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A tale of two countries: Fiscal multipliers and policy coordination

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This paper offers an explanation of why recovery measures – such as fiscal spending, exchange interventions, and large increases in the money supply – had a smaller effect on nominal demand in Japan in the Great Recession (1992-2005) than in the US during the Great Depression (1930's). In both episodes the short-term nominal interest rate was close to zero. The paper studies these episodes in a dynamic general equilibrium model with rational expectations. The paper suggest that the difference is due to Bank of Japan's independence. In contrast, in 1933, the independence of the Federal Reserve was eliminated and monetary and fiscal policy coordinated in conjunction with the recovery measures. The paper makes some preliminary suggestions for an institutional mechanism that takes advantage of policy coordination in the face of deflationary pressures, while preserving the well known advantages of central bank independence under normal circumstances.

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This paper tells a tale of two countries, the US during the recovery from Great Depression in 1930's and Japan during the Great Recession in 1992-2005.[1] Both countries saw unusually large policy actions as measured by interest rate cuts, increases in the money supply, expansion in fiscal variables and exchange market interventions. Yet, the outcomes were very different. In this paper I study these events in a dynamic general equilibrium model building on Eggertsson and Woodford (2003) and Eggertsson (2005,6). I argue that the different outcomes are explained by the independence of the Bank of Japan relative to the Federal Reserve's during the 1930's. Illustrating how economic outcomes, as a function of policy actions, depend on the institutional framework is the main new element in this paper and gives a novel interpretation of these events. In the light of these findings I make a preliminary suggestion for an institutional framework that takes advantage of policy coordination in the face of deflationary pressures, while preserving the well known advantages of central bank independence under normal circumstances.

While the Great Depression in the US and the Great Recession in Japan were very different along several dimensions, there are some important similarities. Both events started with a big decline in the stock market. In the aftermath of these large shocks both central bank cut the interest rate down to zero, albeit somewhat gradually, to counteract an economic slowdown. Table 1 shows that by 1996 the overnight interest rate had declined close to zero in Japan. While there is no comparable data for the US during the Great Depression the closest proxy is the interest paid on 3 month Treasuries. Table 2 shows that according to this measure, by the end of 1932, the short-term interest rate had also declined close to zero in the US. Another similarity is that both countries experienced deflation and contraction in nominal GDP. During the entire Great Recession in Japan nominal GDP stagnated and there was mild deflation, while the US experienced sharp and violent decline in prices and nominal GDP during the first and second phase of the Great Depression in 1929-33 and 1937-38.

Another striking similarity is the response of the policy makers in Japan and the US. After the nominal interest rate reached zero in both countries the central banks expanded the monetary base much beyond what was required to keep the interest rate at zero. The Federal Reserve almost doubled the nominal base of money in 1933-37 (the initial phase of the recovery). Similarly in 1996, once the interest rate reached zero, to 2006 the BoJ more than doubled the base. The BoJ was especially aggressive in the period of "quantitative easing" that started in May 2001 and ended in the spring of 2006 when the base was expanded by 70 percent in nominal terms. On the fiscal front a similar picture emerges. In the US, the government spent 70 percent more dollars in 1937 than in 1933. The expansion of government expenditures, if measured as a ratio of 1933 GDP, was 6 percent. The growth rate of government spending in Japan was smaller. The Japanese government spent 20 percent more yens in 2005 than in 1992. However, if the increase is

[1] Assuming, as seem very likely, that the Great Recession is finally over.

measured as a fraction of 1992 GDP it is about the same as in the US, or 6 percent (table 1).[2] In neither country were these spending increases financed by tax hikes. Instead, both governments ran large deficits. The annual deficits were 4-9 percent of GDP in the US from 1933-37 and they have been of similar order throughout the Great Recession in Japan. In fact, net government debt, as a fraction of GDP, was 94.7 percent in Japan as of 2006 up from 14.3 percent in 1992 before the onset of the Great Recession. Finally, both countries intervened in the foreign exchange markets. The Ministry of Finance in Japan has bought foreign exchange on several occasions. In 2003, for example, the interventions corresponded to about 5,7 percent of GDP and 37 percent of the monetary base (Lipscomb and Tille (2005)). One can to some extent interpret US purchases of gold as corresponding to foreign exchange interventions. The scope of these interventions were of similar order, for example, in 1933-34 (Eggertsson (2005)).[3]

Despite the similarities in policy *actions* the *outcomes* were radically different. A sensible measure of outcomes is nominal GDP. A real business cycle theorist expects a nominal demand stimulus to mainly increase the price level whereas a Keynesian or a monetarist expects some combination of real output and price increases. All theories that I am aware of, however, suggest that *nominal* GDP increases. Consider the reaction of nominal GDP in the US 1933-37 after FDR started expansionary policies in earnest. In 1933-37 nominal GDP expanded by 52 percent, of which about 80 percent is explained by growth in real GDP, and 20 percent by inflation (table 2). In contrast, nominal GDP contracted or stagnated throughout the Great Recession in Japan due to ongoing mild deflation and modest or no real growth (table 1). The nominal GDP in 2005 was only 5 percent higher than it was in 1992 and 2 percent lower than in 1997. What is the reason for the radically different outcomes?

The reigning hypothesis for the US growth in 1933-37 attributes it to the monetary expansion. Leading proponents include Friedman and Schwartz (1963), Romer (1992) and more recently Bordo, Erceg and Evans (2000). All authors point towards the increase of the monetary base (or usually M1). But if 70 percent increase in the nominal stock of money increased nominal GDP by 52 percent in the US, why did the larger increase in Japan not lead to a robust recovery in nominal GDP? The leading alternative is that the fiscal expansion. But if increasing government spending by 6 percent of GDP and running deficits of 4-9 percent increased nominal GDP by 52 percent in the US, why did the larger and more sustained increase in Japan not lead to a robust

[2] This is explained by that the government in Japan was much bigger in 1992 in relative terms than the US government in 1933. It is worth stressing that although deficits and government expenditures have increased in Japan, government consumption of final goods and services has by various measures not been increased substantially since 1996 (Broda and Weinstein (2005)). Similar points, however, have been made about the government expansion in the US during the Great Depression, see Brown (1956), so this fact hardly explains the difference in outcomes.

[3] The US went of the gold standard in 1933. The dollar value of gold was again fixed in 1934 only to be changed in the 1970's but it is generally argued that the US was off the gold standard for all practical purposes from 1933 onwards.

recovery in nominal GDP?

The hypothesis of the US recovery in this paper relies on a recent paper, Eggertsson (2005), which argues that the recovery was driven by a shift in expectation. This shift was triggered by policy choices of FDR. In particular FDR announced an explicit target to raise prices. A large recent literature on the liquidity trap has shown (e.g. Krugman (1998), Auerbach and Obstfeld (2005), Eggertsson (2005,6), Eggertsson and Woodford (2003), Svensson (2001,3) and Jeanne and Svensson (2006)), that when the short-term interest rate is zero, as in 1933 when FDR took power, it is crucial to increase expectation about future money supply to stimulate demand. The problem is how to generate these expectations. I argue in Eggertsson (2005) that FDR achieved this with the fiscal expansion and other actions that affected the balance sheet of the government (such as foreign exchange interventions) because they made future monetary expansion "credible." Printing money in the future became crucial to finance the fiscal actions and preventing future balance sheet losses. This paper adds to the story in Eggertsson (2005) by emphasizing that for this channel to work then monetary and fiscal policy need to be coordinated.

Why did the public's expectation about the future money supply not increase as dramatically in Japan as they did during 1933-37 in the US, when the fiscal and monetary policy actions have been just as dramatic? The most obvious difference is that in addition to the various expansionary actions, FDR announced an explicit objective to inflate the price level to pre-Depression level (Eggertsson (2005)). In Japan, in contrast, despite various expansionary actions, policymakers never made an explicit commitment to future inflation. Yet, if this explanation is the silver bullet, it should leave economist a bit unsettled. Is the lesson that policy *actions* are irrelevant, and all that matters is what policy makers *say*? And why did FDR's words have such tremendous power in 1933? We have several records of President Hoover's pronouncement's in 1929-33 that a recovery in prices and output was just around the corner – even if he did not specify exactly pre-depression levels for prices. Similarly, Japanese policy makers have on occasions made similar predictions. Why did these words not carry the same weight?

In this paper I explain the strong reaction of nominal demand in the US vs the weak response in Japan with differences in the monetary and fiscal institutions in the two countries. In particular I assume that the Bank of Japan is independent, while in the US monetary and fiscal policy were coordinated and I document in section (8) how this coordination was achieved through legislation in the US Congress. This explanation does not rely on policy makers "words". Instead, words have no power in the paper.[4] While extreme, the assumption that words carry no weight is very

[4]This is surely an extreme assumption that does not hold exactly. There is some evidence, for example, that BoJ's announcement in the fall of 2003 were helpful to stimulate demand. At that time the bank announced that the short-term interest rates would be zero until the CPI changes moved back into postitive territory, which helped lowering real rates and stimulate spending. Similar announcements by the Federal Reserve in 2003 most likely also stimulated demand (but Fed funds rate were then at 1% and there were concerns over deflation).

useful to isolate the importance of different institutions, and to distinguish between why some actions had a big effect in the US in the 1930's while little or no effect in Japan. It also highlights what types of actions are likely to be helpful to make various communication strategies *credible* and which institutional reform may facilitate this objective. This is what leads me to consider an equilibrium in which the government is purely discretionary so that it cannot commit to any future actions (as e.g. in Kydland and Prescott (1977)) apart from that it will repay any debt issued (as in Stokey and Lucas (1987)).

In this paper an independent central bank is defined as a bank that has an objective that is different from social welfare and is not constrained by the government budget constraint or borrowing limit. Coordinated monetary and fiscal policy, on the other hand, is when monetary and fiscal policy are set jointly to maximize social welfare and jointly responsible for satisfying the government budget constraint. Under coordination, deficit spending increases output and prices at zero interest rates because it credibly increases expectations about future money supply since this has fiscal benefits (as e.g. stressed by Calvo (1977) and more recently by Eggertsson (2005,6) and Auerbach and Obstfeld (2005)).

While coordination of monetary and fiscal policy can explain the recovery in the US in 1933-37 and the lack thereof the prolonged recession in Japan, there are some alternative explanations. One alternative is that the US recovery was due to the resolution of the banking crisis in the spring of 1933, an explanation that has been emphasized by many authors. Given the difficulties in the Japanese banking system, one could speculate that what was missing in Japan was not coordination of monetary and fiscal policy but a cleanup of the banking system. While solving the banking crisis was certainly a contributing factor in the recovery in 1933-37, this hypothesis has the weakness that it does not explain the second contractionary phase of the Great Depression in 1937-38 and the recovery starting from 1938. During the second phase there were no banking crisis. As I argue in section 8, however, the recession in 1937 can be interpreted through the lenses of the *same theory* as we apply here, namely that the Federal Reserve was re-asserting its independence (mainly through raising reserve requirements) and the private sector *expected* it to renege on the administration commitment to re-inflate prices to pre-Depression levels. Hence FDR's commitment to permanently increase the money supply was no longer credible in 1937. Similarly, I argue in section 8, that the recovery in 1938 can be interpreted as a renewed commitment to inflating the price level by a coordination of monetary and fiscal policy.[5]

[5] A similar comments applies to an alternative hypothesis that abolishing the gold standard explains the recovery in 1933, in exclusion of the channel proposed. While I argue in Eggertsson (2005) argues that going of gold was a necessary condition for the recovery, it was not a sufficient condition. Some countries that abolished the gold standard (such as Britain) did not experience fast growth during the Great Depression. Furthermore, the price of gold was fixed from 1934 until to the 1970's so focusing on the government mandated price of gold in dollar terms cannot explain the recession in 1937-38 and the recovery in 1938.

While the main point of the paper is positive, namely trying to understand the tale of the two countries, we can also draw some normative conclusions. The results indicates that some cooperation between the treasury and the central bank can be helpful to react to deflationary shocks. The normative conclusions I draw formalize an argument for coordination made by Governor Ben Bernanke of the Federal Reserve in Japan in 2003

> It is important to recognize that the role of an independent central bank is different in inflationary and deflationary environments. In the face of inflation, which is often associated with excessive monetization of government debt, the virtue of an independent central bank is its ability to say "no" to the government. With protracted deflation, however, excessive monetary creation is unlikely to be the problem, and a more cooperative stance on the part of the central bank may be called for.

In section 6 I suggest a concrete proposal on how cooperation of this kind may arise which, while calling for temporary coordination, preserves the long-term independence of the central bank.

Jeanne and Svensson (2006) argue that an independent central bank can increase inflation expectations by using its own balance sheet as a commitment device. While my model supports their result, I argue in section 6 that a rational independent central bank may not always choose to use this option, becoming what Paul Samuelson termed "the prisoner of its own independence". The argument I use formalizes a similar argument made by several academics and central bank governors such as Sims (2001), Bernanke (2003), Ito and Mishkin (2005), Ueda (2003) and Fukui (2003).

The importance of fiscal policy emphasized here relates to a recent literature on the fiscal theory of the price level (see e.g. Sargent and Wallace, Leeper (1992), Woodford (1999) and Benhabib, Schmitt-Grohe, Uribe (2003)). The key difference between my model and these contribution is that I model the government as a maximizing agent subject to certain constraints while the fiscal theory characterizes policy by exogenous "policy rules". This allows me somewhat richer interpretation along certain dimensions and clarifies the role of central bank independence.

1 The Model

Here I outline a simplified version of a standard New Keynesian model, assuming reduced form money demand and special functional forms.[6] I assume there is a representative household that maximizes expected utility over the infinite horizon:

$$E_t \left\{ \sum_{T=t}^{\infty} \beta^{T-t} b_T [\log C_T + \chi \log G_T - \psi \frac{h_T^{1+\omega}}{1+\omega}] \right\} \tag{1}$$

[6] A more detailed version is in Eggertsson (2006) with a money-in-utility function and general functional forms.

where b_t is an intertemporal shock, C_t is a Dixit-Stiglitz aggregate of consumption of each of a continuum of differentiated goods

$$C_t \equiv [\int_0^1 c_t(i)^{\frac{\theta}{\theta-1}}]^{\frac{\theta-1}{\theta}}$$

with elasticity of substitution equal to $\theta > 1$, G_t is is a Dixit-Stiglitz aggregate of government consumption, P_t is the Dixit-Stiglitz price index,

$$P_t \equiv [\int_0^1 p_t(i)^{1-\theta}]^{\frac{1}{1-\theta}}$$

and h_t is hours worked. E_t denotes mathematical expectation conditional on information available in period t. For simplicity I assume that only one period riskless government bonds and money are traded so the household faces the budget constraint

$$C_t + B_t + M_t = (1 + i_{t-1})B_{t-1} + M_t + Z_t + n_t h_t - T_t$$

where Z_t is a representative firm profit, T_t taxes, M_t money, B_t one period riskless bonds, i_t one period nominal risk-free interest rate and n_t wages . The household maximizes its utility subject to the budget constraint by choice of its asset holdings, labor and consumption. There is a continuum of firms on the unit interval that maximize expected discounted profits. Firms produce using a production function that is linear in labor and I abstract from capital dynamics. As Rotemberg (1983), I assume that firms face a resource cost of price changes $\frac{\delta}{2}(\frac{p_t(i)}{p_{t-1}(i)} - 1)^2$. For algebraic simplicity I follow Rotemberg and Woodford (1997) by assuming a subsidy $(1+s) = \frac{\theta}{1-\theta}$ for each unit produced so that production is at its efficient level in steady state and there is no inflation bias (see Eggertsson (2006) for the general case).

The first order conditions of the household and firm maximization problems can be summarized by two Euler equations. The household consumption decisions satisfies the Euler equation often referred to as the "IS equation"

$$C_t = (1 + i_t)f_t^e \tag{2}$$

where $f_t^e = E_t C_{t+1}^{-1} \Pi_{t+1}^{-1} \beta \frac{b_{t+1}}{b_t}$ is an expectation variable and $\Pi_t \equiv \frac{P_t}{P_{t-1}}$. This equation says that consumption demand depends on expected future consumption, the nominal interest rate, expected inflation and the intertemporal shocks. The firm optimal pricing decisions on the one hand, and the household optimal labor supply decisions on the other, also satisfy an Euler equation, often referred to as the "AS equation"

$$\Pi_t(\Pi_t - 1) = \frac{\theta}{\delta}(\psi C_t Y_t^{\omega} - 1)Y_t + \beta C_t S_t^e \tag{3}$$

where $S_t^e = E_t \Pi_{t+1}(\Pi_{t+1} - 1)C_{t+1}^{-1} \beta \frac{b_{t+1}}{b_t}$ is an expectation variable. This equation is a standard New Keynesian Phillips curve that says that inflation depends on the marginal cost of production and expected inflation deflated by the stochastic discount factor.

There is an output cost of taxation (e.g. due to tax collection costs as in Barro (1979)) captured by the function $\frac{\gamma}{2}T_t^2$. For every dollar collected in taxes $\frac{\gamma}{2}T_t^2$ units of output are wasted without contributing anything to utility. Total government real spending is then given by

$$F_t = G_t + \frac{\gamma}{2}T_t^2.$$

In the remainder of the paper all expressions are written in terms of F_t instead of G_t using the equation above. The government budget constraint can be written as

$$w_t = (1 + i_t)[w_{t-1}\Pi_t^{-1} + F_t - T_t] \tag{4}$$

where I have defined the variable $w_t \equiv \frac{B_t(1+i_t)+M_t}{P_t}$ as the real value of the end-of-period government debt inclusive of interest payments. To ensure solvency I assume that the government needs to satisfy a debt limit

$$w_t \leq \bar{w} \tag{5}$$

which excludes Ponzi schemes. Market clearing implies that

$$Y_t = C_t + F_t + \frac{\delta}{2}(\Pi_t - 1)^2. \tag{6}$$

Without entering into the details of by what means the central bank controls the nominal interest rate it is important to observe that as long as the government is committed to supply a nominal claim ('money') with zero return there is a zero bound on the short term nominal interest rate

$$i_t \geq 0 \tag{7}$$

An equilibrium is a collection of stochastic processes for $\{T_t, F_t, i_t, C_t, Y_t, \pi_t\}$ that satisfy equations (2)- (7) for a given path for the exogenous shock$\{b_t\}$.

An equilibrium can be defined without any reference to the money supply. A money demand equation can be appended to the model for example by having money supply entering additively separately in utility (see e.g. Eggertsson (2006)). The money demand equation only has a role in determining money demand given the interest rate and consumption. For pedagogic purposes it is somewhat useful to keep track of a money supply since much of the earlier literature is cast in terms of money. I assume, as e.g. Krugman (1998) and King and Wolman (2003), that a certain fraction of production needs to be held in money balances so the following inequality has to be satisfied.

$$\frac{M_t}{P_t} \geq vY_t \tag{8}$$

I abstract from any effect money balances have on utility or welfare. At zero interest rate this inequality can be slack because the households is be indifferent between holding money instead of bonds.

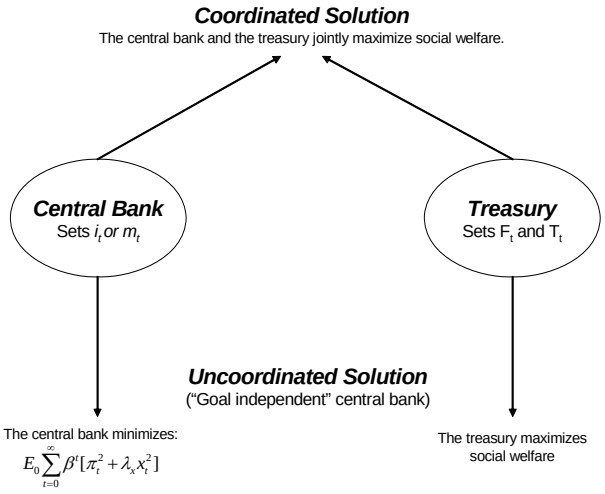

Figure 1: *Diagram 1: The central bank and the treasury can act together or separately when setting their policy instruments.*

2 Institutions

I assume that monetary and fiscal policy were coordinated in the US in 1933-37 during the Great Depression while they were uncoordiated in Japan during the Great Recession. What does coordination mean in this paper? This is illustrated in diagram 1. There are two government agencies, the central bank and the treasury. The central bank sets the interest rate, i_t, (or alternatively the money supply M_t). The treasury decides spending F_t and taxes T_t. Policy is coordinated when the treasury and the central bank join forces to maximize social welfare. Policy is uncoordinated when each agency pursues its own objectives. The example I consider for uncoordinated policy is when the treasury maximizes social welfare but the central bank pursues narrower objective. I refer to this institutional arrangement as a case in which the central bank is "independent". I assume that the independent central bank minimizes the quadratic deviation of inflation and output from a target, a relatively standard objective in the literature, but one could consider other specifications for the preferences of the bank without changing the central results. An important additional assumption is that I assume that the independent central bank is not responsible for that the budget constraint and borrowing limit of the treasury are satisfied. If this assumption is not made the treasury can force the central banks hands by accumulating debt up to the limit and then cut taxes further (in which case the central bank has to inflate for

the budget constraint and borrowing limit to hold). The key difference between coordinated and uncoordinated solution is that the independent central bank does not take into account the fiscal consequences of its actions. While this institutional arrangement is somewhat special, I think it captures a basic of the differences between monetary and fiscal policy in the two countries in the time periods studied.

At a more general level the motivation for this definition of independence is that in several industrial countries monetary policy has been separated from fiscal policy and given to independent central bankers. It is common practice to give the central bank a fairly narrow mandate such as aiming for "price stability" and protecting employment. The central banks mandate almost never includes any considerations of fiscal variables. Indeed the move towards central bank independence has often involved explicitly excluding fiscal policy from the bank's goals. In the case of Japan, for example, the Diet explicitly forbade the BoJ from underwriting government bonds after the experience of hyperinflation in World War II. Similarly the Federal Reserve's role in government finances was substantially reduced in the 1950s. Observe that this definition i.e. the goal independent central bank, is consistent with Rogoff's (1985) conservative central banker and is identical to Dixit and Lambertini (2003) institutional framework, but the latter authors also assume that the treasury maximizes social welfare but the central bank has more narrow goals.[7]

3 Discretionary Equilibrium under Coordinated Policy

3.1 Definition

This section defines optimal policy under discretion when monetary and fiscal policy are coordinated. Under discretion the government cannot commit to future policy. Optimal policy under discretion is sometimes referred to as a Markov perfect equilibrium. The timing of events in the game is: at the beginning of each period t, w_{t-1} is a predetermined state variable. At the beginning of the period, the shock b_t is realized and observed by the private sector and the government. The monetary and fiscal authorities choose policy for period t given the state and the private sector forms expectations f_t^e and S_t^e. I assume that the private sector may condition its expectation at time t on the policy actions of the government i.e. it observes the policy actions of the government in that period so that expectations are determined jointly with the other endogenous variables. The only endogenous state variable in the model at time $t+1$ is w_t. This implies is

[7] There are two key differences between this analysis and Dixit and Lambertini (2003). First, in their model fiscal policy is a choice of the optimal subsidy/tax on the private sector thus changing the equilibrium markup of firms. Here I abstract from any effect fiscal policy can have on relative prices and instead focus on deficit spending and real spending as the principal tools of policy (and these policy instruments have no effect on the markup of firms). Second, and perhaps more obviously, their paper does not address the questions posed by the zero bound.

that the expectation variables f_t^e and S_t^e are a function of w_t and b_t

$$f_t^e = \bar{f}^e(w_t, b_t) \tag{9}$$

$$S_t^e = \bar{S}^e(w_t, b_t) \tag{10}$$

so that the IS and AS equations can be written as

$$C_t = (1 + i_t)\bar{f}^e(w_t, b_t) \tag{11}$$

$$\Pi_t(\Pi_t - 1)^2 = \frac{\theta}{\delta}(\psi C_t Y_t^{\omega} - 1)Y_t + C_t \bar{S}^e(w_t, b_t) \tag{12}$$

Under discretion the government maximizes the value function $J(w_{t-1}, b_t)$ by its choice of the policy instruments taking the expectation functions $\bar{f}^e(w_t, b_t)$, $\bar{S}^e(w_t, b_t)$ as given because it cannot commit to future policy. Thus it solves

$$J(w_{t-1}, b_t) = \max_{F_t, T_t, i_t} \{[\log C_t + \chi \log(F_t - \frac{\gamma}{2}T_t^2) - \psi \frac{h_t^{\omega}}{1+\omega}]b_t + \beta E_t J(w_t, b_{t+1})\} \tag{13}$$

s.t. (4), (5), (6), (7), (11), (12). The first order conditions for the maximization problem are derived by writing the right hand side as a Lagrangian problem and setting the partial derivatives with respect to each of the variables $(\Pi_t, C_t, Y_t, w_t, i_t, F_t, T_t)$ to zero. Because the government is a large strategic player and moves simultaneously with the private sector it can choose a value for all these variables as long as they satisfy the private sector optimality conditions and the resource constraint.[8] The model has a well defined steady state with zero inflation and debt. The model is approximated around this steady state so that the solution is only accurate to the first order. In the next section we characterize this approximate solution.

3.2 Results

Below I show the linear approximation of the equilibrium. To express this solution it is useful to first define two concepts: the natural level of output and the natural rate of interest. The natural level of output is the output that if prices are flexible, i.e. $\delta = 0$ in equation (3). Using this equation in conjunction with (6) we obtain

$$\hat{Y}_t^n = \frac{\sigma^{-1}}{\sigma^{-1} + \omega}\hat{F}_t \tag{14}$$

where $\sigma \equiv \frac{C}{Y}$, $\hat{F}_t = \log F_t/\bar{Y}$ and the natural level is expressed in log deviation from steady state output. Output under flexible prices does not depend on the shock b_t but increases with $\hat{F}_t$ for

[8] There are some recent examples in the literature that assume that the government moves before the private sector within each period (see e.g. King and Wolman (2004), Albanesi, Chari, Christiano (2003)). In those cases there are some examples in which there can be multiple point-in-time equilibria, an issue that does not arize here. The timing assumption here is the same as in the linear-quadratic literature on discretion such as for example Clarida, Gali and Gertler (1999) and Woodford (2003).

familiar reasons from the RBC literature: Higher level of government consumption increases the marginal utility of consumption and thereby increases labor supply. The natural level of interest is the real interest rate when prices are flexible, i.e.

$$r_t^n = \bar{r} + \hat{b}_t - E_t\hat{b}_{t+1} + \frac{\sigma^{-1}\omega}{\sigma^{-1}+\omega}(\hat{F}_t - E_t\hat{F}_{t+1}) = r_t^e + \frac{\sigma^{-1}\omega}{\sigma^{-1}+\omega}(\hat{F}_t - E_t\hat{F}_{t+1}) \tag{15}$$

where $\bar{r} \equiv \log\beta^{-1}$, $\hat{b}_t \equiv \log b_t/\bar{b}$. The natural rate of interest depends both on the intertemporal shock and fiscal spending. I summarize the exogenous component of the natural rate by r_t^e.

A linear approximation of the private sector first order conditions can be written in terms of deviation from these variables. The consumption Euler equation (2) is

$$x_t = E_t x_{t+1} - \sigma(i_t - E_t\pi_{t+1} - r_t^n) \tag{16}$$

where $\pi_t = \log\Pi_t$ is inflation, x_t is the output gap $x_t \equiv \hat{Y}_t - \hat{Y}_t^n$ where $\hat{Y}_t \equiv \log Y_t - \log\bar{Y}$. The term i_t now refers to $log(1+i_t)$ in the notation of the previous section so that we can still express the zero bound in the form (7). This equation can be forwarded to yield

$$x_t = E_t x_T - E_t\sum_{s=t}^{T-1}\sigma(i_s - \pi_{s+1} - r_s^n)$$

which illustrates that the output gap does not only depend on the current nominal interest rate and expected inflation but the entire expected path of future interest rates and inflation.

Equation (3) can be approximated as

$$\pi_t = \kappa x_t + \beta E_t\pi_{t+1} \tag{17}$$

where $\kappa \equiv \frac{\theta}{\delta}(\sigma^{-1}+\omega)$. If this equation is forwarded it says that inflation depends on the expected path of future output gaps.

Finally the budget constraint of the government is approximated by

$$w_t - \bar{w}i_t = \beta^{-1}w_{t-1} - \beta^{-1}\bar{w}\pi_t + \beta^{-1}\hat{F}_t - \beta^{-1}\hat{T}_t \tag{18}$$

where $\hat{T}_t = \log T_t/\bar{Y}$ and I have linearized around a given level for outstanding debt $\bar{w}$. The budget constraint says that for *a given* level of debt monetary policy can improve government finances through two channels. The second term on the left hand side indicates that lower nominal interest rate will reduce the burden of debt rolled over to the next period. The second term on the right hand side indicates that inflation will reduce the real value of outstanding debt because all the debt is issued in nominal terms (nominal bonds and the money supply). Equations (14)-(18) summarize the private sector equilibrium constraints. I now turn to government policy.

This paper is about government policy when there are sufficiently large deflationary shocks that cause the nominal interest rate to decline to zero. I assume that r_t^e is temporarily negative

at time 0, $r_L^e < 0$, and returns to steady state with a probability α in each period. To ensure bounded solution I impose the restriction on α that $\alpha(1-\beta(1-\alpha)) - \sigma\kappa(1-\alpha) > 0$. I call the date r_t^e returns to steady state τ. Once it returns to steady state it stays there forever.

To clarify the organization of the results diagram 2 shows a road map for the remainder of this section. I analyze the results in four steps. I first show the equilibrium under when fiscal policy is inactive ($\hat{F}_t = \hat{T}_t = 0$) which is equilibrium A in diagram 2. I then analyze the consequences of optimally increasing real government spending, $\hat{F}_t$, but holding the budget balanced (so that $\hat{T}_t = \hat{F}_t$) which is equilibrium B. In equilibrium C the government optimally uses deficit spending $\hat{T}_t$ to stimulate demand but real government spending is kept constant at its steady state ($\hat{F}_t = 0$). Finally equilibrium D considers the effect of using both deficit and real spending optimally.

Applied to the Great Depression Eggertsson (2005) argues that equilibrium A corresponds to the policies of President Hoover because he aimed both at keeping the government small and balancing the budget. In that model the "Hoover regime" is optimal discretion under the constraint of "balance budget dogma" and "small government dogma". FDR, in contrast, broke both these dogmas. His policy regime corresponded to equilibrium D, which is unconstrained discretion.

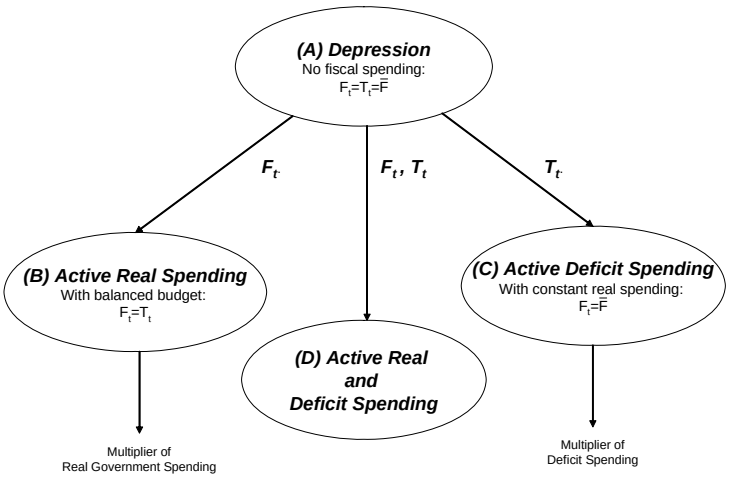

Diagram 2: Roadmap for results under coordination.

The policy rule the government follows under discretion is found by approximating the first order conditions of the maximization problem (13). These conditions are shown in the Appendix. Since these are 7 first order conditions and two complementary slackness conditions it is cumbersome to write them out in the main text. Fortunately, however, one can infer the form of the solution – and even obtain some closed form solutions – using almost no algebra by considering a

second order approximation of the household utility

$$U_t = -\frac{1}{2}\sum_{T=t}^{\infty}\beta^{T-t}\left\{\pi_T^2 + \lambda_x x_T^2 + \lambda_F \hat{F}_T^2 + \lambda_T \hat{T}_T^2\right\}. \tag{19}$$

Consider first the solution in equilibrium A from the perspective of $t > \tau$ when the deflationary shock has subsided (recall that we impose $\hat{F}_t = \hat{T}_t = 0$). Under discretion the government seeks to maximize this objective regardless of its actions in the past. It should be obvious, then, that the best possible equilibrium is when

$$\pi_t = x_t = 0 \text{ for } t \geq \tau. \tag{20}$$

which can be achieved at that time and is dynamically consistent.

Consider now the solution in period $t < \tau$. Ideally the government would wish to achieve zero inflation and zero output gap. The assumption that the shock r_t^e is negative, however, makes this infeasible since it would imply a negative nominal interest rate by equation (16). Hence the government tries to achieve maximum accommodation by setting the interest rate to zero. Because the shock is the same in all $t < \tau$ the solution for π_t and x_t solves the two equations

$$x_t = (1-\alpha)x_t + \sigma(1-\alpha)\pi_t + \sigma r_L^e \tag{21}$$

$$\pi_t = \kappa x_t + \beta(1-\alpha)\pi_t \tag{22}$$

yielding

$$x_t = \frac{1-\beta(1-\alpha)}{\alpha(1-\beta(1-\alpha)) - \sigma\kappa(1-\alpha)}\sigma r_L^e \text{ for } t < \tau \tag{23}$$

$$\pi_t = \frac{1}{\alpha(1-\beta(1-\alpha)) - \sigma\kappa(1-\alpha)}\kappa\sigma r_L^e \text{ for } t < \tau \tag{24}$$

Figure 2 shows the solution for a numerical solution of the model that is calibrated to replicate some basic features of the Great Depression in the US. Each period is a quarter. The parameter $\beta = 0.99$ is set to match 4% real interest rate, $\sigma = 0.9$ is set to match government spending. The parameter α is set at 0.1 so that the shock is expected to last for 10 quarters. The parameter κ governs how much inflation reacts to movements in output. I pick this parameter to match data from 1932. Observe that in 1932 the average nominal interest rate was close to zero. Furthermore there was 10 percent deflation. There is no reliable data on the output gap at that time. A reasonable lower bound for the output gap, however, is that output had declined by about a third from its peak in 1929. Given the calibrated value of α, I can use equation (22) to pick a κ that matches these facts

$$\kappa \equiv (1-\beta(1-\alpha))\frac{\pi}{x} = 0.0091$$

Finally I use (23) to pick the value of the shock r_L^e to match a 30 percent output gap which results in $r_L^e = -3\%$.

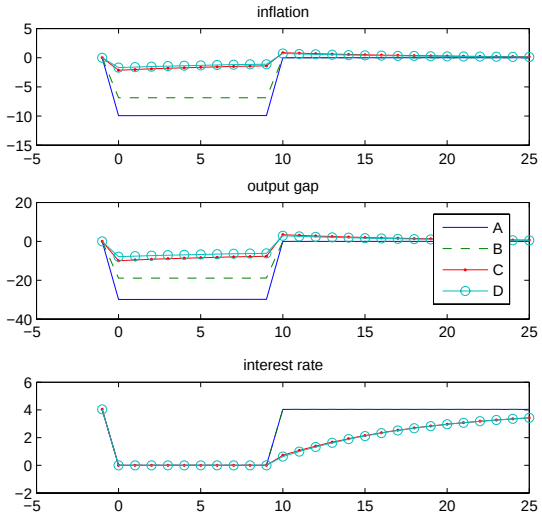

Figure 2: Inflation, the output gap and interest rates under the optimal policy under discretion in equilibrium A,B,C and D.

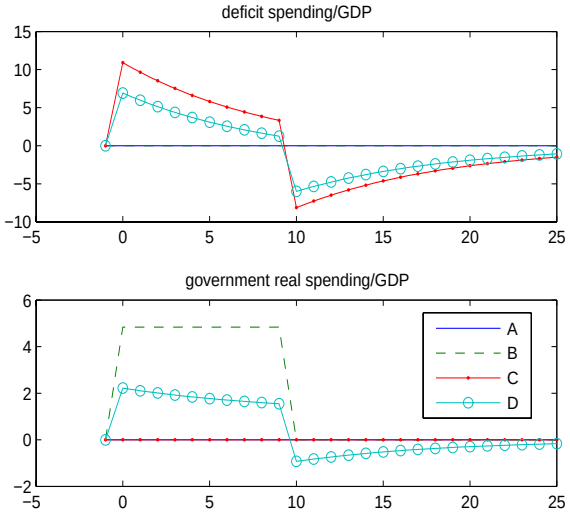

Figure 3: Deficit and real government spending under optimal policy under discretion in equilibrium A,B,C and D.

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). Recall from equations (23) and (24) that these lines would look the same for any other contingency but with a different breaking point corresponding to $t = \tau$ (i.e. the lines would jump up at different time). Because of the choice of r_L^e the model generates a 30 percent collapse in output and 10 percent deflation and the contraction lasts as long as the duration of the shock (which is stochastic). 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 price and output contraction in future periods $t+j < \tau$ for $j > 0$. The contraction in period $t+j$ in turn depends on expectations of contraction in periods $t + j + i < \tau$ for $i > 0$. This creates a vicious cycle that does not even converge unless the restriction on α is satisfied. The overall effect is an output and price collapse.

Observe that the contraction in the model is entirely driven by monetary forces and the zero bound. If the central bank would be able to accommodate the shock by setting negative nominal interest rate of -3% there would be no output contraction and no deflation. 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 and the expectation that inflation will be set at zero at $t > \tau$ this difference cannot be reduced by nominal interest rate cuts. The 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. During the contraction phase of the Great Depression in the US the real rates were of the order of 10 percent (see table 2) – and the Federal Reserve was unable to lower these rates in 1933 because the nominal interest rate was close to zero.

It has no effect to print money in this equilibrium. The reason is that expectations are pinned down by (20) so that any increase in the money supply in periods $t < \tau$ will be expected to be reversed in period τ. Because in periods $t < \tau$ money and bonds are perfect substitutes (so that equation (8) is slack) printing money has no meaningful implication at the time the money is printed: households simply replace government bonds in their portfolio with money. It is impossible for a discretionary central bank to change expectations in period $t < \tau$ under the assumption of discretion. Even if it would be beneficial in period $t < \tau$ to create expectations of lower future interest rates and inflation in period $t \geq \tau$ the bank has an incentive to renege on this promise once the shock has subsided in period τ (this should be obvious because from that time on the government can achieve $\pi_t = x_t = 0$ which maximizes its objective). This problem of discretionary policy is coined the deflation bias in Eggertsson (2006). While the classic inflation bias of Kydland and Prescott (1977) and Barro and Gordon (1983) is a steady state inefficiency, this discretionary bias arises due to temporary deflationary shocks.

The dashed line in figure 2 and 3 shows equilibrium B in diagram 2. In this case the government is no longer constrained to keep real government spending constant. In addition to the parameters

I have already specified I need to calibrate the parameter ω which is the inverse of the Frisch elasticity of labor supply. I calibrated it at $\omega = 2$ which strikes a middle ground between micro-studies (which are usually much higher than 2) and parameters often used in the RBC literature (which are usually around 0.5). The form of the solution can once again be inferred by inspecting (19). In periods $t > \tau$ the government can once again maximize its objective by setting $\pi_t = x_t = \hat{F}_t = 0$. In periods $t < \tau$, however, temporarily increasing $\hat{F}_t$ can improve the outcome. To see this recall that the cause of the contraction is that real interest rate is higher than the natural rate of interest. The natural rate of interest, however, depends in fiscal spending as seen in equation (15) so that increasing $\hat{F}_t$ in periods of the shocks increases the natural interest rate and thus reduces the output gap and deflation in periods $t < \tau$. The cost of doing this is that in these period there is an oversupply of public goods so that the level of $\hat{F}_t$ goes above what would be optimal in the absence of the demand driven depression. A discretionary policy maker trades off the costs and benefits and the resulting government expansion is shown in the figure.

Output increases more than corresponding to the improvement in the output gap reported in the figure. The output effect of the fiscal expansion can be decomposed into an RBC and New Keynesian channel. Observe first that we can write output as

$$\hat{Y}_t = x_t + \hat{Y}_t^n$$

so that the increase in output, by definition, is due to an improvement in the output gap and an increase in the natural rate of output. It is well known from the RBC literature that an increase in government spending increase the natural level of output, and this effect can be seen by equation (14).

A "multiplier" of government spending answers the question: How much does each dollar of real spending increase output moving from the equilibrium in which $\hat{F}_t = 0$ (equilibrium A in diagram 2) to the one where $\hat{F}_t$ is optimally set (equilibrium B in diagram 2)? I measure each variable in net present value. This statistic can be analytically derived, yielding the following result

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

This multiplier is 2.33 under the baseline calibration outlined above. The Keynesian channel, i.e. the improvement in output due to the improvement in the output gap, accounts for 85 percent of the size of the multiplier.

In both equilibrium A and B the private sector expects 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, even when the government is discretionary as we have assumed. 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 (18). This is what I call deficit spending or credit expansion and is shown in the third line in figure 2 called equilibrium C. In this case the government is no longer constrained to keep deficit spending constant and instead I hold real spending constant. As the figure reveals the government chooses to increases deficit spending in period $t < \tau$ and then runs surpluses when the deflationary shocks have subsided. This in turn has a large positive effect on both inflation and output.

The reasons for the big impact of deficit spending on prices and output is that it changes expectation about future inflation, output and nominal interest rates. As can be seen in figure 3 the deficit spending implies that the central bank will keep the nominal interest rate low for a substantially longer time than the duration of the shock and accommodate and an output expansion and inflation in period $t > \tau$. These expectations feed into a large stimulus in period $t < T$ through several channels. The expectation of future inflation lowers the real interest rate, even if the nominal interest rate cannot be reduced further, thus stimulating spending. Similarly, a commitment to lower future nominal interest rate (once the deflationary pressures have subsided) stimulates demand for the same reason. Finally, the expectation of higher future income, as manifested by the expected output boom, stimulates current spending, in accordance with the permanent income hypothesis

The reason why expansionary policy in periods $t > \tau$ are credible for the discretionary policymaker in equilibrium C but not in equilibrium A or B can be seen by inspecting (19) and the government budget constraint (18). The government accumulates additional debt in periods $t < \tau$. Because there is cost of taxation the government wishes to reduce the real value of its debt in periods $t > \tau$ by accommodating inflation (and we assume it only issues nominal bonds and money). Furthermore, because it is rolling its debt over from period to period it wants to keep the real interest rate low. Both consideration give the government an incentive to keep the nominal interest rate low and accommodate inflation and output expansion in periods $t > \tau$ even if it could in principle stabilize prices and output at that time.

For the calculation reported in figure we need to choose the cost of tax collection in the function $\frac{\gamma}{2}T_t^2$. This parameter is chosen so that this cost corresponds to 10 percent of government spending to match the level of deficit spending once FDR took power in 1933 (which was about 9 percent of GDP). A lower value for γ would have little effect on the results but only change the scale of the deficit spending. Once it is taken into account that there was already some debt outstanding in 1933 (once FDR embarked on an inflationary program) one could set this value much smaller and still match the evolution for deficit spending.

Again it may be instructive 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 $\tilde{T}_t$ 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. 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 4.4. One can decompose the size of the multiplier between the RBC channel and the New Keynesian channel. 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 valuable if one assumes sticky prices. Since prices are flexible in an RBC model this channel has no role in that model.

3.3 Extensions: Exchange interventions, unconventional open market operations, bank bailouts, helicopter money

While the last section emphasized cutting taxes relative to spending (deficit spending) to shift expectations about policy in periods $t \geq \tau$, several other policy actions can be described through the same mechanism. Government debt is the driving force for shifting expectations rather than tax cuts in themselves. Government debt, however, can be increased in a variety of other ways. It can, for example, be increased by printing money (or bonds) and buying some private assets such as foreign exchange. As shown in Eggertsson (2003) these actions have the same implication for future government policy. A bailout of domestic banks by money printing or, even more exotically, dropping money from helicopters would have exactly the same effect. While FDR did not drop money from helicopters in 1933, he took a variety of actions beyond deficit spending that expanded government credit such as purchases of gold and the refinancing of private banks. These actions, too, had a large effect on the government balance sheet and should thus have feed into expectations about the future money supply.

4 Discretionary Equilibrium when the Central Bank is Independent

4.1 Definition

In the preceding section I assume that monetary and fiscal policy are coordinated to maximize social welfare. This assumption may be questionable. In many countries the central bank has more narrow goals than social welfare. I now analyze the consequence of this alternative assumption, supposing the central bank is independent in the way defined in section 2 .

The timing of events in the game is as follows: At the beginning of each period t, w_{t-1} is a predetermined state variable. At the beginning of the period, the vector of exogenous disturbances b_t is realized and observed by the private sector, the treasury and the central bank. The monetary

and fiscal authorities simultaneously choose policy at time t given the state and the private sector forms expectations.

$$\begin{bmatrix} F_t \\ T_t \end{bmatrix} = \begin{bmatrix} \bar{F}(w_{t-1}, b_t) \\ \bar{T}(w_{t-1}, b_t) \end{bmatrix} = \bar{T}r(w_{t-1}, b_t) \tag{25}$$

$$i_t = i(w_{t-1}, b_t) \tag{26}$$

Under discretion the Treasury maximizes the value function $J^{TR}(w_{t-1}, b_t)$ by its choice of the policy instruments, taking the expectation functions $\bar{f}^e(w_t, b_t)$, $\bar{S}^e(w_t, b_t)$ as given because it cannot commit to future policy. It solves

$$J^{Tr}(w_{t-1}, b_t) = \max_{T_t, F_t} \{[\log C_t + \chi \log G_t + \psi \frac{h_t^{1+\omega}}{1+\omega})]b_t + \beta E_t J^{Tr}(w_t, b_{t+1})\} \tag{27}$$

s.t. (4), (5), (6), (7), (11), (12), (26).

The Central Bank solves

$$J^{Cb}(w_{t-1}, b_t) = \max_{i_t} [-(\Pi_t - 1)^2 - \lambda(\frac{Y_t}{Y_t^n} - 1)^2 + \beta E_t J^{Cb}(w_t, b_{t+1})] \tag{28}$$

s.t. (6), (7), (11), (12), (25).

The conditions that constrain the actions of the treasury and the central bank in (27) and (28) are the private sector equilibrium conditions and the strategy functions of the other government agency.[9] The debt is a state variable in the central bank problem only because it enters in the strategy function of the Treasury. Apart from the other players strategy functions these constraints are the same for both the treasury and the central bank but with one important exception. The borrowing and budget constraint of the treasury is *only a restriction on the treasury taxing and borrowing strategies*, it does not impose any constraints on the central bank. To see why this is important suppose the contrary was true. In this case there would be a much more complicated strategic game between the treasury and the central bank. The treasury could for example accumulate large amounts of debt up to its debt limit $\bar{w}$ and then cut taxes further. In this case, in order not to violate the borrowing constraint, the central bank would need to inflate away the some of the existing debt. The definition of an independent central bank proposed here is therefore that the central bank has its own objective AND carries no responsibility for government finances.

4.2 Results

I first consider the power of real government spending when the central bank is goal independent. In order to isolate the effect of real government spending I constraint the budget to be balanced at all times so that $\hat{F}_t = \hat{T}_t$ (corresponding to equilibrium B in diagram 2 when the central bank is

[9] Note that the government budget constraint can equivalently be interpretet as the budget constraint of the household and it thus belong in both maximization problems as a private sector equilibrium constraint.

goal independent). The solution does not depend on whether the central bank is goal independent or not. This can be proved in two steps. Observe first that the solution when the natural rate of interest becomes positive (and the zero bound is no longer binding) is the same under either coordination or goal independence because the central bank will target zero inflation and zero output gap at that time (and the treasury will then set $\hat{F}_t = 0$). Consider now the solution when the zero bound is binding. Since monetary policy is constrained by the zero bound at this time, its different objective is irrelevant during this period as long as it implies a zero interest rate. The central bank interest rate policy, therefore, only matters in period $t \geq \tau$ and I have just argued that its policy will be the same in those periods as under coordination. Turning to the the treasury, it maximizes social welfare and it follows that the path for government spending will be exactly the same as analyzed in last section when $t < \tau$. It follows that the solution is the same under coordination and goal independence. A formal way of verifying this is to write out the first order conditions of the two maximization problems and verify that they are identical to the one implied by the joint maximization problem analyzed in the last section.[10]

Consider now the case of deficit spending when the central bank is goal independent and suppose that now instead the real spending is held constant so that $\hat{F}_t = 0$. Now there is dramatic difference in the power of deficit spending depending on whether the central bank is goal independent. If the central bank is goal independent deficit spending has *no effect* on inflation or output.

Proposition 1 *If the central bank is goal independent, and $\hat{F}_t = 0$, deficit spending has no effect on output and prices.*

A formal proof can be obtained by writing out the first order conditions of each of the maximization problems of the treasury and the Central Bank.[11] The logic of the result is as follows: For a given path of F_t Ricardian equivalence holds in the model so that debt does not enter into any of the equilibrium conditions of the private sector apart from the budget constraint of the private sector. Monetary policy is set to minimize $(\Pi_t - 1)^2 + \lambda_x x_t^2$. Government debt or deficits do not enter this objective or the constraints that limit the actions of the central bank. It follows that debt has no effect on the equilibrium determination of inflation, output and interest rates which are determined by exactly the same set of equations as if fiscal policy was completely inactive (i.e. in equilibrium C in diagram 2). It follows that if I set $\hat{F}_t = 0$ to be exogenously given, deficit spending has no effect on the equilibrium outcome when the central bank is goal independent. The central bank will determine inflation and the output gap without any reference to deficits or debt.[12] The effect of fiscal policy when coordinated with monetary policy is thus

[10] See an earlier working paper version of this paper, NYFED Staff Report #241.

[11] See an earlier working paper version of this paper, NYFED Staff Report #241.

[12] Note that if the treasury chooses F_t in each period, deficit spending can in principle have effect by influencing

fundamentally different depending on whether or not monetary and fiscal policy are coordinated. When the central bank is goal independent the deficit spending multiplier is zero.

5 Fiscal multipliers and policy coordination: US during the Great Depression and Japan in the Great Recession

A possible reconciliation of the different outcomes of US during the Great Depression in 1933-37 and Japan today is the different policy multipliers under coordination and central bank independence. To make the comparison more concrete I recalibrate the model to match some basic features of Great Recession in Japan. This calibration is not based on a estimation on Japanese data and is made for illustration purposes. It should be interpreted in this light. Again I assume the same values for β, α as in the previous section. Now I assume $\sigma = 0.8$ to match to size of the Japanese government. To pick the value of κ we can again take advantage of equation 16. To do this we need to take a stance on the size of the output contraction, or the output gap in the Great Recession. There is no reliable measure of this variable. In a recent study Kamada (2004) reviews several measure at the use at the Bank of Japan that are in the range 5-15 percent in this period. Using 10 percent as a value for the output gap and -1.5 percent for deflation we obtain the value

$$\kappa \equiv (1 - \beta(1 - \alpha))\frac{\pi}{x} = 0.0041.$$

which is a lower number than we used for the US during the Great Depression. This indicates that higher degree of price rigidity is needed in Japan to account for the features I match. I assume a shock $r_L^e = -4.5\%$ to match this output gap. In contrast to the other exercise I assume that the central bank is goal independent but that the treasury uses fiscal spending to stimulate demand.

Figure 4 shows the response of the output gap, inflation and government spending policy to the shock r_L^e, given goal independence and discretionary government spending. Observe that the optimal response of the Ministry of Finance is to increase government spending by 3 percent of GDP. An interesting counterfactual is to ask what would have happen in the absence of the expansion of real government spending. The solid line shows that in this case the Great Recession in Japan would have resulted in additional 2.5 percent increase in the output gap (or 3.5 percent in output).

the expectations about future spending F_{t+j}.It can be verified, however, that in this model this effect is only of second order.

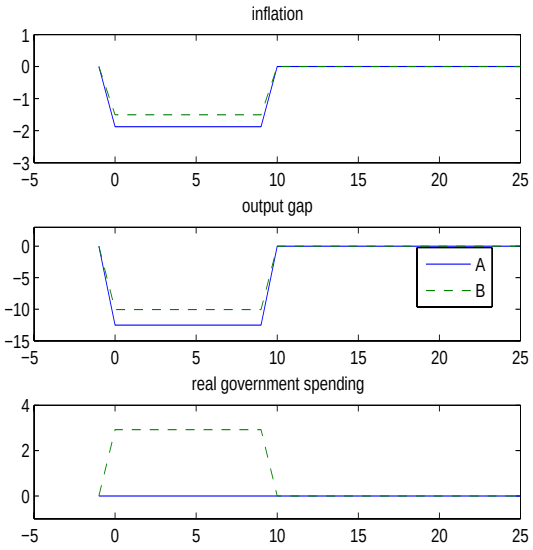

Figure 4: Policy under discretion under central bank independence.

Table 1. Fiscal Multipliers for Coordinated Policy

US during the Great Depression

	$i=0$	$i>0$
Real Spending Multiplier	2.2	0.33
Deficit Spending Multiplier	4.2	0.5

Table 2. Fiscal Multipliers for Uncoordinated Policy

Japan during the Great Recession

	$i=0$	$i>0$
Real Spending Multiplier	1.2	0.33
Deficit Spending Multiplier	0	0

Table 1 and 2 compare the multiplier of real spending across the Great Depression in the US and the Great Recession in Japan in our illustrative calibration examples. The multiplier is higher in the calibrated example for the US which is driven by the different parameter values assumed for κ and σ. I do not wish to dwell on whether these different result reflect important differences in the structure of the US economy during the Great Depression vs Japan in the Great Recession, since the parameters picked to generated the results only aimed to match the basic features of the data I outlined above. If those parameters were assumed to be the same in the two calibrations the real spending multiplier would be the same in the two countries. A formal estimation strategy may yield results that are quite different and these calibration simply show that the model can replicate certain features of the data. The main point I wish to stress is the dramatic difference in the multiplier of deficit spending between the two examples, and this is true regardless of the parameter values assumed. While the deficit spending multiplier is substantial in the US during the Depression in 1933-37, it is zero in Japan during the Great Recession.

The result in the table result reflects that deficit spending, foreign exchange interventions or any other actions by the treasury that affects the government balance sheet are completely irrelevant if the central bank is independent. This can explain the different between the responses of the Japanese and the US economies to the various stimulative actions.

For comparison I have also included in the table the multipliers for the "scenario" when interest rate are positive. This "scenario" reflect the response of output when there are no deflationary pressures but (counterfactually) the path for both the deficit and real spending is the same as if shock occurred. In this case the multipliers are much smaller. The reason is that the central bank counteracts the positive pressure on inflation and the output gap by raising interest rates. When the deflationary shock actually occurs, however, the central bank does not react in this way because both the output gap and inflation are below the level the central bank would wish them to be. This indicates that fiscal policy is mainly effective when the interest rate is zero.

The multipliers under coordination are much bigger than have been found in the traditional Keynesian literature. The most cited paper on fiscal policy during the Great Depression, for example, is Brown (1956). In his baseline calibration the real spending multiplier is 0.5 and the deficit spending multiplier is 2.[13] The reason for this large difference is that the old models ignore the expectation channel. Modelling expectations is the key to understand the large effect of government spending.

6 A proposal for temporary coordination

As emphasized by Ben Bernanke (2003), Governor of the Federal Reserve, one of the standard arguments for an independent central bank is its ability to say "no" to the government's wishes to "monetize its debt". For standard dynamic inconsistency reasons it is good for a goal independent central bank to ignore the fiscal consequences of its actions, because the presence of nominal government debt gives it an inefficient bias to inflate (see e.g. Calvo (1977) and Barro and Gordon (1983)). This remains true in this paper so that in normal circumstances (i.e. in the absence of deflationary shocks) it is optimal to endow a goal independent central bank with a more narrow mandate than social welfare. When the economic is subject to deflationary shocks, however, this is no longer true so that at least "temporarily" coordination of monetary and fiscal policy is beneficial.

How may this "cooperation" take place? Here I make a preliminary suggestion. The arrangement suggested is inspired by Eggertsson and Woodford's (2003) suggestion that a time varying

[13] See Table 1 in Brown (1956). Column 14 is his baseline calibration where he assumes: a="marginal propensity to spend disposable income and profits"=0.8 and b="marginal propensity to spend national product"=0.6. The real spending multiplier in his model is $\frac{1-a}{1-b}$ and the deficit spending multiplier is $\frac{a}{1-b}$ which give the numbers cited above.

price level target implements an optimal commitment solution. The proposal is as follows. 1) The central bank is independent under normal circumstances so that it targets the objectives in diagram 1, i.e. social welfare in exclusion of fiscal developments. 2) If there are deflationary shocks that preclude the central bank from reaching this objective the central bank cuts the interest rate to zero and stands ready to buy any debt issued by the government at zero interest rates. 3) The interest rate stays at zero until the central bank reaches a new price level target that is announced by the government. 4) The government announces a fixed price level target once deflationary pressures have subsided. 5) Once the new price level has been reached the central bank sets the interest rate at its own discretion.

This proposal would maintain central bank independence under normal circumstances. When there are large deflationary pressures, however, it is necessary to give the elected government a role in selecting a price level target, and the central bank cannot move away from zero interest rates until this goal is reached. This is beneficial because it is useful to create a credible commitment to keeping the interest rate low for a substantial time when there are deflationary pressures. This not only reduces nominal long-term interest rates, it also increases inflation expectations, thus reducing real interest rates and stimulating demand.

There are certain advantages of leaving it to the government to decide on the price level target in these circumstances. If the government announces this goal it has several more instruments at its disposal to increase its credibility than the central bank. It can, for example, cut taxes and issue nominal debt to achieve this, or buy foreign exchange, an operation that in all industrial countries (including Japan) is under the control of the treasury. Such operations will credibly increase the expectations of a higher future price level because it is in the interest of the government to attain higher future prices when it has outstanding a nominal debt – thus solving the credibility problem faced by a government at the zero bound. The reason, as we have seen, is that a higher price level will reduce the real value of its debt and avoids balance sheet losses on its foreign currency holdings.

Jeanne and Svensson (2006) argue that an independent central bank can achieve this type of commitment by using its own balance sheet as a commitment device for reasons that are similar. While this may be helpful, a central bank may be too risk averse for this commitment device to be effective. In practice the bank may not use it as long as there is uncertainly. The argument that balance sheet concerns of an independent central bank are a hindrance rather than a help is not new, it is variation on Paul Samuelson argument that during the Great Depression the Federal Reserve "was the prisoner of its own independence" due to balance sheet concerns. Similar arguments have been made by Sims (2001), Bernanke (2003) and Mishkin and Ito (2005).

We can put some further structure on the argument by writing out the balance sheet of the

central bank. We can write it as

$$P_t T_t^{Cb} = (1+q_t)\frac{P_t}{P_{t-1}}\eta_{t-1}M_{t-1} + (1+i_{t-1})(1-\eta_{t-1})M_{t-1} - M_{t-1}$$

where T_t^{Cb} is real transfers in terms of the consumption basket to the Treasury. We assume that all balance sheet losses or gains are transferred to the Treasury. The variable n_{t-1} is the fraction of assets the central bank holds in its balance sheet (against the outstanding money supply M_{t-1}) that it invests in a real asset with a stochastic return q_t, i.e. a real asset that promises to pay $1+q_t$ unit of the consumption good in period t at the price of 1 in period $t-1$, while $(1-\eta_{t-1})$ is the fraction the bank holds in government bonds. Observe that when the central bank only holds government bonds its net transfers are

$$T_t^{Cb} = \frac{i_{t-1}M_{t-1}}{P_t}$$

which is the conventional way in which seigniorage revenues are computed.

Consider now a central bank that purchases some assets by choosing a value $\eta_{t-1} > 0$. Observe that in expectations the two assets prices q_t and i_t have to satisfy an arbitrage equation

$$E_t(1+q_{t+1})\frac{\beta u_c(C_{t+1})}{u_c(C_t)} = E_t(1+i_t)\frac{\beta u_c(C_{t+1})}{u_c(C_t)}\Pi_{t+1}^{-1}$$

which means that no ex ante capital gains or losses can happen in equilibrium. Consider now the ex-post capital gains or losses of the central bank and let us assume the interest rate is 0 at time $t-1$. Then we can write

$$T_t^{Cb} = [1 + q_t - \Pi_t^{-1}]\eta_{t-1}m_{t-1} \tag{29}$$

where I have defined $m_t \equiv \frac{M_t}{P_t}$. This equation says that the net transfer to the treasury (ex post) is positive in the stochastic return q_t and positive if the central bank generates inflation. Observe that these capital gains depend on the inflation to be unexpected. Jeanne and Svensson (2004) point out that if the central bank cares about its balance sheet, e.g. it never wants to get a positive transfer from the treasury (T_t^{Cb} negative), then capital holdings can "lock in" a certain inflation rate. We can observe this from equation (29).

In their model there is no uncertainty from period $t-1$ to period t. The problem with the argument, however, is that it supposes that the central bank can perfectly predict q_t which is plausibly stochastic (think of the real value of foreign exchange, a notoriously unstable variable). In particular if the central bank wants to ensure no capital gains or losses, and $i_{t-1} = 0$, equation (29) implies that the central bank has to set inflation so that

$$\Pi_t = \frac{1}{1+q_t}$$

For an independent central bank this may be a bad bargain if the real asset it has access to are highly volatile, because in those cases there could be some states of the world in which the

bank would need to create a lot of inflation to ensure no capital losses. This is most likely the real reasons several central bankers are reluctant to use their balance sheet for these purposes: A fear that too high inflation may be required in some states of the world. The only way to avoid inflation in those states would be to ask the treasury for a capital injection, which is precisely what an independent central bank would like to avoid as this would threaten its independence. As Fukui (2003), governor of the Bank of Japan, puts it[14]

> Central banks' concern with the soundness of their capital base might not be grounded purely in economic theory but may be motivated rather by the political economy instincts of central bankers. In other words, once the restriction that "the central bank should only take risks consistent with the level of its self-imposed capital base" is violated, the boundary between the functions of the central bank and those of the government may become difficult to discern.

The former board member of the BoJ Ueda puts it differently[15]

> A more crucial point for an insolvent central bank is that the amount of seigniorage it can generate with a reasonable inflation rate is limited. If, therefore, the central bank intended to overcome insolvency in a short period of time solely by earning seigniorage, it would have to aim for a high inflation rate, sacrificing its goal of price stability.

Observe that what Ueda means by "insolvency" is states of the world in which q_t is very low and thus the bank would need too high inflation to overcome this problem. Thus a rational central banker may not wish to use its own balance sheet to commit to an ex post inflation target, because under uncertainly the range of inflation targets this would imply one of the two: To high and volatile inflation or loss of independence.

7 The role of central bank independence during the Great Depression in the US

The model of the paper gives an interesting perspective on the recovery from the Great Depression from the perspective of the independence of the Federal Reserve. The model indicates, at least if one takes the institutional arrangement described here literally, that at zero interest rates a move that coordinates monetary and fiscal policy would increase output and prices. This gives an interesting perspective on the recovery in 1933-37 in the US, the recession in 1937-38 and the recovery in 1938 onwards.

[14] Cited in Jeanne and Svensson (2006)

[15] Cited in Jeanne and Svensson (2006)

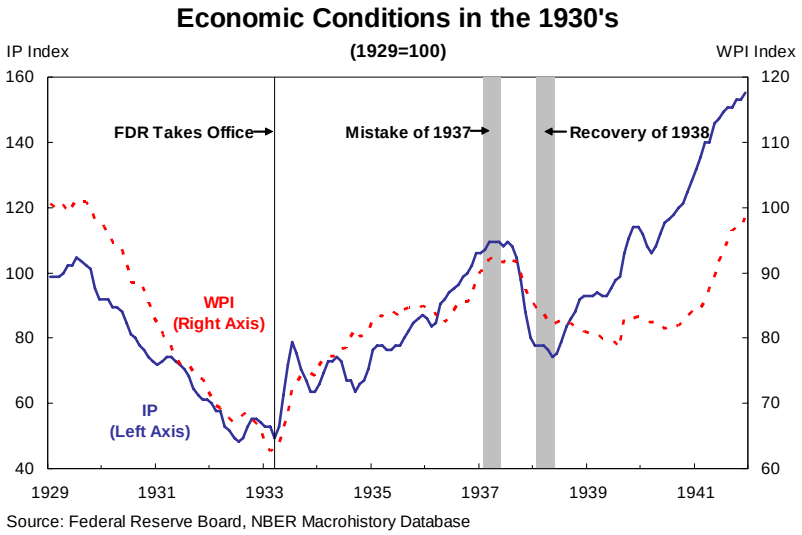

Figure 5: Monthly whole sale prices (WPI) and industrial production (IP) during the Great Depression.

FDR was inaugurated in March 1933. This is what happened the next month: Congress passed a law, the Thomas Amendment, whose two most prominent features were that 1) the president could reduce the gold value of the dollar and 2) issue 3 billion dollars in currency. The 3 billion dollars corresponded to 30 percent of the monetary base at the time and more than half the currency in circulation.[16] While both provisions were only "authorizations" rather than requiring actions, they effectively ended the independence of the Federal Reserve for the time being. FDR used this power to go off the gold standard. In addition he said on several occasions that he wished to inflate the price level to pre-Depression levels. On the 1st of May of 1933, for example, FDR 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.

Figure 5 shows that prices and output immediately responded to these pronouncements and in addition the administration embarked on various spending programs that increased the budget deficit. Where these expansionary programs related to making inflation more "credible"? When the market seemed to be in doubt about the administrations commitment to inflation in the fall of 1933 FDR said in a radio address. "If we cannot do this [reflation] one way we will do it another. Do it, we will" adding

[16] The monetary base is defined as the sum of currency in circulation and non-borrowed reserves.

> 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].

Evidently the administration saw deficit spending – the enlargement of government credit – as crucial to increase inflation. It seem also plausible from reading the press because it was the violation of what Eggertsson (2005) calls the "balanced budget dogma" and created widespread anger in among some commentators in the press that the government would embark on a path of uncontrolled inflation, citing experiences of deficit spending in some countries in the aftermath of WWI (such as Germany).

Perhaps event more interesting, from the perspective of the theory, is the cause of the 1937 recession but Eggertsson and Pugsley (2006) argue that this recession was caused by the administration abandonment of the commitment to inflate the price level to pre-depression levels. Their story is that the administration – especially the Federal Reserve – started warning of too high inflation in the early months of 1937, even if prices had not reached pre-depression levels. The result of this was a shift in expectation and a contraction as can be seen in figure 5. Eggertsson and Pugsley (2006) do not explain why the Federal Reserve started warning against too high inflation, but this paper gives a reason why: They were reneging on the administrations commitment to inflation because they saw their objectives as being different from what people had thought and consistent with the objective we have specified for an independent central bank here: They wanted to avoid inflation because they tough output was reaching potential.

This interpretation seems to be consistent with some narrative evidence. Given the high level of outstanding government debt in 1937 the Fed's warning of "too high inflation" would according to our theory, be consistent with the objective of the Fed (since they thought the depression was essentially over at that time, see Eggertsson and Pugsley (2006)) but inconsistent with the Treasury's objective, the agency responsible for financing the budget deficits and outstanding debt payments. Historical evidence indicate that the Treasury reacted strongly to the Fed's actions in 1937, which included higher reserve requirements that raised short term interest rates, precisely *because* it was inconsistent with the policy regime of coordinated monetary and fiscal policy. 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 triggered by 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 coordinated solution.

The Federal Reserve did not budge in 1937. In 1938, however, the country had experienced another deep recession, as can be seen in figure 5, and a tumble in the price level. In early 1938 FDR restored an inflationary policy by overriding the Federal Reserve, giving them explicit directions on how to conduct policy. The first announcement of considerable importance was made at a February 15th press conference where FDR said that he believed, as he had announced in 1933, that prices should be inflated back to their pre-depression levels (Eggertsson and Pugsley (2006)).

Three days later FDR called another press conference where the explicit goal seems to have been to illustrate overall coordination of monetary and fiscal policy. On that occasion he read a statement which he had instructed Federal Reserve Chairman Eccles, Treasury Secretary Henry Morgenthau, and several other senior government officials to prepare jointly. Flanked by senior administration officials FDR announced, "it is clear that in the present situation a moderate rise in the general price level is desirable." Later that spring the administration took several steps to support an inflationary program, such as lowering the reserve requirement back to its 1936 level, increasing deficit spending and desterilizing government gold stocks. The 1938-1942 recovery was even stronger than in 1933-1937 and by most measures the economy had fully recovered by 1942.

It is often argued that it was wartime spending that finally lifted the US economy out of the Great Depression. This "conventional wisdom" is probably colored by the Keynesian view that monetary policy was impotent during this period. There is no doubt that wartime spending helped stimulate demand. According to the current hypothesis, however, the turnaround from 1937-38 is more appropriately traced back to Roosevelt's recommitment to inflation and coordinated monetary and fiscal policy in the early months of 1938.

8 Coordination during the Great Depression in Japan

While the main motivation of this paper is to compare the US during the Great Depression and Japan during the Great Recession the choice of these two episodes was mainly guided by that

they are relatively well known to economists. It is impossible to leave the topic of coordination without mentioning another historical episode which, while less known, is of great interest for our analysis.

There is perhaps some irony, given the "lost decade" in the 1990's and 2000's in Japan, that there is an interesting historical precedent from Japan for a cooperative solution. During the late 1920's Japan was slipping into a depression. Growth had slowed down considerably, GNP rose by only 0.5 percent in 1929, 1.1 in 1930 and 0.4 percent in 1931. At the same time deflation was crippling the economy. This was registered by several macroeconomic indicators as is illustrated in table 4. In December 1931 Korekiyo Takahasi was appointed the Finance Minister of Japan. Takahasi took three immediate actions. First, he abolished the gold standard. Secondly, he subordinated monetary policy to fiscal policy by having the BoJ underwrite government bonds. Third, he ran large budget deficits. These actions had dramatic effects as can be seen in table 4. All the macroeconomic indicators changed in the direction predicted by our model. As the budget deficit increased, GNP rose and deflation was halted. During the same period, interest rates were at a historical low. At present time I do not have a good measure of the short-term riskfree nominal rate but commercial rates (which while low, were not zero). In addition to the nominal interest rate cuts our model indicates that the other actions taken, i.e. aggressive deficit spending that was financed by underwriting of government bounds, could have had considerable effects on the real rate of return through increasing *expected inflation*. This channel can be of potential importance in explaining the success of these policy measures in Japan in the Great Depression. In 1936 Takahasi was assassinated and the government finances subjugated to military objectives. The following military expansion eventually led to excessive government debt and hyperinflation. Until Takahasi was assassinated, however, the economic policies in Japan during the 1930's were remarkably successful, as the figure reveals. The resulting hyperinflation that followed in later years, however, reflects the dangers association with coordination of this kind.

	Change in GNP deflator	*Change in CPI*	*Change in WPI*	*Change in GNP*	*Government surplus over GNP*
1929	-	-2.3%	-2.8%	0.5%	-1.0%
1930	-	-10.2%	-17.7%	1.1%	2.0%
1931	-12.6%	-11.5%	-15.5%	0.4%	0.4%
1932	3.3%	1.1%	11.0%	4.4%	-3.5%
1933	5.4%	3.1%	14.6%	10.1%	-3.0%
1934	-1.0%	1.4%	2.0%	8.7%	-3.5%
1935	4.1%	2.5%	2.5%	5.4%	-3.3%
1936	3.0%	2.3%	4.2%	2.2%	-2.0%

Table 4: Coordination of Fiscal and Monetary Policy in the Great Depression in Japan.

9 Conclusion

Inflation has been considered the main threat to monetary stability for several decades. In the aftermath of the double digit inflation of the 70's, there was a movement to separate monetary policy from fiscal policy and vest it in the hands of "independent" central bankers whose primary responsibility was to prevent inflation. This development was reinforced by important contributions on the theoretical level, most notably by Kydland/Prescott (1977) and Barro/Gordon's (1983) illustration of the "inflation bias" of a discretionary government. It is easy to forget that in the aftermath of the Great Depression, when deflation was the norm, the discussion at the political and theoretical level was quite the opposite. Paul Samuelson claimed that the Federal Reserve was "the prisoner of its own independence" during the Great Depression, exaggerating the slump by its inability to fight deflation.[17] Similarly Milton Friedman claimed that "monetary policy is much too serious a matter to be left to the central bankers".[18] This paper shows that in a deflationary situation there may be some benefit to fiscal and monetary coordination. While the exact nature of this coordination is certainly an interesting topic of further research, I have attempted to make some progress on that front by proposing a concrete proposal on how this coordination can take place. More research needs to be done, however, before any conclusion can be drawn.

One objection to this proposal is that with deflation waning in Japan, and deflationary pressures having disappeared in the US, a reform to prevent future deflation may not seem worth the effort. Yet, a time when deflation poses little risk, is precisely the right time to discuss such proposals because institutional reforms have more credibility when in a response to a possible future contingency, as opposed to a response to current crisis. In the current environment of low inflation the topic of deflation seems quite likely to re-emerge in the future.

Another objection to this proposal is that it threatens the independence of the central bank. I argue the opposite. The possibility of future deflation carries much more threat to long-term central bank independence than this proposal because an independent central banks may not have the proper instruments or incentives to deal with a deflationary threat. Absent this institutional reform excessive deflation can eliminate central bank independence for a long time because in a deflationary crisis critics could claim that the central bank had failed to achieve its legal mandate. We saw this happen in Japan during the Great Recession when several pundits suggested that its independence should be curtailed. The Economist, for example, said in 2003 that "One obstacle to fiscal and monetary co-operation is the Bank of Japan's independence, which it guards jealously" and that "if monetary policy lacks sufficient power on its own to end deflation, the solution is not to give up but to try a co-ordinated monetary and fiscal stimulus. The central bank should

[17] See Mayer, Thomas (1990) p. 6.

[18] Although he suggested rules to solve the problem rather than coordinated discretion as I do here.

finance tax cuts directly to lift demand."

Deflation posed a threat to BoJ independence and institutional reform that coordinates the central banks actions with the government's temporarily would protect, rather than threaten, its independence. History is a good guide here: The Federal Reserve lost its independence in 1933, as I document in section 8, because Congress believed that it had failed to stabilize prices. Perhaps somewhat ironically, so did the BoJ in 1930, and while the initial result was good, the end result was hyperinflation. What probably saved the BoJ independence during the Great Recession was that the shocks were never big enough to cause a more serious deflation or depression. The actions of the Ministry of Finance and several helpful communication strategies by the BoJ, especially in the fall of 2003 (see footnote 4), surely also helped. There is no guarantee, however, that the BoJ and other central banks in the future will be so lucky.

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11 Appendix

To be added. The first order conditions for the government maximization problem can be found in the Appendix of NY Staff Report NY Fed Staff Report No. 234, December 2005, in a slightly more general notation that used in this version available at

http://www.ny.frb.org/research/economists/eggertsson/papers.html.

12 Data

The data in Table 1 are from various sources noted below the table. All those data are in calander years.

The data in Table 2 are from Eggertsson (2005) were details are provided. I use the third estimate of the budget deficit reported in that paper. Observe that all the data is in fiscal years, apart from the data on nominal GDP an interest rates. The data on the short rate are end of year data from Cecchetti (1988).

Japan 1990-2006

in ten billion Japanese yen

	1990	1991	1992	1993	1994	1995	1996	1997
Nominal GDP	4,401.67	4,682.91	4,805.14	4,841.42	4,865.23	4,931.40	5,028.72	5,125.67
Government Expenditure	1395.65	1474.95	1559.29	1657.46	1693.06	1763.92	1823.40	1797.02
per cent of GDP	31.71	31.50	32.45	34.24	34.80	35.77	36.26	35.06
Deficit (-) / Surplus (+)	90.24	84.83	37.90	-115.10	-182.70	-232.45	-254.81	-194.44
per cent of GDP	2.05	1.81	0.79	-2.38	-3.76	-4.71	-5.07	-3.79
Nominal Monetary Base	3,922.01	3,981.29	3,892.81	4,024.69	4,209.61	4,415.16	4,778.78	5,144.47
Short-term Interest Rates (per cent)	8.25	5.50	3.84	2.38	2.22	0.40	0.38	0.44
Real GDP	100.00	105.81	109.97	112.00	109.17	111.22	114.16	115.74
per cent change	5.26	3.33	0.95	0.20	-2.52	1.87	2.65	1.39
Real Monetary Base	100.00	98.26	94.31	96.33	100.05	105.22	113.93	121.05
GDP Deflator	100.00	100.55	99.27	98.20	101.24	100.74	100.08	100.61
per cent change	-3.00	0.55	-1.28	-1.07	3.09	-0.50	-0.65	0.53
CPI	100.00	103.31	105.25	106.53	107.28	106.99	106.95	108.36
per cent change	3.10	3.31	1.88	1.22	0.71	-0.27	-0.04	1.32

	1998	1999	2000	2001	2002	2003	2004	2005
Nominal GDP	5,027.52	4,956.31	5,013.39	4,968.74	4,897.47	4,907.74	4,961.24	5,026.07
Government Expenditure	1,815.90	1,659.28	1,789.89	1,810.81	1,845.99	1,830.20	1,812.10	1,867.69
per cent of GDP	36.12	37.70	38.22	37.68	38.13	36.75	36.75	37.16
Deficit (-) / Surplus (+)	-277.27	-318.13	-350.11	-294.35	-381.73	-373.36	-321.50	-322.99
per cent of GDP	-5.51	-7.23	-7.48	-6.13	-7.88	-7.67	-6.52	-6.42
Nominal Monetary Base	5,585.80	5,993.81	6,450.79	6,930.20	8,711.11	10,142.94	10,865.43	11,079.76
Short-term Interest Rates (per cent)	0.34	0.01	0.22	0.00	0.00	0.00	0.00	0.00
Real GDP	113.59	113.47	116.76	117.19	117.35	119.49	122.20	125.40
per cent change	-1.86	-0.11	2.90	0.37	0.14	1.82	2.27	2.62
Real Monetary Base	130.35	140.46	152.67	165.89	210.65	246.23	264.04	270.69
GDP Deflator	100.55	99.24	97.55	96.33	94.81	93.31	92.24	91.06
per cent change	-0.06	-1.31	-1.70	-1.25	-1.57	-1.58	-1.15	-1.28
CPI	109.27	108.80	107.74	106.52	105.44	105.03	104.92	104.36
per cent change	0.84	-0.42	-0.98	-1.13	-1.01	-0.39	-0.10	-0.53

Sources: Bank of Japan, OECD Economic Outlook 76 Database, The World Bank Group.

United States of America 1930-1941

in millions of US dollars

	1930	1931	1932	1933	1934	1935	1936	1937	1938	1939	1940	1941
Nominal 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
Government Expenditure	3,545.90	4,300.30	4,572.30	5,115.60	5,216.00	6,843.80	8,532.80	8,835.00	8,453.34	9,319.80	9,794.45	19,052.80
per cent of GDP	3.64	5.13	6.76	8.88	8.52	9.83	10.87	9.38	9.50	10.46	10.12	16.70
Deficit (-) / Surplus (+)		-1,402.00	-1,520.00	-3,305.00	-5,502.50	-5,440.00	-6,659.00	-3,158.00	-738.00	-5,558.00	-5,735.00	-7,038.00
per cent of GDP		-1.67	-2.25	-5.74	-8.99	-7.82	-8.48	-3.60	-0.83	-6.24	-5.92	-6.17
Nominal Monetary Base	6,393	6,426	7,364	7,821	9,402	11,405	13,014	13,283	15,428	18,883	22,539	23,597
Short-term Interest Rates (per cent)	1.25	2.75	0.05	0.5	0.2	0.15	0.2	0.12	0.05	0.05	0.06	0.35
Real GDP	100.00	93.60	81.43	80.37	89.05	96.98	109.59	115.18	111.26	120.27	130.86	153.23
per cent change	-8.60	-6.40	-13.00	-1.30	10.80	8.90	13.00	5.10	-3.40	8.10	8.80	17.10
Real Monetary Base	100.00	110.53	141.10	158.22	183.77	217.25	245.42	241.61	286.20	354.88	420.55	419.24
GDP Deflator	100.00	89.60	79.03	76.95	81.20	82.84	83.80	87.35	84.84	84.06	85.01	90.73
per cent change	-3.67	-10.38	-11.76	-2.7	5.57	2.01	1.12	4.32	-2.91	-0.97	1.17	6.7
CPI	100.00	90.94	81.63	77.33	80.03	82.12	82.95	86.00	84.33	83.24	83.84	88.05
per cent change	-2.55	-9.06	-10.23	-5.28	3.50	2.61	1.01	3.68	-1.95	-1.29	0.72	5.02

Source: Federal Reserve Board, Banking and Monetary Statistics