-	-	13.7 (1946)
Average	6.7	11.0	2.7	6.3	4.3	0.1	

Notes: The liquidation rate is absolute value of the real interest rate during liquidation years.
See table 3 for sample period. The measure of real interest rate is the Contractual Interest Rate.
- Subperiods not included in the sample of the country
* Subperiods which are part of the sample but have no LE years

Table 5: Liquidation Revenues

Country	Average Liquidation Effect Revenues as percentage of GDP					
	Full Sample	1945-1956	1957-1968	1969-1980	1981-1993	1994-2008
	(1)	(2)	(3)	(4)	(5)	(6)
Argentina	3.1	3.8	3.0	2.5	-	
Australia	3.3	6.7	0.6	0.8	-	-
Belgium	2.5	4.9	0.6	1.3	-	-
France	3.8	12.4	0.2	0.2	-	-
India	1.5	1.6	1.4	1.5	-	-
Ireland	1.8	-	0.5	2.2	2.9	-
Italy	1.6	13.3	0.4	1.1	-	-
Japan	5.9	17.8	0.1	0.6	*	0.1
South Africa	1.3	1.5	0.2	1.2	-	-
Sweden	0.8	1.6	0.3	0.6	1.3	-
United Kingdom	3.0	4.4	0.6	2.6	-	-
United States	2.3	4.3	0.0	1.2	-	-

Notes:See Table 3 for sample period.The measure of real interest rate is the Contractual Interest Rate.
- Subperiods not included in the sample of the country
* Subperiods which are part of the sample but have no LE years

Table 6: Comparison Liquidation Revenues as percentage of:

Country	GDP				Tax Revenues			
	CIR		HPR		CIR		HPR	
	Average	Median	Average	Median	Average	Median	Average	Median
Argentina	3.1	2.4	3.1	2.2	38.3	27.3	39.0	28.6
Australia	3.3	1.1	n.a.	n.a.	12.9	4.4	n.a.	n.a.
Belgium	2.5	1.2	3.5	3.5	18.6	10.3	23.9	18.9
France	3.8	0.2			35.3	1.1		
India	1.5	1.6	1.5	1.8	27.2	27.6	27.2	28.4
Ireland	1.8	1.1	n.a.	n.a.	7.9	6.1	n.a.	n.a.
Italy	1.6	0.8	1.6	0.7	24.6	5.4	26.5	4.9
Japan	5.9	0.4	n.a.	n.a.	37.9	3.0	n.a.	n.a.
South Africa	1.3	1.4	n.a.	n.a.	8.0	6.8	n.a.	n.a.
Sweden	0.8	0.4	1.3	0.9	4.4	2.1	4.4	2.1
United Kingdom	3.0	1.9	3.1	1.8	18.8	11.0	19.6	10.0
United States	2.3	0.7	2.7	1.3	13.4	3.9	15.9	7.1

Notes:See Table 3 for sample period.

Table 7: Comparison of Median Inflation between LE Years and 1930-2010

	Contractual Interest Rate	
	Liquidation Years	1930-2009
Argentina	21.1	15.3
Australia	9.0	3.8
Belgium	7.6	2.6
India	9.4	5.6
Ireland	10.0	3.2
Italy	11.3	4.5
Japan	8.3	3.0
South Africa	7.5	5.8
Sweden	7.0	4.0
United Kingdom	8.3	3.8
United States	6.0	3.0
	Holding Period Return	
	Liquidation Years	1930-2009
Argentina	21.4	15.3
Belgium	8.6	2.6
India	9.3	5.6
Italy	12.2	4.5
Sweden	7.0	4.0
United Kingdom	11.9	3.8
United States	5.6	3.0

Table 8: Regressions for Inflation Expectations

	Argentina	Australia	Belgium	France	India	Ireland	Italy	Japan	South Africa	Sweden	United Kingdom	United States
Constant	0.92	0.02	-0.34	0.00	-0.05	0.36	0.02	-0.52	-0.03	0.05	-0.02	0.02
	(3.15)	(2.7)	-4.76	-0.05	(-1.18)	(2.94)	(1.41)	(-4.39)	(-0.92)	(2.08)	(-0.51)	(2.86)
Infl(T-1)	-0.08	-0.65	0.34	-0.52		-0.32	-0.11	-0.14	-0.32	-0.30	-0.52	-0.24
	(-1.96)	(-5.36)	1.58	-3.53		(-2.16)	(-6.04)	(-4.76)	(-1.86)	(-2.2)	(-3.73)	(-2.16)
Infl(T-2)	0.04	0.37	0.60	0.12		-0.02	0.02	-0.02	-0.09	0.16	0.15	0.23
	(1.1)	(3.07)	3.42	0.58		(-0.02)	(0.78)	(-0.73)	(-0.53)	(1.14)	(1.12)	(2.01)
Infl(T-3)			0.16	-0.12		0.26	-0.08	0.07				
			0.96	-0.58		(1.78)	(-4.05)	(2.71)				
Infl(T-4)			0.48	0.07			0.05					
			2.83	0.46			(3.35)					
GM1(T-1)		-0.25			-0.35		-0.08					-0.39
		(-4.13)			(-2.33)		(-4.05)					(-2.41)
GM1(T-2)		-0.01			-0.15		0.05					0.13
		(-0.11)			(-0.9)		(3.35)					(0.67)
GM1(T-3)					-0.50		-0.08					0.21
					(-2.4)		(-0.76)					(1.25)
GM1(T-4)												-0.31
												(-3.47)
Growth(T-1)	0.00				0.00					0.00		
	(-3.26)				(1.51)					(-2.09)		
Growth(T-2)					0.00							
					(-1.14)							
Trend	-0.03		0.03			0.00		0.04	0.00	0.00	0.01	
	(-1.03)		5.16			(3.24)		(3.91)	(1.71)	(0.97)	(0.87)	
Trend2	0.00		0.00									
	(2.07)		-5.33									
Trend3	0.00							0.00			0.00	
	(-1.54)							(3.07)			(1.35)	
R2_bar	0.52	0.63	0.61	0.47	0.27	0.55	0.89	0.62	0.47	0.27	0.45	0.53
Durbin Watson	1.93	1.86	1.86	1.44	2.04	1.80	1.53	1.19	1.97	1.95	1.87	2.47
F Sig.	0.00	0.00	0.00	0.00	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Obs.	38	36	24	26	32	31	36	63	36	46	46	36

Table 9: Inflation Surprises and Liquidation Years

Country	Share of Inflation Suprises		Overlap Liquidation Years			
			CIR		HPR	
	Lower	Upper	Lower	Upper	Lower	Upper
Argentina	42	17	43	17	32	4
Australia	25	8	42	16		
Belgium	8	4	18	9	13	13
France	15	12	20	15		
India	9	6	18	6	18	6
Ireland	6	3	10	5		
Italy	22	14	39	28	39	28
Japan	14	8	39	22		
South Africa	19	8	35	18		
Sweden	9	4	18	9	18	9
UK	17	8	29	14	29	14
US	11	9	22	17	17	17
Average	17	8	28	15	24	13

Notes: Inflation suprises are defined as years where the realized inflation rate is two standard deviations above the estimated expected inflation rate. The actual standard errors cannot be obtained but a lower and upper bound for them.

Table 10: Comparison between Ex Ante and Ex Post Yield to Maturity for securities issued within sample period (in percent)

Country	Nominal YTM at issuance			Ex-post real YTM as of time of issuance			Number of bonds
	Average	Maximum	Minimum	Average	Maximum	Minimum	
Australia[a]	4.2	5.4	2.0	-0.6	4.7	-12.3	50
India[b]	5.3	6.5	3.6	-2.3	4.6	-5.0	98
Ireland[c]	8.4	14.6	5.4	-2.2	3.5	-10.2	26

[a] Bonds issued between 1945-1968
[b] Bonds issued between 1960-1978
[c] Bonds issued between 1965-1975

Table 11: Comparison Liquidation Effect Revenues and Inflation Tax (as %GDP)

	Country	Subperiod	Inflation Tax	LE Revenues CIR
Group 1	Belgium	1945-1954	13.8	23.3
		1955-1964	4.1	3
		1965-1974	1.1	7.3
	India	1949-1959	8.4	6.3
		1960-1969	11.5	10.9
		1970-1980	15.5	13.9
	Ireland	1960-1969	13.8	7.6
		1970-1979	20.4	25.5
		1980-1990	10.6	11.2
	Sweden	1945-1956	6.5	10.5
		1957-1968	4.7	2.1
		1969-1979	6.8	5.2
		1980-1990	5.0	2.8
	United Kingdom	1945-1956	6.4	35.7
		1957-1968	3.8	1.7
		1969-1980	9.4	28.8
Group 2	Australia	1945-1956	43.6	65.3
		1957-1968	7.8	0.5
		1969-1980	22.6	14.8
	France	1945-1956	74.1	97.5
		1957-1968	16.1	0.8
		1969-1980	23.7	2.1
	Japan	1946-1956	15.3	73.6
		1957-1968	28.0	1.1
		1969-1980	37.8	6.3
		1981-1993	9.1	0.0
		1994-2008	1.9	0.1
	United States	1945-1956	17.6	26.8
		1957-1968	8.5	0.1
		1969-1980	21.0	17.0
Group 3	Argentina	1945-1956	61.4	53.5
		1957-1968	42.4	37.8
		1969-1980	50.3	40.2
	Italy	1946-1956	29.7	19.2
		1957-1968	15.8	1.8
		1969-1980	117.1	23.4
	South Africa	1945-1956	23	12
		1957-1968	8	0
		1969-1980	24	18

Table 12: Stock of Debt under different paths for the inflation rate

Country	Period	Debt/GDP	Debt/GDP (End)			
		Initial	Actual	Median Inflation	Infl=Nominal Int Rate	Infl=2%
		(1)	(2)	(3)	(4)	(5)
Argentina	1942-1980	42.0	10.4	181.4	2914.2	8080.2
Australia	1945-1980	145.4	18.1	50.3	40.5	98.9
Belgium[a]	1945-1974*	112.8	38.4	54.5	45.5	64.2
France[b]	1945-1980*	0.0	0.0	0.0	0.0	0.0
India	1949-1980	26.2	25.4	24.3	39.0	71.1
Ireland	1960-1990	61.7	48.4	242.3	53.1	346.4
Italy	1946-1980	67.0	26.2	97.0	58.9	220.4
Japan	1947-1980	27.5	39.1	257.4	137.6	355.9
South Africa	1945-1980	56.6	32.1	28.5	43.3	109.9
Sweden	1945-1990	52.6	39.2	91.0	37.6	224.8
United Kingdom	1945-1980	236.2	44.4	111.6	82.7	211.7
United States	1945-1980	116.0	31.6	50.7	33.8	71.7

Notes: Initial D/GDP refers to the debt ratio in the first year of the sample period for each country, and the D/GDP (end) is the debt ratio in the last year of the sample.

[a] Missing data for 1964-1968

[b] Missing data 1953-1958 and 1960-1963

Table 13: Panel Estimation Results- Dependent Variable: CIR

	(1)	(2)	(3)	(4)	(5)
intgdp	-0.230***	-0.218***	-0.221***	-0.221***	-0.220***
	(-16.07)	(-18.81)	(-12.84)	(-18.70)	(-18.74)
defgdp		0.681***		0.676***	0.670***
		(8.67)		(9.59)	(9.53)
trgdp			0.0606		
			(0.62)		
stlt				0.0722	0.0750
				(1.57)	(1.61)
cbind					-0.0876
					(-1.85)
finrep					
Constant	-0.0286	0.0563	-0.0207	0.154***	0.179***
	(-0.72)	(1.35)	(-0.39)	(3.40)	(3.88)
Country FE	Yes	Yes	Yes	Yes	Yes
Time FE	Yes	Yes	Yes	Yes	Yes
N	446	445	443	434	432

Notes: t-statistics in parenthesis
* p<0.05; ** p<0.01; *** p<0.001

Table 14: Comparison of Real Returns Bills, Bonds and Equity 1945-1980 (in percent)

Country	Sample Period	Bills (%)			CIR (%)			HPR (%)			Stock Market (%)		
		Geo	Arith	SD	Geo	Arith	SD	Geo	Arith	SD	Geo	Arith	SD
Australia	1945-1980	-0.7	-0.7	2.9	-1.7	-1.7	4.5				5.0	8.5	21.3
Belgium[a]	1945-1974	2.1	2.2	3.1	-0.5	-0.6	4.3	0.6	1.0	5.8	2.6	5.0	15.4
France[b]	1945-1980	-5.8	-4.8	12.7	-6.1	-7.3	12.7				5.4	3.0	24.6
India	1949-1980	-2.2	-1.9	6.9	-0.9	-0.7	6.8	-1.3	-1.3	6.9	2.7	2.4	11.5
Italy	1946-1980	-1.8	-1.6	6.5	-1.9	-1.6	6.8	-1.3	-1.0	6.7	4.3	7.8	28.2
Japan	1946-2008	-5.5	-3.2	15.6	-5.2	-6.4	19.2				2.8	9.3	31.6
South Africa	1945-1980	-1.5	-1.5	3.1	-0.6	-0.5	2.7				2.9	5.4	23.3
Sweden	1945-1990	-1.1	-1.1	3.3	-0.7	-0.7	3.0	-1.3	-1.2	4.7	3.9	5.3	17.2
UK	1945-1980	-0.6	-0.5	3.9	-1.5	-1.4	3.7	-1.5	-1.2	7.3	4.4	6.3	20.0
US	1945-1980	-0.3	-0.2	3.5	-0.9	-0.8	4.1	-0.5	-0.4	4.2	6.5	8.2	19.0
Average		-1.7	-1.3	6.1	-2.0	-2.2	6.8	-0.9	-0.7	6.0	4.1	6.1	21.2

Notes: Table shows geometric average (Geo), arithmetic average (Arith) and standard deviation of the arithmetic average (SD) and standard deviation of the arithmetic average (SD)
[a] Missing data for 1964-1968
[b] Missing data 1953-1958 and 1960-1963

Table 15: Percentage of the time stocks outperform bonds for different holding periods

Country	Sample Period	Stocks outperform CIR holding periods (in years)						Stocks outperfom HPR holding periods (in years)					
		1	2	5	10	20	30	1	2	5	10	20	30
Australia	1945-1980	64	71	75	96	100	100						
Belgium[a]	1945-1974	58	60	66	89	100	100	53	51	63	59	65	100
France[b]	1945-1980	56	66	72	78	94	100						
India	1949-1980	66	68	79	83	100	100	66	71	82	87	100	100
Italy	1946-1980	64	63	59	67	82	100	64	63	59	67	76	100
Japan	1946-2008	61	77	94	100	100	100						
South Africa[c]	1949-1980	62	65	88	100	100							
Sweden	1945-1990	58	63	78	89	100	100	64	66	78	89	100	100
UK	1945-1980	61	77	78	100	100	100	53	77	75	100	100	100
US	1945-1980	67	74	78	85	100	100	69	74	78	81	100	100

Notes: The geometric return for different holding periods was used.
[a] Missing data for 1964-1968
[b] Missing data 1953-1958 and 1960-1963
[c] Total return data for the stock market available from 1949

Table 16: Real Returns on Bonds and Bills during 1900-2000

	Bonds				Bills			
	1900-2000	1900-1939	1940-1979	1980-2000	1900-2000	1900-1939	1940-1979	1980-2000
Australia	1.1	2.6	-2.8	5.8	0.4	1.1	-2.5	4.9
Belgium	-0.4	-3.0	-1.5	6.9	-0.3	-2.0	-0.9	4.6
France	-1.0	-2.0	-4.5	7.9	-3.3	-1.8	-7.8	2.6
Ireland	1.5	0.9	-1.5	8.7	1.3	1.9	-1.1	4.5
Italy	-2.2	0.1	-8.2	5.4	-4.1	-1.1	-9.5	1.1
Japan	-1.6	3.1	-9.7	3.3	-2.0	3.6	-9.3	2.1
South Africa	1.4	3.4	-1.1	2.4	0.8	1.8	-1.4	3.2
Sweden	2.4	3.6	-1.4	7.3	2.0	3.5	-0.8	4.7
UK	1.3	1.0	-1.9	8.2	1.0	1.3	-1.2	4.5
US	1.6	2.3	-1.8	6.9	0.9	2.0	-1.2	2.8
Average	0.4	1.2	-3.4	6.3	-0.3	1.0	-3.6	3.5

Source: Dimson, Marsh and Staunton (2002)

Table 17: Real Returns on Stocks during 1900-2000

	Equity			
	1900-2000	1900-1939	1940-1979	1980-2000
Australia	7.5	10.3	4.4	8.3
Belgium	2.5	-2.0	2.7	11.4
France	3.8	1.4	1.9	12.7
Ireland	4.8	1.3	4.2	12.7
Italy	2.7	3.3	-1.6	10.1
Japan	4.5	7.9	1.5	4.1
South Africa	6.8	7.5	6.6	6.1
Sweden	7.6	5.7	4.8	17.3
UK	5.8	3.0	5.3	12.2
US	6.7	5.2	6.0	11.2
Average	5.3	4.4	3.6	10.6

A Evidence of the Presence of Financial Repression

This appendix provides a description of some of the policies and regulations that were in place during the sample period in the different countries of the sample. The policies included are examples of financial repression and hence provide narrative evidence in support of the analysis in the main body of the paper.

It is important to understand the context in which these policies were imposed. Financial liberalization has not evolved monotonically over time. Historical indexes of capital mobility show that there was a peak in capital mobility in 1914 when World War I began (Obstfeld and Taylor, 2004; and Reinhart and Rogoff, 2009). After that, a period of low capital mobility -interrupted briefly during the interwar period- lasted until 1980 when capital mobility began to increase once again.

The period of low capital mobility took place during the Bretton Woods era. At the time there was favorable political and economic consensus to accept restrictions on the flow of capitals. Capital controls were viewed as a way to avoid speculation and maintain the stability of the international financial system. Policymakers wanted to avoid a situation similar to the one during the interwar period, where competitive devaluations and lack of coordination across countries were common (Bordo, 2003; Eichengreen and Sachs, 1986). Capital controls may acted by reducing the ability to arbitrage across countries, and are only one example of the policies in place at the time.

Some of the policies described below provide direct evidence to restrictions in the market of government securities, whereas some others are not directly related. One way to interpret the evidence provided in this appendix, is that the overall set of policies and regulations that were in placed during the period 1945-1980 speak to a period where financial markets were highly regulated. More emphasis is placed in the United States and the United Kingdom, countries which are usually considered among the most financially liberalized economies in the world.

A.1 United States

Government Securities Price Support

During World War II there was an agreement between the Fed and the Treasury to support the price of government securities in the market. The Treasury had set a structure of return for securities of different maturities: 3/8 of a percent on 90-day T-Bills, 7/8 of a

percent on 12-month certificates of indebtedness, and higher rates on long-term issues, the maximum rate was 2.5 percent on the longest term taxable bond. The Fed announced that it would buy and sell securities in the market in order to maintain the prices of bonds at par. As a result, long term securities were perfectly liquid and investors were protected from capital losses.

Once the War was over, there was a consensus between the Treasury and the Fed that the policy of low interest rates should be continued. Studenski and Krooss (1952) wrote:

> The Treasury's debt-management program had three principal objectives: to reduce the amount of the debt, to maintain government credit and keep debt costs low, and to widen the distribution of Federal securities. Of the three objectives, the Treasury considered the second to be the most important, and it sought to achieve this aim by maintaining control over interest rates and by stabilizing government security prices at a low yield. It insisted that, if the interest rate was not controlled, interest charges on the debt would rise, the already enormous Federal expenditures would increase even further.

Towards the end of the decade, some members of the Fed started to push to eliminate the price support and to allow interest rates to rise. In 1950, there was consensus among the Fed members about the need for the change in the policy. After several negotiations, the Fed and the Treasury reached an "accord" in March of 1951. The joint statement issued at the time announced:

> The Treasury and the Federal Reserve System have reached full accord with respect to debt-management and monetary policies to be pursued in furthering their common purpose to assure the successful financing of the Government's requirements and, at the same time, to minimized monetization of the public debt.
>
> *Board Minutes, March 2 1951, 1-2*

Geisst (1997) argues that the policy had an impact on future generation who thought of bonds as a stable investment, and got surprised by the increase in the volatility of bonds in the late 1960s.

More details on the policy: Chandler (1949), Studenski and Krooss (1952), Horvitz and Ward (1987), Metzler (2003)

Exchange of Marketable for Nonmarketable Debt There are several examples of security exchanges in which marketable securities were exchanged for non-marketable securities. As an example, in 1951, marketable bonds with a coupon of 2.5 percent and 16 to 21 years to maturity were exchange for nonmarketable bonds at 2.75 percent with 29.5 years to maturity. In Martin's words:

> Some people will think the 2.75 nonmarketable bond is a trick issue. We want to meet that head on. It is. It is an attempt to lock up as much as possible of these longer-term issues.
>
> *Assistant Secretary of the Treasury William McChesney Martin Jr. FOMC minutes, March 1-2, 1951.*

Moral Suasion

Moral Suasion refers to a situation by which the Central Bank attempts to persuade commercial banks of following certain policy. Even if there is no legal obligation to act accordingly, there is a view among bankers that it is better to remain cooperative with the Fed. Horvitz and Ward (1987) give two examples of moral suasion in the US.

The first one is related to the voluntary foreign-credit-restrain program launched by the Fed during the 1960s to limit the outflow of dollars from the US. There were several calls to cooperate, but also implicit and explicit threats to those banks who decided not to cooperate.

> In September 1966, for example, the Federal Reserve Board sent a letter to all member banks calling for restraint in granting business loans,... The letter indicated that banks that failed to cooperate could not expect the increase in their loan portfolios to be considered adequate reason for the extension of Federal Reserve credit through the discount window"
>
> *Horvitz and Ward, 1987, p.348-349*

The second example the authors give is related to the "New Economic Policy" of 1971. It was a program for voluntary restrain on interest rates, administered by the Committee on Interest and Dividend created by the Executive Order of October 15, 1971,101. According to the Order "the President established a Committee on Interest and Dividends whose duty was to devise and execute a program to obtain voluntary restraint on interest rates and dividends. This proposal was ratified by Congress in the 1971." (Edward R. Lev, 1972)

Interest Rate Ceilings

"The original impetus for deposit rate ceilings in the United States rested on the argument that excessive competition for deposits promoted instability of the banking system by raising the cost of funds and by encouraging banks to make higher-risk loans." (Robert A. Taggart, 1981) After the Great Depression, interest payments on time and saving deposits were prohibited.

The ceilings remained mostly unchanged until early 1960s when non-bank thrift institutions were paying higher interest rates than commercial banks, as a result of their rates being non regulated. In 1966, Regulation Q was extended to non-thrift institutions. During the following years several changes were made to the ceilings for different types of accounts and institutions.

In 1980, the Depository Institutions Deregulation and Monetary Control Act was passed, with effective date in 1986.

Further details on the history of Regulation Q: Green, Pentecost and Weyman-Jones (2011)

Margin Requirements

Regulation T allowed the Fed to set margin requiremenrs on loans by brokers to customers. The Fed used changes in margin requirements to control the amount of credit in the stock market. The objective of imposing higher margin requirements was to guarantee the stability of the stock market and avoid large increases in the prices of stocks driven by speculation or excessive use of credit. In January of 1946 the margin requirement was set to 100 percent. It subsequently fluctuated between 50-90 percent between 1947 and 1974.

Broker's Commissions

Until May of 1975, brokerage firms were obligated to charge minimum commission. Over time, brokerage firms had found ways to offer a discount to certain investors, such as research or other work, but their practices were to a large extent limited.

Gold restrictions

In 1933, President Roosevelt prohibited private holdings of gold coins, bullion, and certificates. The restriction was lift at the end of 1974.

A.2 United Kingdom

Cheap Money Policy and Minimum Price for Government Securities

Domestic financial policy during the War and in the immediate years after its end, was design to obtain money for the government as soon as it was issued. This was achieved primarily through Treasury Deposit Receipts (90-day nonmarketable paper sold to banks), tap loans, and arrangements to have insurance companies invest its funds in government securities.

Minimum prices on government securities were imposed at the beginning of the war. The rule was only enforced in the market controlled by the London Stock Exchange, and trading grew outside when the price dropped below the minimum level (Michie, 1999). The minimum prices served as a benchmark for future borrowing, which allowd the government to issue debt at low interest rates. The controls were not removed immediately after the war, because the government worried that speculation would lead to increase in the interest rates, which it was seen as damaging given the weak status of the economy.

Similar to the US, there was also an interest to keep nominal interest rates at low levels.

> In 1945 government officials and economist, including Lord Keynes, James Meade and Lionel Robbins, recommended the retention of cheap money and direct controls for at least a transitional period after the war. Their advice reflected widespread anticipation of a post-war slump like that which followed the First World War, recognition that relying on high nominal interest rates (dear money) to restrain inflation without controls would substantially increase the interest cost of the large post-war debt, and, to a lesser extent, skepticism as to the influence of interest rates on private sector expenditure.
>
> *Susan Howson, 1994*

Interest rates were cut after the end of the war. According to Fforde (1992), the cut was presented as a "technical adjustment", a term that would be often used during the postwar period in the UK instead of referring to a "change of policy." There was also a conversion of maturing stock on lower-yielding Exchequer Bonds. Several Local Loans at 3% were exchanged for irredeemable 2.5% bonds.

To some extent, the acceptance of the public of these low yielding securities appears to be explained by a perception that the cheap money policy would be kept for the foreseeable future. But also there were controls over issues by British companies and the "virtual

prohibition on the issue or purchase of foreign securities. ... In 1950 around half of all quoted securities, whether nominal, or market value, consisted of UK government debt."[35] In addition to private demand for government securities, there was a large demand by several government agencies and banks, such as the Postal and Trustee Saving Banks.

Further reading: Fforde (1992), Sayers (1976)

Monetary Policy and Banking Regulation in the 1950s and 1960s

With the end of the cheap money policy in early 1950s, credit control became an important tool for monetary policy. There were quantitative restrictions (Bank Rate, pressure on liquidity ratios) as well as persuasion. The banking system during this period was characterized by lack of competition, regulations on advances and on interest-bearing deposits.

Explicit minimum liquidity ratios were placed in 1951. It was advised that the liquidity ratio should be between 28 and 32 percent, and the minimum was 25 percent. The liquidity ratio had increased to 30 percent byt 1957, and remained in place with the exception of a small decrease to 28 percent in 1963, until 1971 when new regulation was passed.

The "Special Deposit Scheme" was established in 1958. Commercial banks would make deposits with the Bank of England who would then lend them to the Treasury. Even if it was designed as an instrument of monetary policy, it was in practice an instrument for raising forced loans by the government. These deposits were remunarated the going Treasury bill rate, but did not qualify as liquid assets.

Competition and Credit Control of 1971

Effective September 16th of 1971, a uniform minimum reserve ratio of 12.5 percent was imposed on banks. The eligible reserve assets were: balances with the BoE, British government and Nothern Ireland Treasury Bills, company tax reserve certificates, money at call with the London money market, British government stocks with one year or less to final maturity, local authiruty bills eligible for rediscount at the Bank of England and (up to a maximum of 2 percent of the eligible liabilities) commercial bills eligible for rediscount at the BoE.

Moral Suasion

Several sources cite the use of moral suasion or persuasion by the Bank of England as a tool of monetary policy. The high degree of concentration in the banking system and lack of competition made it possible for this to be an effective instrument.

[35] Michie (1999), p.359

> The informal approach to bank supervision is best exemplified by the approach taken by Bank of England. In Britain, supervision was traditionally carried out by the Bank of England in consultation with banks. Moral suasion, discretion, and personal contact were the principal tools of bank supervisors. Each bank had an individual relationship with the Bank of England. ... For many years this system worked relatively well in a highly concentrated banking industry. However, the system came under stress when the number of banks increased as a result of the creation of so-called secondary banks and the influx of foreign banks in the late 1960s and early 1970s.
>
> *Polizatto, 1990*

Bank Rate and Minimum Lending Rate

Until 1971, the main policy objective had been the control over the supply of credit available in the economy as well as the level and structure of interest rates. As it has been mentioned before, credit restrictions were achieved through quantitative and qualitative restrictions. The control over interest rates was achieved by the Bank Rate, an interest rate set by the Bank of England.

The Bank Rate was the interest rate at which the central bank was willing to lend to members of the discount market. But it was also an interest rate that served as a reference point for rates which the London Clearing Banks paid on deposits and charged on advances.

As a result of the reforms that took place at the end of 1971, the Bank Rate was replaced by the Minimum Lending Rate (MLR). The rate was pegged at 1/2% above the Treasury bills rate, rounded to the nearest 1/4% above and effective. The system allowed though arbitrary changes. The Bank was also allowed to, in situations in which the formula would lead to a reduction in the rate, to leave the MLR unchanged or change it by less that what would be prescribed by the formula. From May of 1978, the rate started to be determined by administrative decision.

Capital Controls

Initial controls had been established at the outbreak of the war in 1939. In 1946, the Exchange Control Act was passed which remained in place until 1979. The controls restricted the funding of foreign investment except when it had a positive effect on the balance of payments. In addition, UK residents were not allowed to hold foreign currency deposits or lend to overseas residents. Purchases of foreign exchange to invest overseas could be made

only from the sale of existing foreign securities or from foreign currency borrowing. (Artis and Taylor, 1989)

A.3 Japan

The organization of the financial sector in Japan shares many characteristic to those of Western societies, however it is characterized by an important role played by the government. The influence of the government goes beyond the formulation of monetary policy or the determination of interest rates, and includes the extension of credit to certain firms or projects.

> Following World War II and until 1970-1, the Japanese financial system, and its economy in general, were characterized by strict government control and objectives of growth and productivity through investment and exports. ... The postwar environment was characterized chiefly by "export/investment-led high growth," the artificially low interest rate policy, and barriers to internationalization as well as predominance of indirect (bank) financing
>
> *Kanovsky, 1990*

> The most important institution in the field of banking and credit, however, is the Ministry of Finance which shapes fiscal and monetary policies, supervises not only all credit institutions but also the financial behavior of all corporations, collects taxes and custom duties, controls foreign exchange, and has a decisive voice in the approval of foreign investment in Japan an Japanese investment overseas.
>
> *Adams and Hoshii, 1972*

From its establishment the Bank of Japan was under the direction of the Ministry of Finance (Cargill, Hutchison, and Itō, 2001). The Bank had to report once a month to the Ministry Finance, and the government could change the By-laws of the Bank at any point it considered relevant. In 1942, during the War, there was a change in the Law that rendered the Bank more dependent on the government. The important role played by the Ministry of Finance, is also evident in the fact that since 1949 one of the members in the Board of the Bank of Japan was a representative of the Ministry of Finance. Despite some changes, the 1942 Law remained in place until 1998.

Interest Rate Regulation

In Japan there were two types of interest rates: free or market rates and regulated rates. Regulations on deposit rates were first introduced in 1901 by the Osaka Bankers Association. The argument to establish interest rates ceilings was that competition among banks to capture deposits could lead to a financial crisis.

In 1947, the Temporary Interest Rate Law was passed. The law controlled maximum interest rates for bank deposits. In addition to aiming at a stable banking system, the regulation was aimed at contributing to price stability by holding down interest costs. The restrictions started to be removed in 1975.

Interest rates on government bonds were also regulated. Suzuki (1987) describes in great detail how different interest rates were determined. He mentions that the mechanism to set the interest rate on different types of government bonds differed by type of bond. For instance, for long-term bonds, "the issue terms are decided by the long-term Government bond facilitation committee (*sewanin kai*), which consists of the Ministry of Finance, the Bank of Japan, and representatives of the underwriting syndicate." It turns out that de facto most of the issues are regulated, even in the absence of a legal requirement to do so.

Capital Controls

Restrictions to cross-border transactions were established in 1932 through the Anti-Capital Flight Laws. During the War the controls were strengthen, and remained in place after its end. The Foreign Exchange and Foreign Trade Control Act was passed in 1949,which forbade in principle all cross-border transactions, unless the Government lifted a restriction.

> In this way, through the high growth period, exchange controls were gradually eased but still remained rather restrictive, at least with respect to financial transactions. These controls, which separated domestic and foreign markets and regulated transactions in funds between foreign and domestic markets, protected the various regulations and customs in the domestic financial market, ... Thus, the regulation of foreign transactions played an important role in helping regulations on domestic transactions to function effectively.
>
> *Suzuki, 1987*

Directed Lending

During the postwar a system, called Fiscal Investment and Loan Program (FILP), was designed to transfer funds from the public to specific sectors of the economy. The system

is under the direction of the Ministry of Finance which operated through its Trust Fund Bureau. The postal savings system provides an important share of the funds, which are then transferred to one of the ten government banks. These banks make subsidized loans to sectors in the economy or projects that the government considers important for the development of the country. Two of the government banks are the Export-Import Bank of Japan which was established in 1950, and the Japan Development Bank established in 1951.

Despite other regulations in the economy, such as the ceiling on interest rates, have been removed, the FILP remains in place in the Japanese economy. In 1999, almost 20% of the households' financial assets were deposited in postal savings accounts. According to current regulations, 80% of the postal savings assets have to be invested in government bonds.

A.4 France

France was one of the countries occupied by German forces during World War II. During the occupation, the Germans tried to obtain as many resources as possible from French economy, which left the country in a severe fiscal stress. The weak state of the finances was combined by the need to rebuild the country and that of increasing economic growth. Policymakers at the time decided that, because of the special situation in which the economy found itself, credit could not left to market forces and that it was necessary for the government to take an active role in directing credit to the sectors in the economy that needed it the most.

This goal was achieved by the establishment of what was called *the circuit*. In December of 1945 three major changes to the financial system were implemented: nationalization of the Bank of France, ownership of the four largest deposit banks[36] and government officials at major commercial banks, and the creation of the Conseil National du Crédit. The ownership of these banks made explicit the importance that government policy would have during this period in the functioning of the financial system. In addition, to this change in the structure of the system there were restrictions to bank lending which will be discussed in more detail below.

The second element necessary for the functioning of *the circuit* was to make sure that the government would obtain the necessary funds to carry out its policy. This was achieved through several means: portfolio requirements on banks, restrictions on purchase of other assets besides government securities, and tax benefits associated to the purchase of govern-

[36]The banks were: Crédit Lyonnais, Société Générale, Banque Nationale pour le Commerce et l'Industrie, Comptoir National d'Escompte

ment securities. Finally, *the circuit* was somewhat isolated from foreign markets through the presence of capital controls.

Some of the policies in place during this period were:

- **Government securities floor:** Banks were forced to hold a certain proportion of the funds in the form of Treasury bills. These bills at the time were issued on tap by authorities at regulated rates. "The Banks had on one hand to keep in their portfolios a reserve of government bills equal to at least 95 per cent of the sum held on 20 September (9 days before), and on the other hand reemploy at least 20 per cent of the annual increase in their deposits in taking up government bills" (Patat and Lutfalla, 1990).

- **Rediscount ceilings** which was intended to avoid excessive indebtedness. The ceilings were establishment specific. Banks who needed funds above the ceiling could often obtain them at a higher interest rate. These two rates mechanism was nicknamed "hell" and "superhell". It was abolished in 1967 and replaced by a single penalty rate set at 2.5 points above the discount rate.

- **Direct control of interest rates**

  - Ceilings on lending rates
  - Ceilings on deposits. These were made more flexible in the mid-1960s.
  - Regulations to influence long term interest rates. Bond issuances were decided by the Treasury Directorate of the Ministère des Finances, which also set the schedule for issuances.

- **Reserve requirements**

  - From 1967 on there were non-interest bearing compulsory reserves against bank deposits. It was used to control the expansion of bank credit, but also to discourage the inflow of capital. Since May 1971, the Banque du France, could set the reserve ratio for franc deposit by non-residents up to a maximum of 100 percent.
  - There were also reserve requirements to credit granted by banks and other financial institutions.There were two types of reserve requirements: i) ordinary reserves, and ii) supplementary reserves. The former apply to the change in the amount of credit relative to a reference date, and the later to the total amount of credit outstanding.

- **Foreign exchange controls** were applied to non-franc countries. The restrictions included controls on direct investment, restrictions on the purchase of foreign securities by residents, tight controls on foreign issues in the French market, borrowing and lending abroad required case-by-case authorization.

- **Directed credit.** There were special institutions to channel below market credit to housing, agriculture, exports, industrial development, and local entities.

- **Regulations on consumer lending.** Because the government wanted to control the allocation of credit in the economy, the conditions for consumer lending were restrictive.

- **Ceiling on bank lending** Initially established in 1958, the *encadrement du crédit*, limited bank lending. A bank which did not abide by the rule was subject to a sanction which consisted of a lowering in its re-discount ceiling. The Bank also applied *selective credit control* to induce banks to lend to certain sectors that were considered important for the economy.

- Borrowing was also encouraged by: indexation, tax exemptions, lotteries, and forced borrowing

A.5 Italy

Similar to other countries, the Italian finances were in precarious state at the end of the war. During the period 1945-1980 there were two moments of more instability in the economy: at the end of WWII and in the 1970s. The government would play an important role throughout the overall period.

At the end of the war there were several institutional changes that gave the Bank of Italy more control over the financial system, and at the same time rendered the Bank of Italy more dependent on the Treasury. For instance, according to the Decree no.1 of 1945 the governor of the Bank of Italy would be appointed or removed by the Primer Minister in consultation with the Treasury Minister. The central bank became independent in the 1980s.

Some of the policies and regulation during the period 1945-1980 were:

- **Reserve requirements** It was one of the main instruments of monetary policy. There were different reserve requirements for certain types of deposit as well as for different types of institutions. In contrast to the situation in other countries, reserves were remunerated in Italy, usually at the rate of discount. Deposits by non-residents were until 1962 subject to a flat 50 percent reserve requirement.

- **Peg of interest rates**. Lasted for three years between 1966 and 1969. It was part of the so-called "stabilization plan" of the yield curve.

- **Floor prices on government securities.** Since 1975, the central bank was allowed to act as a residual buyer, and the Treasury set a minimum price for each auction. Which resulted effectively in a ceiling on the interest rate payed by government securities. The Bank was not allowed to finance more than 14 percent of the budget of the Treasury. In share of debt held by the Bank of Italy went from 12 percent in 1966 to 48 percent in 1975. Floor prices on 6 and 12-month Treasury bills were eliminated in 1989, and those in medium and long term bonds in 1992.

- **Maximum deposit rates**

- **Portfolio requirements.** As in the case of France, Italian authorities designed a "circuit" to transfer funds to the government. Banks were forced to invest a proportion of customer deposits in government securities. In 1973, portfolio constraints (vincolo portafoglio) were re-imposed. Banks were forced to invest 6 percent of its deposits as of December 31st 1972 in long term government securities.

- **Restriction on banks net foreign position**. The government required at times, depending on whether it wanted to prevent an inflow or outflow of capitals, a positive or negative net foreign position, a ceiling on net indebtedness, a balance position, or any net positive position. Banks were free to choose the gross amounts of liabilities and assets.

- **Two-tier foreign exchange market:** a freely quoted and an official exchange rate.

- **Credit control**. At different points in time, controls on the allocation of credit or its growth rate were imposed. Such was the case in 1973. The controls were made sector and even firm specific. An institution which violated the rules was subject to a penalty which consisted of depositing in the Bank of Italy an amount equal to the loan in excess of the ceiling in a non-interest bearing account. The controls were still in place in early 1980s.

- **Discretionary credit from central bank**. The banking system did not have direct access to central bank credit. Instead, the Bank would make a decision case-by-case.

For more details see: OECD (1973), Frattiani and Spinelli (1997)

A.6 Australia

- **LGS Convention** The liquid assets and government securities (LGS) convention did not have statutory basis but, since 1956, established a minimum ratio of its assets in notes and coins, cash with the Reserve Bank, Commonwealth treasury bills and notes and other Commonwealth Government securities. The ratio initially set at 14 percent, had been increased to 18 percent by 1962.

- **Controls over Bank Lending.** The Reserve Bank controlled through reserve requirements the overall amount of funds available to commercial banks, and through other regulations its allocation. In many occasions, the Bank issues directives for the banks and monitored their lending, even in the absence of a legal restriction.

  - *Farm Development Loan Funds* Designed to provide medium to long term funds to small farmers
  - *Australian Resources Development Bank Limited* Bank established in 1967 with capital from the major trading banks, the Reserve Bank, Bank of New South Wales, and the Rural and Industries Banks of Western Australia. The purpose was to direct credit towars enterprises to develop of Australian's natural resources
  - *Australian Banks' Export Re-Finance Corporation Limited*

- **Control on Interest Rates** The Reserve Bank has, with the approval of the Treasury, statutory power to set limits on the interest rates paid or received by banks. During this period there were ceilings on deposit rates and lending rates.

- **Capital Controls**

A.7 India

Selective controls, instruments of monetary policy that are applied to certain sectors, were extensively used in India.

- Margin Requirements on Security Loans
- Controls on Consumer Credit
- Moral Suasion
- Rationing of Credit

Around mid-1950s the Reserve Bank of India imposed restrictions on advances by banks. The purpose was to limit the credit available for speculation of food commodity prices. The Bank believed that part of the increase in the price of these commodities was due to excessive bank credit (Mutalik-Desai and Ghonasgi,1969)

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B Data Appendix and Glossary

The data appendix describes the sources and variables used throughout the paper. Except for electronic databases all the data used is in the public domain and comes primarily from official publications. The glossary contains the definition of important terms, not common in the literature, used throughout the paper.

B.1 Glossary

- **Government Domestic Debt** All debt liabilities of a government that are issued under and subject to national jurisdiction, regardless of the nationality of the creditor or the currency of denomination of the debt (Reinhart and Rogoff, 2009). Historically most of the domestic debt has been denominated in local currency. Notable exceptions are Mexican Tesobonos in the 1980's and Brazil dollar-denominated bonds a decade after.

- **Liquidation Year** Years when the real interest rate on the portfolio of domestic government securities is negative.

- **Moral Suasion** Moral "suasion" refers to the use of the influence of the central bank upon commercial banks to follow its suggestions and recommendations, such as in exercising credit restraint or diverting loans to specified sectors of the economy. Such suggestions do not possess the force of law, though the threat of converting suggestions into legal orders, if necessary, often backs such suggestions (Handa, 2000).

B.2 Variable Definition

Panel Data

- Central Bank Independence: Cukierman index, weighting as suggested in the book.

- Deficit-to-GDP: difference between total revenues and total spending divided by GDP.
- Interest Payments-to-GDP: (weigthed) average nominal interest rate times stock of debt and divided by GDP. Series for interest rate constructed by the author.

Stock Market Index used to calculate total return

Australia: ASX
Belgium: Brussels All-Share Return Index
France: CAC All-Tradable Total Return Index
Ireland: ISEQ
Italy: BCI
Japan: Nikko
South Africa: Johannesburg
Sweden: Affarsvarlden Return Index
United Kingdom FTSE All-Share Return Index
United States: S&P 500 Total Return Index.

B.3 Data Sources

Common sources

- Global Financial Data: Consumer Price Index, Gross Domestic Product, Stock Market Total Return.
- International Financial Statistics: Gross Domestic Product, Fiscal Accounts
- Mitchell: Gross Domestic Product, Fiscal Accounts

Table I: Country Specific Data Sources

Country	Sample Period	Source	Data Description
Argentina	1942-1980	Ministerio de Hacienda	Detailed Debt Data. Tax Revenues
		Banco Central de la República Argentina	Detailed debt data, prices of government bonds.
		Ferreres, Orlando (2004)	Tax Revenues, M1
Australia	1945-1980	Bureau of Census and Statistics	Detailed Debt Data, tax revenues
		The Parliament of the Commonwealth of Australia	Detailed Debt Data
		Reserve Bank of Australia	M1
Belgium	1945-1974	Banque Nationale de Belgique	Detailed Debt Data, prices of government bonds, tax revenues, M1
France	1945-1980	Ministere des Finances	Detailed Debt Data
		Metzler, Allan (1959) and GFD	M1
India	1949-1980	Reserve Bank of India	Detailed debt data, bond prices, M1 and tax revenues.
Ireland	1960-1990	Department of Finance	Detailed debt data
		Central Statistics Office	Detailed Debt Data. Tax Revenues
		Central Bank of Ireland	M1
Italy	1945-1980	Istituto Centrale di Statistica	Detailed Debt Data
		Banca d'Italia	Detailed Debt Data, price of government securities, M1
		Fratianni and Spinelli (1997)	M1
		Mitchell	Fiscal Accounts
Japan	1945-2008	Okurasho	Detailed Debt Data
		Statistics Bureau Japan	Tax Revenues, M1
South Africa	1945-1980	Control and Audit Office	Detailed debt data and tax revenues.
		South African Reserve Bank	M1
		International Monetary Fund- IFS	M1
Sweden	1945-1980	Riksgäldskontoret	Detailed Debt Data
		Fiscal Statistics for Sweden 1719-2003	Tax Revenues
		Riksbank	M1
United Kingdom	1945-1980	Bank of England	Detailed debt data, price of government securities, M1
		Central Statistical Office	Detailed debt data. Tax Revenues
United States	1945-1980	Department of Treasury	Detailed debt data, tax revenues
		CRSP database	Price of government securities
		Friedman and Schwartz	M1
		Federal Reserve Board	M1

Composition of Debt Portfolios for India and the US

Table II: India: Composition of Domestic Debt (as percentage of total domestic debt)

	1950	**1960**	**1970**
Marketable Rupee Loans	59	48	39
Treasury Bills	15	25	21
Small Savings	17	17	19
Other Obligations	9	10	21

Table III: US: Composition of Domestic Debt (as percentage of total domestic debt)

	1946	**1956**	**1966**	**1976**
Interest bearing obligations				
Marketable obligations	67.3	58	65.8	64.5
Treasury Bills	6.5	9.1	20.3	25.1
Certificates of Indebtedness	11.4	6.9		
Treasury Notes	3.8	12.8	17.8	33.2
Treasury Bonds	45.5	29.2	27.7	6.2
Other Bonds	0.1	0		
Non-marketable obligations	22.7	24.7	16.7	35.4
Special Issues	9.4	16.5	16.6	
Matured debt on which interest has ceased	0.2	0.3	0.1	0.1
Debt bearing no interest	0.4	0.6	0.8	0.1

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