Federal Reserve Bank of New York
Staff Reports

Great Expectations and the End of the Depression

Gauti B. Eggertsson

Staff Report no. 234
December 2005

Great Expectations and the End of the Depression

Gauti B. Eggertsson

Federal Reserve Bank of New York Staff Reports, no. 234
December 2005
JEL classification: E52, E63

Abstract

This paper argues that the U.S. economy's recovery from the Great Depression was driven by a shift in expectations brought about by the policy actions of President Franklin Delano Roosevelt. On the monetary policy side, Roosevelt abolished the gold standard and—even more important—announced the policy objective of inflating the price level to pre-depression levels. On the fiscal policy side, Roosevelt expanded real and deficit spending. Together, these actions made his policy objective credible; they violated prevailing policy dogmas and introduced a policy regime change such as that described in work by Sargent and by Temin and Wigmore. The economic consequences of Roosevelt's policies are evaluated in a dynamic stochastic general equilibrium model with sticky prices and rational expectations.

Key words: deflation, Great Depression, regime change, zero interest rates

---

Eggertsson: Federal Reserve Bank of New York (e-mail: gauti.eggertsson@ny.frb.org).
The author thanks Stephen Cecchetti, Helima Croft, Stefano Eusepi, Mark Gertler, Bart Hobijn, Nobu Kiyotaki, Rick Mishkin, Maurice Obstfeld, Hugh Rockoff, Scott Sumner, Eric Swanson, Andrea Tambalotti, Alan D. Viard, and Michael Woodford for helpful discussions. He also thanks seminar participants at the Federal Reserve Bank of New York, the Fiscal and Monetary Policy conference at the Federal Reserve Bank of San Francisco, and the fall 2005 NBER Monetary Economics Program meeting (especially Anna Schwartz for insightful comments). He also thanks Benjamin Pugsley for excellent research assistance and many helpful discussions and comments. The views expressed in this paper are those of the author and do not necessarily reflect the position of the Federal Reserve Bank of New York or the Federal Reserve System.

Dogma: An authoritative principle, belief, or statement of ideas or opinion, especially one considered to be absolutely true.

The American Heritage Dictionary of the English Language, Fourth Edition

If we cannot do this [reflation] one way we will do it another. Do it, we will.

President Franklin Delano Roosevelt, October 22th, 1933[1]

1 Introduction

What ended the Great Depression in the United States? This paper argues that the recovery was driven by a shift in expectations. This shift was triggered by President Franklin Delano Roosevelt's (FDR) policy choices. On the monetary policy side, FDR abolished the gold standard and – even more importantly – announced an explicit policy objective of inflating the price level to pre-depression levels. On the fiscal policy side, FDR expanded government real and deficit spending (i.e. government credit expansion) which made his policy objective *credible*. The key to the recovery was the successful management of expectations about *future policy*.

FDR was elected President in the fall of 1932 and inaugurated in March 1933. This was at the height of the Great Depression, when the short-term nominal interest rate was close to zero and deflation ran at double digits (output contracted by 13.4 percent in 1932 and CPI by 10.2 percent). FDR immediately implemented several radical policies, including an aggressive fiscal expansion and a change in monetary policy. These policy changes violated three policy dogmas of the time: (i) the gold standard, (ii) a balanced budget and (iii) that real government spending should not be used to increase demand.

I interpret the elimination of these policy dogmas as a *policy regime change*, as in Sargent (1983) and Temin and Wigmore (1990). The new regime implied a coordination of monetary and fiscal policy to increase demand. Coordinated monetary and fiscal policy ended the Great Depression by engineering a shift in expectations from "contractionary", i.e. the private sector expected future economic contraction and deflation, to "expansionary", i.e. the public expected future economic expansion and inflation. The expectation of higher future inflation lowered the real rate of interest, thus stimulating demand, while the expectation of higher future income stimulated demand by raising permanent income.

It is hard to overstate how radical the regime change was. "This is the end of Western civilization," declared Lewis Douglas, Director of the Budget, for example.[2] During FDR's first year in office several senior government officials resigned in protest.[3] Interestingly, the end of the gold standard and the fiscal expansion were largely unexpected. Both policy measures violated the Democratic presidential platform.

[1] See Roosevelt (1933c).

[2] Cited in Davis (1986), p. 107.

[3] These included Lewis Douglas. The acting Secretary of the Treasury, Dean Acheson, was forced to resign due to his oppisition to unbalanced budgets and the abolishment of the gold standard.

Their effect, therefore, should not be found in the data until FDR took office and announced the details of the "New Deal".

The effect of the FDR regime shift is clearly evident in the data. When FDR was inaugurated in March 1933 excessive deflation turned into modest inflation. There was little change in the trend growth of the monetary base around this turning point. Money growth did not start on a sustained upward trend until several months after prices started to rise. Similarly, the fiscal expansion happened with a substantial lag. This evidence suggests that the recovery was driven almost exclusively by expectations about future policy. The comparison between FDR's first term in office (1933-37) and President Herbert Hoover's last (1929-33) is striking. Hoover's last term resulted in 26 percent deflation, while FDR's first registered 13 percent inflation. Similarly, output declined by 30 percent from 1929-1933. This was the worst depression in US history. In contrast, 1933-1937 registered the strongest output growth (39 percent) of any four year period in the US history outside of war. The historical evidence is discussed in the next section.

I evaluate the economic consequences of FDR in a dynamic stochastic general equilibrium (DSGE) model with rational expectations and sticky prices. In the model the Great Depression is triggered by structural shocks that make the natural rate of interest – the real interest rate that would clear the market – temporarily negative. If these shocks are coupled with what I call "the Hoover regime" the model predicts an output collapse and deflation of the same order as in the Great Depression. The Hoover regime leads to this disastrous outcome because (i) the central bank aims for price stability and (ii) the treasury balances the budget (balanced budget dogma) and refuses to stimulate spending by real government spending (no additional spending dogma). The Gold Standard – another notable dogma of the Hoover regime – is not needed to explain the Great Depression, although taking it into account can explain an even larger contraction in the model.[4] The reason for the collapse is that the central bank cannot lower interest rates enough to accommodate deflationary shocks, due to the zero bound on interest rates and is unable to change expectations about future policy. This creates a strong deflation bias. The deflation bias helps explain the severity of the Great Depression, because real interest rates were excessively high in 1929-33 due to double digit deflation. This choked spending, especially investment. "Money was king" during this period. Nobody was interested in investing when the returns from stuffing money under the mattress were 10-15 percent in real terms. People gained more, in other words, from holding money than spending it.

The short-term nominal interest rate was close to zero during the Great Depression. The yield on three month Treasuries, for example, was only 0.05 percent in January 1933. Further interest rate reductions were clearly not feasible. Open market operations, in themselves, had no effect, since money and government bonds were perfect substitutes. This explains why several observers at the time were skeptical of the effectiveness of monetary policy and believed that open market operations were just like "pushing on a string". Despite this, however, monetary policy was far from powerless. While increasing the money

[4] This is an important strength of the model because many authors, such as Hsieh and Romer (2001) and Bordo, Choudhri and Schwartz (2000), have argued that the Gold Standard did not impose serious constraints on policy in 1930-33. The model is not subject to this criticism, but it indicates that the gold standard may have made the outcome even worse.

supply at zero interest rate has no effect, expectations about higher future money supply (once deflationary pressures have subsided and interest rates are positive again) have large effects because they change people's expectations about the future price level, thus reducing real interest rates. What was needed to end the Depression was a regime shift that changed expectations about future policy in a credible way. This is precisely what FDR achieved.

The FDR policy regime, in contrast to the Hoover regime, implied a sustained increase in both the monetary base and government spending. The permanent increase in the monetary base was made credible by an aggressive fiscal expansion. This expansion was publicly announced as a major shift in policy in a campaign of public propaganda – the "New Deal" – so that it was well understood by the public and expected to endure until the economy would recover. By any measure the change in fiscal policy was dramatic. The federal government's consumption and investment increased by 80 percent if one compares FDR's first calendar year in office (1934) to Hoovers last (1932). This counteracted the deflationary shocks directly through higher spending on goods and services. The spending spree was not financed by tax increases but through deficit spending (or what I also call government credit expansion). The deficit during FDR's first fiscal year (from June '33 to June '34) was 9 percent of GDP, the highest in the US history outside of war. This made a *permanent* increase in the money supply credible, thus firming up inflation expectations, because it was a crucial strategy to finance the government's debt payments. The data are discussed in the next section. Both government real and deficit spending were crucial to change expectations from being deflationary to inflationary, which was key to the recovery. While the excessive deflation in 1929-1933 implied very high real interest rates that strangled the economy, the modest inflation in 1933-1937 made real interest rates negative. This was a major boost to spending.

A policy regime is defined by a policy objective and a set of constraints that limit the government's ability to achieve it. I assume that both President Hoover and FDR maximized social welfare. The only difference between their regimes is that Hoover was constrained by the policy dogmas outlined above. I assume that neither president was able to commit to *future* policy apart through the issuance of government debt. The FDR *regime change* is defined by the elimination of the policy dogmas that constrained Hoover's actions. Policy dogmas are at the heart of the paper because eliminating them implies a dramatic change in expectations about future policy. The results in the paper, however, do not depend on the dogmas being permanently abandoned. It is enough that the public believes them to be temporarily abandoned with some probability so their abandonment can be blamed on an "emergency".

While the main results in the paper are analytical I put some flesh on the them by calibrating the model using commonly assumed parameters. In the calibrated model the Hoover policy regime leads to a 25 percent output contraction and double digit deflation. Moving to the FDR policy regime leads to a rapid recovery. The recovery is supported by an aggressive fiscal expansion of the same order as observed in the data that makes a permanent increase in the money supply credible. I compute dynamic multipliers of real government spending and deficit spending/government credit expansion. These statistics compute

by how much one dollar of government spending (real or deficit) increases output in net present value. The real spending multiplier is 3.4 and the deficit spending multiplier is 3.7. Both statistics are much higher than traditional estimates due to the expectational channel. I finally compute the welfare consequences of replacing Hoover with FDR. I find that the representative household would have been ready to pay what corresponds to about 16.7 percent of output per year (in consumption equivalence units) to replace Hoover with FDR.

The goal of the paper is to illustrate the power of one channel – expectations – and to show how to model it as a function of the policy choices of Presidents Hoover and Roosevelt. The model and the narrative are therefore highly stylized and tailored to this purpose. While several forces were surely important in explaining the downturn and the recovery, this paper's result indicates that expectations, and the role of fiscal and monetary policy in shaping them, were of first order importance. This does not preclude other forces from playing important roles. Indeed the deflationary shocks that trigger the Great Depression in the model are most likely due to a host of factors, including the stock market crash, banking problems and other familiar culprits. Instead of modelling these impulses I take them *as given* and ask: How did the policy regimes of Hoover and FDR propagate these shocks? Is this propagation mechanism sufficiently strong so that the policy regime change – taking the shocks as given – can help explain the turnaround in 1933?

This paper differs from many other theoretical papers on the zero bound, such as Krugman (1998), Eggertsson and Woodford (2003,2005), Eggertsson (2005), Jeanne and Svensson (2004), Auerbach and Obstfeld (2005), and Adam and Billi (2005), by modeling policy regime changes.[5] Furthermore I analyze a Markov Perfect Equilibrium (MPE), while Eggertsson and Woodford (2003,5) study optimal policy under commitment. The assumption of MPE is important because it implies that the policy regime change is *credible*.[6]

Friedman and Schwartz (1963) indicate that the recovery from 1933-37 was driven by money supply increases. Nominal interest rates, however, were close to zero during this period. As shown by Eggertsson and Woodford (2003), this implies that the evolution of the monetary base was irrelevant. Nevertheless, Eggertsson and Woodford (2003) and this paper indicate that *expectations* about future monetary aggregates mattered a great deal. In this sense the main point of Friedman and Schwartz is confirmed in this paper: Appropriate monetary policy was essential to end the Great Depression and could have prevented it altogether.[7] There are several papers that study the Great Depression in DSGE models.[8] The current

[5] For other work on the zero bound see e.g. Svensson (2004) for an excellent survey of the literature.

[6] Jeanne and Svensson (2004), Eggertsson (2005) and Adam and Billi (2005) also study optimal policy without commitment but do not model regime changes.

[7] Romer (1992) also emphasizes that monetary base increases ended the Great Depression. While she also discusses expectations the difference between this analysis and hers is that she assumes that inflation expectations depend on the current level of the monetary base while in this paper they depend on aggregate government credit of which the monetary base is only one component. The effect of some policies, such as gold purchases, will have the same effect in the two frameworks because they increased *both* the monetary base and government credit.

[8] There are numerous examples, for leading recent examples see e.g. Lucas and Rapping (1967), Bordo, Erceg and Evans (2000), Christiano, Motto and Rostagno (2003), and Cole and Ohanian (2005).

paper shares many elements with these papers. The main difference is that I focus on the regime shift associated with FDR's rise to the presidency and its implication on output and prices. While many of these papers recognize the importance of expectations they do not model why and how they changed in 1933 with FDR's election.[9]

Temin and Wigmore (1990) also argue that FDR's presidency signalled a regime shift that changed expectations about future policy. While their analysis is narrative, however, I use a general equilibrium model to evaluate this hypothesis. To some extent one may interpret my results as a formalization of their work (although my results differ from theirs in several respects).[10]

A surprisingly large part of the literature the Great Depression treats the recovery from the Great Depression as inevitable and unrelated to, or even in spite of, FDR's inauguration. Kindelberger (1986), for example, argues that "the fact that gross investment has a limit of zero is useful in explaining that the depression had to end .... At some point gross investment turns up again and the accelerator principle comes back into its own." The problem with Kindelberger's hypothesis is that it has little predictive power. Why did the recovery happen exactly in the months after FDR took power? Another explanation for the recovery is that, by abandoning the gold standard, FDR devalued the US dollar relative to other currencies. This encouraged exports and stimulated demand for domestic products relative to foreign ones. The expansion in 1933, however, cannot be attributed to an increase in net exports. Sumners (1997), for example, documents that exports increased by only 3 percent in the first five months after the devaluation, whereas imports soared by 20 percent, suggesting that rising domestic aggregate demand, not improved terms of trade, was the key to the recovery.[11] Eichengreen and Sachs (1985) also emphasize that leaving the gold standard was an important source of the recovery in several countries, although they do not focus on the US. I illustrate that in addition to leaving gold, a program of reflation was needed for a recovery. The gold standard was only one of several policy dogmas that needed to be eliminated to achieve this. The analysis can shed light on why some countries that left gold recovered faster than others. Britain, for example, recovered only sluggishly when it left gold in 1931.

In a recent paper, Cole and Ohanian (2005) argue that the recovery from 1933 to 1939 was excessively slow. They explain this by monopoly and cartelization regulations introduced by the New Deal through the National Recovery Act (NRA). In the next section, I argue that slowness of the recovery is to some extent explained by a short but severe recession in 1937-38. As argued by Friedman and Schwartz (1963), and discussed in better detail in the next section, this recession is most plausibly explained by monetary policy

[9] The strong emphasis on expectations is complementary to a recent study by Harrison and Weder (2005) who argue that the dynamics of the Great Depression were driven by fluctuations in expectations. The key difference between that study and the current paper is that I model shifts in expectations endogenously as being due to policy shifts, while Harrison and Weder assume that they are due to exogenous nonfundamental sunspot shocks.

[10] The most important difference is that I find that the zero bound on interest rate is the key constraint to explain the large effect of the regime change, but this constraint plays no role in their analysis. Furthermore while they put the elimination of the gold standard at center stage of their analysis, this constraint is only one of several *policy dogmas* that needed to be eliminated in this paper for a successful regime change (fiscal policy, instead, plays a key role).

[11] Furthermore exports, as a fraction of GNP, remained less than three percent during this period so they could hardly be expected to be responsible for the robust recovery.

mistakes which are not taken into account by Cole and Ohanian. While Ohanian and Cole's conclusion is different in tenor than mine, the two are not necessarily inconsistent. Their model shows that some aspects of the New Deal lowered the natural level of output. This paper, in contrast, shows that other aspects of the New Deal, i.e. monetary and fiscal policy, eliminated the output gap, which is the difference between actual output and the natural level. While FDR's New Deal ended the Great Depression by closing the output gap, it may have reduced the natural level of output in the process.

2 The Great Depression in the US and Franklin Delano Roosevelt: A brief historical narrative

According to the theory suggested in this paper, both nominal and real variables should have taken an abrupt turn in March 1933 when FDR was inaugurated. On the nominal side, figure 2 shows that prices measured by CPI and WPI rebounded around March 1933 after a long and persistent decline in previous years. Figure 4 shows the time series for a few leading commodity prices–reflation of commodity prices was of primary concern to the FDR administration. These prices were determined on spot markets and should thus be expected to react more strongly than CPI to expectations about future policy. In fact, commodity prices rebounded even more strongly than CPI. The price of wheat, for example, nearly doubled in the remaining months of 1933. On the real side figure 1 shows the remarkable turnaround in GNP in 1933. The recovery was led by a rebound in investment. Investment nearly doubled in 1933 with the turnaround in March of that year. Figure 3 (from Temin and Wigmore (1990)) shows investment in a one year window around FDR's inauguration.

The hypothesis of the paper is that the recovery was triggered by a shift in expectations about prices and output. While there is no direct data on expectations, the available estimates confirm that there was an abrupt change in expectations in 1933. Using very different estimation methods Hamilton (1992), who uses commodity price futures data, and Cecchetti (1992), who uses interest rate and CPI data, find a large change in expectations about future inflation in the spring of 1933, a conclusion that is not surprising given the large movements in the price level in figures 2 and 4. Expectations about future output also appear to have rebounded in the spring of 1933. The stockmarket increased by over 66 percent during FDR's first 100 days with a turning point in March 1933. Figure 5 shows the evolution of the stockmarket in a one year window around FDR's inauguration. To the extent that the stockmarket is driven by expectations about future GNP, the figure indicates that FDR's inauguration resulted in a shift in expectations about future output.

Much of the previous literature, such as Friedman and Schwartz (1963), has focused on changes in the money supply as responsible for the recovery. Figure 6 shows that there was no abrupt change in the trend growth of the money supply at the time FDR assumed office. There was a temporary increase in currency in circulation in March and February 1933, due to the banking crises, but this increase was reversed the

next month as the crises subsided (and was in any case mostly offset by changes in non-borrowed reserves thus leaving the monetary base unchanged). As the figure shows, the money stock in the fall of 1933 was still below its level from the beginning of the year (prior to the banking crisis). It was only in later years that the monetary base started a strong upward trend, as shown in Table 1. According to this paper's hypothesis, money supply changes were unimportant in 1933 because the interest rate was close zero at that time. Expectations about the future money supply were all that mattered.

FDR made several announcements in the early months of his administration that helped shape expectations about future policy. The overriding objective of monetary policy, according to FDR, was reflation, i.e. to increase the price level, even at the expense of more traditional objectives (such as the stable price of gold which FDR declared would be "subservient" to domestic recovery). FDR's goal was to increase prices to their pre-Depression levels in 1-3 years. He stated this objective on several occasions. At a press conference on April 19th, for example, FDR stated the "definitive objective" of raising commodity prices. This press conference was called after Congress had passed a bill (the Thomas Amendment) that gave FDR broad powers to inflate.[12] Another example is that after a joint meeting with the Prime Minister of Canada on the 1st of May of 1933 Roosevelt said in the *Wall Street Journal*:

> We are agreed in that our primary need is to insure an increase in the general level of commodity prices. To this end simultaneous actions must be taken both in the economic and the monetary fields.

FDR reiterated this in a radio address to the nation in one of his "fireside chats" on May 7th.[13] By late spring there could be no doubt in the minds of market participants that the administration was aiming to inflate.

Roosevelt did more than simply announce his desire to raise prices. He also took direct *actions* to achieve it, actions that can be interpreted as having made the policy objective of reflation *credible*. Table 1 shows several policy measures that made an increase in the price level credible (this point will be formalized in the model that I present in coming sections). Apart from the elimination of the gold standard the most important was an aggressive fiscal expansion.

On the real spending side the data indicate a substantial expansion as reported in Table 1. Consumption and investment of the federal government, for example, were 90 percent higher in 1934 (FDR's first full calendar year in office) relative to 1932 (Hoovers last).[14] Other measures of federal spending also increased substantially. Table 1 also reports total government expenditures. This measure includes several transfer

[12] See FDR (1933a) on p. 156-158 Volume 1: "Here is a team that has a perfectly definite objective, which is to make a touchdown, so far as commodity prices go. The basis of the whole thing really comes down to commodity prices. And, this is entirely off the record, the general thought is that we have got to bring commodity prices back to a recent level."

[13] See FDR (1933a) "Radio Address of the President May 7".

[14] Data in fiscal years were not available from NIPA, but I report other data on fiscal policy in fiscal years. The increase in federal government consumption was somewhat offset by reductions at the local government level. To the extent that these reductions were not caused by the federal spending increases this has no effect on the analysis since we are interested in the effect of the regime change at a federal level and its interaction with monetary policy. See Brown (1956) for discussion of local government spending.

programs and the gold purchases of the Treasury that are not included in the consumption and investment statistic, but which had an important impact on the government budget.[15] The spending increases were not financed by new taxes. Instead FDR ran significant budget deficits.

Deficit spending plays a key role in the paper because it measures the change in the inflation incentive of the government. The deficit is defined as the difference between the governments expenditures and tax revenues. Table 1 shows three estimates of the deficit. The estimate that corresponds most closely to the deficit in the model of the paper is the third one. This estimate takes advantage of that – as a matter of accounting – any shortfall between expenditures and taxes can be financed in one of two ways: printing money or issuing government bonds. Deficit spending, therefore, can be measured as the change in the government's nominal liabilities – i.e. the government credit expansion – in a given fiscal year (government liabilities is the sum of government bonds and the monetary base).[16] The deficit, according to this estimate, increased by 66 percent in the fiscal year June 1933 to June 1934 and stood at 9 percent of GDP in that fiscal year, the highest in US history outside of war. The other estimates show a smaller but yet significant increase. (The reason for the differences is discussed in the Data Appendix). Leaving measurement issues aside, however, there is even stronger evidence for the regime change than reported in Table 1.

The most convincing evidence of the regime change is found by investigating the primary sources on how fiscal policy was *decided*. The deficits during Hoover's presidency were almost entirely due to a collapse in output and the inability of the Treasury to predict the associated fall in revenues (total tax revenues are reported in Table 1). The deficit was not a deliberate policy; it accumulated despite President Hoover's frantic efforts to balance the budget by *tax rate increases*.[17] The deficit under FDR, in contrast, was deliberate and a part of the reflation program that was expected to endure until the economy recovered. One piece of evidence is reading the last Annual Report of the Secretary of the Treasury under Hoover and comparing it to the first Annual Report by FDR's Secretary. In June 1932 Treasury Secretary Mills reported to the House of Representatives a 2.5 billion deficit which was projected to decline in the next two years.[18] Despite the projected decline, the Secretary was deeply perturbed and recommended radical government spending cuts because there "is no course for the government to follow but [...] to live within its

[15] The gold inflows to the US after 1933 are particularly important. The government stood ready to buy gold at a fixed price. The price of gold was changed througout 1933 but was fixed in 1934 (see Sumner (2004)). The administration bought the gold by issuing nominal liabilities (i.e. government credit). On the government balance sheet these purchases mainly showed up as non-borrowed reserves held by commercial banks at the Federal Reserve. Since the nominal interest rate was zero during this period, there was no meaningful difference between base money (defined as non-borrowed reserves plus currency in circulation) and short-term government debt. Both were nominal liabilities to private entities that carried zero interest. This means that the "gold program" pursued by FDR was important to make future inflation credible because it increased the inflation incentive of the government, a conclusion that is at variance with a common verdict of FDR gold purchases. The same point is made in Sumner (2004) who states that "the gold-buying program has been unfairly maligned by both contemporaneous critics and modern historians." See Eggertsson (2003) for a formal analysis of the effect of buying real asset on the inflation incentive of the government.

[16] This way of estimating the deficit is also appealing for my model because I proof that government liabilities are the unique "state variable" in the model of the paper.

[17] President Hoover successfully sponsored a massive tax increase in late 1931 to recoup the decline in federal tax revenues. The maximum personal income tax rate rose from 25 to 63 percent. Corporate income taxes rose, estate taxes were doubled and gift taxes reintroduced. See Temin and Wigmore (1990).

[18] This is slightly different from the OMP estimate reported in Table 1. This number is the actual number he gave in his report to Congress and has undoubtedly gone through several revisions in later publications.

income." One year later Secretary Woodin, then recently appointed by FDR, reported to Congress that the deficit had exploded to a whopping 3 billion dollars, a number three time higher than Mills had predicted the year before (partially because of FDR's spending initiatives in the last quarter of the fiscal year). Instead of suggesting spending cuts Secretary Woodin proposed one of the biggest government spending campaign in US history. As for the deficit for the fiscal year 1934, he projected it to be even higher or 6.6 billion dollars, more than double the deficit in 1933. This indicates a key difference in the policy regime. While the deficits were Hoovers miscalculation, they were FDR's strategy (see also quotes in section 5).

The deficits were probably more important than real government spending to end the depression because they played a greater role in making the permanent monetary expansion (made technically feasible by the elimination of the gold standard) *credible* – thus raising inflation expectations of the public. FDR's actions thus satisfied Sargent's (1983) criteria for a regime change:

> There must be an abrupt change in the continuing government policy, or strategy, for setting deficits now and in the future that is sufficiently binding to be believed.

It is quite likely that it was the deficit side of fiscal policy which was mainly responsible for firming up inflation expectations, since it was well understood at the time that deficit financing could lead to future inflation. In fact the belief that deficits caused inflation was one of the foundations of the "balanced budget dogma" of the time. This is evident in the writings of many commentators at the time, especially in the conservative press, that were worried that FDR's deficit spending would in fact be *too inflationary*.[19] As proof, many "sound money men" pointed towards the deficits of several European countries after WWI and the resulting hyperinflation.[20]

The hypothesis of this paper is that the FDR regime change shifted expectations from being deflationary to being inflationary. This, in turn, reduced the real rate of interest and stimulated demand. Figure 7 shows some suggestive evidence that is consistent with this story. The real rate of interest – measured as the difference between the yield on 3 month US Treasury notes and certificates minus actual inflation 3 months ahead – declined substantially with the policy regime change. If this decline was responsible for the recovery, as predicted by the model in this paper, the expansion should be evident in the most interest rate sensitive components of demand, such as investment, as indicated by figure 3. Romer (1992) gives further evidence on this by showing that fixed investment and consumption durables also responded strongly to movements in real interest rates during this period.

While GDP growth in 1933-37 was the strongest in US history outside of war there is a common conception that the recovery from the Great Depression was slow. Partially this is explained by that the economy was recovering from an extremely low level of output. Romer (1992), for example, assumes a 3.15

[19] See e.g. and opinion piece in the Wall Street Journal on the 2cond of November 1933, p. 6 under the heading "Unconvincing Reassurance". See also Davis (1986) p. 107 who writes that Lewis Douglas, the Director of the Budget, "scoffed at the notion that there could ever be a "mild" or "controlled" inflation; public knowledge that greenback issuance was an available executive option would of itself alone set off wild inflation, leading to "complete chaos"."

[20] See e.g. Davis (1986) p. 107.

growth per year from 1927 to 1942. According to this trend the US economy did not fully recover until 1942. Another useful observation is that there was a short but severe recession in 1937-38, which resulted in a slowdown in growth in 1937 and an output contraction of 5 percent in 1938. If not for this contraction the economy could have fully recovered as early as 1938. In this case a full recovery from the worst depression in US history, which reduced output by a third, left a quarter of the population unemployed, and devastated the capital stock, would have taken only 5 years. Explaining the slow recovery, therefore, is to a large extent to explain the recession in 1937-38.

The most convincing explanation for the depression in 1937-38 is given by Friedman and Schwartz (1963). They argue that the Federal Reserve's increase in reserve requirement of commercial banks in May 1937 was responsible for the contraction. Following this the economy went into tailspins of deflation and output losses. This explanation is often criticized on the grounds that banks were already holding large excess reserves so that imposing these requirement did not have any real effects (interest rates rose only modestly in response)[21]. The model of this paper, however, supports Friedman and Schwartz's hypothesis and to some extent strengthens it by taking the expectation channel into account. The increase had such a disastrous effect because it changed expectations from being inflationary to being deflationary.[22] It was the expectation that the Federal Reserve would stand ready to stamp down any further inflation that caused the collapse in 1937-38 rather than the new reserve requirement itself. Interestingly, the disastrous effect of this policy had already been predicted by market participants as early as 1935. S. Parker Gilbert, a partner in J.P Morgan & Company, warned the Federal Reserve in the *New York Times* in December 1935 that an increase in reserve requirements would strangle the recovery because it would be *interpreted* as if the Federal Reserve had reversed its inflationary policies.[23] The recovery did not resume until 1938, when FDR forced the Federal Reserve to reverse its policy and the Treasury simultaneously embarked on further fiscal expansion (see Meltzer (2003) p. 531). The growth rate in 1938-42 was even higher than in 1933-1937.

3 The Model

To model the FDR regime change I utilize a standard New Keynesian model, as e.g. in Clarida, Gali and Gertler (1999) and Woodford (2003), with some modifications. I present the model here, to economize on space and notation, in linearized form, where I have approximated the equilibrium conditions around a

[21] See e.g. Eccles (1951) who makes this argument.

[22] The impression that the government was reverting back to a "Hoover regime" was reinforced by fiscal policy, thus fuelling deflationary expectations. In 1936 there was a large bonus paid to veterans of WWI. In 1937 there was not only no payment of this kind, but social security taxes were also collected for the first time.

[23] Gilbert wrote: "There is also a general consideration bearing on the whole problem of recovery, namely that any restrictive measures which were to be taken at this stage by the Federal Reserve authorities, whether by raising reserve requirements or by letting government securities run off, *might be construed* a reversal of the cheap money policy which has been pursued since the day of the bank holiday. This monetary policy, it may even be said, is an essential of recovery and in recent months it has really begun to work." (cited in Eccles (1951)). In a news analysis of the debate the *New York Times* (December 22, 1935) reported on the opponents of reserve requirement: "Their main point was that with recovery in its early stage the psychological effect of credit restriction might be to shock buiness confidence and start a new period of deflation."

deterministic steady state. I prove the existence of this steady state in the Technical Appendix. The fully non-linear model is presented in the Technical Appendix where all the results of the paper are confirmed in the non-linear model.

The equation that determines the relationship between aggregate demand and the interest rate is derived from the consumption Euler equations of households often referred to as the IS equation. This equation relates current demand to future demand and the discrepancy between the nominal interest rate and the natural rate of interest

$$\hat{Y}_t - \hat{Y}_t^n = E_t(\hat{Y}_{t+1} - \hat{Y}_{t+1}^n) - \tilde{\sigma}(\hat{\imath}_t - E_t\pi_{t+1} - \hat{r}_t^n) \tag{1}$$

where $\tilde{\sigma} > 0$, π_t is inflation, E_t an expectation operator and $\hat{\imath}_t$ is the short term nominal interest rate. The hat denotes percentage deviation from the deterministic steady state. The term $\hat{Y}_t$ is aggregate output and $\hat{Y}_t^n$ is the natural rate of output which is the output that would be produced if prices were flexible (or alternatively the production level that would clear the market). The natural rate of output is

$$\hat{Y}_t^n = \tilde{Y}_t^n + \frac{\tilde{\sigma}^{-1}}{\tilde{\sigma}^{-1} + \omega}\hat{F}_t \tag{2}$$

where $\omega > 0$. The term $\tilde{Y}_t^n$ is an exogenous disturbance term. The effect of real government spending, $\hat{F}_t$, on the natural rate of output is well known from the RBC literature (see e.g. Baxter and King (1992)). An increase in government spending decreases consumption for a given production level. This, in turn, increases the marginal utility of consumption, thus increasing labor supply, lowering real wages and increasing production. Since $\hat{Y}_t^n$ denotes output under flexible prices, it maps directly into output analyzed in the RBC literature (which assumes flexible prices) which is the advantage of this notation. The term $\hat{r}_t^n$ is the natural rate of interest, i.e. it is the real interest rate that would be consistent with market clearing if prices were flexible. It can be expressed as

$$\hat{r}_t^n = \frac{1-\beta}{\beta} + \frac{1}{\beta}\tilde{r}_t^n + \frac{\tilde{\sigma}^{-1}\omega}{\tilde{\sigma}^{-1} + \omega}E_t(\hat{F}_t - \hat{F}_{t+1}) \tag{3}$$

where $\tilde{r}_t^n$ is an exogenous disturbance term that is only a function of preference and technology shocks. Real government spending also directly increases the natural rate of interest because government spending changes the intertemporal price of consumption in the RBC block of the model. Equation (1) relates current output gap $\hat{Y}_t - \hat{Y}_t^n$ (which can be interpreted as a demand slack if negative) to expectations of future output gap and the discrepancy between the real interest rate and the natural interest rate. Demand can thus be increased by either real interest rate reductions or expectations of higher future income.

The Euler Equation of firms gives rise to the New Keynesian Phillips curve, often referred to as the AS equation:

$$\pi_t = \kappa(\hat{Y}_t - \hat{Y}_t^n) + \beta E_t\pi_{t+1} \tag{4}$$

where $\kappa, \beta > 0$. This equation relates current inflation to the output gap (the measure of demand slack

in the economy) and expected inflation. Nominal interest rate cuts increase demand by the IS equation. This increase in demand does not feed one to one to the price level because prices are sluggish. The AS equation indicates by how much demand pressures increase prices. Expectations of future inflation also have an effect on current inflation because firms are forward looking in their price setting so that expected future demand conditions feed into their pricing decisions.

Monetary policy is the determination of money supply, M_t, which can be changed by open market operations in government bonds. It does not change the results to assume that the policy, instead, is the determination of the real monetary base, i.e. the nominal stock of money deflated by the price level, $m_t \equiv \frac{M_t}{P_t}$.[24] While money does not enter directly into the IS and AS equations, it changes the equilibrium through the nominal interest rate. The nominal interest rate, in turn, has to satisfy a money demand equilibrium condition that is derived from the household optimization problem. Money demand can be approximated by

$$\hat{m}_t \geq \eta_i \hat{\imath}_t + \eta_y \hat{Y}_t \tag{5}$$

where $\eta_i < 0$ and $\eta_y > 0$. The inequality applies with equality when the interest rate is positive. When the interest rate is zero, however, money demand is indeterminate. This is because the household is satiated in liquidity at zero interest rate so that it makes no difference whether it holds money or government bonds as an asset. Both are government nominal liabilities with zero return. The assumption of no arbitrage (complete markets) implies that there is a zero bound on the short term nominal interest rate. No one would lend one dollar unless he/she gets at least 1 dollar in return! Since I express the interest rate in terms of deviation from steady state this bound can be expressed as:

$$i_t = \frac{\hat{\imath}_t}{\beta} + \frac{1-\beta}{\beta} \geq 0 \tag{6}$$

There is a detailed discussion in Eggertsson and Woodford (2003) and Eggertsson (2005) on the accuracy of a first order approximation of each of the equilibrium conditions above and the complications posed by the zero bound on the short-term interest rate.

Fiscal policy is the determination of real government spending F_t and taxes T_t. For simplicity, I assume that the government can only issue one period nominal debt B_t. At the end of each period t, total government liabilities carried to the next period are then given by the sum of the money stock and nominal bonds, $W_{t+1} = (1 + i_t)B_t + M_t$. The budget constraint in each period is then given by $B_t + M_t = W_t + P_t(F_t - T_t)$. Thus while the discrepancy of F_t and T_t (deficit spending) determine aggregate nominal liabilities ,W_t, or government credit, monetary policy is the determination of how this aggregate is divided between money, M_t, and bonds, B_t.

Defining $w_t \equiv \frac{W_{t+1}}{P_t}$ as government nominal liabilities deflated by the price level (I date this variable at

[24] See Eggertsson (2005) for more discussion.

date t because it is determined at that date) I can write the government budget constraint as:

$$w_t = (1 + i_t)\{\frac{w_{t-1}}{1 + \pi_t} + F_t - T_t\} - i_t m_t \tag{7}$$

At any date t (taking the debt w_{t-1} as given) the government can pay off the real value of its debt by cutting spending, increasing taxes or engineering inflation that reduces the real value of outstanding nominal debt (although if the inflation is anticipated this will be reflected in a higher interest rate at time $t-1$ so that no gain in tax reduction will be realized in equilibrium due to this channel). The last term in equation (7) is seigniorage revenues. These revenues are increasing with the nominal interest rate and the value of the real monetary base. Rather than express the budget constraint in a linearized form, I prefer to show the fully nonlinear constraint in (7), since the non-linear interaction between inflation at time t and debt dated $t-1$ will be important in the paper. A key assumption in the model is that there is an output cost of taxation, so that for every dollar collected in taxes some fraction $s(T_t)$ is wasted on tax collection. This gives the government an incentive to minimize taxation required to finance a given level of expenditures. Government spending F_t is therefore the sum of $s(T_t)$ and government consumption G_t.

The welfare consequences of different policies can be evaluated by a second order expansion of the utility of the representative household (see Woodford (2003)). For initial condition of zero debt at time t it is equal to[25]

$$U_t = -\frac{1}{2}\sum_{s=t}^{\infty}\beta^{s-t}\left\{\pi_s^2 + \lambda_y(\hat{Y}_s - \hat{Y}_s^n)^2 + \lambda_F(\hat{F}_s - \hat{F}_s^n)^2 + \lambda_T(\hat{T}_s - \hat{T}_s^n)^2\right\} \tag{8}$$

where the weights $\lambda_y, \lambda_F, \lambda_T > 0$. The derivation of this expression is shown in the Technical Appendix. Utility can can be expressed as deviation of inflation, output, government spending and taxes from their target values. The target value for inflation is zero while the other target values are time-varying. The terms $\hat{F}_t^n$ and $\hat{T}_t^n$ are both functions of exogenous shocks defined in the Technical Appendix while $\hat{Y}_t^n$ is given by (2).

4 An Output Collapse and Excessive Deflation under a Hoover policy regime

In this section I outline a policy regime, coined the Hoover regime, that helps account for the large output decline observed during the Great Depression. A policy regime is defined by the government's policy objective and a set of constraints. I assume that President Hoover maximized social welfare in (8). His policy options were constrained by the equilibrium conditions (1) to (7), and that he could only determine policy sequentially, i.e. he could not commit to future policy. President Hoover, for example, could not

[25] Here I abstract from the utility of holding real money balances, see Technical Appendix for discussion.

determine FDR's policies. In addition, I assume that President Hoover was constrained by the policy dogmas of the time as I outline below.

4.1 The Policy Dogmas

First, I assume a "no additional spending dogma" so that real government spending is constant at all times, i.e. $F_t = \bar{F}$. This viewpoint or "dogma" captures Hoover's views on fiscal policy. We read, for example, in his address to the American Legion on 21st of September 1931 (Hoover (1934)):

> Every additional expenditure placed upon our government in this emergency magnifies itself out of all proportion into intolerable pressures, whether it is by taxation or by loans. Either loans or taxes [...] will increase unemployment.[...] We can carry our present expenditures without jeopardy to national stability. We can carry no more without grave risks.

Second, I assume a "balanced budget dogma" so that $T_t = F_t$, i.e. every government expenditure needs to be financed by taxes.[26] This dogma represents Presidents Hoover's views at the time. In a press statement at the early stages of the Depression on July 18th 1930, for example, he stated (Hoover (1934)):

> For the Government to finance by bond issues deprives industry and agriculture of just that much capital for its own use and for employment. Prosperity cannot be restored by raids on the public Treasury.

His views on deficits remained unchanged throughout the depression although he was unable to prevent them during parts of his presidency. These two dogmas form the foundations of the Hoover Policy Regime.

Definition 1 The Hoover Policy Regime: *The government maximizes (8) subject to (i) the balanced budget dogma $F_t = T_t$, (ii) the no additional spending dogma $F_t = \bar{F}$, and (iii) has a limited ability to commit to future policy.*

In the definition above I state that the government has a limited ability to commit to future policy. In the next section this statement is made precise. For simplicity I exclude the gold standard dogma from the definition above, but President Hoover was a strong supporter of the gold standard. This dogma could be added without changing the results because the US government held gold in excess of the monetary base at the time, as stressed by Hsieh and Romer (2005), so this constraint was not binding.[27]

[26] For simplicity I abstract from seignorage revenues in the remainder of the paper but will refer to them when they are relevant. This is an innocent assumption since assuming these revenues would only strengthen my analytical result. It would give the government an even further reason to inflate if it violates the balanced budget dogma.

[27] One could, for example, include this dogma as a simple constaint of the form $M_t \leq p^g R_t$ where M_t is the monetary base, p^g is the price of each unit of gold and R_t is the quantity of the gold reserves of the government. This constraint says that every dollar of the outstanding monetary base needs to be backed up by corresponding gold reserves. They key to notice is the inequality. The gold standard forced each dollar to be backed up by *at least* p^g units of gold, but the government was free to hold more gold than correponded to the outstanding base. This assymmetry is well known in the literature. In 1933 this inequality was not binding in the US, as e.g. stressed by Hsieh and Romer (2005), so that that the Federal Reserve could have expanded the monetary base without violating the gold standard dogma. It can be shown that this implies that the result derived below would remain unchanged even if this inequality is added to the list of constraints that the equilibrium must satisfy.

4.2 The Markov Perfect Equilibrium

The equilibrium concept used throughout this paper is a Markov Perfect Equilibrium (MPE). The MPE is a standard equilibrium concept in macroeconomics and was first applied in Kydland and Prescott's (1977) classic exposition of the inflation bias. The idea is that the government cannot make any commitments about future policy but instead reoptimizes every period taking the state (which may be endogenous) as given. The government maximizes the utility of the representative household (8). Following Stokey and Lucas (1983) I also assume that the government has to pay back the nominal value of any debt issued so that the variable w_t in the government budget constraint is an endogenous state variable.

The MPE is formally defined in the Technical Appendix in the non-linear model but the linear quadratic approximation makes the solution more transparent. Observe first that the balanced budget dogma implies that $w_t = \bar{w}$. This implies that the equations (4)-(6) are completely forward looking, so that there is no intrinsic state variable in the model. It follows that the expectations $E_t\pi_{t+1}$and $E_t\hat{Y}_{t+1}$ are taken by the government as exogenous, since they refer to expectations of variables that will be determined by future governments (I denote them by $\bar{\pi}$ and $\bar{Y}$ below). To solve the government maximization problem one can then write the Lagrangian

$$\begin{aligned} L_t &= -E_t[\frac{1}{2}\{\pi_t^2 + \lambda_y(\hat{Y}_t - \hat{Y}_t^n)^2 + \lambda_F(\hat{F}_t - \hat{F}_t^n)^2 + \lambda_T(\hat{T}_t - \hat{T}_t^n)^2\} \\ &\quad +\phi_{1t}(\pi_t - \kappa(\hat{Y}_t - \hat{Y}_t^n) - \beta\bar{\pi}) \\ &\quad +\phi_{2t}(\hat{Y}_t - \hat{Y}_t^n - \bar{Y} + \hat{Y}_{t+1}^n + \sigma(\hat{\imath}_t - \bar{\pi} - \hat{r}_t^n)) \\ &\quad +\phi_{3t}(\frac{\hat{\imath}_t}{\beta} + \frac{1-\beta}{\beta})] \end{aligned} \tag{9}$$

and obtain three first order conditions that are necessary for optima plus one complementary slackness condition

$$\pi_t + \phi_{1t} = 0 \tag{10}$$

$$\lambda_y(\hat{Y}_t - \hat{Y}_t^n) - \kappa\phi_{1t} + \phi_{2t} = 0 \tag{11}$$

$$\tilde{\sigma}\phi_{2t} + \beta^{-1}\phi_{3t} = 0 \tag{12}$$

$$\phi_{3t} \geq 0,\ \phi_{3t}i_t = 0 \tag{13}$$

where in the last first order condition, for simplicity, I have substituted out for $\hat{\imath}_t$ in terms of i_t. An equilibrium under the Hoover regime is a collection of stochastic processes that satisfy the private sector equilibrium conditions (4)-(6) on the one hand, and the equations that characterize the policy regime (10)-(13) on the other.

4.3 The output collapse and a calibration

To replicate the output collapse and excessive deflation during the Great Depression, I consider the effects of shocks to the exogenous component $\tilde{r}_t^n$ of the natural rate of interest (as in Eggertsson and Woodford (2003)). In this case the zero bound is temporarily binding as during the Great Depression.

A1: The Great Depression structural shocks $\tilde{r}_t^n = \tilde{r}_L^n < 0$ *at date* $t = 0$. *It returns back to steady state* $\tilde{r}_H^n$ *with probability* α *in each period. Furthermore,* $\tilde{Y}_t^n = 0 \ \forall \ t$. *The stochastic date the shock returns back to steady state is denoted* τ. *To ensure a bounded solution the probability* α *is such that* $\alpha(1-\beta(1-\alpha)) - \tilde{\sigma}\kappa(1-\alpha) > 0$

For simplicity I have assumed that $\tilde{Y}_t^n$ is constant so that the dynamics of the model are driven by the exogenous component of the natural rate of interest $\tilde{r}_t^n$. There are several possible sources for a temporary decline in $\tilde{r}_t^n$. It can be negative due to a series of negative demand shocks (i.e. shifts in the utility of consumption) or expectations of lower future productivity (i.e. shift in the disutility of working or technology). A temporary collapse in some autonomous component of aggregate spending (that is separate from private consumption) can also be interpreted as a preference shock. More generally, the most plausible reason for a collapse in aggregate spending is a collapse in investment. A host of candidates could lead to an investment collapse, such as problems in financial intermediation, adverse shocks to the balance sheets of firms, or a productivity slowdown that may lead to a capital overhang (and thus excess capital, leading to a decline in the natural rate of interest). These shocks are not modelled in detail at this level of abstraction but could be studied in a model with capital and financial intermediation frictions.

It is useful to characterize how monetary and fiscal policy are set in a MPE. The following proposition characterizes policy conditional on A1.

Proposition 1 ***Equilibrium Policy under the Hoover Regime****. If A1 then equilibrium policy under the Hoover regime is: (i) Fiscal policy:*

$$F_t = \bar{F} = T_t \ \forall \ t. \tag{14}$$

(ii) Monetary policy:

$$i_t = r_t^n \ \textit{so that} \ \pi_t = \pi_t^* = 0 \ \textit{when} \ t \geq \tau \tag{15}$$

$$i_t = 0 \ \textit{when} \ 0 \leq t < \tau \tag{16}$$

Proof. The first part of the proposition is just a restatement of the fiscal policy dogmas. For the second part consider first the solution at positive interest rates. In this case then $\phi_{3t} = 0$ for equation (13) to be satisfied. Then equation (10)-(12) imply the unique bounded solution $\hat{Y}_t = \hat{Y}_t^n$ and $\pi_t = 0$ and $\hat{\imath}_t = \hat{r}_t^n$. This proves the first part of the proposition, namely the form of the policy regime when $t > \tau$. This, however, cannot be an equilibrium when $\hat{r}_t^n < -1 - \beta$ because this would violate (13). We now need to show that in this case we must have $i_t = 0$. This is easy to do by a proof by contradiction. Suppose this

was not the case. Then $\phi_{3t} = 0$. But this would, according to (10)-(12) and the IS and AS equation, imply that $\hat{Y}_t = \hat{Y}_t^n$ and $\pi_t = 0$ and $\hat{\imath}_t = \hat{r}_t^n$ which violates (13). In contrast, the solution with $i_t = 0$ satisfies all the conditions for equilibrium. Note that the monetary aggregate plays no role in the analysis because the money supply only appears in the money demand equation so that the value of the Lagrangian multiplier with respect to $\hat{m}_t$ is always zero. ■

This characterization of equilibrium policy is sufficient to close the model, i.e. an equilibrium can be described without any reference to a MPE if one assumes that policy is determined by equations (14),(15) and (16). An alternative definition of the Hoover regime – somewhat more general than the MPE — is therefore the "reduced form policy rule" (14), (15) and (16). These equations imply that the Federal Reserve behaved as if it was following a strict zero inflation target with the twist that it may not be able to achieve this if the natural rate of interest is negative, in which case the Fed lowers the interest rate to zero. This behavior appears to accord relatively well to the narrative record of the Federal Reserve during this period. While it was formally bound by the gold standard, one of its main objectives was price stability which is the main reason why it was holding gold in excess of its gold holding requirements.[28] Assuming this policy and A1 it is now straight forward to derive the evolution of output and prices.

Proposition 2 ***Equilibrium Output and Prices under the Hoover Regime****. If A1 then output and inflation under the Hoover regime are:*

$$\hat{Y}_t^H = \frac{1-\beta(1-\alpha)}{\alpha(1-\beta(1-\alpha)) - \tilde{\sigma}\kappa(1-\alpha)}\tilde{\sigma}\tilde{r}_L^n < 0 \text{ if } \tilde{r}_t^n = \tilde{r}_L^n \text{ and } \hat{Y}_t^H = 0 \text{ otherwise} \tag{17}$$

$$\pi_t^H = \frac{1}{\alpha(1-\beta(1-\alpha)) - \tilde{\sigma}\kappa(1-\alpha)}\kappa\tilde{\sigma}\tilde{r}_L^n < 0 \text{ if } \tilde{r}_t^n = \tilde{r}_L^n \text{ and } \pi_t^H = 0 \text{ otherwise} \tag{18}$$

Proof. Consider first the solution at date $t > \tau$. The first order conditions (10)-(13) indicate that then $\pi_t = \hat{Y}_t = 0$. Then, conditional on the natural rate of output being negative (i.e. $t < \tau$), the simple assumption made on the natural rate of interest implies that inflation in the next period is either zero (with probability α) or the same as at time t i.e. π_t (with probability $(1-\alpha)$). Then the expectation of future inflation is $E_t\pi_{t+1} = (1-\alpha)\pi_t$ and similarly the expectation of future output is $E_t\hat{Y}_{t+1} = (1-\alpha)\hat{Y}_t$. Substituting this into (4) and (1) and taking account of the first order condition (13) indicates that $i_t = 0$ when $t < \tau$ one obtains the solution above. The restriction on α in A1 is needed for the model to converge. If it is violated the output collapse and deflation are unbounded and a linear approximation is no longer valid. ■

It is instructive to put some numbers on these results. Figure 8 shows the output contraction and deflation predicted by the model calibrating it using commonly assumed parameters (apart from the size of the government, which is calibrated to match its small size during the Great Depression).[29] In the figure,

[28] See e.g. discussion in Meltzer (2003) p. 275 who points out that the gold reserve requirements were not binding in most of the 20's or early 30's and that much of its actions in the 1920's can be interpreted as actions intended to stabilize inflation.

[29] The parameters are $\tilde{\sigma} = 0.5$, $\omega = 2$, $\kappa = 0.02$, $\beta = 0.99$. The government is assumed to be 10 percent of GDP in steady state and tax and administration cost account for 5 percent of government spending. There is a more detailed discussion in

it is assumed that the natural rate of interest is -4 percent in the r_L^n state and that the probability α that it reverts back to steady state of $+4$ percent in each period is 10 percent. The figure shows the case in which the natural rate of interest returns to steady state in period $\tau = 10$ (which is the expected duration of the shock). The model predicts 25 percent collapse in output under this calibration and the contraction lasts as long as the duration of the shock. The contraction at any time t is created by a combination of the deflationary shock in period $t < \tau$ – but more importantly – the *expectation* that there will be deflation and output contraction in future periods $t + j < \tau$ for $j > 0$. The deflation in period $t + j$ in turn depends on expectations of deflation and output contraction in periods $t + j + i < \tau$ for $i > 0$. This creates a vicious cycle that would not even have converged were the restriction on α in A1 not satisfied. The overall effect is an output collapse for a relatively small shock to the natural rate of interest.[30]

The output collapse is mostly driven by the IS equation (1). It can be forwarded to yield

$$\hat{Y}_t = \hat{Y}_t^n - \tilde{\sigma} E_t \sum_{s=t}^{T-1} \{\hat{\imath}_s - \pi_{s+1} - \hat{r}_s^n\} + (\hat{Y}_T - \hat{Y}_T^n). \tag{19}$$

The expectation hypothesis says that the long-term interest rate is simply the sum of current and expected future short-term rates. Hence the above equation indicates that demand depends on long-term real interest rates and the output gap at time T. The contraction is caused by a discrepancy between long-term real interest rate and the long-term natural interest rate. Due to the zero bound this difference cannot be reduced by nominal interest rate cuts. This difference increases with expectations about future deflation, since expected deflation increases the short and long-term real interest rates. Real interest rates can be particularly high when there is expected deflation, since the real interest rate is the difference between nominal interest rate and expected inflation. Figure 7 shows that during the Great Depression the real rates were of the order of 10-20 percent – and the Federal Reserve was unable to lower these rates in 1933 because the nominal interest rate was close to zero.

The duration of the contraction can be several years in the model, or as long as the shock lasts, even if the degree of price flexibility is high. The formulas in (17) and (18) reveal a puzzling conclusion, that the higher the price flexibility (i.e. the higher the parameter κ) the stronger the output collapse. This is paradoxical because, when prices are perfectly flexible, output is constant by assumption A1. The forces at work here were first recognized by Tobin (1975) and De Long and Summers (1986). These authors show that more flexible prices can lead to the expectation of further deflation in a recession. If demand depends on expected deflation, as in equation (19), higher price flexibility can therefore lead to ever lower demand in recession, thus increasing output volatility. This dynamic effect, the so called "Mundell effect", must be weighted against the reduction in the static output inflation trade-off in the AS curve due to higher

the Technical Appendix about the calibration.

[30] The sense in which the shock is "small" is that the real rate of interest (which is equal to $\tilde{r}_t^n$ in the absence of an output slack) has been of this order several times in US history, such as the 70s (see e.g. Summers (1991) for discussion). On those occasions, however, there has been positive inflation so that negative real rate of interest has easily been accomodated.

price flexibility. In some cases the Mundell effect can dominate, depending on the parameters of the model. Formula (*17*) indicates that the Mundell effect will always dominate at zero interest rates.

Figure 11 shows the implied long run money stock under the Hoover regime in the numerical example reported in figure 8. In the long run, the nominal stock of money will be proportional to the price level and output. The long-run stock of money would be equal to 1 in the figure in the absence of shocks. The figure reveals that under the Hoover regime the Federal Reserve accommodates any deflation by contracting the long-term monetary stock once the deflationary shocks subside.

The policy rule derived in equations (15) and (16) is too simplistic to account for the Federal Reserve's policy in 1929-33. The policy indicates that if inflation is below target the interest rate will immediately be cut down to zero. Instead the Federal Reserve reduced the interest rate more gradually as can be seen in figure 7. Since the interest rates were close to zero at the time FDR took office this does not change the analysis of the regime change that is the focus of this paper. By failing to move faster, however, the model indicates that the Federal Reserve exaggerated the output decline and propagated the deflationary shocks even further.[31] This suggests that other policy objectives (such as the gold standard which was responsible for interest rate hikes in 1931 as Britain went of gold), institutional inertia, and policy mistakes made the Hoover policy regime even more deflationary.

4.4 The Liquidity Trap under the Hoover Regime and the Deflation Bias

Would unlimited open market operations in government bonds increase inflation in the model? Under the Hoover regime this policy is ineffective. The reason is that money supply has its effect through the short-term interest rate and by 1933 they were already close to zero. Any money supply above $\eta_i \hat{i}_t + \eta_y \hat{Y}_t$ during the period of zero interest rates is thus consistent with equilibrium. More importantly, open market operations will not change expectations either. Since the private sector expects inflation to be $\pi^* = 0$ as soon as the deflationary shocks subside, it will expect the central bank to reverse any money supply increase as soon as the shock subsides, no matter how large it is at time $t < \tau$. Any monetary expansion will thus be expected to be transitory. Hence Proposition 2 remains valid even if I allow for an aggressive expansion in the monetary aggregate at times when nominal interest rates are zero. To summarize:

Proposition 3 ***The liquidity trap***. *Suppose the government expands M_t by arbitrary large amounts by open market operations when the interest rate is zero. Assume that all other aspects of policy are determined by the Hoover regime. Then the equilibrium is still given by equation (17) and (18) in Proposition 2 and is independent of by how much M_t is expanded.*

[31] To show this one can modify the policy rule in equations (15) and (16) to allow for a more gradual decrease in the nominal interest rate. Suppose that instead of setting the interest rate zero when the central bank misses its inflation target $\pi_t = 0$ it instead sets $i_t = \epsilon_t$ where ϵ_t is some noise terms that must be strictly positive (otherwise the zero bound would be violated). If I interpret ϵ_t as a policy shock (e.g. due to policy mistakes or considerations related to maintaining other objectives such as the gold standard) there is an even larger collapse in output because this will increase current and expected real interest rates at dates $t < \tau$.

This proposition follows from Eggertsson and Woodford (2003). That paper shows that the level of the monetary base at zero interest rate has no effect on the equilibrium outcome when the central bank follows an interest rate rule. It is easy to verify that the Hoover regime equilibrium policy is a special case of the general policy rule in that proposition. Eggertsson and Woodford (2003) furthermore show that this result is unchanged even if the central bank can purchase a variety of other assets with the money printed, such as long term government bonds (another example is foreign exchange). This proposition may thus appear to support a famous statement made by Marriner Eccles, governor of the Federal Reserve, in front of the Senate Banking committee in 1935 (see Eccles (1935) p. 377):

> One cannot push on a string. We are in the depths of a depression and, as I have said several times before this committee, beyond creating an easy money situation through reduction of discount rates and through the creation of excess reserves, there is very little, if anything, that the reserve organization can do toward bringing about recovery.

Monetary policy is not as impotent as Eccles suggests, at least not in this paper. What is required, however, is not to "create an easy money situation through reduction of discount rates and excess reserves" but increasing expectations about future inflation. A commitment to future inflation increases demand because it reduces the real rate of interest and increases expectations about future output. These effects can be very large for the converse of the reason described above. Higher expectations about future inflation reduce the real rate of interest and thus stimulate demand by making consumption cheaper relative to the future; this effect is captured by the second term on the right hand side of the IS equation (1). Furthermore expectations of higher future income also stimulates demand by the permanent income hypothesis; this is captured by the first term on the right hand side of the IS equation. This is the key behind the large effect of the FDR policy regime change we explore in the next section.

One way of interpreting the FDR regime change was that it indicated a policy of "higher inflation." Consider a policy rule that says that the Federal Reserve targets an inflation rate $\pi_t^* = \pi^* > 0$ whenever possible. If π^* is less than $-\tilde{r}_L^n$ the Federal Reserve will be unable to achieve the inflation target in periods $0 < t < \tau$ and the policy takes the same form as (15) and (16) apart from that $\pi_t^* = \pi^* > 0$. Call this new policy rule "inflation targeting". A change from the Hoover regime to inflation targeting is an example of a *regime change*. The regime change does not imply any increase in the monetary base in period $t < \tau$ when the interest rate is zero. What is important, however, is the expectation that the money supply will be increased in periods $t > \tau$ at a constant rate that is proportional to the inflation target.[32] A regime change from the Hoover regime to an inflation targeting regime can have a very large effect. The third panel in figure 9 computes an inflation target multiplier. This statistic answers the question: By how much does a permanent increase in the inflation target π^* by 1 percent increase output when the interest rate

[32] An exception to this is if the inflation target is high enough so that $\pi^* > -\tilde{r}_t^n$ in which case negative real rates of interest can be accommodated with positive interest rates. In this case the central bank need to support this equilibrium by a corresponding increase in the monetary base in periods $t < \tau$.

is zero? In the numerical example from last section one percent increase in the inflation target increases output by 6.6 percent. This number depends on the assumed stochastic process. In the absence of the shocks the multiplier is only 0.13 percent. The inflation target multiplier is helpful to understand why FDR's announcements to inflate had such a large and immediate effect in March 1933.

To describe the FDR regime change as a movement to inflation targeting is much too simplistic. While FDR's public commitment to inflate was undoubtedly helpful shaping expectations, it is unlikely that it would have been sufficient if were not complemented by concrete actions. One problem of making statements about future policy is that they may not be deemed credible. In the words of Sargent "a regime change must be sufficiently binding to be believed." This is a problem FDR faced. Sumner (1997), for example, notes that "financial markets initially seemed reluctant to accept these announcements as official administrative policy" when discussing FDR's commitment to inflate the price level. Furthermore, as can be seen in figure 2, FDR never in fact fulfilled his promise to inflate to the pre-recession price level. While it is optimal in the model to increase inflation expectations, FDR had an incentive to promise future inflation and then renege on this promise once the deflationary shocks subsided. To see this, observe that the objective of the government depends both on inflation and the output gap. Even if increasing inflation expectations at date $t < \tau$ is optimal for the government at that time, it has an incentive to renege at time τ when deflationary pressures have subsided because at that time it can achieve zero inflation without any output gap. Hence positive inflation expectations cannot be sustained under rational expectations about discretionary policy. This is what Eggertsson (2005) coins the deflationary bias of discretionary policy.

The equilibrium shown in last section excludes the possibility of increasing inflation expectation by announcement that are not credible because in a MPE "words" of the government carry no weight if they are not associated with policy actions. While it is extreme to assume that FDR words carried no weight it is an useful assumption because it allows us to give some further interpretation to some of the *actions* he took. These actions can be interpreted as having made his inflation program credible and thus more effective to increase demand. In the next section I will show that FDR's elimination of the fiscal policy dogmas, and the subsequent fiscal expansion, are examples of policies that made his inflation program credible. They made a sustained increase in the money supply "sufficiently binding to be believed".

5 An Economic Expansion under a FDR Policy Regime

In this section I outline the consequences of relaxing the policy dogmas of the Hoover policy regime. Abolishing these dogmas is what I define as the policy regime change. I show that the new policy regime, the FDR policy regime, results in reflation and a dramatic increase in output. Thus the regime change is modelled as follows:

Hoover Regime —> Elimination of Policy Dogmas —> FDR Regime

Both FDR and Hoover maximize social welfare. Their policy regime are identical apart from the policy dogmas that constrained Hoover:

Definition 2 The FDR Regime *The government maximizes (8) free from policy dogmas and has a limited ability to commit to future policy.*

I first study the effect of relaxing the no additional spending dogma, keeping the budget balance dogma intact. I call this policy regime FDRa. I then study the effect of relaxing the balanced budget dogma keeping the no additional spending dogma inact. I call this policy regime FDRb. Under both policy regimes I calculate a policy multiplier which is a summary statistic that shows by how much output increases for each dollar of fiscal spending. Finally I study the full FDR policy regime defined above when both dogmas have been eliminated.

Throughout this section I assume that the gold standard dogma has been abolished. There is no need to discuss separately the consequences of relaxing it. As previously pointed out the reason for this is that the gold standard constraint was not binding during the Hoover regime, so by it self it would have had little effect to abolish it in the model. This does not imply, however, that abolishing this dogma was unimportant. It may in fact have been a necessary condition for making the fiscal expansion technically feasible. The reason for this is that fiscal expansion under the FDR regime is associated with a sustained increase in the monetary base, which could ultimately have made the gold standard a binding constraint (depending on the duration of the shock in the model). Eliminating the gold standard, therefore, was a necessary but not a sufficient condition for the FDR regime change.

5.1 The Multiplier of Real Government Spending

First I eliminate the dogma that the federal government should not increase its spending on goods and services. FDR made clear that he would violate this dogma once he assumed power. In his inauguration address he announced.

> Our greatest primary task is to put people to work. This is no unsolvable problem if we face it wisely and courageously. It can be accomplished in part by direct recruiting by the Government itself, treating the task as we would treat the emergency of a war, but at the same time, through this employment, accomplishing greatly needed projects to stimulate and reorganize the use of our natural resources.

Contrast this statement to Hoover's claim that "every additional" government expenditure would cause "intolerable pressures." The change can be no more direct in words as it was in deeds (as discussed in section 2 but federal spending increased by unprecedented amounts).

To analyze the consequences of abolishing this dogma consider a MPE when the government can increase real government spending but is subject to the balanced budget dogma: this is policy regime FDRa. In

this case the government can have an effect on both the natural rate of interest and the natural rate of output. The problem of the government can again be analyzed by writing up the Lagrangian (9) but in this case I substitute equation (2) and (3) into the constraints (4) and (1). Once again I obtain the first order conditions (10)-(13). In addition I obtains a first order condition with respect to $\hat{F}_t$ which gives

$$\frac{\tilde{\sigma}^{-1}}{\omega+\tilde{\sigma}^{-1}}\lambda_y(\hat{Y}_t-\hat{Y}_t^n)+\lambda_F(\hat{F}_t-\hat{F}_t^n)+\lambda_T(\hat{F}_t-\hat{T}_t^n)-\frac{\tilde{\sigma}^{-1}}{\omega+\tilde{\sigma}^{-1}}\kappa\phi_{1t}-\phi_{2t}=0 \tag{20}$$

If the zero bound is not binding (i.e. shocks are small enough) both Lagrangian multipliers ϕ_{1t} and ϕ_{2t} are zero, $\hat{Y}_t=\hat{Y}_t^n$ and $\pi_t=0$. In this case

$$\hat{F}_t=\frac{\lambda_F}{\lambda_T+\lambda_F}\hat{F}_t^n+\frac{\lambda_T}{\lambda_T+\lambda_F}\hat{T}_t^n.$$

For simplicity $\hat{F}_t^n$ and $\hat{T}_t^n$ are are assumed to be such that $\hat{F}_t=0$ in the absence of large enough shocks that make the zero bound binding. This done to abstract from variations in the size of the government due to shifts in preferences or taxation technology and isolate the stabilization role of fiscal policy.

Assumption 2 (A2) *The natural rate of fiscal spending and taxation is such that* $\hat{F}_t^n=-\frac{\lambda_T}{\lambda_F}\hat{T}_t^n$.

I can now characterize policy under FDRa.

Proposition 4 *The Equilibrium Policy under the FDRa Regime. If A1 and A2 then FDRa can be described by: (i) Fiscal Policy:*

$$T_t=F_t\ \forall\ t \tag{21}$$

and

$$F_t=\bar{F}\ for\ t>\tau \tag{22}$$

$$F_t=\bar{F}-f_r\tilde{r}_t^n\ for\ 0<t<\tau \tag{23}$$

where the value of f_r satisfies (10)-(13) and (20). (ii) Monetary policy takes the same form as in (15) and (16)

Proof. Equation (21) is just a restatement on the balanced budget dogma. To prove (22) and (23) I can use A1 and A4 to write (20) as

$$\frac{\tilde{\sigma}^{-1}}{\omega+\tilde{\sigma}^{-1}}\lambda_y(\hat{Y}_t-\frac{\tilde{\sigma}^{-1}}{\omega+\tilde{\sigma}^{-1}}\hat{F}_t)+\lambda_F\hat{F}_t+\lambda_T\hat{F}_t-\frac{\tilde{\sigma}^{-1}}{\omega+\tilde{\sigma}^{-1}}\kappa\phi_{1t}-\phi_{2t}=0 \tag{24}$$

Consider first the optimal policy at $t>\tau$. Using the same argument as in the proof of Proposition **??** we see that the equilibrium is $\pi_t=\hat{Y}_t=\phi_{1t}=\phi_{2t}=0$. The equation above then implies that $\hat{F}_t=0$, i.e. $F_t=\bar{F}$. Consider now the case in which $t<\tau$. Using the same argument as in the last proof (proof by contradiction) I can once again show that in this case $i_t=0$. What remains to be shown is that fiscal

policy takes the form $\hat{F}_t = -f_r \tilde{r}_t^n$. To see this recognize that equations (4), (2), (1), (3), (10)-(13) and (24) can be solved to yield a solution for $\hat{F}_t$ in terms of $\tilde{r}_t^n$.The second part is proofed in the same way as 1. ■

This characterization of policy is sufficient to close the model. An alternative definition of the FDRa regime – somewhat more general than the MPE — is the reduced form policy rule (15),(16) and (21)-(23). This policy says that fiscal policy is expanded during the periods in which the zero bound is binding and kept constant at steady state when the deflationary shocks have subsided. (Recall that under assumption A1 the term $\tilde{r}_t^n$ is negative in period $t < \tau$ (when the interest rates are zero) but zero at time $t \geq \tau$). This is consistent with how FDR thought about the real spending side of fiscal policy cited above. The main goal of the spending was temporary or "emergency" relief programs to battle the unemployment of the Great Depression. The idea was that the spending was temporary due to extreme circumstances comparable to an "emergency of a war". Hence it was clear that the aim was not a permanent increase in government spending but some spending in addition to what would have been mandated under "regular" circumstances by the term $\hat{F}_t^n$ which captures the "natural" level of government spending.

Figure 8 illustrates the effect of real government spending by dotted lines. Countercyclical real government spending reduces the output contraction by about half and reduces deflation by about a quarter. The policy works through two separate channels. Real spending increases the natural level of output through the first channel. This channel has been extensively documented in the RBC literature (see e.g. Baxter and King (1993) and references therein).[33]

Government spending also increases output through the *Keynesian channel* of government spending. The Keynesian channel only works if prices are sticky, i.e. if the real rate can be different from the natural rate of interest. To see the Keynesian channel note that an increase in government spending (holding everything else constant) increases the natural rate of interest by equation (3). Then if the nominal interest rate is held fixed and expectations about future inflation are held constant, a wedge opens between the real interest rate and the natural rate of interest. By the IS equation (holding expectation about future output gap constant) a positive wedge between $\hat{r}_t = \hat{\imath}_t - E_t \pi_{t+1}$ and $\hat{r}_t^n$ stimulates demand; this is the Keynesian channel for government spending.

One aspect of figure 8 that may be surprising is that only 3.7 percent of government spending (as a fraction of GNP when the zero bound is binding) increases output by about 10.4 percent. This large effect of a small amount of government spending is due to the expectation channel. The main cause of the large decline in output and prices is the expectation of a future slump and deflation. Consider the outcome from the perspective of period 0. If the private sector expects even a small increase in government spending in all future states when the zero bound is binding, deflation and output expectation are changed in all these states, thus having a large effect on output in period 0. A useful summary statistic is what I coin the

[33] In the context of our model, just as in Baxter and King, the natural rate of output increases if government expenditures increase as can be seen by equation (2). This increase is due to a higher willingness of people to work. Higher government spending increases the marginal utility of consumption (for given level of consumption) which induces people to work more to equate the marginal utility of private consumption and the disutility of working.

policy multiplier of government spending. This measure answers the question: How much does each dollar of real spending increase output moving from one policy regime to the other? This statistic is well defined because the only difference between the Hoover regime and FDRa is that in the latter real government spending can be increased.

Proposition 5 ***The Real Spending Multiplier.*** *The multiplier of real government spending is*

$$MP_{FDRa,H}(F) \equiv \frac{E_0 \sum_{t=0}^{\infty} \beta^t (\hat{Y}_t^{FDRa} - \hat{Y}_t^H)}{E_0 \sum_{t=0}^{\infty} \beta^t (\hat{F}_t^{FDRa} - \hat{F}_t^H)} = \frac{[\frac{1}{1-\alpha} - \beta]\tilde{\sigma}^{-1} - \alpha^{-1}\kappa \frac{\tilde{\sigma}^{-1}}{\tilde{\sigma}^{-1}+\omega}}{[\frac{1}{1-\alpha} - \beta]\tilde{\sigma}^{-1} - \alpha^{-1}\kappa} > 1$$

where Y_t^{FDRa} is output under the FDRa regime and Y_t^H under the Hoover regime. The multiplier is always greater than 1.

Proof. To prove this proposition write equation (4) in terms of output under the FDRa and Hoover regime, conditional on that the natural rate of interest is negative, i.e. $t < \tau$. This yields

$$\pi^{FDRa} - \pi^H = \kappa(\hat{Y}^{FDRa} - \hat{Y}^H) - \kappa(\hat{Y}^{nFDRa} - \hat{Y}^{nH}) + \beta(1-\alpha)(\pi^{FDRa} - \pi^H).$$

Similarly substituting into (1) and rearranging yields

$$\alpha(\hat{Y}^{FDRa} - \hat{Y}^H) - \alpha(\hat{Y}^{nFDRa} - \hat{Y}^{nH}) = \tilde{\sigma}(1-\alpha)(\pi^{FDRa} - \pi^H) + \tilde{\sigma}(\hat{r}^{nFDRa} - \hat{r}^{nH}).$$

Using (2) I can solve $(\hat{Y}^{nFDRa} - \hat{Y}^{nH}) = \frac{\tilde{\sigma}^{-1}}{\tilde{\sigma}^{-1}+\omega}(\hat{F}^{FDRa} - \hat{F}^H)$ and using (3) I obtain $(\hat{r}^{nFDRa} - \hat{r}^{nH}) = \alpha\frac{\omega\tilde{\sigma}^{-1}}{\tilde{\sigma}^{-1}+\omega}(\hat{F}^{FDRa} - \hat{F}^H)$. Substituting these two values into the two equations above, solving for the ratio $\frac{(\hat{Y}^{FDRa} - \hat{Y}^H)}{(\hat{F}^{FDRa} - \hat{F}^H)}$ and observing that $\hat{Y} = \hat{F} = 0$ when $t \geq \tau$, one obtains the multiplier. ■

The policy multiplier measures how one unit of real government spending increases output. I measure each variable in net present value. In the baseline calibration the value of the multiplier is 3.4. This large number may perhaps be somewhat surprising. If consumers completely offset an increase in government spending by cutting back on their own consumption, for example, the value of this multiplier is zero. Another interesting aspect of this multiplier is that it is always strictly greater than 1. The old fashion Keynesian literature, for example, predicted "a balance budget" multiplier of 1. This large effect is mostly due to the expectation channel.

Figure 9 decomposes the size of the multiplier between the RBC channel and the New Keynesian channel. As the figure reveals about 85 percent of the multiplier can be attributed to the New Keynesian channel and 15 percent to the RBC channel. This multiplier is computed under A1 so that it is assumed that the zero bound is binding and that inflation is below the central banks target. This implies that monetary policy will always accommodate the increase in demand due to fiscal spending. The size of the multiplier at positive interest rates is also included as a comparison. In this case the multiplier is much smaller. The reason is that at positive interest rates inflation is at target (by the assumption about the

policy regime) and the central bank will offset any inflationary consequences of the fiscal expansion. In contrast, since inflation is below the central bank target at zero interest rates, it will fully accommodate any inflationary consequences of the fiscal expansion.[34]

Figure 11 shows the implied long run stock of money under the policy regime FDRa for $\tau = 10$ studied in figure 9. The FDRa policy regime implies a commitment to a higher future money stock than the Hoover regime. Nevertheless it still implies that the central bank will contract the monetary base relative to its level prior to the recession. The regime mandates a zero inflation as soon as the deflationary pressure subside. The central bank's long run money stock will therefore accommodate any deflation that occurred in period $t < 10$.

5.2 The Multiplier of Deficit Spending

Under both the Hoover and FDRa policy the private sector expect zero inflation after the deflationary shocks have subsided. Even if the government expands the money supply the private sector expects it to be reversed once deflationary pressures subside. Can a permanent increase in the money supply be credible? There is a straightforward policy tool to increase inflation expectations in the model. One way of making inflation policy credible is to expand government liabilities, i.e. the sum of the monetary base and the government debt, given by the variable w_t in equation (7). This is what I call deficit spending or credit expansion.

There is some narrative evidence that Roosevelt viewed government credit expansion as crucial to increase inflation. Interestingly FDR made no distinction between government debt and the monetary base, which is consistent with this interpretation. In one of his fireside chats in 1933 (Roosevelt (1933b)), for example, he stated, "in the first place, government credit and government currency are really one and the same thing."

This suggestion is theoretically correct, as discussed in the historical narrative, since interest rates were at zero at the time so there was *no* economic difference between government debt and the monetary base. Furthermore FDR stated that government credit would be used to increase inflation. In the same speech, when firming up his commitment that prices would be inflated, he stated

> that is why powers are being given to the Administration to provide, if necessary, for an enlargement of credit [...] These powers will be used when, as, and if it may be necessary to accomplish the purpose [i.e. increasing inflation].

When the government runs budget deficits (i.e. expands government credit) the analysis of the MPE is considerably more complicated. The reason is that there is a nontrivial state variable in this game. In the Technical Appendix I prove that the unique state variable in the game between the government and the

[34] In computing the multiplier at positive interest rate I assumed the same shock but that the central bank was not constrained by the zero bound.

private sector is the real value of government credit (also referred to here as government debt), which is defined as the sum of the nominal stock of money and government bonds, deflated by the price level i.e. w_t. One can see the implications of the issuance of nominal debt on the budget constraint (7). The government needs to finance a given level of debt w_{t-1} and government spending $\hat{F}_t$ by one of three ways, issuing more debt w_t, raising taxes $\hat{T}_t$ or inflating. The growth rate of the debt is limited by a transversality condition of the representative household. The choice, then, is between taxation and inflation. The objective of the government (8) depends on both inflation and taxes. This indicates that in equilibrium the government does a little of both for any given level of debt, suggesting that in a Markov Equilibrium inflation expectations are increasing in the level of nominal credit. To increase inflation expectations, therefore, the government only needs to increase government credit. While this logic is clear enough, the linear quadratic framework is insufficient to derive the strategy functions of the government (even to a first order). The reason is that the key element that increases inflation expectations is the interaction between inflation and credit.[35] I defer the proof of the next proposition the Technical Appendix since it require the exposition of the nonlinear model which I have omitted in the main text for brevity.

Proposition 6 *The FDRb Regime Characterization. If A1 then FDRb can be described by: (i) Fiscal Policy: Satisfies the No Additional Spending dogma*

$$F_t = \bar{F} \ \forall \ t \tag{25}$$

and $\hat{T}_t$ *is set so that*

$$\hat{w}_t = d_r \tilde{r}_L^n \ - d_w \hat{w}_{t-1} when \ 0 < t < \tau \tag{26}$$

and

$$\hat{w}_t = s_w \hat{w}_{t-1} \ when \ t \geq \tau \tag{27}$$

where $d_w, d_r > 0$ *and* $s_w > 0$. *(ii) Monetary Policy: The Central Banks sets*

$$i_t \ so \ that \ \pi_t = \pi_t^* = \pi_w \hat{w}_{t-1} > 0 \ when \ t \geq \tau \tag{28}$$

$$i_t = 0 \ when \ t < \tau \tag{29}$$

Proof. *See Technical Appendix* ■

This characterization closes the model so an equilibrium can be described without any reference to a MPE if one assumes that the government behaves according to equations (25)-(29). They key to understanding this policy rule is that inflation expectations are increasing in aggregate government credit, w_t,

[35] Consider the budget constraint in period $t+1$. In the linearized version of the budget constraint this term is $\bar{w}\pi_{t+1}$. This term does not capture the interaction between debt issued at time t and inflation at time $t+1$ because the constraint is linearized around some debt level $\bar{w}$.

according to equation (28). Furthermore equation (26) indicates that the government will issue government credit to increase inflation expectations. Both these features of the FDRb policy rule are consistent with the narrative evidence discussed above. FDR wanted reflation and announced that he would achieve this by issuing government credit. Figure 8 illustrates the effect of this policy regime. As can be grasped by the figure, this policy regime reduces the contraction and deflation by about 90 percent.

The channel is as follows: Budget deficits increase government credit. Government credit increases inflation expectations because the government uses inflation to pay off its debt. Higher debt is undesirable for the government if there are some tax distortions. One can alternatively think of this channel as working through the budget constraint of the household. This interpretation may be better aligned with FDR's view of "government credit" cited above. The deficit spending implies that the government gives credit to the private sector (either through actual tax cuts or because taxes do not increase as much as government real spending F_t). This means that the household now holds more dollar assets either in the form of government bonds or money than it did before. It will have no effect *if* the household expects its future taxes to be increased correspondingly. Under this expectation households increase their savings one to one with the expansion of government credit; this is the principle of Ricardian Equivalence. But these savings decisions are not rational in the model, because taxation is costly the household has no reason to expect the government to increase future nominal taxes to this extent. Instead the government has an incentive to create inflation in the future to avoid raising taxes. As a consequence the household will view its net wealth as increasing with the expansion of government credit. This means that government credit increases private demand under the policy shown in the proposition above.

Again it is useful to summarize the effect of the deficit spending/credit expansion on output through the multiplier. I need to make some adjustment to the definition of the multiplier, however, for it to be useful. What I consider instead is a variable $\tilde{T}_t$ that has the defined as $\tilde{T}_t = \hat{T}_t$ if $\tilde{r}_t^n = r_t^L$ and $\tilde{T}_t = 0$ if $\tilde{r}_t^n = 0$. (The results derived for $\hat{F}_t$ would have been unchanged if I had defined $\tilde{F}_t$ in this way because $\hat{F}_t = 0$ if $\tilde{r}_t^n = 0$). This variable captures the deficit spending used in the depression state. Hence I define the multiplier of deficit spending/credit expansion as[36]

$$MP_{FDRb,H}(\tilde{T}) = -\frac{E_0 \sum_{t=0}^{\infty} \beta^t (Y_t^{FDRb} - Y_t^H)}{E_0 \sum_{t=0}^{\infty} \beta^t (\tilde{T}_t^{FDRb} - \tilde{T}_t^H)}$$

The value of this multiplier answers the following question: By how much does each dollar spent on deficit spending/credit expansion in a liquidity trap increase output? In our baseline calibration the answer is 3.7. Figure 9 decomposes the size multiplier between the RBC channel and the New Keynesian channel. As the figure reveals no part of the multiplier can be explained by the RBC channel. The reason is that the effectiveness of deficit spending comes entirely through increasing inflation expectations, and this is only

[36] To the first order the net present value of taxes will alway be equal to zero for the transversality condition of the representative household to be satisfied. A summary statistic like the one introduced earlier will then not be defined.

valuable if one assumes sticky prices. Since prices are flexible in an RBC model this channel has no role in that model. As a comparison I also include the size of the multiplier when interest rates are positive. In this case the multiplier is much smaller. The reason is that when interest rates are positive the central bank's actions are not constrained by the zero bound. This implies that there is a much lower gain for the bank to increase inflation and it will thus seek to offset any increase in inflation expectations by raising interest rates.[37] In contrast the central bank will keep interest rate low when the zero bound is binding due to deflationary shocks because in that case inflation is below the bank's desired inflation target.

The output benefit of the credit expansion can also be interpreted as the value of increasing inflation expectations at zero interest rates. If credible commitment about future monetary policy is possible then credit expansion in MPE is *equivalent* to announcing a higher future inflation target in periods in which the zero bound is no longer binding. Franklin Delano Roosevelt used both *persuasion* (i.e. commitment by announcement of his intentions about future prices) and policy *actions* that made these announcement more credible. Thus while I mostly focus on deficit spending this does not exclude the possibility that inflation expectations were also increased by FDR's announcements about his *policy objectives*. This alternative interpretation does not invalidate the thrust of the paper, rather, it makes the implementation of monetary expansion simpler (i.e. the government can engineer a monetary expansion without making it credible by fiscal policy actions). It also changes the interpretation of the deficit multiplier. It would, therefore, be misleading to characterize the result of this paper as showing that fiscal policy is effective but monetary policy is not. Here deficit spending is effective only through monetary policy, i.e. it makes a monetary expansion credible.[38]

While the economic logic of debt on the inflation incentive of the government is clear one may ask: How important was this channel during the Great Depression? One problem with addressing this question is the absence of the counterfactual. We do not know what would have happened if the government had not expanded its credit. An interesting episode, which serves as close to a counterfactual as possible, is provided by the recession of 1937-38. The recession was largely due to the fact that the Federal Reserve increased reserve requirements, which resulted in a slightly higher short-term nominal interest rate, as discussed in section 2. Given the high level of outstanding government debt at the time, this violated the policy rule FDRb. The government officials most closely monitoring that monetary policy was consistent with this policy rule were at the Treasury, the agency responsible for financing the budget deficits and debt

[37] In computing the multiplier at positive interest rate I assumed the same shock but that the central bank was not constrained by the zero bound.

[38] One interesting aspect of deficit spending versus real spending (see figure 9) is the different time paths of these policy variables. While the real spending solution involves a permanent increase in real spending during all periods in which the zero bound is binding, deficit spending is only temporarily higher. Deficit spending is thus more consistent with the old Keynesian idea that a quick jolt of spending can "jump start" the economy. The reason is that government debt is the state variable that increases inflation expectation. Only temporary deficit spending is needed to permanently increase government debt. In contrast, stimulating demand by real government spending requires a sustained increase in government spending in all periods in which the zero bound is binding. Interestingly the deficit and real spending under FDR were broadly consistent with this pattern. Deficit spending was strongest in FDR's first full year in office, 1934, and then declined. Government consumption, on the other hand, increased permanently.

payments. Historical evidence indicate that the Treasury reacted strongly to this action precisely because it was inconsistent with the policy regime suggested above. Marriner Eccles, the governor of the Federal Reserve, described the reaction of the Secretary of Treasury, Henry Morgenthau, to the increase in interest rates in May 1937 which was due to an increase in reserve requirements (see Eccles (1951) p. 292).

> I was out of Washington when this happened. After hurrying back to do what I could to correct the situation, I found Secretary Morgenthau understandably disturbed about the fall in government bond prices [i.e. increase in short term interest rate]. He insisted that the Federal Reserve Board rescind its order for the second part of the [reserve requirement] increase, which was to go into effect on May 1. In a tense meeting at his home on Saturday night he let it be known that if the Board failed to do what he urged, he would release a substantial amount of sterilized gold and thereby create new reserves that could be used to bolster the government bond market.

What this quote illustrates is that the Secretary of the Treasury threatened to take monetary policy away from the Federal Reserve unless it kept interest rate low. As Eccles notes the action the Secretary threatened "would indicate that the Secretary of the Treasury had taken over control of monetary and credit policy" because a release of sterilized gold would have lead to a corresponding increase in the monetary base. This narrative evidence indicates that the Treasury wanted inflationary policies to protect the low interest rate it was paying on its outstanding debt, consistent with the policy regime FDRb. It would take some time for Secretary Morgenthau to cow the Federal Reserve into reversing its policy but it finally did so in 1938 by order of FDR (see Meltzer (2003) p. 531).

5.3 The Economic Consequences of Franklin Delano Roosevelt measured in consumption equivalence units

I am now in a position to discuss the full scale FDR policy regime. In this case the government uses both deficit spending and real spending to stabilize output and prices. Figure 10 shows the FDR regime. This regime is a combination of FDRa and FDRb and takes the same form, i.e. it is characterized by equations (22), (23) and (25)-(29). There is an expansion in both real and deficit spending that results in a reflation and recovery in output relative to the Hoover policy regime. I compare the FDR regime regime with the optimal policy under commitment in figure 10, i.e. the policy if the government can commit to future policy (often referred to as the Ramsey equilibrium). The figure illustrates that the policy regime under commitment takes the same general form. In particular the optimal commitment is to commit to a higher price level and an output boom. Furthermore the optimal commitment is a temporary expansion in real spending. Deficit spending, however, plays a minor role in the Ramsey equilibrium because deficits are not needed in this case to make future inflation credible.

The model suggests that an unexpected shift in the policy regime from the Hoover policy regime to

the FDR policy regime results in an immediate increase in both deficit and real government spending. This policy shift is associated with a stabilization in prices and output. The model is thus successful in accounting for the movement of all these variables. To the extent the policy announcements of FDR in 1933 were not fully credible at the time, one should have observed a more gradual recovery as expectation adjusted with increasing debt and higher government spending. This can explain why prices and output recovered more gradually than predicted by the model. The reason why the policies were not fully credible immediately when announced can for example be explained by that it took time to enact legislation to put the spending programs in practice or that it took the private sector some time to learn about the regime change. One could account for an even more gradual increase in output by adding further sources of inertia in the model, such as habit in consumption, adjustment cost of capital and so on. This would complicate the model and I leave these extensions to future research.

What is the effect of the regime shift in the policy regime on the welfare of the representative household? Table 2 gives the answer to this question and measures the welfare consequences by evaluating the utility of the representative household. The utility is measured in terms of consumption equivalence units. It measures how much steady state consumption the household would be ready to give up in order to avoid the structural shocks which gave rise to the Great Depression in our numerical example. As the table full coordination (i.e. using both fiscal policy instruments) in a MPE implies a trivial welfare cost of the shocks (and almost as small as if the government could fully commit to future policy). Deficit spending (FDRb) is more important to increase welfare than real government spending. If the government uses only real spending the welfare cost of the shocks is quite substantial or 7.7 percent of steady state consumption per period. The welfare consequences of the shocks are very severe under the Hoover Policy Regime. In this case the households would be ready to give up 16.7 percent of their steady state consumption in each period to avoid the shocks. This also indicates that the representative household would have been ready to give up quite a lot, i.e. close to 16.4 percent (the difference between the Hoover policy regime and FDR) in order to replace Hoover in office with FDR. This is a measure of the economic consequences of Franklin Delano Roosevelt. It may also help explaining his landslide election victory in 1936.

6 Conclusions

What lessons can modern policy makers learn from the US experience in the Great Depression? The recession in Japan in the past several years has much in common with the Great Depression in the US (even if the output contraction and deflation is not of the same order). Since 2001 the Bank of Japan (BoJ) has maintained a zero interest rate, not unlike the near zero rates when FDR came into power. At the same time, as in the US during the Great Depression, Japan's CPI has consistently registered deflation and unemployment has been high. Below I offer some speculations on the similarities and differences between the actions of Japanese policymakers and FDR.

At a superficial level the reaction of the Japanese policymakers has been somewhat similar to FDR's actions in 1933. On the real government spending side there have been many attempts to increase demand by higher government spending. On the deficit side the Ministry of Finance has run large budget deficits so that gross debt over GDP has exploded to over 140 percent of GDP (although net debt remains lower see e.g. Eggertsson and Woodford (2003b) for discussion). Both the real and deficit spending in Japan are reminiscent of FDR's fiscal expansion. In addition to this the Ministry of Finance has engaged in aggressive purchases of foreign exchange. In 2003, for example, these operations amounted to close to 5% of Japanese GDP! This policy is reminiscent of FDR gold purchase program which was of similar order in 1933-34 and was conducted on foreign exchange markets. Finally the BoJ has adopted a policy of "quantitative easing" since 2001, a measure that is beyond what the Federal Reserve did in 1933. This policy mandates that the BoJ increases the monetary base (by targeting non-borrowed reserves) more than is required to maintain zero interest rate. The monetary base has been expanded on several occasions since 2001. Indeed, as of today, the monetary base is nearly double the size of what it was in 2001!

Despite these policy actions inflation expectations have barely moved in Japan (see Eggertsson and Ostry (2005)) and the CPI has showed little, or at least weak, signs of reversing its deflationary trend. This stands in sharp contrast to the FDR regime change where prices and expectations responded immediately to the new policy regime in the spring of 1933 as discussed in section 2. What is the missing link? Why has CPI responded so little in Japan while it rebounded so strongly in response to FDR's policies? The most plausible explanation, as argued in Eggertsson and Ostry (2005), is that the policy actions in Japan have not been taken in the context of a clear commitment to inflate the price level. Indeed the BoJ has been very reluctant to announce any goals for the price level or inflation.[39] This is in sharp contrast to the FDR policy regime change, where FDR explicitly stated that he aimed to inflate the price level to its pre-depression level. The policy actions he took, such as the gold purchases, and fiscal expansion, were thus effective because they were conducted in the context of a coherent reflation program and worked mainly because they made the reflation credible. In Japan, in contrast, the fiscal expansion and exchange interventions have been largely conducted by the Ministry of Finance and without any coordination with the BoJ or any explicit goals of inflating the price level. Furthermore the BoJ has full goal and instrument independence and there is little reason for market participants to link the evolution of the debt position of the Ministry of Finance to future inflation developments as argued in Eggertsson (2005). This is in sharp contrast to the FDR reflation program because that was conducted by a coordination of monetary and fiscal policy which was made possible by the Thomas Amendment passed in Congress in April 1933 which gave FDR broad powers to inflate. For a fiscal expansion to be effective a coherent reflation program is needed with explicit coordination of monetary and fiscal policy.

Given the outstanding debt in Japan, it may be sufficient for the BoJ to openly recognize the inherent

[39] With a notable exeption in October 2003 when the BoJ released a statement that said that interest rate would be kept low until inflation was postitive. While this commitment was in the right direction, and there is some evidence it had some effect, it did not go nearly as far as FDR policy statments and prices did not rebound strongly.

value of inflation from both the monetary and fiscal policy standpoint. The fact that there is such large outstanding debt should make a higher inflation goals credible, as long as it is believed that the BoJ is concerned about the fiscal health of the government. As a way of signalling this commitment, one approach would be to conduct large scale open market operations, a policy suggested by Auerbach and Obstfeld (2005), which would then be effective because of their signalling value.[40] If a credible inflation program is implemented in Japan, with coordinated monetary and fiscal policy, it is quite likely that the effect will be swift and visible, much in the same way as the recovery in 1933-37 in the US under Franklin Delano Roosevelt.

[40] Even if in principle they do not change the incentive of the government or interest rates, they may be usful to demonstrate BoJ willingness to inflate and its concern over the fiscal health of the government.

7 Technical Appendix

This Technical Appendix is released as a separate Staff Report.

Can also be downloaded at:

http://www.ny.frb.org/research/economists/eggertsson/index.htm

where all programs and data can be found.

8 Data

Real Gross National Product as plotted in figure 1 is taken from Romer (1988). It is Romer's revised estimates of pre-1929 GNP spliced with the real GNP series from the 1986 vintage of the National Income and Product Accounts (NIPA). Gross Domestic Product on a fiscal year basis, as reported in table 1, is published by the White House Office of Management and Budget. The federal government consumption and gross investment component of GDP is from the current NIPA tables. It is not available on a fiscal year basis for the time period under study, so it is reported it in calendar years in the table.

Total federal expenditures along with revenues are published by the White House OMB. The gold purchases are taken as the change in the monetary gold stock. This is found in table 156 of the Federal Reserve's volume of Banking and Monetary Statistics 1914-1941 (BMS); it can also be downloaded as series m14076 from the NBER Macro History database. The gold purchase series has been corrected for the $2.81 billion increase resulting from the decrease in the gold weight of the dollar.

It is important to take under consideration that much of the debt was held by the government itself. The Treasury, for example, bough a large part of the debt issued by the Reconstruction and Finance Corporation. Similarly the Federal Reserve bought a large part of the debt issued by the Treasury. I take this into account in table 1 by only counting public debt held by the private sector. It is the sum of all direct government debt and guaranteed securities (those issued as liabilities of government agencies with an explicit guarantee of the Federal government) less any interagency holdings and debt held by the Federal Reserve system. These series are also found in BMS from table 149 in section 13. This volume can be accessed online via the Federal Reserve Bank of St Louis' FRASER system at http://fraser.stlouisfed.org/publications/bms/.

The first two estimates of the deficit in table 1 are computed by subtracting tax revenues from total government spending. The first estimate corresponds to the deficit reported by the Office of Management and Budget. This estimate does not, however, take account of the Treasury's gold purchases which had a big impact on the government budget. The gold purchases are taken into account in the second estimate, also reported in table 1, which is better than the OMB one because it is a better account of the difference between *all* government spending and taxes and is therefore a better indicator of the increase in the government's inflation incentive. Even if one corrects the OMB deficit estimate for the gold purchases, however, it still does not reflect the true scale of the deficit spending in '34. The OMB budget data mostly reflect direct inflows and outflow from the General Fund of the Treasury. Under the New Deal, however,

several new government agencies were established and the mandate of others (such as the Reconstruction and Finance Corporation) was considerably extended. These agencies went on a spending spree that was only partially financed by funds from the General Fund. To make up for the difference they issued their own debt (guaranteed by the Treasury). This extra spending is usually not factored into the standard estimate of the deficit. One can get a better measure by adding the spending programs of the various agencies into total expenditures in Table 1 before taking the difference between spending and tax revenues to estimate the deficit. This approach is beyond the scope of this paper. Fortunately a much simpler approach is possible, which takes account of all the factors above, and that is the one taken in the third estimate reported in the text. The government must issue debt (either directly or indirectly) or increase the base in order to pay for goods and services in excess of tax revenues. Thus one can consider the period to period increase in the government's total liabilities as an alternative and more complete measure of the deficit.

The monetary base is measured as the end of year stock of currency held outside the Federal Reserve and Treasury plus the amount of non-borrowed reserves held by member banks of the Federal Reserve. Both series are downloaded from the NBER Macro History database, m14135 and m14123 respectively.

Total CPI and WPI are from the NBER Macro History database: series m04128 and m04048c respectively. Commodity prices are taken from the NBER Macro History database, they are m04019b (Wheat Flour), m04006b (Cotton), m04005 (Corn), m04007 (Cattle), m04008 (Hogs), m04015b (Copper), and m04123b (Gasoline). They are normalized to 100 at FDR's inauguration in March of 1933. The short-term interest rate is the constant maturity yield on 3 month Treasuries estimated by Cecchetti (1988). Ex-post real interest rates are deflated using the 3 month ahead annualized percent change in the Total CPI.

The monthly investment series is an index of new plant equipment orders from the 1937 Moody's Industrial Manual (a14). It is also reported in Temin and Wigmore (1990).

9 References

1. Auerbach, Allan, and Maury Obstfeld (2005) "The Case for Open Market Operations," American Economic Review, Volume 95, No. 1.

2. Barro, Robert J. (1979), "On the Determination of the Public Debt," The Journal of Political Economy, Volume 87, Issue 5, 940-971.

3. Barro, Robert J., and David B. Gordon. (1983) "A Positive Theory of Monetary Policy in a Natural Rate Model," The Journal of Political Economy, Volume 91, Issue 4, 589-610.

4. Baxter, Marianne and Robert G. King. (1993) "Fiscal Policy in General Equilibrium," American Economic Review, Volume 83.

5. Bordo, M., Evans, C. and C. Erceg (2000), "Money, Sticky Wages, and the Great Depression" (with Michael Bordo and Charles Evans), American Economic Review, vol. 90, pp. 1447-63.

6. Bordo, Michael, Ehsan Choudhri, and Anna Schwartz (2000), "Was Expansionary Monetary Policy Feasible during the Great Contraction: An Examination of the Gold Stnadard Constant." Explorations in Economic History 39, 1-28.

7. Blinder, Alan S. (1998), "Central Banking in Theory and Practice", MIT University Press.

8. Brown, E. Cary, "Fiscal Policy in the 'Thirties: A Reappraisal," American Economic Review, Vol. 46, No.3, p. 857-879.

9. Bureau of Economic Analysis (1986), The National Income and Product Accounts, 1929-1982. Washington D.C.

10. Calvo, Guillermo. (1978) "On the Time Consistency of Optimal Policy in a Monetary Economy," Econometrica, November 1978.

11. Calvo, Guillermo. (1983) "Staggered Prices in a Utility-Maximizing Framework," Journal of Monetary Economics, 12: 383-98.

12. Clarida, Richard, Jordi Gali and Mark Gertler (1999), "The Science of Monetary Policy: A New Keynesian Perspective," Journal of Economic Literature 37: 1661-1707.

13. Cole, H, and L. Ohanian, "New Deal Policies and the Persistence of the Great Depression: A General Equilibrium Analysis," Journal of Political Economy, Volume 112, Number 4.

14. Cecchetti, S. (1988), "The Case of the Negative Nominal Interest Rates: New Estimates of the Term Structure of Interest Rates During the Great Depression," Journal of Political Economy, Decmeber, 96, p. 1111-41.

15. Cecchetti, S. (1992), "Prices during the Great Depression," American Economic Review, Vol 82, No. 1, March, p. 141-156.

16. Christiano, L., Motto, R. and M. Rostagno (2004), "The Great Depression and the Friedman-Schwartz Hypothesis," Journal of Money, Credit and Banking.

17. Davis, Kenneth, S. (1986) "FDR The New Deal Years 1933-37," New York: Random House.

18. De Long, J.B., and Summers, (1986), "Is Increased Price Flexibility Stabilizing?" American Economic Review 76, 1031-1044.

19. Eccles, Marriner S. (1935). Testimony. House Committee on Banking and Currnecy. Hearings on the Banking Act of 1935. 74th Congress., 1st sess. Washington DC: Government Printing Office.

20. Eccles, Marriner S. (1951) "Beconing Frontiers," New York: Alfred A. Knopf Inc.

21. Eichengreen, B. and J. Sachs (1985), "Exchange Rates and Economic Recovery in the 1930s," Journal of Economic History, Vol. XLV, No. 4.

22. Eggertsson, Gauti (2003), "Fighting Deflation at Zero Interest Rates: Committing to Being Irresponsible," IMF Working Paper WP/03/64.

23. Eggertsson, Gauti. (2005), "The Deflation Bias and Committing to Being Irresponsible," Journal of Money, Credit, and Banking, forthcoming.

24. Eggertsson, Gauti and Jonathan Ostry (2005) , "Does Excess Liquidity Pose a Threat in Japan," Federal Reserve Bank of New York Economic Policy Review, forthcoming.

25. Eggertsson, Gauti and Woodford, Michael (2003a), "The Zero Bound on Interest Rates and Optimal Monetary Policy," Brookings Papers on Economic Activity 1, 212-219.

26. Eggertsson, Gauti and Woodford, Michael (2003b), "Optimal Monetary Policy in a Liquidity Trap," NBER Working Paper no. 9968.

27. Eggertsson, Gauti and Michael Woodford. (2004), "Optimal Monetary and Fiscal Policy in a Liquidity Trap," ISOM conference volume, forthcoming.

28. Federal Reserve Board (1943), Banking and Monetary Statistics. Washington D.C. Available via FRASER at http://fraser.stlouisfed.org/publications/bms/.

29. Friedman, Milton. (1969), "The Optimum Quantity of Money," in The Optimum Quantity of Money and Other Essays, Chicago: Aldine, 1969.

30. Friedman, Milton and Anna Schwartz. (1963), "A Monetary History of the United States," Princeton University Press.

31. Goodfriend, M. and Robert King (1997), "The New Neoclassical Synthesis and the Role of Monetary Policy," National Bureau of Economic Research 1997 Macroeconomics Annual, pp.231-95.

32. Hamilton, James D. (1992), "Was the Deflation During the Great Depression Anticipated? Evidence from teh Commodity Futures Market," American Economic Review, March, 82, p.157-82.

33. Harrison, Sharon G and Weder, Mark (2002), "Did Sunspot Forces Cause the Great Depression?," Journal of Monetary Economics, forthcoming.

34. Hsieh, C.T., and Christina Romer (2001), "Was the Federal Reserve Fettered? Devaluation Expectations and the 1932 Monetary Expansion," NBER Working Paper No. 8113.

35. Hoover, Herbert, (1934): "The state papers and other public writings of Herbert Hoover". edited by William Starr Myers. Doubleday, Doran & Co. Available at http://www.geocities.com/mb_williams/hooverpapers/.

36. Jeanne, O., and Svensson, L. (2004) "Credible Commitment to Optimal Escape from a Liquidity Trap: The Role of the Balance Sheet of an Independent Central Bank," mimeo, Princeton University.

37. Keynes, John Maynard. (1936) "The General Theory of Employment Interest and Money", London: Macmillan.

38. Kinderlberger, C.P. (1986), "The World in Depression, 1929-1939", Berkeley: California University Press.

39. Krugman, Paul. (1998), "It's Baaack! Japan's Slump and the return of the Liquidity Trap," Brookings Papers on Economic Activity 2:1998.

40. Kydland, Finn E. and Edward C. Prescott. (1977): "Rules Rather than Discretion: The Inconsistency of Optimal Plans." J.P.E. (85): 473-91.

41. Lucas, Robert and Stokey, Nancy. (1983), "Optimal Fiscal and Monetary Policy in an Economy without Capital," Journal of Monetary Economics 12, p55-93.

42. Maskin, Eric. and Jean Tirole. (2001) "Markov Perfect Equilibrium: Observable Actions", Journal of Economic Theory.

43. Meltzer, Allan H. (2003): "A History of the Federal Reserve. Volume 1: 1913-1951", University of Chicago Press.

44. The New York Times (1935),"Caution Discerned in Reserve Policy," pg.F1, December 21.

45. Romer, Christina D. (1988), "World War I and the Postwar Depression: A Reinterpretation Based on Alternative Estimates of GNP," Journal of Monetary Economics 22, pp 91-115.

46. Romer, Christina D. (1992), "What Ended the Great Depression?" Journal of Economic History 52, December : 757-784.

47. Roosevelt, Franklin D (1933a), "Presidential Press Conference on April 19th 1933," in "Complete presidential press conferences of Franklin D. Roosevelt," volume 1 p. 152-161. Da Capo Press. New York: 1972.

48. Roosevelt, Franklin D. (1933b), "Radio Address of the President on the 7th of May 1933", in The Public Papers and Addresses of Franklin D. Roosevelt. Random House. New York: 1938.

49. Roosevelt, Franklin D. (1933c), "Radio Address of the President on October 22cond 1933", in The Public Papers and Addresses of Franklin D. Roosevelt. Random House. New York: 1938.

50. Rotemberg, Julio. (1982), "Sticky prices in the United States", Journal of Political Economy 90, p. 1187–1211.

51. Sargent, Thomas and Neil Wallace. (1981) "Some Unpleasant Monetarist Arithmetic," Federal Reserve Bank of Minneapolis Quarterly Review, 5:3, 1-17.

52. Sargent, Thomas (1983), "The Ends of Four Big Inflations," in Robert Hall (Ed.), Inflation: Causes and Effects. University of Chicago Press.

53. Summers, Lawrence. (1991), "Panel Discussion: Price Stability. how Should Long-Term Monetary Policy Be Determined?" Journal of Money, Credit and Banking, 23(3), 625-631.

54. Sumner, Scott (1996), "Bold and Persistent Experimentation: Macroeconomic Policy during 1933," Bentley College, working paper

55. Sumner, Scott (1997), "News, Financial Markets, and the Collapse of the Gold Standard, 1931-32," Research in Eocnomic History, 17, p. 39-89.

56. Sumner, Scott (2004), "Roosevelt, Warren, and the Gold-Buying Program of 1933", in Exchange Rates and Economci Policy in the 20th Century, eds. Catterall, R. and Aldcroft, D., Ashgate Publishing Group.

57. Svensson, Lars (2003), "Escaping from a Liquidity Trap and Deflation: The Foolproof Way and Others," Journal of Economic Perspectives 17-4, p. 145-166.

58. Temin, Peter, and Barrie Wigmore (1990), "The End of One Big Deflation," Explorations in Economic History, 27: p. 483-502. October.

59. Tobin, James, "Keynesian Models of Recession and Depression," American Economic Review Papers and Proceedings, May, 65, pg. 195-202.

60. The Wall Street Journal (1933a), "Unconvincing Reassurance," pg. 5, November 2.

61. The Wall Street Journal (1933b), "Higher Commodity Prices Held Needed," pg. 11, May 1.

62. United States Department of the Treasury.(1932), "Annual Report of the Secretary of the Treasury, 1934," Government Printing Office.

63. United States Department of the Treasury.(1933), "Annual Report of the Secretary of the Treasury, 1934," Government Printing Office.

64. Woodford, Michael. (2003), "Interest and Prices: Foundations of a Theory of Monetary Policy", Princeton University.

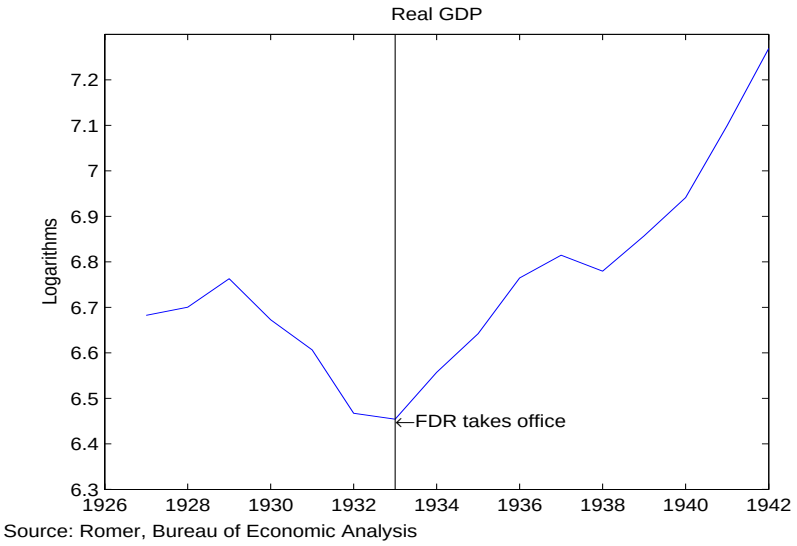

Figure 1: GDP rebounded when FDR took office.

Table 1. Measures of the Federal Deficit. Millions of Dollars, Fiscal Years Ending June of

	1930	1931	1932	1933	1934	1935	1936	1937	1938	1939	1940	1941
Total GDP	97,400	83,800	67,600	57,600	61,200	69,600	78,500	87,800	89,000	89,100	96,800	114,100
Federal government consumption[1] and gross investment	1,830	1,879	1,829	2,286	3,278	3,374	5,565	5,092	5,719	6,018	6,472	17,973
Total Expenditures	3,540	3,917	3,749	4,958	7,521	7,612	9,718	9,260	7,600	12,221	12,998	16,693
Federal expenditures (excl. gold)	3,320	3,577	4,659	4,598	6,541	6,412	8,228	7,580	6,840	9,141	9,468	13,653
Gold purchases[2]	220	340	-910	360	980	1,200	1,490	1,680	760	3,080	3,530	3,040
Total Revenues	4,058	3,116	1,924	1,997	2,955	3,609	3,923	5,387	6,751	6,295	6,548	8,712
Total Liabilities (stocks)	20,727	22,129	23,649	26,954	32,456	37,896	44,555	47,713	48,451	54,009	59,744	66,782
Monetary Base	6,397	6,742	6,873	7,484	9,165	10,552	11,598	13,358	14,364	17,110	21,406	22,701
Currency in circulation	4,255	4,525	5,305	5,515	5,400	5,580	6,120	6,495	6,495	7,025	7,810	9,500
Non-borrowed reserves	2,142	2,217	1,568	1,969	3,765	4,972	5,478	6,863	7,869	10,085	13,596	13,201
Public debt[3]	14,330	15,387	16,776	19,470	23,291	27,344	32,957	34,355	34,087	36,899	38,338	44,081
Deficit measures (+)												
Expenditures excl. gold - revenues	-738	461	2,735	2,601	3,586	2,803	4,305	2,193	89	2,846	2,920	4,941
Total expenditures - revenues	-518	801	1,825	2,961	4,566	4,003	5,795	3,873	849	5,926	6,450	7,981
Change in total liabilities		1,402	1,520	3,305	5,503	5,440	6,659	3,158	738	5,558	5,735	7,038

Source: Fiscal year GDP, expenditures, and revenues are from the White House Office of Management and Budget; government consumption is taken from NIPA; all other series are found in the Federal Reserve Board publication *Banking and Monetary Statistics 1914-1941*

[1] Reported in calendar years

[2] Gold Purchases are corrected for a 2.81 billion increase in 1934 after the revaluation of gold against the dollar

[3] Measures the total privately held debt of government direct and guaranteed securities

Key monetary and fiscal statistics from the Great Depression

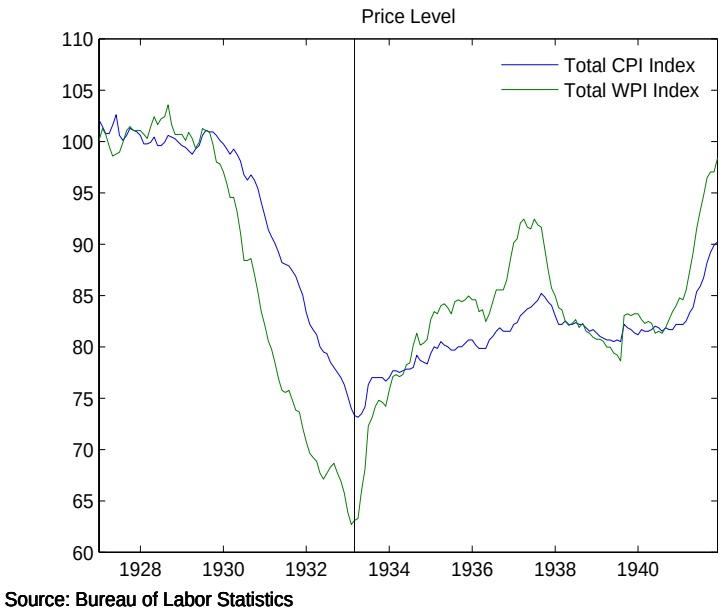

Figure 2: Prices started on an upward trend when FDR took office.

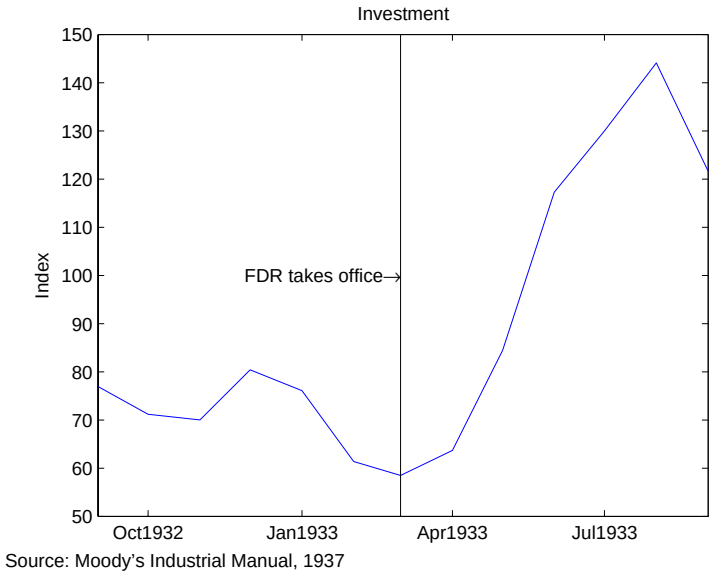

Figure 3: Investment responded most strongly to the FDR regime change consistent with the theory of the paper.

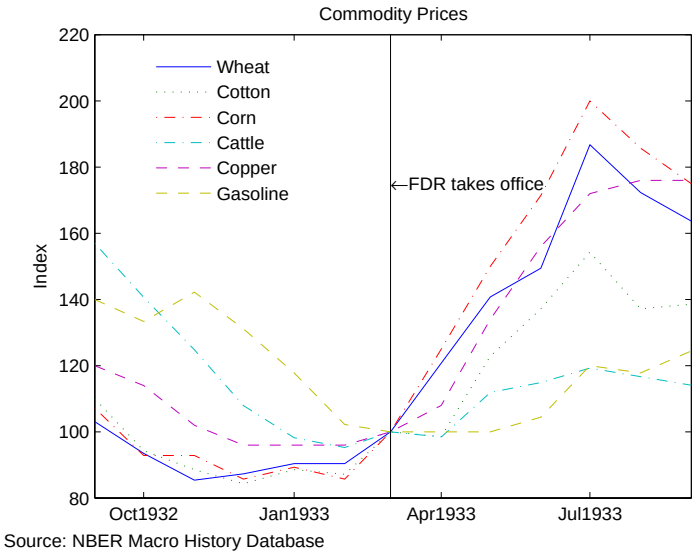

Figure 4: Prices determined on auction markets, and thus most sensistive to change in expectation, responded even more strongly than the CPI to the FDR regime change. The figure shows a one year windows around FDR inauguration.

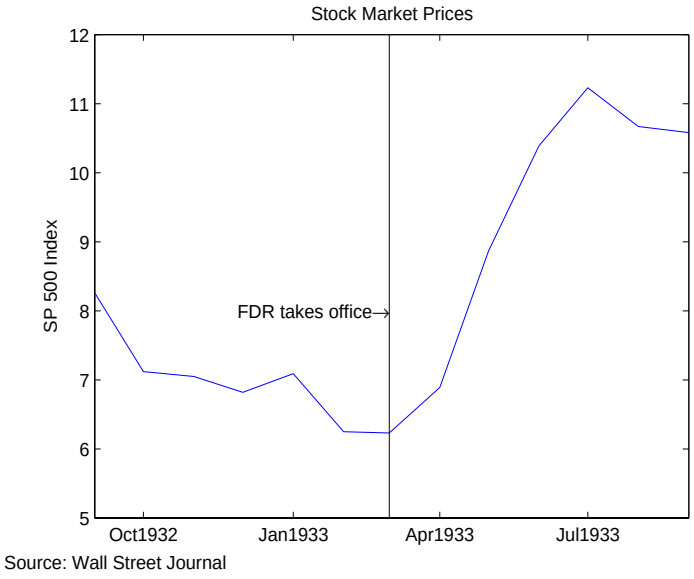

Figure 5: The stock market increased by over 66 percent in FDR's first 100 days.

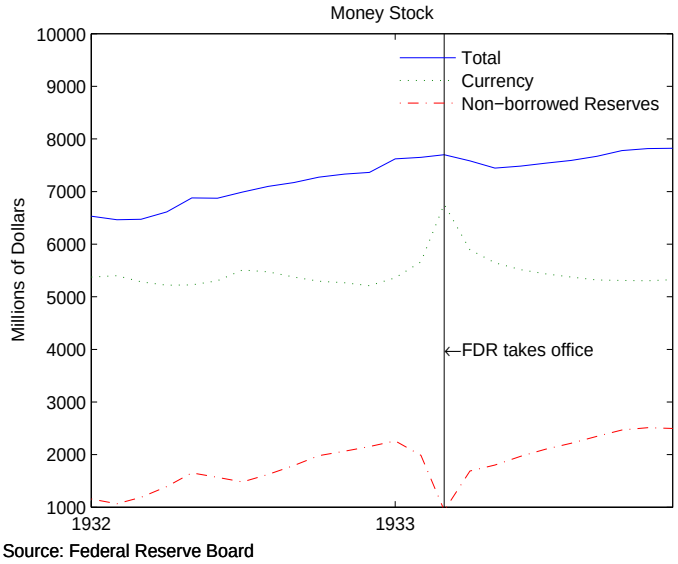

Figure 6: There is no evidence that the rebound in prices and output due to FDR rise to power was due to an increase in the money stock.

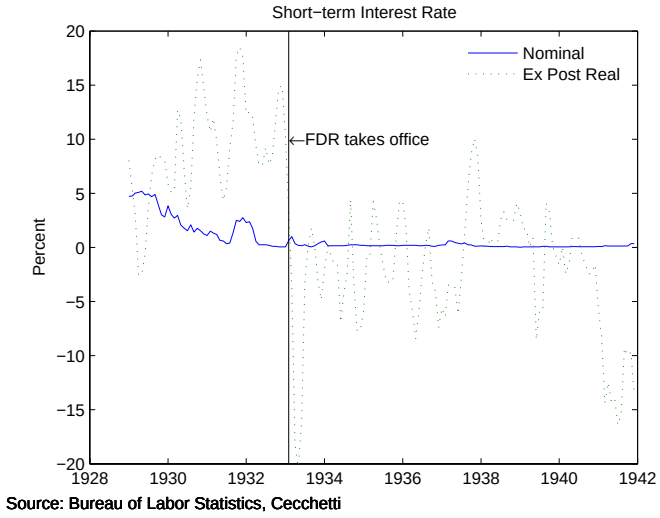

Figure 7: Real Rates collapsed with FDR rise to power thus stimulating demand.

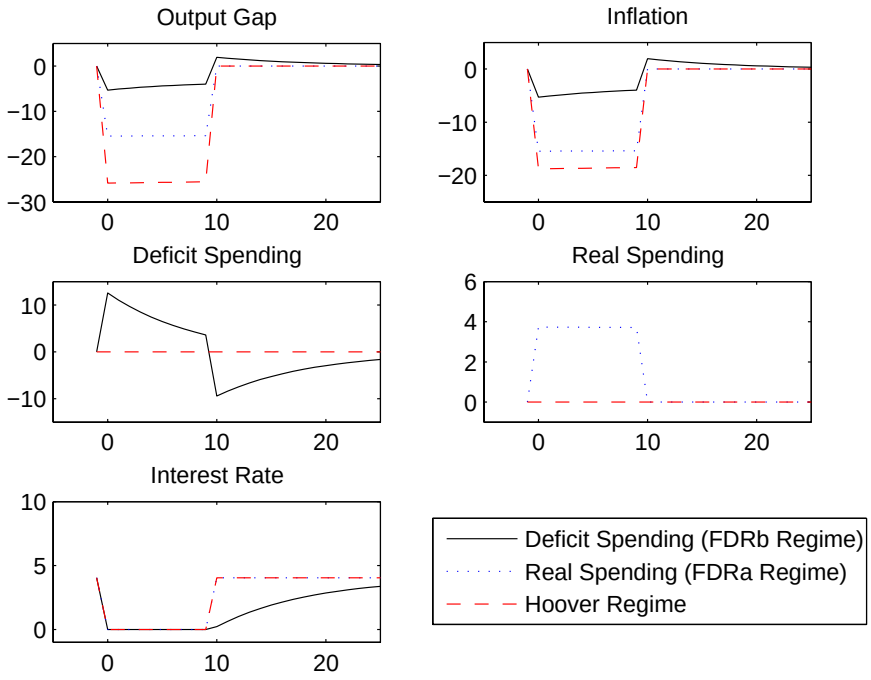

Figure 8: The model predicts an output collapse and double digit deflation under the Hoover policy regime but a very modest contraction under the FDR regime.

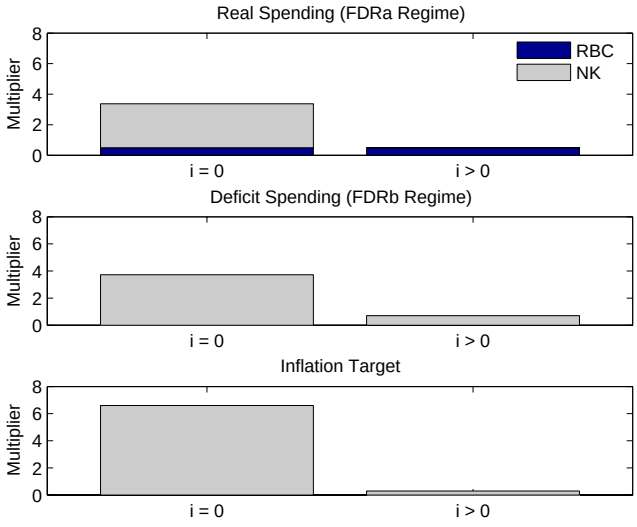

Figure 9: Fiscal policy is much more important to increase demand at zero interest rate than under normal circumstances when interest rate are positive.

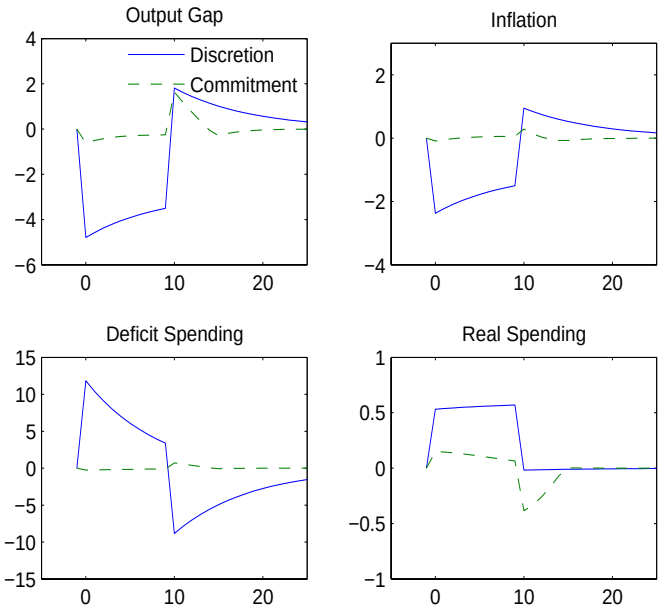

Figure 10: The FDR policy regime is relatively close to the optimal equilibrium if the government can commit to future policy.

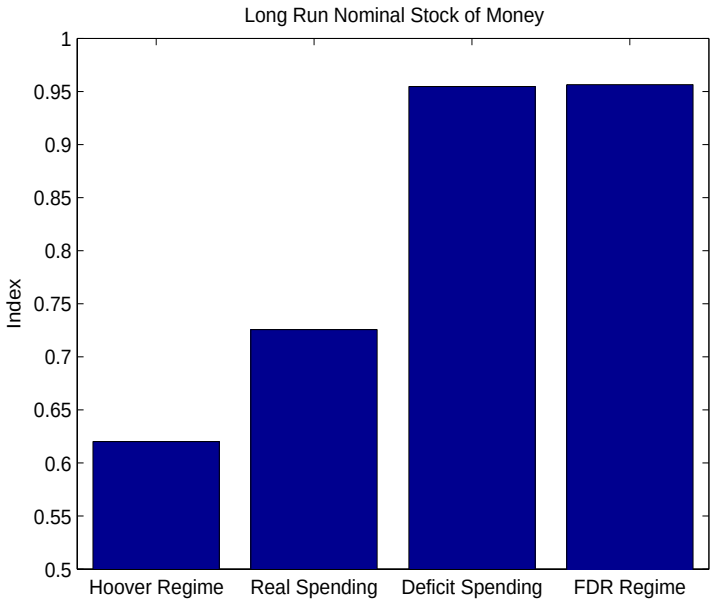

Figure 11: The long run nominal money stock = 1 in the absence of shocks.

Table 2.

	Consumption Equivalence Units Per Quarter
Ramsey Equilibrium	-0.0028
FDR Policy Regime	-0.2150
FDRa	-0.2395
FDRb	-7.6811
Hoover Policy Regime	-16.6508