The New Deal as a Theory of the Optimal Second Best

April, 2006

– preliminary draft –

Gauti B. Eggertsson*

Abstract

This paper shows that policies that temporarily reduce the natural level of output can increase equilibrium output under certain conditions. It documents that these conditions were satisfied during the Great Depression in the United States. In a simulation of a general equilibrium model with sticky prices optimal policy reduces the *natural level of output* by 5 percent leading to an increase in *equilibrium output* by 25 percent. The paper argues that the notorious National Industrial Recovery Act and the Agricultural Adjustment Act, policies installed by Franklin Delano Roosevelt in 1933 as a part of the New Deal, worked in this manner. These acts involved several policies that reduced the natural level of output such as facilitating monopoly pricing of firms, unionization of workers and outright destruction of output. The result is in sharp contrast to the one suggested by Cole and Ohanian (2004) who reach to opposite conclusion. The reason for the different conclusion is due to the combination of (i) shocks that reduce the natural rate of interest to negative levels, (ii) nominal rigidities and (iii) the zero bound on the short-term nominal interest rate. These three factors give foundations of a theory of the New Deal as the optimal second best policy.

—————————

*Federal Reserve Bank of New York. Gauti.Eggertsson@ny.frb.org. The views expressed do not reflect the opinions of the Federal Reserve Bank of New York or the Federal Reserve System. I thank Jim Kahn, Simon Potter, Mike Woodford, and Ben Pugsley for useful comments.

Can government policies that reduce the *natural level* of output increase *actual* output? These policies could for example involve facilitating monopoly pricing of firms, increasing the bargaining power of workers' unions or, even more exotically, burning production such as pigs, corn or cattle. Most economist would find the mere question absurd. In this paper, however, I show that the answer is yes under the "special conditions" that the short-term nominal interest rate is zero and there is excessive deflation. I show this analytically and in a relatively standard general equilibrium model with nominal frictions due to sticky prices. Furthermore I document that these "special conditions" were satisfied during the Great Depression in the United States. This startling result indicates that the notorious National Industrial Recovery Act (NIRA) and the Agricultural Adjustment Act (AAA), policies universally derided by economists from Keynes (1933) to Friedman and Schwartz (1963), and more recently in an important paper by Cole and Ohanian (2004), may have increased output in 1933 when Franklin Delano Roosevelt (FDR) became the President of the United States and announced the New Deal. The NIRA and AAA involved all the policies described above and some more. In a calibrated example I show that the optimal utilization of these New Deal policies – in the absence of other policy options – reduces the natural level of output by 5 percent. Surprisingly this leads to an increase in equilibrium output by 25 percent. I argue that the optimal NIRA and AAA policies in the model are similar to actual policy in 1933 both in terms of intended and actual effects.

To explain how the New Deal policies had this effect I first need to model excessive deflation, because the explicit aim of these policies was to battle deflation. The paper shows, building on Eggertsson and Woodford (2003) and Eggertsson (2006), that under certain conditions the government can lose control of the price level. Excessive deflation will follow from deflationary shocks that imply that a negative real interest rate would be needed to clear the market. In this case the central bank cannot accommodate the shocks because that would require negative nominal interest rate, and the nominal interest rate cannot be negative. Deflation at zero interest rates is an unpleasant business in a general equilibrium model with nominal frictions, especially if the government has a limited ability to manipulate expectations about future policy. If the shocks are expected to persist then the real rate of interest, the difference between nominal interest rate and expected inflation, can be too high relative to the market clearing interest rate. This suppresses demand. Excessive deflation helps explain the output collapse during the Great Depression: double digit deflation raised real interest rates in 1929-33 as high as 10-15 percent (even if the short-term nominal interest rates was close to zero). This choked spending, especially investment. Nobody was interested in investment when the returns from stuffing money under the mattress were 10-15 percent in real terms. Sitting on the money was more economical than investing it.

The New Deal policies are helpful in the model because they break the deflationary cycle. In the model optimal policy reverses deflationary price expectations into those consistent with price stability. This lowers the real rate of interest and stimulates demand even if it simultaneously reduces the natural level of output. Furthermore, this channel is strong enough to increase expected future income, which also feeds into higher demand.

How do the New Deal policies increase prices in the model? I model them as government policies that distort the natural level of output away from its efficient level. I define the natural level of output as the output that would be produced if prices were flexible and the efficient level of output as the optimal output allocation if prices are flexible. I follow Chari, Kehoe and McGrattan (2006) by coining the distortions that distort the natural level from the efficient one "wedges" because they introduce a wedge between the marginal rate of substitution between hours and consumption on the one hand and the marginal rate of transformation of hours into output on the other. I model two sources of these wedges, one that increases the monopoly power of firms ("price collusion") and another that increases the bargaining strength of workers ("unionization"). The effect of the wedges on prices is transparent in the model. The monopoly pricing wedge increases prices directly through stronger monopoly power of firms and the wage bargaining wedge increases prices through increasing marginal costs of firms. In general equilibrium both wedges have the same effect and are equivalent to what Chari, Kehoe an McGrattan (2006) call "labor wedges".

The consensus against the NIRA and AAA is well documented. Keynes (1933), for example, was one of its earliest critics, followed by Friedman and Schwartz (1963), and more recently by Cole and Ohanian (2004). The chorus against these policies, therefore, has been long-standing and consistent. At the time of the writing of the AAA, for example, its principle author Regford Guy Tugwell said that "for the economic philosophy which it represents there are no defenders at all."[1]

The conventional wisdom appears to be built on one of the most basic – and forceful – insights of economics. Any undergraduate economics textbook has a lengthy discussion of the inefficiencies created by the monopoly powers of firms or workers. If firms gain monopoly power they will, all other things constant, increase prices to increase their profits. The higher prices lead to lower demand, and therefore – in the aggregate – reduce GDP. Encouraging workers collusion has the

[1] Kennedy (1999), p. 141. A notable exception from the conventional wisdom about the NIRA is a paper by Summers and De Long (1985). They also emphasize that the NIRA may have been helpful because it facilitated "reflation". Their result is different, however, in how they model the NIRA. In their model the NIRA "increased nominal rigidities". More specifically, they argue that it had the effect of increasing the contract length of workers in a model with Taylor contracting. I confirm Summers and De Long (1985) result in the current model by exploring the effect of lengthening the contract length by increasing the "Calvo" parameter for price changes in the model. In this paper, in contrast to Summers and De Long, however, the NIRA means introducing distortionary wedges and hence the result does not rely on making prices or wages "more sticky". The current application has thus a more natural correspondence to actual New Deal policies which involved facilitating monopoly powers of firms and unions and outright destruction of output, rather than mandating longer duration of price or wage contracts. This paper is also better comparable with other studies, such as Cole and Ohanian (2004), who abstract from nominal rigidities and shocks but also model the NIRA through introducing distortionary wedges.

same effect. The workers conspire to prop up their wages, this reduces the hours demanded by firms and again – in the aggregate – GDP declines. These results can be derived in a wide variety of models.

While this insight still holds firm in an economy at a first best equilibrium, the current paper indicates it fails as one moves away from the first best. This paper can therefore be interpreted as an application of the General Theory of Second Best suggested by Lipsey and Lancaster (1956). The General Theory of Second Best says that if one of the necessary Paretian optimality conditions of a social planner is violated, then, in general, all other conditions for optimum have to be violated as well to reach a "second best" optimum. The central result can be summarized by the aid of a few equations.

In this paper's model social welfare is given by the utility of a representative household. This criterion can be approximated by a second order Taylor Expansion to yield

$$U_t \approx -\sum_{T=t}^{\infty} \beta^{T-t}\{\lambda_\pi \pi_T^2 + \lambda_y(\hat{Y}_T - \hat{Y}_T^e)^2\} + t.i.p. \tag{1}$$

where π_t is inflation, $\hat{Y}_t$ output and $\hat{Y}_t^e$ the efficient level of output (the best flexible price allocation), $t.i.p.$ are terms independent of policy, and the coefficients $\lambda_\pi \geq 0$ and $\lambda_y > 0$. This welfare function is maximized when $\pi_t = 0$ and $\hat{Y}_t = \hat{Y}_t^e$. I prove that the necessary conditions for achieving this maximum are that the government sets its policy instruments so that

$$i_t = r_t^e$$

$$\hat{\omega}_t = 0$$

where i_t is the nominal interest rate, r_t^e the efficient real interest rate (which is only a function of exogenous shocks) and $\hat{\omega}_t$ the inefficiency wedges (in terms of deviation from their efficient steady state level). To achieve the first best solution the government sets the nominal interest rate to track the efficient real interest rate and the wedges at their efficient level so that all monopoly distortions in the economy are eliminated.

If the r_t^e is negative, however, the first necessary condition cannot be satisfied due to the zero bound on the short-term nominal interest rate. The General Theory of the Second Best suggests that then the second necessary condition has to be violated as well. The central proposition of the paper shows that, somewhat surprisingly, this wedge, $\hat{\omega}_t$, has to be *positive* when the first condition cannot be satisfied due to the zero bound. This gives a theory of the New Deal as the optimal second best. It becomes optimal for the government to facilitate monopoly power of firms and/or workers when the zero bound is binding.

There are many examples of restrictions imposed on social planner's problems that give rise to second best analysis, such as legal, institutional, fiscal, or informational constraints (see e.g. Mas-Colell, Winston and Green (1995)). The distinction between a first and a second best planner's problem is not always sharp because it is not always obvious if a constraint makes a social planner's problem "second best" rather than a "first best". In this paper it is the zero bound constraint that gives rise to the second best planning problem. This distinction between first and second best is natural because in the absence of the zero bound the social planner can always achieve the social maximum (that corresponds to the efficient flexible price allocation). The "first best" equilibrium also has the intuitive property that it is the equilibrium associated with price stability so that second best considerations arise only when the government cannot achieve price stability.

There are two conditions required for the distinction between the first best and the second best to be meaningful. First, there have to be large enough shocks so that the zero bound becomes a binding constraint in equilibrium, a condition that is satisfied when the efficient interest rate r_t^e is temporarily negative. In this case interest rate cuts cannot ensure price stability and there is excessive deflation. Second, prices have to be rigid so that $\lambda_\pi > 0$ in (1). If prices were flexible then the social planner could always achieve the efficient allocation by selecting $\hat{\omega}_t = 0$ and the equilibrium paths for inflation and interest rate would be of little interest since they would have no effect on welfare. In Cole and Ohanian's paper cited above, prices are perfectly flexible and the economy is not subject to shocks. This is why they reach the opposite conclusion from this paper. To clarify the reasons for the different conclusions I calibrate the wedges in my model to match the same statistic as Cole and Ohanian, namely that real wages were on average about 6 percent above trend in the recovery phase. I find that if I calibrate the wedges in this way the wedges are close to those mandated by the optimal second best policy and output is 25 percent higher than it would have been in the absence of the New Deal policies. This is exactly the opposite conclusion to the one in Cole and Ohanian (2004) who find that output was 27 percent lower in 1939 that it would have been if not for the New Deal policies.

The basic channel for the economic expansion in this paper is the same is in many recent papers that deal with the problem of the zero bound on the short term interest rate such as for example Krugman (1998), Svensson (2001) and Eggertsson and Woodford (2003,4). In these papers there can be an inefficient collapse in output if there are large deflationary shocks so that the zero bound is binding. The solution is to commit to higher inflation once the deflationary shocks have subsided. The New Deal policies analyzed here facilitate this commitment because when policy is conducted optimally these policies reduce deflation in states of the world in which the zero bound is binding, beyond what would be possible with monetary policy alone. While this is always true *analytically*, i.e. regardless of the equilibrium concept used to study government policy, it is especially important *quantitatively* if there a limits to the government ability to manipulate expectations about future policy.

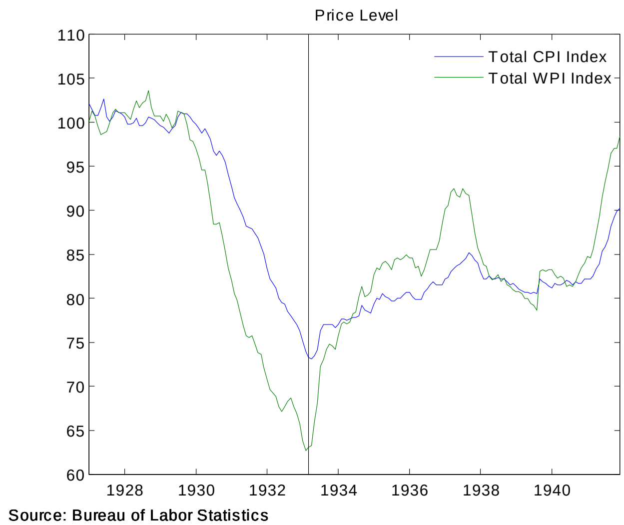


Figure 1: *Prices started on an upward trend when FDR took office.*

1 Historical Narrative: The Great Depression and the NIRA and AAA

The "special conditions" outlined in the previous section were satisfied during the period of NIRA and AAA. First, short-term interest rate were extremely low in 1933 before FDR implemented the NIRA and AAA. In January 1933, for example, the yield on the 3 month short-term government bonds was only 0.05. Further interest rate reductions were clearly not feasible. Second, excessive deflation prevailed during 1929 to 1933 of about 10-20 percent per annum (see figures 1). Output contracted by a third during this period as shown in figure 2. When FDR rose to power and announced the New Deal, the NIRA and AAA were among of several policy initiatives that aimed at reflating the price level. The policy of reflation was successful. Around FDR's inauguration there was an abrupt turnaround in both CPI, WPI and commodity prices (see figure 1 and 3). Similarly the stock market rebounded, registering an increase of about 70 percent in FDR's first 100 days (see figure 4). The output growth in 1933-37 is the strongest four-year expansion in US history outside war (see further discussion of the recovery in 1933-37 in Eggertsson (2005)).

This paper interprets the NIRA and AAA as initiatives to increase prices, and it is the reflation that drives the recovery in the model. This is consistent with what policy makers at the time declared as the being role of these policies. In the *Wall Street Journal*, for example, Franklin Delano Roosevelt declared after a joint meeting with the Prime Minister of Canada on the 1st of May of 1933:

> We are agreed in that our primary need is to insure an increase in the general level

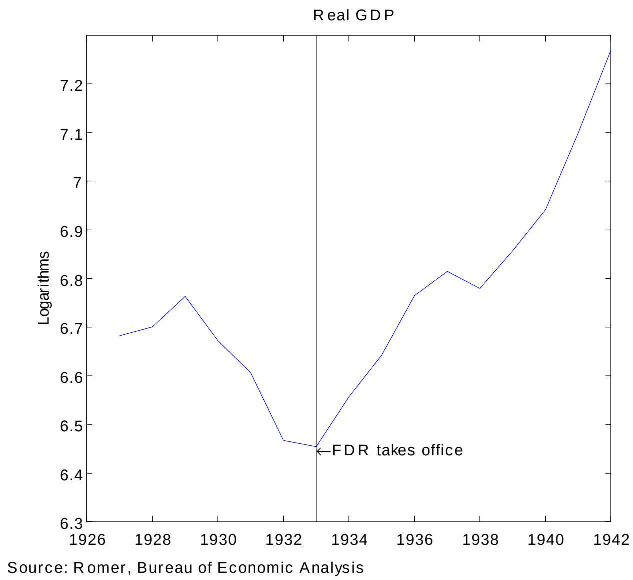


Figure 2: *GDP rebounded when FDR took office.*

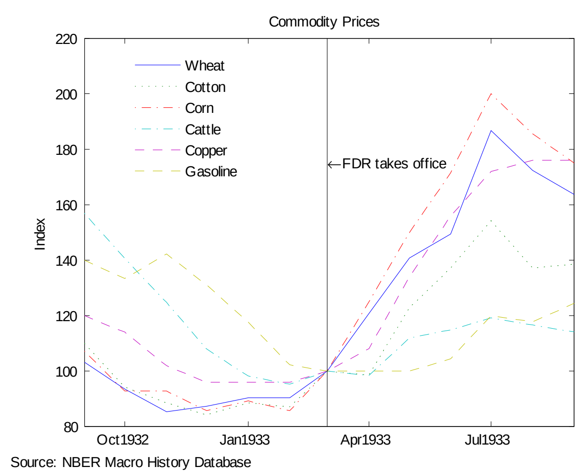


Figure 3: *Prices determined on auction markets, and thus most sensistive to change in expectation, responded even more strongly than the CPI to the FDR regime change. The figure shows a one year window around FDR's inauguration.*

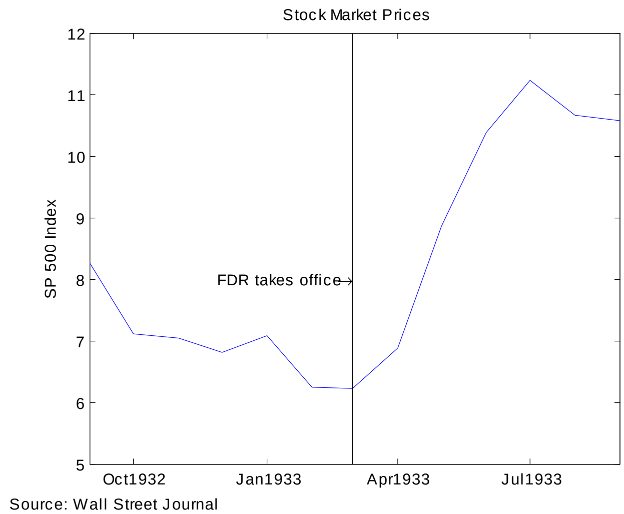


Figure 4: *The stock market increased by over 66 percent in FDR's first 100 days.*

> of commodity prices. To this end simultaneous actions must be taken both in the economic and the monetary fields.

The actions in the "economic field" FDR referred to were the NIRA and AAA. There were several other actions taken to increase prices, however. The most important ones were the elimination of the gold standard and an aggressive fiscal expansion that made a permanent increase in the monetary base credible as well as stimulating aggregate demand through higher government consumption of goods and services. The effect of these policies is analyzed in Eggertsson (2005) in a general equilibrium model. It remains an important research topic to estimate how much each of these policies contributed to the recovery. This paper takes a different focus by studying the contribution of the NIRA and AAA at the margin by abstracting from fiscal policy or institutional constraints such as the gold standard. This is important because the conventional wisdom is that the NIRA and AAA worked in the opposite direction to the stimulative policies described above. I find, in contrast, that they worked in the same direction. These policies facilitated the recovery rather than halting it.

The NIRA and AAA were struck down by the Supreme court in 1935. Many of the policies, however, were maintained in one form or another throughout the 1930's. Some authors, such as Cole and Ohanian (2004), argue that other policies that replaced them, such as the National Labor Relation Act, had a similar effect.

While 1933-37 registers the strongest growth in US economic history outside of war there is a common perception among economists that the recovery from the Great Depression was very slow (see e.g. Cole and Ohanian (2004)). One way to reconcile these two observations is to note that the economy was recovering from an extremely low level of output. Even if output grew fast

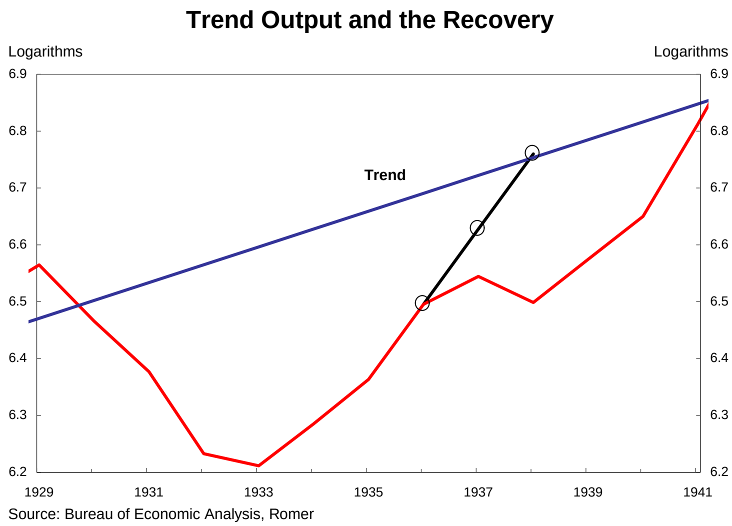


Figure 5: *The "slow recovery puzzle" is partially explained by the recession in 1937-38 which was triggered by abandonment of a commitment to reflation.*

in 1933-37, some may argue, it should have grown even faster, and registered more than 9 percent average growth in that period. Another explanation for the perception of "slow recovery" is that there was a serious recession in 1937-38. If the economy had maintained the momentum of the recovery and avoided the recession of 1937-38 GDP would have reached trend in 1938, so that a full recovery would have taken only 5 years.

Figure 5 illustrates this point by plotting the natural logarithm of output and an estimated linear trend for Romer's (1992) data on GDP (her data is from 1909-1982). The trend reported is estimated by least squares. This trend differs from the one reported in Cole and Ohanian's because the estimation suggest that the economy was 10 percent above trend in 1929 but Cole and Ohanian assume that the economy was at potential in 1929. The circled line shows the evolution of output if the economy would have escaped the recession of 1937-38 and maintained the growth rate of 1935-36. In this case output reaches trend in 1938.

To some extent, therefore, explaining the slow recovery is explaining the recession of 1937-38. This challenge is taken up in Eggertsson and Pugsley's (2006) paper "The Mistake of 1937: A General Equilibrium Analysis". They provide some evidence for that the recession is explained by that in early 1937 the administration reneged on its commitment from 1933 to reflate the price level to pre-depression levels. This created pessimistic expectations of future prices and output and propagated into a steep recession. The NIRA and AAA do not feature in Eggertsson and Pugsley's story. It is worth pointing out, however, that in the spring of 1937 FDR lost one of the most important political battles of his life in the so called "court packing fiasco". This fiasco was brought about because FDR tried to use his reelection victory in 1936 to reorganize the Supreme Court by mandating several of the Judges to retire "due to age." FDR viewed the Supreme Court court as an obstacle to his recovery program because it had struck down several New Deal programs during his first term. The court packing failed due to adverse reactions by Congress and the public. To the extent that this fiasco signaled FDR's inability to legislate further reflationary policies such as NIRA and AAA, it could also have contributed to the deflationary expectation in 1937 and thereby help explain the recession of 1937-38.

2 The Wedges and the Model

I extend a relatively standard general equilibrium model to allow for government induced distortionary wedges. The model abstracts from endogenous variations in the capital stock, and assumes perfectly flexible wages, monopolistic competition in goods markets, and sticky prices that are adjusted at random intervals in the way assumed by Calvo (1983). I assume a representative household that seeks to maximize a utility function of the form

$$E_t \sum_{T=t}^{\infty} \beta^{T-t} \left[u(C_T;\xi_T) - \int_0^1 v(H_T(j);\xi_T)dj \right],$$

where C_t is a Dixit-Stiglitz aggregate of consumption of each of a continuum of differentiated goods,

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

with an elasticity of substitution equal to $\theta > 1$, P_t is the Dixit-Stiglitz price index,

$$P_t \equiv \left[\int_0^1 p_t(i)^{1-\theta} di \right]^{\frac{1}{1-\theta}} \tag{2}$$

and $H_t(j)$ is the quantity supplied of labor of type j. Each industry j employs an industry-specific type of labor, with its own wage $w_t(j)$.

For each value of the disturbances ξ_t, $u(\cdot,;\xi_t)$ is concave function that is increasing in consumption. Similarly, for each value of ξ_t, $v(\cdot;\xi_t)$ is an increasing convex function. The vector of exogenous disturbances ξ_t may contain several elements, so that no assumption is made about correlation of the exogenous shifts in the functions u and v.

For simplicity I assume complete financial markets and no limits on borrowing against future income. As a consequence, a household faces an intertemporal budget constraint of the form

$$E_t \sum_{T=t}^{\infty} Q_{t,T} P_T C_T \leq W_t + E_t \sum_{T=t}^{\infty} Q_{t,T} \left[\int_0^1 \Pi_T(i)di + \int_0^1 w_T(j)H_T(j)dj - T_T \right]$$

looking forward from any period t. Here $Q_{t,T}$ is the stochastic discount factor by which the financial markets value random nominal income at date T in monetary units at date t, i_t is the riskless nominal interest rate on one-period obligations purchased in period t, W_t is the nominal value of the household's financial wealth at the beginning of period t, $\Pi_t(i)$ represents the nominal profits (revenues in excess of the wage bill) in period t of the supplier of good i, $w_t(j)$ is the nominal wage earned by labor of type j in period t, and T_t represents the net nominal tax liabilities of each household in period t.

Optimizing household behavior then implies the following necessary conditions for a rational-expectations equilibrium. Optimal timing of household expenditure requires that aggregate demand $\hat{Y}_t$ for the composite good[2] satisfy an Euler equation of the form

$$u_c(Y_t, \xi_t) = \beta E_t \left[u_c(Y_{t+1}, \xi_{t+1})(1 + i_t) \frac{P_t}{P_{t+1}} \right], \tag{3}$$

where i_t is the riskless nominal interest rate on one-period obligations purchased in period t.

Household optimization similarly satisfies the transversality condition

$$\lim_{T \to \infty} \beta^T E_t[u_c(Y_T, \xi_T) W_T / P_T] = 0 \tag{4}$$

looking forward from any period t, where W_t measures the total nominal value of government liabilities. I assume throughout that the government issues no debt so that (4) is always satisfied.

Without entering into the details of how the central bank implements a desired path for the short-term interest rate (see Eggertsson (2006) for details), it is important to observe that it will be impossible for it to be negative, as long as private sector parties have the option of holding currency that earns a zero nominal return as a store of value. Hence the zero lower bound

$$i_t \geq 0. \tag{5}$$

This constraint plays a prominent role in the analysis of the second best equilibrium.

It is convenient for the exposition to define the price for a one period real bond. This bond promises its buyer to pay one unit of a consumption good at date $t + 1$, with certainty, for a price of $1 + r_t$. This asset price is the short term real interest rate. It follows from the household maximization problem that the real interest rate satisfies the arbitrage equation

$$u_c(Y_t, \xi_t) = (1 + r_t) \beta E_t u_c(Y_{t+1}, \xi_{t+1}) \tag{6}$$

Each differentiated good i is supplied by a single monopolistically competitive producer. There are assumed to be many goods in each of an infinite number of "industries"; the goods in each industry j are produced using a type of labor that is specific to that industry and also change their prices at the same time. Each good is produced in accordance with a common production function[3]

$$y_t(i) = A_t h_t(i),$$

[2] For simplicity, I abstract from government purchases of goods.

[3] There is no loss of generality in assuming a linear production function because I allow for arbitary curvature in the disutility of working.

where A_t is an exogenous productivity factor common to all industries, and $h_t(i)$ is the industry-specific labor hired by firm i. The representative household supplies all types of labor as well as consuming all types of goods.[4] It decides on its labor supply by choice of $H_t(j)$ so that every labor supply of type j satisfies

$$\frac{w_t(j)}{P_t} = (1 + \omega_{1t}(j)) \frac{v_h(\frac{y_t(j)}{A_t}; \xi_t)}{u_c(Y_t; \xi_t)} \tag{7}$$

where I have substituted for hours using the production function and assumed market clearing. The term $\omega_{1t}(j)$ is a distortionary wedge as in Chari, Kehoe and McGrattan (2005) or what Benigno and Woodford (2004) call labor market markup. The household takes this wedge as exogenous to its labor supply decisions. If the labor market is perfectly flexible then $\omega_{1t}(j) = 0$. Instead I assume that by varying this wedge the government can restrict labor supply and thus increase real wages relative to the case in which labor markets are perfectly competitive. The government can do this by facilitating union bargaining or by other anti competitive policies in the labor market. A marginal labor tax, rebated lump sum to the households, would have exactly the same effect.

The supplier of good i sets its price and then hires the labor inputs necessary to meet any demand that may be realized. Given the allocation of demand across goods by households in response to the firms pricing decisions, given by $y_t(i) = Y_t(\frac{p_t(i)}{P_t})^{-\theta}$, nominal profits (sales revenues in excess of labor costs) in period t of the supplier of good i are given by

$$\Pi_t(i) = \{1 - \omega_{2t}(j)\} p_t(i) Y_t(p_t(i)/P_t)^{-\theta} + \omega_{2t} p_t^j Y_t(p_t^j/P_t)^{-\theta} - w_t(j) Y_t(p_t(i)/P_t)^{-\theta}/A_t \tag{8}$$

where p_t^j is the common price charged by the other firms in industry j and $p_t(i)$ is the price charged by each firm.[5] The wedge $\omega_{2t}(j)$ denotes a monopoly markup of firms - in excess of the one implied by monopolistic competition across firms – due to government induced regulations. This term can be interpreted as a policy variable that introduces price collusion by the firms in each industry. A fraction $\omega_{2t}(j)$ of the sale revenues of the firm is determined by a common price in the industry, p_t^j, and a fraction $1 - \omega_{2t}(j)$ by the firms own price decision. (Observe that in equilibrium the two prices will be the same). This wedge works in the same fashion as a tax on the firms sales that is directly rebated to the other firms in industry j (the second term in the profit function). A positive $\omega_{2t}(j)$ acts as a price collusion because a higher $\omega_{2t}(j)$, in equilibrium, increases prices and also industry j's wide profits (local to no government intervention). A consumption tax – rebated either to consumers or firms lump sum – would introduce exactly the same wedge. In the absence of any government intervention $\omega_{2t} = 0$.

[4] We might alternatively assume specialization across households in the type of labor supplied; in the presence of perfect sharing of labor income risk across households, household decisions regarding consumption and labor supply would all be as assumed here.

[5] In equilibrium, all firms in an industry charge the same price at any time. But we must define profits for an individual supplier i in the case of contemplated deviations from the equilibrium price.

2.1 Equilibrium with Flexible Prices

If prices are fully flexible, $p_t(i)$ is chosen each period to maximize (8). This leads to the first order condition for the firms maximization

$$p_t(i) = \frac{\theta}{\theta - 1} \frac{w_t(j)/A_t}{1 - \omega_{2t}(j)} \tag{9}$$

which says that the firm will charge a markup $\frac{\theta}{\theta-1}\frac{1}{1-\omega_{2t}(j)}$ over its labor costs due to its monopolistic power. In the absence of any government intervention the term $\omega_{2t}(j) = 0$ and the firm charges a constant markup. As this equation makes clear this policy variable can create a distortion by increasing the markup in industry j charges beyond what is socially optimal. Under flexible prices all firms face the same problem so that in equilibrium $y_t(i) = Y_t$ and $p_t(i) = P_t$. Combining (7) and (9) then gives an aggregate supply equation

$$\frac{\theta - 1}{\theta} = \frac{1 + \omega_{1t}}{1 - \omega_{2t}} \frac{v_h(Y_t/A_t; \xi_t)}{A_t u_c(Y_t; \xi_t)} \tag{10}$$

where I have assumed that the wedges are set symmetrically across sectors.

I can now define an equilibrium and the efficient level of output.

Definition 1 *A flexible price equilibrium is a collection of stochastic processes for* $\{P_t, Y_t, i_t, r_t, \omega_{1t}, \omega_{2t}\}$ *that satisfy (3), (5), (6) and (10) for a given sequence of the exogenous processes* $\{A_t, \xi_t\}$. *The output in this equilibrium is called the natural rate of output and is denoted* Y_t^n.

Definition 2 *A efficient allocation is the flexible price equilibrium that maximizes social welfare. The equilibrium output in this equilibrium is called the efficient output and is denoted* Y_t^e *and the real interest rate is the efficient level of interest and denoted* r_t^e.

The next proposition shows the how the government should set the wedges to achieve the efficient allocation.

Proposition 1 *In the efficient equilibrium the government sets* $\frac{1+\omega_{1t}}{1-\omega_{2t}} = \frac{\theta-1}{\theta}$ *and output,* Y_t^e, *is determined by (10).*

Proof. The constraint 3, 5, 6 play no role apart from in determining the nominal prices and real and nominal interest rate are thus redundant in writing the social planners problem.[6] The Lagrangian for optimal policy can thus be written as:

$$E_0 \sum_{t=0}^{\infty} \beta^t \{u(Y_T; \xi_T) - v(Y_t/A_t; \xi_T) + \psi_{1t}\{\frac{\theta - 1}{\theta} - \frac{1 + \omega_{1t}}{1 - \omega_{2t}} \frac{v_h(Y_t/A_t; \xi_t)}{A_t u_c(Y_t; \xi_t)}\}.$$

[6] This can be shown formally by adding them to the Lagrangian problem and show that the Lagrance multipliers of these constraint are zero.

The first order condition with respect to Y_T is

$$u_c(Y_T;\xi_T) - \frac{v_h(Y_t/A_t;\xi_T)}{A_t} - \psi_{1t}\frac{\partial \frac{1+\omega_{1t}}{1-\omega_{2t}}\frac{v_h(Y_t/A_t;\xi_t)}{A_t u_c(Y_t;\xi_t)}}{\partial Y_t} \tag{11}$$

The first order condition with respect to ω_{1t} and ω_{2t} are that

$$\psi_{1t} = 0 \tag{12}$$

Substituting this into (11) we obtain that $\frac{v_h(Y_t/A_t;\xi_T)}{u_c(Y_T;\xi_T)A_t} = 1$.Substituting this into (10) to obtain the result. ■

The efficient policy only pins down the ratio $\frac{1+\omega_{1t}}{1-\omega_{2t}}$ but says nothing about how each of the variable is determined. The condition in Proposition (1) says that the wedges should be set to eliminate the distortions created by the monopolistic power of the firms.

There are many paths for prices and nominal interest rate that are consistent with the efficient allocation when prices are flexible. The implication is that the zero bound constraint (5) plays no role in determining the efficient output or the real interest rate (i.e. Y_t^e and r_t^e).

2.2 Equilibrium with Nominal Frictions

To analyze second best policy I assumed that instead of being flexible prices remain fixed in monetary terms for a random period of time. Following Calvo (1983) I suppose that each industry has an equal probability of reconsidering its price each period. Let $0 < \alpha < 1$ be the fraction of industries with prices that remain unchanged each period. In any industry that revises its prices in period t, the new price p_t^* will be the same. Then I can write the maximization problem that each firm faces at the time it revises its price as

$$E_t\left\{\sum_{T=t}^{\infty}(\alpha\beta)^{T-t}Q_{t,T}\{\{1-\omega_{2T}\}p_t^* Y_T(p_t^*/P_T)^{-\theta} + \omega_{2T}p_t^j Y_T(p_t^j/P_T)^{-\theta} - w_T(j)Y_T(p_t^*/P_T)^{-\theta}/A_T\}\right\} = 0.$$

The price p_t^* is then defined by the first-order condition

$$E_t\left\{\sum_{T=t}^{\infty}(\alpha\beta)^{T-t}u_c(C_T;\xi_T)(\frac{p_t^*}{P_T})^{-\theta}Y_T\{(1-\omega_{2T})\frac{p_t^*}{P_T} - \frac{\theta}{\theta-1}(1+\omega_{1T})\frac{v_h(\frac{Y_T(p_t^*/P_T)^{-\theta}}{A_T};\xi_T)}{u_c(Y_T;\xi_T)A_T}\}\right\} = 0. \tag{13}$$

where I have used (7) to substitute out for wages and substituted for the stochastic discount factor that is given by

$$Q_{t,T} = \beta^{T-t}\frac{u_c(C_T;\xi_T)P_t}{u_c(C_t;\xi_t)P_T}.$$

This first order condition says that the firm will set its price to equate expected discounted sum of its nominal price to a expected discounted sum of its markup times nominal labor costs. Finally, the definition (2) implies a law of motion for the aggregate price index of the form

$$P_t = \left[(1-\alpha)p_t^{*1-\theta} + \alpha P_{t-1}^{1-\theta}\right]^{\frac{1}{1-\theta}}. \tag{14}$$

Equilibrium can now be defined as follows.

Definition 3 *A sticky price equilibrium is a collection of stochastic processes* $\{Y_t, P_t, p_t^*, i_t, r_t, \omega_{1t}, \omega_{2t}\}$ *that satisfies (3), (5), (6),(13), (14) for a given sequence of the exogenous shocks* $\{\xi_t, A_t\}$.

Proposition 2 *If there are no shocks so that* $\xi_t = \bar{\xi}$ *and* $A_t = \bar{A}$ *then in a sticky price equilibrium (i) a social planner can achieve the efficient equilibrium by selecting* $i_t = 1/\beta - 1$ *and* $\frac{1+\omega_{1t}}{1-\omega_{2t}} = \frac{\theta-1}{\theta}$ *and ensure that* $P_{t+1} = P_t = \bar{P}$, $Y_t = Y_t^n = Y_t^e$ *and (ii) the efficient equilibrium is the optimal allocation.*

Proof. To prove the first part observe that if $P_t = \bar{P}$ for all t then $p_t^* = P_t$. This implies conditions (13) is identical to (10) so that the sticky price allocation solves the same set of equations as the flexible price allocation. Then the first part of the Proposition follows from Proposition 1. The second part of this proposition can be proved by following the same steps as Benigno and Woodford (2003) (see Appendix A.3 of their paper). They show that the deterministic solution of a social planners problem that is almost identical to this one, apart from that in their case the wedge is set to collect tax revenues. ■

It is can be shown that this equilibrium is time consistent and thus corresponds both to a Ramsey solution, the optimal policy from a forward perspective and the Markov Perfect Equilibrium, equilibrium concepts I will discuss in more detail later in this paper.

2.3 Approximate Sticky Price Equilibrium

In this section I approximate the model around the steady state in Proposition (2) to analyze the dynamics of the model when there are shocks. In the steady state $1 + \omega \equiv \frac{1+\omega_{1t}}{1-\omega_{2t}} = \frac{\theta-1}{\theta}$, $\Pi = 1$, $\bar{Y} = \bar{Y}^e = \bar{Y}^n$. By equation (10) and Proposition 1 the efficient level of output can be approximated by

$$\hat{Y}_t^e = \frac{\sigma^{-1}}{\sigma^{-1} + \nu} g_t + \frac{\nu}{\sigma^{-1} + \nu} q_t + \frac{1+\nu}{\sigma^{-1} + \nu} a_t \tag{15}$$

where the hat denotes log deviation from steady state and the three shocks are $g_t \equiv -\frac{\bar{u}_{c\xi}}{\bar{Y}\bar{u}_{cc}}\xi_t$, $q_t \equiv -\frac{\bar{v}_{h\xi}}{\bar{H}\bar{v}_{hh}}\xi_t$, $a_t = \ln(A_t/\bar{A})$ where a bar denotes that the variables (or functions) are evaluated in steady state. I define the parameters $\sigma \equiv -\frac{\bar{u}_c}{\bar{u}_{cc}\bar{Y}}$ and $\nu \equiv \frac{\bar{v}_{hh}\bar{h}}{\bar{v}_h}$. Using equation (6), and the expression of Y_t^e in (15) the efficient level of interest can be approximated by[7]

$$r_t^e = \frac{1-\beta}{\beta} + \frac{\sigma^{-1}\beta^{-1}}{\sigma^{-1} + \upsilon}(g_t - E_t g_{t+1}) + \frac{\upsilon\beta^{-1}}{\sigma^{-1} + \upsilon}(q_t - E_t q_{t+1}) + \frac{(1+\upsilon)\beta^{-1}}{\sigma^{-1} + \upsilon}(a_t - E_t a_{t+1}) \tag{16}$$

[7] To simplify the notation this variable corresponds to the one refined in equation 6 times by β^{-1}.

I can now express the consumption Euler equation (3) as[8]

$$\hat{Y}_t - \hat{Y}_t^e = E_t\hat{Y}_{t+1} - E_t\hat{Y}_{t+1}^e - \sigma(i_t - E_t\pi_{t+1} - r_t^e) \tag{17}$$

This equation says that current demand depends on expectation of future demand and the difference between the real interest rate and the efficient rate of interest.

Using equation (10) and (15) the relation between the natural level of output and the efficient level can be approximated by

$$\hat{Y}_t^n = \hat{Y}_t^e - \frac{1}{\sigma^{-1} + v}\hat{\omega}_t \tag{18}$$

This equation illustrates that while the efficient level of output in (15) is only a function of the exogenous shocks, policy induced distortionary wedges can change the natural level of output.

The Euler equation (13) of the firm maximization problem, together with the price dynamics (14), can be approximated to yield

$$\pi_t = \kappa(\hat{Y}_t - \hat{Y}_t^n) + \beta E_t\pi_{t+1} \tag{19}$$

where $\kappa \equiv \frac{(1-\alpha)(1-\alpha\beta)}{\alpha}\frac{\nu+\sigma^{-1}}{1+\nu\theta}$. The shocks in the model are now completely summarized by the stochastic processes of r_t^e and $\hat{Y}_t^e$ so that an equilibrium of the model can be characterized by equations (17), (18) and (19) for a given sequence of $\{\hat{Y}_t^e, r_t^e\}$.

Definition 4 *An approximate sticky price equilibrium is a collection of stochastic processes for the endogenous variables $\{\hat{Y}_t, \pi_t, \hat{Y}_t^n, i_t, \hat{\omega}_t\}$ that satisfy (5), (17),(18), (19) for a given sequence for the exogenous shocks $\{\hat{Y}_t^e, r_t^e\}$.*

To analyze optimal policy in the approximate economy one needs to determine the welfare function of the government. The next proposition characterizes the objective of the government to a second order. As shown by Woodford (2003), given that I only characterize fluctuations in the variables to the first order, I only need to keep track of welfare changes to the second order.

Proposition 3 *Utility of the representative household in an approximate sticky price equilibrium can be approximated to a second order by*

$$U_t \approx -\frac{1}{2}\sum_{t=0}^{\infty}\beta^t\{\pi_t^2 + \lambda(\hat{Y}_t - \hat{Y}_t^e)^2\} + t.i.p \tag{20}$$

where t.i.p. denotes terms independent of policy.

[8] In this approximated equation the variable i_t refers to interest rate defined before times β^{-1} and is not defined in terms of deviation from stead state like some of the other variables. I do this to simplify notation, i.e. so that I can express the zero bound as the constraint that i_t cannot be less than zero.

Proof. Follows from Proposition 6.1, 6.3 and 6.4 in Woodford (2003) with appropriate modifications of the proofs. For the proof of 6.1 we need the modification that $\Phi_y = 0$ because we expand around the fully efficient steady and replace equation E.6 on p. 694 with equation (15). The rest follows unchanged. ■

This proposition indicates that in a model in which there are shocks so that $\hat{Y}_t^e$ varies over time then, at least to a second order, social welfare is maximized when inflation is stable at zero and the equilibrium output tracks the efficient level of output.

3 Necessary Conditions for the First Best Equilibrium and a Naive Policy Recommendation

In this section I prove necessary conditions for achieving the first best equilibrium. A first best equilibrium is usually defined as a social planners problem that does not impose some particular constraint of interest (what kind of constraint is being considered varies by application). As discussed in the introduction I define the first best as the equilibrium in which policy is set optimally but is not constrained by the zero bound on the short-term interest rate.

Definition 5 *The first best policy is a solution of a social planner's problem that does not take account of the zero bound on the short-term interest rate. The second best policy is a solution to a social planner's problem that takes the zero bound into account.*

The first best social planner's problem is then to maximizes (20) subject to the IS equation (17) and AS equation (19) taking the process for $\{r_t^e, \hat{Y}_t^e\}$ as given. The second best social planners problem takes into account the zero bound constraint (5) in addition to the IS an AS equations.

The solution to the first best planning problem is simple because there exists an equilibrium that achieves the unconstrained maximum of (20) i.e. $\pi_t = 0$ and $\hat{Y}_t = \hat{Y}_t^e$. Since this is the unconstrained maximum of (20) it is obvious that, as long as the equilibrium is consistent with the IS and AS equations, it corresponds to the first best solution. The necessary conditions for this equilibrium are given in the next proposition.

Proposition 4 *Necessary conditions for implementing the first best solution in which $\hat{Y}_t = \hat{Y}_t^e$ and $\pi_t = 0$ are that*

$$i_t = r_t^e \tag{21}$$

$$\hat{\omega}_t = 0 \tag{22}$$

Proof. Substitute $\pi_t = 0$ and $\hat{Y}_t = \hat{Y}_t^e$ into equation 17 $\Longrightarrow i_t = r_t^e$. Substitute equation 18 into equation 19 and use $\pi_t = 0$ and $\hat{Y}_t = \hat{Y}_t^e \Longrightarrow \hat{\omega}_t = 0$ ■

It can be shown that the first best is time consistent so that it corresponds to both a Markov Perfect Equilibrium and the Ramsey equilibrium of a policy problem in when the zero bound is not imposed as a constraint.

Condition (21) says that the nominal interest rate should be set equal to the efficient level of interest. There is no guarantee, however, that this number is positive in which case this necessary condition has to be violated due to the zero bound on the short-term interest rate. Given the two necessary conditions derived in Proposition (4) a tempting policy recommendation is to direct the government to try to achieve these conditions "whenever possible" and when not possible then to satisfy them "as closely as possible", taking future conditions as given. I will now explore consequences of this "naive" policy advice.

4 Excessive Deflation and an Output Collapse under the Naive Policy

In this section I explore the consequences of the naive policy discussed in the last section when r_t^e is temporary negative. In this case, one of the necessary conditions for the first best solution cannot be satisfied due the zero bound on the short-term nominal interest rate. I consider a shock process for r_t^e as in Eggertsson and Woodford (2004):

A1: The Great Depression structural shocks $r_t^e = r_L^e < 0$ *unexpectedly at date* $t = 0$*. It returns back to steady state* r_H^e *with probability* γ *in each period. Furthermore,* $\hat{Y}_t^e = 0 \ \forall \ t$*. The stochastic date the shock returns back to steady state is denoted* τ*. To ensure a bounded solution the probability* γ *is such that* $\gamma(1-\beta(1-\gamma)) - \sigma\kappa(1-\gamma) > 0$

For simplicity I have assumed that $\hat{Y}_t^e$ is constant so that the dynamics of the model are driven by the exogenous component of the natural rate of interest r_t^e. There are several possible sources for a temporary decline in this term. It can be negative due to a series of negative demand shocks (i.e. shifts in the utility of consumption) or expectations of lower future productivity (i.e. shift in the disutility of working or technology), see Eggertsson and Woodford (2004) for a detailed discussion. A temporary collapse in some autonomous component of aggregate spending (that is separate from private consumption) can also be interpreted as a preference shock.[9]

[9] More generally, the most plausible reason for a collapse in aggregate spending is a collapse in investment. A host of candidates could lead to an investment collapse, such as problems in financial intermediation, adverse shocks to the balance sheets of firms, or a productivity slowdown that may lead to a capital overhang (and thus excess capital, leading to a decline in the natural rate of interest). These shocks are not modelled in detail at this level of abstraction but could be studied in a model with capital and financial intermediation frictions.

A policy which aims at satisfying (21) and (22) "whenever possible" and if that is not feasible then "as closely as feasible" takes the form

$$i_t = 0 \text{ for } 0 < t < \tau \tag{23}$$

$$i_t = r_H^e \text{ for } t \geq \tau \tag{24}$$

$$\hat{\omega}_t = 0 \text{ for all } t \tag{25}$$

I call this the "naive" policy. It is now straight forward to prove the following proposition

Proposition 5 ***Output Collapse and Deflation under Naive Policy****. If A1 then the evolution of output and inflation under the naive policy is:*

$$\hat{Y}_t = \frac{1-\beta(1-\gamma)}{\gamma(1-\beta(1-\gamma))-\sigma\kappa(1-\gamma)}\sigma r_L^e < 0 \textit{ if } t < \tau \textit{ and } \hat{Y}_t^D = 0 \textit{ if } t \geq \tau \tag{26}$$

$$\pi_t = \frac{1}{\gamma(1-\beta(1-\gamma))-\sigma\kappa(1-\gamma)}\kappa\sigma r_L^e < 0 \textit{ if } t < \tau \textit{ and } \pi_t^D = 0 \textit{ if } t \geq \tau \tag{27}$$

Proof. Consider first the solution at date $t > \tau$. Then $\pi_t = \hat{Y}_t = 0$. Then, conditional on r_t^e being negative (i.e. $t < \tau$), the simple assumption made on the natural rate of interest implies that inflation in the next period is either zero (with probability γ) or the same as at time t i.e. π_t (with probability $(1-\gamma)$). Then the expectation of future inflation is $E_t\pi_{t+1} = (1-\gamma)\pi_t$ and similarly the expectation of future output is $E_t\hat{Y}_{t+1} = (1-\gamma)\hat{Y}_t$. Substituting this into (19) and (17) and taking into account that (23) says that $i_t = 0$ when $t < \tau$ one obtains the solution above. The restriction on γ in A1 is needed for the model to converge. If it is violated the output collapse and deflation are unbounded and a linear approximation is no longer valid.

■

Table 1

parameters	calibrated values
σ	0.5
ν	2
β	0.99
θ	10
κ	0.02
γ	0.1

While the results are analytical, it is useful to put some numbers on them for illustration purposes. Figure 6 shows the output contraction and deflation under A1 for a particular calibration

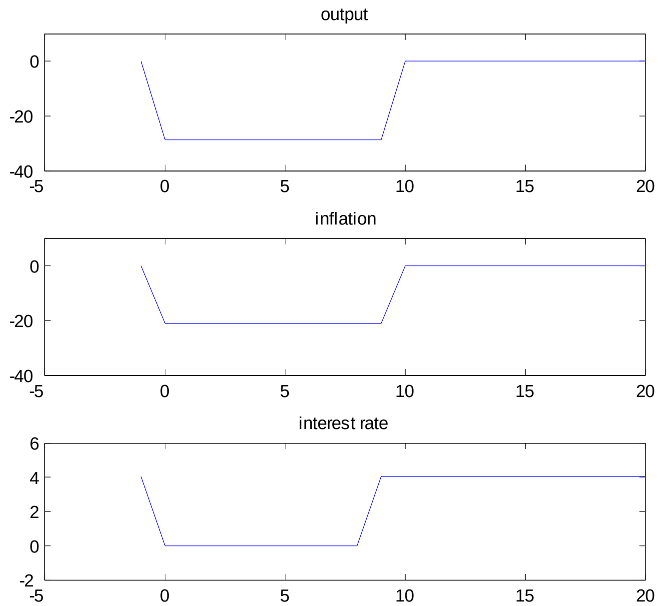


Figure 6: The economic consequences of the naive policy rule.

of the parameters. The parameters, shown in Table 1, are taken from Eggertsson (2006) and described in the footnote.[10]

In the figure it is assumed that the natural rate of interest is -4 percent in the r_L^e state to match the output contraction during the Great Depression. The figure shows the case in which the natural rate of interest returns to steady state in period $\tau = 10$ (which is the expected duration of the shock). The model indicates an output collapse of 30% under this calibration and the contraction lasts as long as the duration of the shock. The contraction at any time t is created by a combination of the deflationary shock in period $t < \tau$ – but more importantly – the *expectation* that there will be deflation and output contraction in future periods periods $t + j < \tau$ for $j > 0$. The deflation in period $t + j$ in turn depends on expectations of deflation and output contraction in periods $t + j + i < \tau$ for $i > 0$. This creates a vicious cycle that will not even converge unless the restriction on γ in A1 is satisfied. The overall effect is an output collapse as shown in figure 6

[10] The parameter σ is the intertemporal elasticity of substitution and is set so that the coefficient of relative risk aversion is 2 which is in line with micro evidence, ν is the inverse of Frisch labor supply which implies a Frisch elasticity of 0.5 which is in line with micro evidence, β is calibrated to match a steady state real interest rate of 4% per year, θ corresponds to a markup of 10 percent. The parameter κ is from the estimate by Rotemberg and Woodford (1997). I discuss how this parameter relates to price stickiness in section 7, i.e. what the calibration implies for the parameter α. The parameter γ is calibrated at 10 percent (implying an expected duration of the shock for 10 periods).

for a relatively small shock to the natural rate of interest.[11] The duration of the contraction can be several years in the model, or as long as the shocks last.

5 The Optimal Second Best Policy

I now turn to the optimal second best policy. To study optimal policy one needs to take a stance on whether there are any additional restrictions on government policy beyond those prescribed by the private sector equilibrium conditions. The central result will be cast assuming that government conducts optimal policy from a forward looking perspective (OFP) as in Woodford (2002) and Eggertsson and Woodford (2003,4). The optimal policy from a forward looking perspective is the optimal commitment under the restriction that the policy can only be set as a function of the physical state of the economy. The result is then extended to a Ramsey equilibrium, in which the government can fully commit to future policy and, at the other extreme, a Markov Perfect Equilibrium (MPE) in which case the government cannot commit to any future policy. Quantitatively the OFP and MPE are almost identical under A1.

There are good reason to start our analysis of the OFP over the Ramsey solution or the MPE. The appeal of the Ramsey solution is that it is the best possible outcome the planner can achieve. The main weakness for my purposes is that it requires a very sophisticated commitment that is subject to a serious dynamic inconsistency problem, especially in the example I consider. This casts doubt on how realistic it is as a description of policy making in the 1930's. The MPE, in contrast, is dynamically consistent by construct, an may thus capture a little better actual policy making. Its main weakness, however, is that it is not a well defined social planner's problem because each government is playing a game with future governments. The optimal MPE government strategy is therefore not a proper second best policy, as defined in Definition 5, because showing that the government at time t chooses to use a particular policy instrument (e.g. ω_t) is no guarantee that this is optimal. Indeed in certain class of games it is optimal to restrict the government strategies to exclude certain policy instrument or conform to some fixed "rules" (see e.g. Kydland and Prescott (1977)).

The optimal policy from a forward looking perspective strikes a good middle ground between Ramsey equilibrium and the MPE. It is a well defined planner's problem and thus appropriate to illustrate the main point. Yet it is very close to the MPE in the example I consider and thus not subject to the same dynamic inconsistency problem as the Ramsey equilibrium (as further discussed below). Furthermore it requires a relatively simple policy commitment by the government,

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

which makes it a more plausible description of actual policy during the Great Depression.

In the approximate sticky price equilibrium there are two physical state variables $\hat{Y}_t^e$ and r_t^e. The definition of an optimal forward looking policy is that it is the optimal policy commitment subject to the constraint that policy can only be a function of the physical state. I can therefore define the optimal policy from a forward looking policy as follows:

Definition 5 *The optimal policy from a forward looking perspective is a solution of a social planner's problem in which policy in each period only depends on the relevant physical state variables. In the approximated sticky price equilibrium the policy is a collection of functions* $\pi(\hat{Y}^e, r^e), Y(\hat{Y}^e, r^e), \omega(\hat{Y}^e, r^e), i(\hat{Y}^e, r^e)$ *that maximize social welfare.*

The social planner problem at data t is then

$$\min_{\pi(\hat{Y}^e,r^e),\hat{Y}(\hat{Y}^e,r^e),\hat{\omega}(\hat{Y}^e,r^e),i(\hat{Y}^e,r^e)} E_t \sum_{T=t} \beta^{T-t}\{\pi_T^2 + \lambda(\hat{Y}_T - \hat{Y}_T^e)^2\}$$
$$\text{s.t. } (5), (17), (19)$$

Under $A1$ the only state variable is r_t^e so I suppress $\hat{Y}^e$ from the policy functions. The minimization problem can be solved by forming the Lagrangian

$$\begin{aligned} L_0 \quad = \quad & E_0 \sum_{t=0}^{\infty} \beta^t \{\frac{1}{2}\pi(r_t^e)^2 + \frac{1}{2}\lambda \hat{Y}(r_t^e) + \psi_1(r_t^e)[\pi(r_t^e) - \kappa \hat{Y}(r_t^e) - \frac{\kappa}{\sigma^{-1}+\upsilon}\hat{\omega}(r_t^e) - \beta\pi(r_{t+1}^e)] \\ & \psi_2(r_t^e)[\hat{Y}(r_t^e) - \hat{Y}(r_{t+1}^e) + \sigma i(r_t^e) - \sigma\pi(r_t^e) - \sigma r_t^e] + \psi_3(r_t^e) i(r_t^e)\} \end{aligned} \tag{28}$$

where the functions $\psi_i(r^e)$ $i = 1, 2, 3$ are Lagrangian multipliers. Under $A1$ r_t^e can only take two values. Hence each of the variables can only take on one of two values, $\pi_L, \hat{Y}_L, i_L, \omega_L$ or $\pi_H, \hat{Y}_H, i_H, \omega_H$ and I find the first order conditions by setting the partial derivative of the Lagrangian with respect to these variables equal to zero. In A1 it is assumed that the probability of the switching from r_H to r_L is "remote", i.e. arbitrarily close to zero, so in the Lagrangian used to find the optimal value for $\pi_H, \hat{Y}_H, i_H, \hat{\omega}_H$ (i.e. the Lagrangian conditional on being in the H state) can be simplified to yield[12]

$$L_0 = \frac{1}{1-\beta}\{\frac{1}{2}\pi_H^2 + \frac{1}{2}\lambda\hat{Y}_H + \psi_{1H}((1-\beta)\pi_H - \kappa\hat{Y}_H - \frac{\kappa}{\sigma^{-1}+\upsilon}\hat{\omega}_H) + \psi_{2H}(i_H - \pi_H - r_H) + \psi_{3H} i_H\}$$

It is easy to see that the solution to this minimization problem is:

$$\pi_H = \hat{Y}_H = \hat{\omega}_H = 0 \tag{29}$$

[12] In the Lagrangian we drop the terms involving the L state because these terms are weighted by a probability that is assumed to be arbitrarily small.

and that the necessary conditions for achieving this equilibrium (in terms of the policy instruments) are that

$$i_H = r_H \tag{30}$$

$$\hat{\omega}_H = 0. \tag{31}$$

Taking this solution as given and substituting it into equations *(17)* and *(19),* the social planner's feasibility constraint in the states in which $r_t^n = r_L$ are

$$(1-\beta(1-\gamma))\pi_L = \kappa\hat{Y}_L + \frac{\kappa}{\sigma^{-1}+\upsilon}\hat{\omega}_L$$

$$\gamma\hat{Y}_L = -\sigma i_L + \sigma(1-\gamma)\pi_L + \sigma r_L^e)$$

$$i_L \geq 0$$

Consider the Lagrangian (28) given the solution (29)-(31). There is a part of this Lagrangian that is weighted by the arbitrarily small probability that the low state happens (which was ignored in our previous calculation). Conditional on being in that state and substituting for (29)-(31) the Lagrangian at a date t in which the economy is in the low state can be written as:

$$\begin{aligned} L_t &= E_t\sum_{T=t}^{\infty}\beta^{T-t}\{\frac{1}{2}\pi(r_T^e)^2 + \frac{1}{2}\lambda\hat{Y}(r_T^e) + \psi_1(r_T^e)[\pi(r_T^e) - \kappa\hat{Y}(r_T^e) - \frac{\kappa}{\sigma^{-1}+\upsilon}\hat{\omega}(r_T^e) - \beta\pi(r_{T+1}^e)] \\ &\quad +\psi_2(r_T^e)[\hat{Y}(r_T^e) - \hat{Y}(r_{T+1}^e) + \sigma i(r_T^e) - \sigma\pi(r_T^e) - \sigma r_t^e] + \psi_3(r_T^e)i(r_T^e)\} \\ &\quad \frac{1}{1-\beta(1-\gamma)}\{\frac{1}{2}\pi_L^2 + \frac{1}{2}\lambda\hat{Y}_L^2 \\ &\quad +\psi_{1L}((1-\beta(1-\gamma))\pi_L - \kappa\hat{Y}_L - \frac{\kappa}{\sigma^{-1}+\upsilon}\hat{\omega}_L) \\ &\quad +\psi_{2L}(\gamma\hat{Y}_L + \sigma i_L - \sigma(1-\gamma)\pi_L - \sigma r_L^n) + \psi_{3L}i_L\} \end{aligned}$$

The first order conditions with respect to π_L, $\hat{Y}_L, \omega_L$ and i_L respectively are

$$\pi_L + (1-\beta(1-\gamma))\psi_{1L} - \sigma(1-\gamma)\psi_{2L} = 0 \tag{32}$$

$$\lambda\hat{Y}_L - \kappa\psi_{1L} + \alpha\psi_{2L} = 0 \tag{33}$$

$$-\frac{\kappa}{\sigma^{-1}+\upsilon}\psi_{1L} = 0 \tag{34}$$

$$\sigma\psi_{2L} + \psi_{3L} = 0 \tag{35}$$

$$i_L \geq 0,\ \psi_{3L} \geq 0,\ i_L\psi_{3L} = 0 \tag{36}$$

Consider first the optimal forward looking policy under the constraint that the $\hat{\omega}_t$ is constrained at $\hat{\omega}_t = 0$ which is one of the conditions for the naive policy (so that (34) cannot be satisfied).

The solution of the conditions above (replacing (34) with $\hat{\omega}_t = 0$) then takes exactly the same form as shown for the naive policy in (23) and (24). This means that the naive policy can be interpreted as the *optimal forward looking policy under the constraint the government cannot use* $\hat{\omega}_t$ *to stabilize output and prices.*

Consider now the optimal second best solution in which the government can use both policy instruments. Observe first that $i_L = 0$. This leaves 6 equations with 6 unknowns ($\pi_L, \hat{Y}_L, \omega_L, \psi_{1L}, \psi_{2L}, \psi_{3L}$ and equations (32)-(35) together with IS and AS equations) that can be solved to yield:

$$\hat{Y}_L = \frac{\sigma}{[\gamma + \lambda\sigma^2 \frac{(1-\gamma)^2}{\gamma}]} r_L^e$$

$$\pi_L = -\frac{\sigma^2 \lambda \frac{1-\gamma}{\gamma}}{[\gamma + \lambda\sigma^2 \frac{(1-\gamma)^2}{\gamma}]} r_L^e > 0$$

$$\hat{\omega}_L = -(\sigma^{-1} + \upsilon) \frac{\sigma + \sigma^2 \lambda \frac{1-\gamma}{\gamma}[1 - \beta(1-\gamma)]\kappa^{-1}}{[\gamma + \lambda\sigma^2 \frac{(1-\gamma)^2}{\gamma}]} r_L^e > 0$$

The central proposition of the paper follows directly.

Proposition 6 *The New Deal as a Theory of Second Best. Suppose the government is a purely forward looking social planner and A1. If the necessary conditions for the first best* $i_t = r_t^e$ *is violated due to the zero bound so that* $i_t > r_t^e$*, then the optimal second best policy is that the other necessary condition* $\hat{\omega}_t = 0$ *is also violated so that* $\hat{\omega}_t > 0$.

This proposition is a classic second best result. To cite Lipsey and Lancaster (1956): "The general theorem of the second best states that if one of the Paretian optimum condition cannot be fulfilled a second best optimum is achieved only by departing from all other conditions."

What is perhaps surprising about Proposition 5 is not so much that both of the necessary conditions for the first best are violated by the way in which they are departed from. The proposition indicates that to increase output the government should *facilitate monopoly power of workers and firms to stimulate output and inflation.* This goes against the classic microeconomic logic that facilitating monopoly power of either firms and workers reduces output. Another noteworthy feature of the proposition is its unequivocal force. *The result holds for any parameter configuration of the model.* Some fundamental assumptions of the model need to be changed for the result to be overturned.

Figure 7 shows the evolution of output and inflation under the optimal second best policy and compares it to the naive policy, which, as discussed earlier, can also be interpreted as the optimal forward looking policy when the government cannot use $\hat{\omega}_t$ as a policy instrument. As shown the increase in the wedge $\hat{\omega}_t$ leads to a dramatic recovery in output and prices relative to the naive policy. The reason for this is as follows: The increase in $\hat{\omega}_t$ increases expected inflation

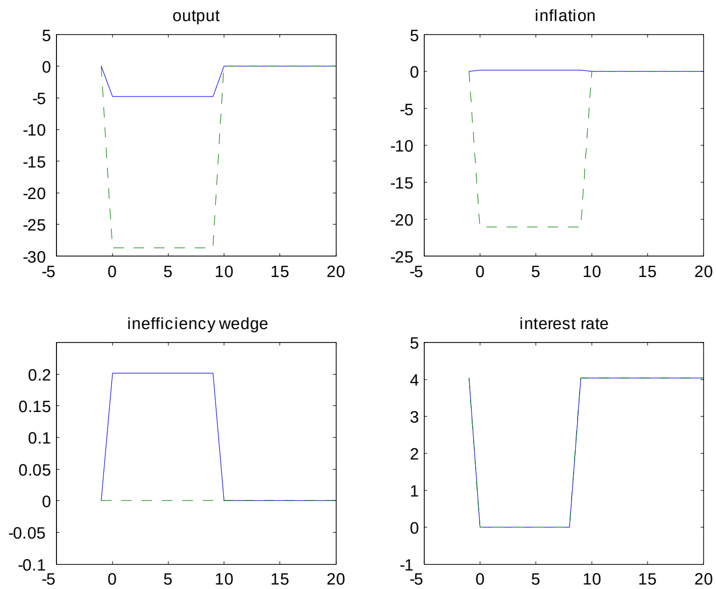


Figure 7: Comparing the naive policy to the optimal second best.

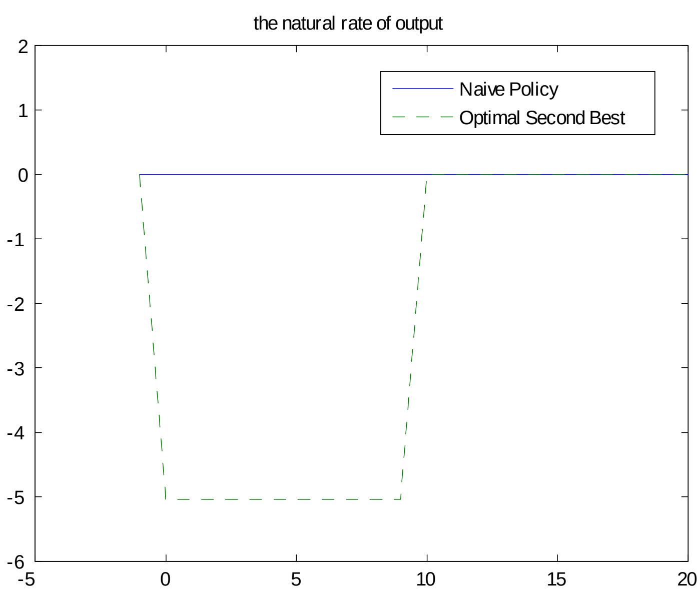


Figure 8: The optimal second best policy reduces the natural rate of output.

by increasing the markup of firms and/or workers unions. Higher expected inflation stimulates demand because it lowers the real rate of interest. The quantitative effect of this is large in the model.

In the figure the dashed line represents the equilibrium in the absence of New Deal policies, $\hat{\omega}_t$, which is interpreted as the equilibrium before FDR rose to power in 1933. This interpretation is logical since we showed that the naive policy can both be justified on the "naive" ground but it is also the optimal forward looking policy if the government does not use the second instrument $\hat{\omega}_t$ for policy. The solid line is interpreted as the solution after FDR rose to power and implemented the NIRA and AAA which implied an increase in $\hat{\omega}_t$.

As can be seen from the path of inflation in figure 7 the real interest rate in the model goes from +20 percent prior to the NRA to being slightly negative under the New Deal, i.e. moving from the dashed line to the solid line in the figure. This leads to an increase in output of about 25 percent. As can seen from the data from the Great Depression in figures 1-4 similar movements occurred in the US after the introduction of the New Deal policies in the spring of 1933. The real interest rate fell from double digits to slightly negative levels. As a result output grew by about a 39 percent from 1933-37, registering the strongest economic expansion in US economic history outside of war. Of course several other policies were implemented during this period. For discussion of other policy actions of FDR see Eggertsson (2005) and for a discussion of the depression in 1937-38, see Eggertsson and Pugsley (2006). This paper, however, is concerned with NIRA and AAA at the margin, abstracting from other policy options. The result, therefore, indicates that these policies may have contributed to the expansion.

In the calibrated example the wedge increases by about 20 percent. This is equivalent to a government introduced policy that increased monopoly markups of firms or workers unions by 20 percent. Figure 8 shows the implied change in the natural rate of output due to the change in the wedges. The New Deal policies lead to a decline in the natural rate of output by 5 percent. Despite this large *decline* in the natural rate of output there is a large *increase* in equilibrium output as figure 7 shows.

6 Extensions: The Markov Perfect Equilibrium and the Ramsey Solution

In this section I extend the result derived in the last section to an environment in which the government cannot commit to any future policy (the Markov Perfect Equilibrium) and one in which it can fully commit (Ramsey equilibrium). The basic conclusion of the paper holds for both extensions.

6.1 The Markov Perfect Solution

The MPE is standard equilibrium concept in macroeconomics. The idea is that the government cannot make any commitments about future policy but instead reoptimizes every period, taking *future government actions* and the physical state as given. Observe that the government's objective and the system of equation that determine equilibrium are completely forward looking so that they only depend on the exogenous state $(r_t^e, \hat{Y}_t^e)$. It follows that the expectations $E_t\pi_{t+1}$and $E_t\hat{Y}_{t+1}$ are taken by the government as exogenous since they refer to expectations of variables that will be determined by future governments (I denote them by $\bar{\pi}(r_t^e, \hat{Y}_t^e)$ and $\bar{Y}(r_t^e, \hat{Y}_t^e)$ below). To solve the government's period maximization problem one can then write the Lagrangian

$$L_t = -E_t \begin{bmatrix} \frac{1}{2}\{\pi_t^2 + \lambda_y(\hat{Y}_t - \hat{Y}_t^e)^2\} \\ +\phi_{1t}\{\pi_t - \kappa\hat{Y}_t + \kappa\hat{Y}_t^e - \frac{\kappa}{\sigma^{-1}+\upsilon}\hat{\omega}_t - \beta\bar{\pi}(r_t^e, \hat{Y}_t^e)\} \\ +\phi_{2t}\{\hat{Y}_t - \bar{Y}(r_t^e, \hat{Y}_t^e) + \sigma(i_t - \bar{\pi}(r_t^e, \hat{Y}_t^e) - r_t^e)\} + \phi_{3t}i_t \end{bmatrix} \tag{37}$$

and obtain four first order conditions that are necessary for optimum and one complementary slackness condition

$$\pi_t + \phi_{1t} = 0 \tag{38}$$

$$\lambda_y(\hat{Y}_t - \hat{Y}_t^e) - \kappa\phi_{1t} + \phi_{2t} = 0 \tag{39}$$

$$-\frac{\kappa}{\sigma^{-1} + \upsilon}\phi_{2t} = 0 \tag{40}$$

$$\sigma\phi_{2t} + \beta^{-1}\phi_{3t} = 0 \tag{41}$$

$$\phi_{3t} \geq 0,\ \ \phi_{3t}i_t = 0 \tag{42}$$

Consider first the equilibrium in which the government does not use $\hat{\omega}_t$ to stabilize prices and output (i.e. $\hat{\omega}_t = 0$) in which case the equilibrium solves the first order conditions above apart from (40). In this case the solution is the same the optimal forward looking policy subject to $\hat{\omega}_t = 0$ and thus also equivalent to the naive policy in Proposition 5.

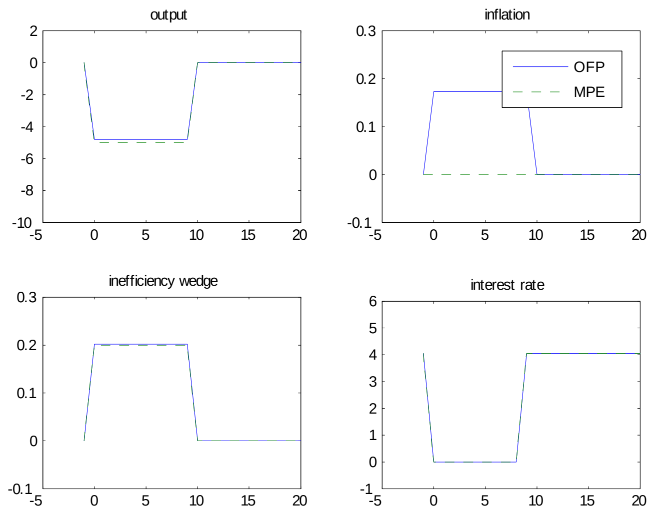
Next consider the optimal policy when the government can use $\hat{\omega}_t$. In this case the solution that solves (38)-(42) and the IS and AS equations is:

$$\hat{Y}_t = \frac{\sigma}{\gamma}r_L^e \text{ if } t < \tau \text{ and } \hat{Y}_t = 0 \text{ if } t \geq \tau \tag{43}$$

$$\pi_t = 0\ \forall t \tag{44}$$

$$\hat{Y}_t^n = \frac{\sigma}{\gamma}r_L^e \text{ if } t < \tau \text{ and } \hat{Y}_t^n = 0 \text{ if } t \geq \tau \tag{45}$$

$$\hat{\omega}_t = -\frac{\sigma}{\gamma}(\sigma^{-1} + \upsilon)r_L^e > 0 \text{ if } t < \tau\ \hat{\omega}_t = 0 \text{ if } t \geq \tau \tag{46}$$



The analytical solution above confirms the key insight of the paper, that the government will increase $\hat{\omega}_t$ to increase inflation and output when the efficient real interest rate is negative. There is however some qualitative difference between the MPE and the OFP. Under the optimal forward looking policy the social planner increases the wedge beyond the MPE to generate inflation in the low state. The reason for this is that under OFP the policy maker uses the wedge to generate expected inflation to lower the real rate of interest. In the MPE, however, this commitment is not credible and the wedge is set so that inflation is zero.

The quantitative significance of the difference between MPE and OFP, however, is trivial. Figure (6.1) compares the OFP and the MPE in our baseline calibration. A the figure shows the quantitative difference is trivial in our baseline calibration.

6.2 Ramsey Equilibrium

I now turn to the Ramsey equilibrium. In this case the government can commit to any future policy. The policy problem can then be characterized by forming the Lagrangian:

$$L_t = E_t \begin{bmatrix} \frac{1}{2}\{\pi_t^2 + \lambda \hat{Y}_t^2\} + \phi_{1t}(\pi_t - \kappa \hat{Y}_t - \frac{\kappa}{\sigma^{-1}+\upsilon}\hat{\omega}_t - \beta \pi_{t+1}) \\ +\phi_{2t}(\hat{Y}_t - \hat{Y}_{t+1} + \sigma i_t - \sigma \pi_{t+1} - \sigma \hat{r}_t^e) + \phi_{3t} i_t \end{bmatrix} \tag{47}$$

which leads to the first order conditions:

$$\pi_t + \phi_{1t} - \phi_{1t-1} - \sigma \beta^{-1} \phi_{2t-1} = 0$$

$$\lambda \hat{Y}_t - \kappa \phi_{1t} + \phi_{2t} - \beta^{-1} \phi_{2t-1} = 0$$

$$\sigma \phi_{2t} + \phi_{3t} = 0$$

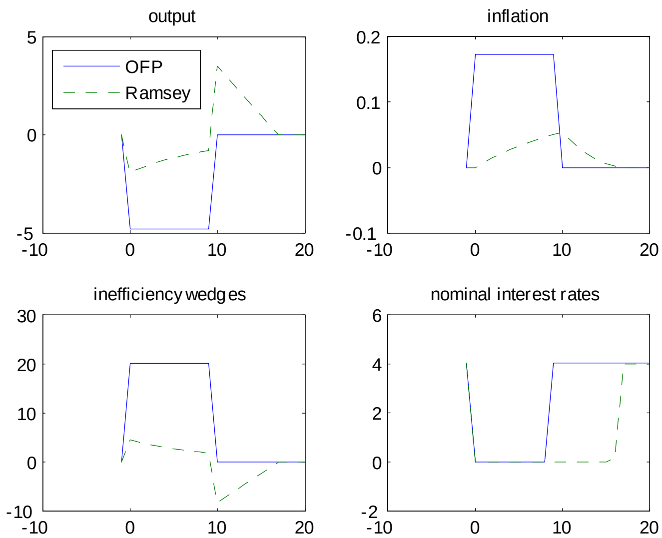


Figure 9: The qualiatative features of the optimal foreward looking and Ramey policy are the same. The key difference is that the Ramey policy achieves a better outcome by manipulating expectations about policy at the time at which the deflationary shocks have subsided.

$$\phi_{1t} = 0$$

$$\phi_{3t} i_t = 0 \; i_t \geq 0 \text{ and } \phi_{3t} \geq 0$$

Figure 9 shows the solution of the endogenous variables, using the solution method suggested in Eggertsson and Woodford (2004). Again the solution implies an increase in the wedge in the periods in which the zero bound is binding. The wedge is about 5 percent initially. In the Ramsey solution, however, there is a commitment to reduce the wedge temporarily once the deflationary shocks have reverted back to steady state. There is a similar commitment on the monetary policy side. The government commits to zero interest rates for a considerable time after the shock has reverted back to steady state.

The optimal commitment thus also deviates from the first best in the periods $t \geq \tau$ both by keeping the interest rate at zero beyond what would be required to keep inflation at zero at that time and by keeping the wedge below its efficient level. This additional second best leverage, which the government is capable of using because it can fully commit to future policy, lessens the need to increase the wedge in period $t < \tau$. This is the main difference between the Ramsey equilibrium and the MPE and OFP. The central conclusion of the paper, however, is confirmed, the government increases the wedge ω_t to reduce deflation during the period of the deflationary shocks.

The key weakness of this policy, as a descriptive tool, is illustrated by comparing it to the

MPE. The optimal commitment is subject to a serious dynamic inconsistency problem. To see this consider the Ramsey solution in periods $t \geq \tau$ when shocks have subsided. The government can then obtain higher utility by reneging on its previous promise and achieve zero inflation and output equal to the efficient level. This incentive to renege is severe in our example, because the deflationary shocks are rare and are assumed not to reoccur. Thus the government has strong incentive to go back on its announcements. This incentive is not, however, present to the same extent under optimal forward looking policy. Under the optimal forward looking policy the commitment in periods $t \geq \tau$ is identical to the MPE.

7 A comparison to Cole and Ohanian's result

In this section I compare the results to the ones obtained in Cole and Ohanian (2004) and clarify the reason for the different conclusions reached. Cole and Ohanian assume that there is a productivity shock that causes the Great Depression in 1929-33. They assume that this shock is over in 1933 and compute the transition paths of the economy for given initial conditions. They show that the recovery, given this initial condition, is slower than implied by a standard growth model and give possible explanations for the slow recovery. The slow recovery in Cole and Ohanian's model is due to that they calibrate the size of a "cartelized sector" to match data that show that real wages were 20 percent above trend in the manufacturing sector in 1939. Because this sector, in their calibration, corresponds to 32 percent of the economy this indicate that real wages, on average, were 6 percent higher than they otherwise would have been. The high real wages, due to cartelization policy, create an inefficiency wedge and thus suppress employment and aggregate output.

The two most important differences between assumptions and calibration parameters in this paper and Cole and Ohanian's are: 1) prices are sticky and 2) there are deflationary shocks that make the market clearing interest rate negative throughout the period 1933-39. Below I discuss each of these assumptions. Before detailing whether or not they were likely to be satisfied it is useful to ask the following question: Given 1) and 2), what is the response of the economy if the inefficiency wedges in the current model are calibrated to match the same data as Cole and Ohanian match, i.e. that real wages were above trend? Just as in their model, the high real wages in the recovery phase *imply* a particular wedge in the model of this paper. To see this one can approximate equation (7) and use the assumption A1 that $\hat{Y}_t^e = 0$ (and assuming no productivity shocks) to yield

$$\hat{w}_t^p = \hat{\omega}_t + (\sigma^{-1} + \nu)\hat{Y}_t$$

where $\hat{w}_t^p$ is the deviation of the average real wage from steady state. Because the model abstract from productivity growth I interpret this variable as deviation of real wages from trend. I now assume that policy takes the same form as the MPE and the optimal forward looking policy, i.e. that the wedge is temporarily increased during the periods in which there are deflationary shocks. This implies that $\hat{\omega}_H = 0$ where H denotes that the shock r_t^n has reverted to steady state. Using the equation above along with the IS and the AS equation the implied wedge $\hat{\omega}_L$ solves the three equations

$$\hat{w}_L^p = \hat{\omega}_L + (\sigma^{-1} + \nu)\hat{Y}_L$$

$$(1 - (1-\gamma)\beta)\pi_L = \kappa Y_L + \kappa \frac{1}{\sigma^{-1} + \nu} \hat{\omega}_L$$

$$\gamma Y_L = \sigma(1-\gamma)\pi_L + \sigma r_L^n$$

If we calibrate $\hat{w}_L^p$ to match that real wages were on average 6 percent above trend during the recovery phase we can solve for $\omega_L, \hat{Y}_L$ and $\hat{\pi}_L$. Under our baseline calibration this value for the real wages imply that the inefficiency wedge is 21 percent, output -3.8 percent and inflation 1 percent. Compare these values to the equilibrium in which the inefficiency wedge is zero. Then there is an output contraction of 30 percent and deflation of 20 percent. Thus the New Deal policies, if we match the same real wage data as Cole and Ohanian, increased output by about 25 percent in this model, and thus supported a recovery rather than prolonging the depression. Incidentally this value of the inefficiency wedge is very close to the optimal second best policy, as we saw in preceding sections.

This conclusion relies on the assumed degree of price stickiness. If prices were perfectly flexible then the output would be equal to the natural rate of output. Using equation (18) an inefficiency wedge of 21 implies that the natural rate of output is -5.3 percent below steady state but at steady state when the inefficiency wedge is zero. Thus when prices are perfectly flexible the model delivers the same result as Cole and Ohanian's analysis. How sensitive are the results to the assumed degree of price rigidness? The assumed value of κ in table 1 is calibrated to match an estimated value for Rotemberg and Woodford (1997). Using the expression for $\kappa \equiv \frac{(1-\alpha)(1-\alpha\beta)}{\alpha} \frac{\nu+\sigma^{-1}}{1+\nu\theta}$ and assuming $\theta = 10$ the implied frequency of price adjustment is 0.75. This means that the average duration of a given price is four quarters under the baseline calibration. This may seem like a large number and one may wonder how the result changes assuming more flexible prices. Somewhat surprisingly, however, the quantitative result is even *stronger* if one assumes that prices are *more flexible*. The formulas in (26) and (27) reveal the puzzling conclusion that the higher the price flexibility (i.e. the higher the parameter κ) the stronger the output collapse in the absence of the New Deal policies. This is paradoxical because, when prices are perfectly flexible as in Cole and Ohanian (2005), output is constant by assumption A1 (in the absence of New Deal policies).

The forces at work here were first recognized by Tobin (1975) and De Long and Summers (1986). These authors show that more flexible prices can lead to the expectation of further

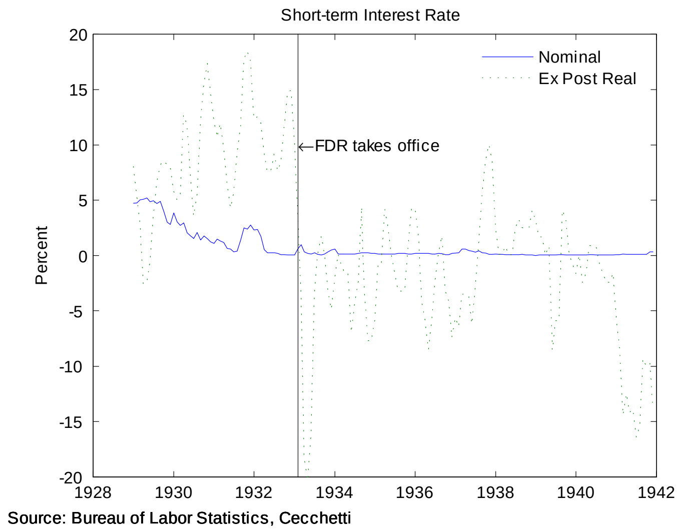


Figure 10: *Real Rates collapsed with FDR rise to power.*

deflation in a recession. If demand depends on expected deflation, as in equation (17), higher price flexibility can therefore lead to ever lower demand in recession, thus increasing output volatility. This dynamic effect, the so called "Mundell effect", must be weighted against the reduction in the static output inflation trade-off in the AS curve due to higher price flexibility. In some cases the Mundell effect can dominate, depending on the parameters of the model. Formula (26) indicates that the Mundell effect will always dominate at zero interest rates.

This result indicates that higher price flexibility will make the New Deal policies even more beneficial in the model, since it attenuates the output collapse in their absence. It is only in the very extreme case when prices are perfectly flexible that the result of the paper collapses because in that case, by definition, the equilibrium output has to be equal to the natural rate of output.

The second key assumption in the paper is that there are shocks such that the efficient rate of interest – or market clearing interest rate – is temporarily negative. In the absence of any shock there are no deflationary pressures. For a given inflation target, therefore, output will be equal to the natural level and inefficiency wedges will thus only reduce output as long as the government tries to maintain a given inflation target. Thus, in the absence of these shocks, the results of the model will coincide with those derived by Cola and Ohanian. Is it plausible to assume that the market clearing interest rate was negative throughout the recovery period? Figure 10 shows the ex post real interest rate in the US in the 1930's. The real rate of interest does not need to be equal to the efficient level. Indeed equation (17) shows that if the (current and expected) real rate of interest is higher that then efficient level of interest there will be a recession. In contrast if the real rate of interest is lower than the efficient level of interest there is a boom. During 1929-1933 the real rate of interest were extremely high relative to the assumed efficient real interest rates in the calibration, consistent with the collapse in output. In 1933-1937, however, the short-term real interest rates were slightly negative. If there were no shocks during this period, the model would imply that output had to be above its efficient level during this period. This does not, however, appear consistent with the data since output was mostly recovering to its pre-depression level and is generally considered to have been below potential during this period. This indicates that the efficient level of interest was even more negative than the ex post real interest rate during this period, consistent with the assumed path of the shocks in this paper. While this evidence is suggestive, I leave it to future research to fully estimate the model to match the shocks and the parameters to the data (this could for example be done using the Bayesian methods as in Primiceri, Tambalotti and Schaumburg (2006)).

8 Conclusion

This paper shows that an increase in the monopoly power of firms or workers unions can increase output. This theoretical result, if interpreted literally, may change the conventional wisdom about the general equilibrium effect of the National Industrial Recovery Act and the Agriculture Adjustment Act during the Great Depression. It goes without saying that this does not indicate that the these policies are good under normal circumstances. Indeed, the model indicates that facilitating monopoly power of unions and firms is suboptimal in the absence of shocks leading to inefficient deflation. It is only under the condition of excessive deflation and an output collapse that these policies pay off. The historical record indicates that this was well understood by policy makers during the Great Depression. The NIRA, for example, was always considered as a temporary recovery measure.

This paper can be also interpreted as an application of the General Theory of Second Best proposed by Lipsey and Lancaster (1956). These authors analyze what happens to the other optimal equilibrium conditions of a social planner problem when one of the conditions cannot be satisfied for some reason. Lipsey and Lancaster show that, generally, when one optimal equilibrium condition is not satisfied, for whatever reason, all of the other equilibrium conditions will change. The previous literature of the National Recovery Act is usually explicitly or implicitly cast in the context of an economy that is at a first best equilibrium. Cole and Ohanian (2005), for example, study an economy without shocks and fully flexible prices and show that in that environment facilitating monopoly powers of firms or workers reduces output. Their result built on standard economic logic that has been applied by various authors ranging from Keynes (1933) to Friedman and Schwartz (1963).

The Theory of the Second Best, however, teaches us that if one of the optimality conditions of a social planner fails, then all the other conditions change as well. In this paper the social planner's optimality condition that holds under regular circumstances fail due to a combination of sticky prices, shocks that make the natural rate of interest negative, and the zero bound on the short term interest rate (that prevents the government from accommodating the shocks by interest rate cuts). This combination changes the optimality conditions of the social planner so that, somewhat surprisingly, it becomes optimal to facilitate the monopoly pricing of firms and workers alike. This result provides a new and surprising policy prescription that has been frowned upon by economists for the past several hundred years, dating at least back to Adam Smith who famously claimed that the collusion of monopolies to prop up prices was a conspiracy against the public.

9 References

1. Benigno, Pierpaolo and Michael Woodford (2003), "Optimal Monetary and Fiscal Policy: A Linear Quadratic Approach" NBER Macroeconomics Annual.

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

3. Chari, V. Kehoe, P., and McGrattan, E., (2006), "Business Cycle Accounting," Econometrica, forthcoming.

4. Cole, H, and L. Ohanian (2004), "New Deal Policies and the Persistence of the Great Depression: A General Equilibrium Analysis," Journal of Political Economy, Volume 112, Number 4.

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

6. Eggertsson, Gauti (2005), "Great Expectations and the End of the Depression," Federal Reserve of New York Staff Report nr. 235.

7. Eggertsson, Gauti. (2006), "The Deflation Bias and Committing to Being Irresponsible," Journal of Money, Credit, and Banking, forthcoming.

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

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

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

11. Keynes, John Maynard. (1933) "", New York Times.

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

13. Kydland, Finn E. and Edward C. Prescott (1977): "Rules Rather than Discretion: The Inconsistency of Optimal Plans." Journal of Political Economy (85): 473-91.

14. Lipsey and Lancaster (1956), "The General Theory of Second Best," Review of Economic Studies, p. 11-32.

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

16. Primiceri, G., Schaumburg, E., and Tambalotti, A. (2006),"Intratemporal Shocks," Federal Reserve Bank of New York, mimeo.

17. Rotemberg, Julio J., and Michael Woodford (1997) "An Optimization-Based Econometric Framework for the Evaluation of Monetary Policy," NBER Macroeconomics Annual, p. 297-346.

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

19. Svensson, Lars (2001), ”The Zero Bound in an Open-Economy: A Foolproof Way of Escaping from a Liquidity Trap,” Monetary and Economic Studies 19(S-1), 277-312.

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

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