Facoltà di economia

Cattedra di Money and Banking

A WAY OUT OF THE LIQUIDITY TRAP:

optimal monetary and fiscal policy when nominal interest rates approach the zero bound.

RELATORE

Prof. Salvatore Nisticò

CANDIDATO

Martina Fazio

Matr. 152261

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1. INTRODUCTION

A liquidity trap describes a situation in which prices steadily fall and output is persistently below its potential level, notwithstanding a policy interest rate already at or near zero. Any further expansionary monetary policy is prevented from the constraint on nominal interest rates to be non-negative. In such a circumstance, money and bonds become near-perfect substitutes, since they both guarantee an almost zero interest rate: the quantity of money that circulates into the economy is thus irrelevant, and any massive increase in money supply can be absorbed by the public without affecting outcome. When the zero bound becomes a relevant constraint on interest rates, the economy is characterized by an excess of savings, if compared to the level of investments. This, together with persistently low spending and pessimistic expectations regarding the future, causes the recession to reinforce itself in a vicious cycle.

The first to define the concept of "liquidity trap" was J.M. Keynes in his *General Theory of Employment Interest and Money* (1936). He identified a speculative reason to hold money, starting from the assumption that money is a financial asset with the peculiar characteristics of highest liquidity and zero return. Allowing for a high substitutability between money and other securities, under normal circumstances the quantity of money in the economy defines the level of the interest rate, given heterogeneous expectations concerning bond prices and different preferences for liquidity. But in case of a recession, where interest rates are already at incredibly low levels, everyone in the economy can only expect them to rise, even though no one knows when this will happen. Since the entire private sector has this same kind of expectation, nobody is willing to hold bonds, because everyone supposes their prices will eventually fall. Whatever quantity of money is flooded into the economy, it will be absorbed without succeeding in affecting the interest rate: monetary policy is completely ineffective.

This is why J. Hicks called the Keynesian *General Theory* “the Economics of Depression”. In 1937 he wrote an article[1] commenting on Keynes work, reconciling to some extent his view with the Classical Marginalist School. He emphasized the particular shape that Keynes assumed for the Liquidity-Money schedule, almost vertical to the right but flat and infinitely elastic to the left, in correspondence to a certain minimum level of the interest rate. An economy in a liquidity trap is described by a point of equilibrium such that the IS intersects the LM curve in its horizontal part. An increase in money supply can only shift the sloping part of the schedule downward, while the flat part stays unchanged. This is what makes monetary policy unsuccessful in combating a liquidity trap and, on the other hand, fiscal stimulus very powerful in boosting output.

While the debate was extremely topical during the 1930s following the deflationary slump of the Great Depression, the main concern in the post World War II industrialized economy was inflation. Hence, for many decades, the liquidity trap was confined to exclusively academic conjectures. With the Monetarist view prevailing, it was denied from ever happening, and regarded as a ridiculous unrealistic phenomenon from nations plagued by hyperinflation.

It seemed so easy to create inflation in modern monetary systems that no one could have deemed the circumstances of Japan in the 1990s as likely. But in fact, an entire “Lost Decade” was characterized by persistent deflation and output growth slowdown, with any hint of recovery being immediately followed by downturns. No one even judged the recession to be so serious and long lasting as it turned out to be.

Paul Krugman was the first to identify the Japanese situation as a liquidity trap in 1998 (*It’s Baaack! Japan’s Slump and the Return of the Liquidity Trap*). He harshly criticized how Japanese central bankers were managing the situation and called on the monetary

1 “Mr. Keynes and the “Classics”; A Suggested Interpretation” in *Econometrica*

and fiscal authorities to give a stonger support to the flagging economy. In his model, he demonstrated the necessity for the monetary authorities to commit to a looser policy stance, and hence to a higher level of inflation than would have otherwise been welcomed, trying not to fear excessively for the consequences of such a policy: “commit to be irresponsible”, to put it in his own words.

After Krugman, a multitude of economists wrote on the subject, suggesting different ways to overcome the impasse in monetary policy’s effectiveness, using different tools and attitudes towards the problem. Almost everybody seemed to agree that the monetary authority is far from powerless when facing a situation of liquidity trap, and that the key to the recovery is the management of expectations (among others: L.E.O. Svensson “*The Zero Bound in an Open Economy: a Foolproof Way of Escaping from a Liquidity Trap*” (2000), M. Goodfriend “*Overcoming the Zero Bound on Interest Rate Policy*” (2000), B.S. Bernanke “*Deflation: Making Sure “It” Doesn’t Happen Here*” (2002), A.J. Auerbach and M. Obstfeld “*The Case for Open-Market Purchases in a Liquidity Trap*” (2003)).

In a New-Keynesian framework M. Woodford provided thorough, robust micro-foundation to the analysis and management of this policy problem (M. Woodford, G. Eggertsson *“The zero bound on interest rates and optimal monetary policy”* (2003), *“Optimal monetary and fiscal policy in a liquidity trap”* (2004)). These two papers will be taken as cornerstones in reviewing the situation of a liquidity trap and the consequent feasible responses to the shock that hit the economy.. This appears particularly relevant in light of the recent events in the U.S. and Europe, where central bankers are currently fighting against downward pressures on prices and output, following the financial crisis in late 2007.

The present writing is structured as follow: first the context of a New-Keynesian economy is presented, where households make consumption and labor supply decisions by maximizing their utility, while firms set prices by maximizing profits. Then monetary policy is introduced assuming that no fiscal tools are available to counteract the disturbance that forces the economy into the liquidity trap: it is demonstrated that the zero lower bound does constitute an impediment to the achievement of the policy target. Optimal monetary policy is revealed to be history dependent, hence the presence of a liquidity trap at a certain point in time, causes the authorities to subsequently act differently from what they would have if that circumstance had never occurred.

The possibility for Quantitative Easing to represent an additional and separate tool in the hands of the policymaker is ruled out, while its importance emerges in guiding future expectations and in helping policy commitment to appear as fully credible. In general, and as mentioned above, monetary policy is far from helpless in such a circumstance. Next, the classical Keynesian remedy to a liquidity trap, i.e. fiscal policy, is analyzed. It turns out that a fairly satisfactory outcome can be achieved even with forward-looking policies, provided that fiscal instruments are used for stabilization purposes. When both fiscal and monetary policies are chosen optimally they continue to be history-dependent, and they involve the commitment to create an inflationary and output boom once the zero bound has ceased to bind. This is achieved by promising to maintain nominal interest rates at zero and to cut taxes, after the disturbance has been removed.

In the end, a comparison between the measures taken in Japan in the late 90s and in the US today is made. The recession in the two different countries, although stemming from very similar situations (that is, a meltdown in the real estate and the stock markets), spread out in substantially and structurally different financial systems. This of course implied different responses on the part of the policymakers.

What is clear is that monetary policy measures, such as quantitative or credit easing, although essential in mitigating the initial outburst of the crisis, are fundamentally temporary steps. Therefore, other structural reforms need to be taken in order to effectively tackle the question, depending on the sort of disturbance that caused the zero bound to become binding.

2. THE BASIC NEW KEYNESIAN MODEL

This model is based on the maximization of the representative household's utility function, and on firms making pricing decisions in order to maximize their profits, where monopolistic competition and nominal rigidities are assumed.

2.1. Households

Households make labor supply and consumption/savings decisions in order to maximize their utility, which depends positively on consumption (C_t) and negatively on the hours of work (N_t).

Assuming an infinitely-lived representative household, its utility function is

$$E_0 \sum_{t=0}^{\infty} \beta^t \, U(C_t; N_t) \tag{2.1}$$

Households can consume a continuum of differentiated goods, with $C_t\ (i)$ representing the quantity of good *i* consumed in period *t*. C_t is thus a consumption index given by

$$C_t \equiv \left(\int_0^1 C_t\ (i)^{\frac{\epsilon-1}{\epsilon}}\ di \right)^{\frac{\epsilon}{\epsilon-1}}$$

Each family can allocate its income either in consumption or buying government bonds. Maximization of households' utility is subject to a period budget constraint of the form

$$\int_0^1 P_t\,(i) C_t(i) di\ + Q_t B_t \ \leq\ B_{t-1} +\ W_t N_t + T_t \tag{2.2}$$

Where B_t is the quantity of one-period, riskless discount bonds bought in period t at price Q_t, paying one unit of money in period t+1; P_t (i) is the price of good *i*; W_t is the nominal wage; N_t the hours of work and T_t is a lump sum addition or subtraction to period income, which may represent government transfers, lump-sum taxes or dividends. The solvency condition to the budget constraint is $\lim_{T\to\infty} E_t\{B_T\} \geq 0$.

Maximizing the consumption index C_t for any given level of expenditures $\int_0^1 P_t\,(i) C_t(i) di$ yields the demand equation for every single good *i*

$$C_t(i) = \left(\frac{P_t(i)}{P_t}\right)^{-\epsilon} C_t \tag{2.3}$$

Where $P_t \equiv \left[\int_0^1 P_t(i)^{1-\epsilon} di\right]^{\frac{1}{1-\epsilon}}$ denotes an aggregate price index.

Given the optimal choice concerning the demand of every good i and the definition of the price index, it follows that $\int_0^1 P_t\,(i) C_t(i) di = P_t C_t$. Substituting this in the budget constraint (2.2) one obtains

$$P_t C_t + Q_t B_t \;\leq\; B_{t-1} +\; W_t N_t + T_t \tag{2.4}$$

Optimality conditions are:

$$-\frac{\partial U/\partial N_t}{\partial U/\partial C_t} = \frac{W_t}{P_t} \tag{2.5}$$

$$Q_t = \;\beta E_t \left\{\frac{\partial U/\partial C_{t+1}}{\partial U/\partial C_t}\,\frac{P_t}{P_{t+1}}\right\} \tag{2.6}$$

Where Q_t represents the stochastic discount factors by which consumers discount every stream of income. Assuming isoelastic preferences on consumption and labor supply of the kind

$$U(C_t; N_t) = \frac{C_t^{1-\sigma}}{1-\sigma} - \frac{N_t^{1+\varphi}}{1+\varphi}$$

and log-linearizing, conditions (2.5) and (2.6) result in

$$w_t - p_t = \sigma c_t + \varphi n_t \tag{2.7}$$

$$c_t = \;E_t\{c_{t+1}\} - \frac{1}{\sigma}\,(i_t - E_t\{\pi_{t+1}\} - \;\rho) \tag{2.8}$$

Where i_t is the short term nominal interest rate and ρ denotes the discount rate. They are defined as $i_t = -\log Q_t$ and $\rho = -\log \beta$.

2.2. Firms

Each differentiated good i is supplied by a monopolistically competitive producer. Technology is common to all firms. The common production function is

$$Y_t(i) = A_t N_t(i)^{1-\alpha}$$

where A_t is the exogenously given level of technology. Each producer sets the price for good i according to the demand that it faces, and hiring the necessary labor inputs. In any given period, every producer has a probability $1-\theta$ to reset its price. Given the law of big numbers, in each period only a fraction $1-\theta$ of firms will readjust prices, while a fraction θ keeps prices unchanged[2]. Aggregate price dynamics are described by

$$P_t = [\theta P_{t-1}^{1-\epsilon} + (1-\theta)(P_t^*)^{1-\epsilon}]^{\frac{1}{1-\epsilon}}$$

Where P_t^* is the optimal price identically chosen in period t by all reoptimizing producers. Dividing everything by P_{t-1} and with $\frac{P_t}{P_{t-1}} \equiv \Pi_t$ being the gross inflation rate, one obtains

$$\Pi_t^{1-\epsilon} = \theta + (1-\theta)\left(\frac{P_t^*}{P_{t-1}}\right)^{1-\epsilon}$$

Around a steady state with zero inflation where $\Pi_t = 1$, prices are constant so that $P_t = P_{t-1} = P_t^*$. Log-linearizing around that steady state, it ensues

$$\pi_t = (1-\theta)(p_t^* - p_{t-1}) \tag{2.9}$$

which shows that any deviation of inflation from its zero steady state level is explained by the fact that reoptimizing firms choose a different optimal price in period t with respect to its previous average level in period t–1. It is thus important to analyze how firms make their pricing decisions.

[2] Here Calvo's staggered price framework is adopted

They choose the optimal price not only in order to maximize current profits, but they also take into account the fact that they might be keeping the same price for at least k periods. Therefore, the optimally chosen price will maximize the current market value of the profits for the k random periods during which that price is effective, subject to the constraint represented by the demand schedule (2.3). Formally

$$\max_{P_t^*} \sum_{k=0}^{\infty} \theta^k E_t \left\{ Q_{t,t+k} \left(P_t^* Y_{t+k|t} - \Psi_{t+k}\left(Y_{t+k|t}\right) \right) \right\}$$

$$\text{s.t.} \qquad Y_{t+k|t} = \left(\frac{P_t^*}{P_{t+k}} \right)^{-\epsilon} C_{t+k}$$

$Q_{t,t+k}$ represents the stochastic discount factor from period t to period t+k, $\Psi_{t+k}(\cdot)$ is the cost function, while $Y_{t+k|t}$ represents output in period t+k related to a price that was last reset in period t. The first order condition, obtained deriving with respect to P_t^* is

$$\sum_{k=0}^{\infty} \theta^k E_t \{ Q_{t,t+k} Y_{t+k|t} (P_t^* - \mathcal{M} \psi_{t+k}) \} = 0$$

ψ_{t+k} is the marginal cost in period t+k and represents the first derivative of the function Ψ_{t+k}, $\mathcal{M} \equiv \frac{\epsilon}{\epsilon - 1}$ represents the gross markup. If prices were fully flexible ($\theta = 0$) the optimal price would coincide with the marginal cost plus the frictionless markup:

$$P_t^* = \mathcal{M} \psi_{t|t}$$

In case that $\theta > 0$ the optimality condition must be divided by P_{t-1}, while the real marginal cost is defined as $MC_{t+k|t} \equiv \psi_{t+k|t} / P_{t+k}$, so that the result is

$$\sum_{k=0}^{\infty} \theta^k E_t \left\{ Q_{t,t+k} Y_{t+k|t} \left(\frac{P_t^*}{P_{t-1}} - \mathcal{M} MC_{t+k|t} \Pi_{t-1,t+k} \right) \right\} = 0$$

In the zero inflation steady state, prices are constant, $Y_{t+k|t} = Y$, $MC_{t+k|t} = MC = 1/\mathcal{M}$ and $Q_{t,t+k} = \beta^k$. Taking the first order Taylor expansion of the previous condition in the steady state one obtains:

$$p_t^* - p_{t-1} = (1-\beta\theta)\sum_{k=0}^{\infty}(\beta\theta)^k E_t\{\widehat{mc}_{t+k|t} + (p_{t+k} - p_{t-1})\} \qquad (2.10)$$

With $\widehat{mc}_{t+k|t}$ being the log deviation of the marginal cost in period t+k with respect to the steady state level: $\widehat{mc}_{t+k|t} \equiv mc_{t+k|t} - mc$, $mc = -\mu$, with $\mu \equiv \log \mathcal{M}$. Equation (2.10) can be rewritten as

$$p_t^* = \mu + (1-\beta\theta)\sum_{k=0}^{\infty}(\beta\theta)^k E_t\{mc_{t+k|t} + p_{t+k}\}$$

From this formulation, it is evident that the optimal price won't be equal to the marginal costs plus a markup, as in the frictionless case, but to a markup over a weighted average of the current and expected marginal costs, considering the probability that the price is effective at each period.

2.3. Equilibrium

The market clearing condition in the good market is

$$Y_t(i) = C_t(i) \quad for\ all\ t, and\ i \in [0,1] \qquad (2.11)$$

Aggregate output is defined as $Y_t \equiv \left[\int_0^1 Y_t(i)^{1-\frac{1}{\epsilon}} di\right]^{\frac{\epsilon}{1-\epsilon}}$. It can therefore be concluded that $Y_t = C_t$. The Euler's equation for consumption (2.8) takes the form of an equilibrium condition:

$$y_t = E_t\{y_{t+1}\} - \frac{1}{\sigma}\left(i_t - E_t\{\pi_{t+1}\} - \rho\right) \qquad (2.12)$$

In the labor market, the market clearing condition is

$$N_t = \int_0^1 N_t(i) di$$

Which yields

$$N_t = \int_0^1 \left(\frac{Y_t(i)}{A_t}\right)^{\frac{1}{1-\alpha}} di = \left(\frac{Y_t}{A_t}\right)^{\frac{1}{1-\alpha}} \int_0^1 \left(\frac{P_t(i)}{P_t}\right)^{-\frac{\epsilon}{1-\alpha}} di$$

Taking logs:

$$(1-\alpha)n_t = y_t - a_t + d_t$$

d_t is defined as a measure of price and output dispersion across firms: $d_t \equiv (1-\alpha)\log\int_0^1 (P_t(i)/P_t)^{-\frac{\epsilon}{1-\alpha}}$. Around a zero inflation steady state, $d_t \simeq 0$ so that an approximate relation for the aggregate output is

$$y_t = a_t + (1-\alpha)n_t \tag{2.13}$$

The definition for marginal cost is $mc_t = (w_t - p_t) - mpn_t$. From here, the marginal productivity of labor can be rewritten, using equation (2.13), so that marginal cost results in

$$mc_t = (w_t - p_t) - \frac{1}{(1-\alpha)}(a_t - \alpha y_t) - \log(1-\alpha) \tag{2.14}$$

Rearranging and combining (2.14) with the demand schedule (2.3) and the market clearing condition (2.10), it yields

$$mc_{t+k|t} = mc_{t+k} - \frac{\alpha\epsilon}{(1-\alpha)}(p_t^* - p_{t+k})$$

Introducing this relation in the optimal price condition (2.10), it follows

$$\begin{aligned} p_t^* - p_{t-1} &= (1-\beta\theta)\sum_{k=0}^{\infty}(\beta\theta)^k E_t\{\Theta\,\widehat{mc}_{t+k} + (p_{t+k} - p_{t-1})\} \\ &= (1-\beta\theta)\Theta\sum_{k=0}^{\infty}(\beta\theta)^k E_t\{\widehat{mc}_{t+k}\} + \sum_{k=0}^{\infty}(\beta\theta)^k E_t\{\pi_{t+k}\} \end{aligned}$$

With $\Theta \equiv \frac{1-\alpha}{1-\alpha+\alpha\epsilon}$. Rearranging and combining with the linear definition for the aggregate price index (2.9), it ensues

$$\pi_t = \beta E_t\{\pi_{t+1}\} + \lambda\,\widehat{mc}_t \tag{2.15}$$

With $\lambda \equiv \frac{(1-\theta)(1-\beta\theta)}{\theta}\,\Theta$. The last equation can be solved forward to show how current inflation depends on the discounted sum of present and expected future deviations of marginal costs from their steady state level

$$\pi_t = \lambda\sum_{k=0}^{\infty}\beta^k E_t\{\,\widehat{mc}_{t+k}\}$$

Considering that $\mu_t = -mc_t$, it follows that any increase in inflation is due to the fact that current markup is set below its steady state level ($\mu_t < \mu$), thus every firm that has the chance to reset the price will choose a higher one, in order to get closer to the desired markup. Combining the definition for marginal costs (2.14) with household's optimality condition (2.7) and the approximate aggregate output equation (2.13) one obtains

$$\widehat{mc}_t = \left(\sigma + \frac{\varphi + \alpha}{1 - \alpha}\right)(y_t - y_t^n)$$

Where y_t^n is the natural level of output corresponding to flexible-price equilibrium and the difference between the actual and the natural level of output is called "output gap" ($\tilde{y}_t \equiv y_t - y_t^n$). By putting the inflation relation (2.15) together with this last definition of marginal cost one obtains the *New Keynesian Phillips Curve* (NKPC):

$$\pi_t = \beta E_t\{\pi_{t+1}\} + \kappa \tilde{y}_t \tag{2.16}$$

This relation remains valid only in the short term, since in the long run the output gap is closed and the trade-off between inflation and output no longer exists.

If the output equilibrium condition (2.12) is rewritten in terms of the output gap, it results in the D*ynamic IS* equation (DIS)

$$\tilde{y}_t = E_t\{\tilde{y}_{t+1}\} - \frac{1}{\sigma}(i_t - E_t\{\pi_{t+1}\} - r_t^n) \tag{2.17}$$

r_t^n is the natural rate of interest (i.e. the equilibrium real interest rate in case that the output gap is zero at all times) and is equal to $r_t^n \equiv \rho + \sigma E_t\{\Delta y_{t+1}^n\}$

The NKPC together with the DIS constitute the building blocks of the model. The NKPC determines inflation given a certain level of output gap, the DIS determines the output gap given the real and natural interest rate. In order to close the model, a specification of how monetary policy is conducted is needed.

Hence, in the short run real variables cannot be determined independently from monetary policy: monetary policy is non-neutral.

3. MONETARY POLICY

3.1. The zero bound as a binding constraint under a forward-looking policy

Assume that the central bank pursues a strict inflation target and therefore aims at obtaining a certain given level of inflation. Interest rates are adjusted in accordance to the authority's objective, following a rule in the Taylor-fashion. The policy commitment takes the form

$$\pi_t = \pi^* \quad at\ all\ times$$

on condition that it is possible to achieve this result with a non-negative nominal interest rate. From the NKPC (2.16), it emerges that if $\pi_t = \pi^*$ at all times then $\tilde{y}_t = 0$. In order for this hold, the DIS (2.17) implies a necessary condition of the form

$$i_t = r_t^n + \pi^*$$

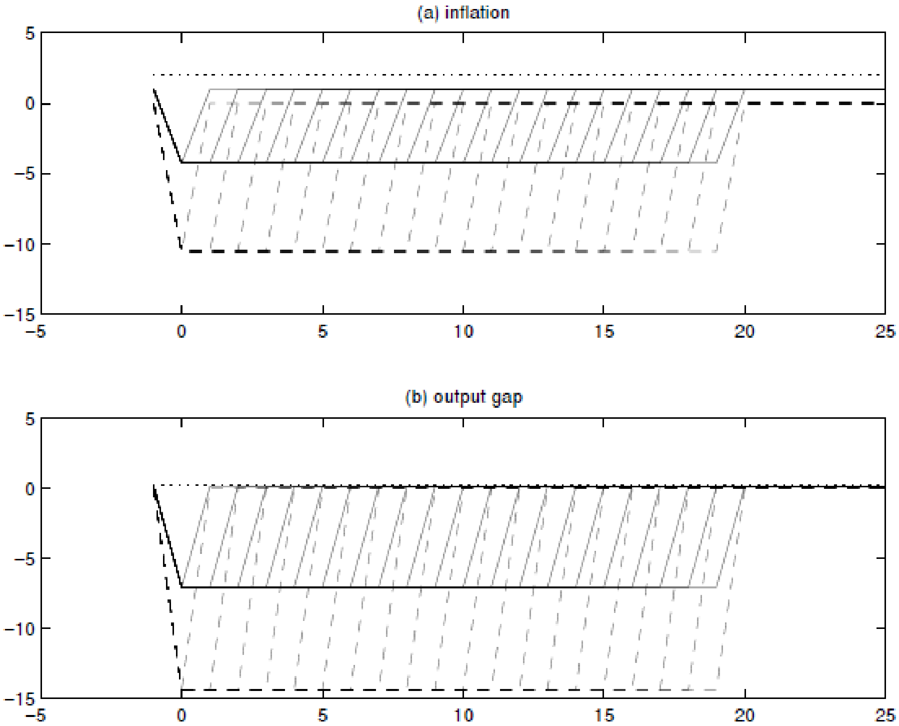
which requires that the natural rate must equal the real rate for all t. Combining this equation with the requirement that

$$i_t > 0 \tag{3.1}$$

it follows that the target cannot be hit if $r_t^n < -\pi^*$. Thus the zero bound does frustrate the attempts of the central bank under certain circumstances. In fact, if the central bank's target is $\pi^* = 0$, which is an optimal commitment in case that the zero bound never binds, this objective won't be achieved any time the natural rate of interest happens to be negative. Indeed, a negative natural rate implies deflation expectations, which in turn imply a negative output gap which causes even further deflation. Lowering the nominal rate to zero is also useless since deflation expectations cause the real rate to be positive.

If the central bank's target is slightly above zero, there are less chances that the zero bound will come to bind. On the other hand, it is only by accepting a permanently high level of inflation that the central bank is likely to be able to hit the target even when the natural rate turns negative. For example, if a shock causes the natural rate to become -2%, while its steady state value is +4%, it is only by fixing a target of inflation of $\pi^* = +2\%$ that the zero bound doesn't become binding. But in this case, the price to pay is the distortion created by chronic inflation.

Figure 1: Dynamics of inflation and the output gap under strict inflation targeting, for three alternative inflation targets (dashed lines are for $\pi^* = 0$, solid lines for $\pi^* = 1\%$ and dotted lines for $\pi^* = 2\%$)



SOURCE: G. Eggertsson, M. Woodford (2003) p. 32.

3.2. Optimal policy commitment: history dependent policy

Assuming that credible commitment is possible, one can determine the optimal monetary-policy rule by minimizing a government's loss function derived from the utility of the representative household (2.1):

$$\min E_o \left\{ \sum_{t=0}^{\infty} \beta^t (\pi_t^2 + \lambda \tilde{y}_t^2) \right\}$$

$$s.t. \quad \pi_t = \beta E_t \pi_{t+1} + \kappa \tilde{y}_t$$

$$and \;\; \tilde{y}_t \leq E_t \tilde{y}_{t+1} + \frac{1}{\sigma}(r_t^n + E_t \pi_{t+1}) \tag{3.2}$$

where the second constraint comes from the combination of the DIS (2.17) together with the zero lower bound on the nominal rate of interest (3.1). The problem can be solved using a Lagrangian

$$\mathcal{L}_0 = E_o \sum_{t=0}^{\infty} \beta^t \left\{ \frac{1}{2}(\pi_t^2 + \lambda \tilde{y}_t^2) + \varphi_{1t} \left(\tilde{y}_t - \tilde{y}_{t+1} - \frac{1}{\sigma} r_t^n - \frac{1}{\sigma} \pi_{t+1} \right) + \varphi_{2t} (\pi_t - \beta \pi_{t+1} - \kappa \tilde{y}_t) \right\}$$

First order conditions are:

$$\pi_t + \varphi_{2t} - \varphi_{2t-1} - \beta^{-1}\sigma^{-1}\varphi_{1t-1} = 0 \tag{3.3}$$

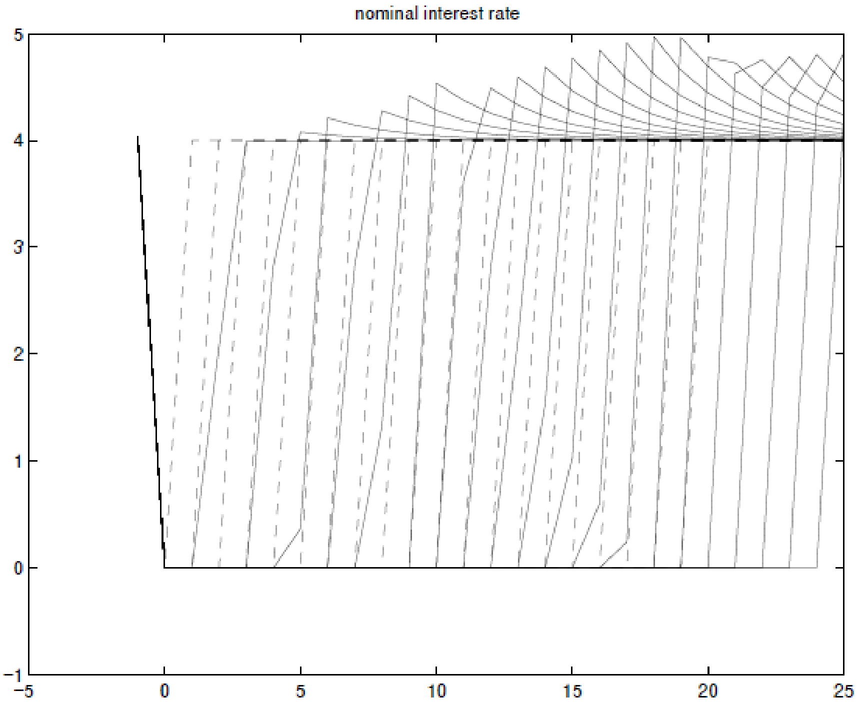
$$\lambda \tilde{y}_t + \varphi_{1t} - \kappa \varphi_{2t} - \beta^{-1}\sigma^{-1}\varphi_{1t-1} = 0 \tag{3.4}$$

$$\varphi_{1t} \geq 0, \qquad i_t \geq 0, \qquad \varphi_{1t} i_t = 0 \tag{3.5}$$

Observing equations (3.3) and (3.4), it is evident that the optimal values for both output gap and inflation are history dependent, since they both are determined by past values of the Lagrangian multipliers. Condition (3.5) implies that the first constraint is only binding ($\varphi_{1t} > 0$) when the zero lower bound is binding ($i_t = 0$). Otherwise, positive interest rates allow to reach equilibrium and there is no need to impose that constraint.

From figure 2, it clearly emerges that the optimal policy suggests that the nominal interest rate be kept at zero even after the natural rate has returned positive, and then be raised slowly overtime. This means creating inflation expectations after the zero bound ceases to bind, which produces many positive effects. Firstly, the commitment to create an output boom in the future reduces deflationary pressures in the present, while the economy is still in the trap.

Figure 2: short-term nominal interest rate path under a zero inflation targeting (dashed line) and under optimal policy (solid line)



SOURCE: G. Eggertsson, M. Woodford (2003), p. 38

Secondly, the creation of inflation expectations helps reducing the real interest rate, even though nominal interest rates cannot be lowered further, and since the real rate is a crucial variable to consider when making investment decisions, current spending is stimulated. Finally, if the permanent income hypothesis is correct, the awareness of a higher income in the future will also stimulate current spending.

Of course, the realization of an inflationary policy once out of the trap has some costs in terms of distortion. The authority needs to counterbalance this two effects: this is why during the trap some deflation and recession may appear even under the optimal policy commitment.

A distinct problem that the authority encounters is how to put into practice the optimal commitment. In fact, even once the interest rate path has been defined, it is not automatic that it will lead to the desired outcome in terms of inflation and output. A specification of how the central bank will react to unexpected variations of those variables is needed. A fairly simple policy rule has to be specified, easily understandable by the public and which doesn't involve the knowledge of the exact process of the natural interest rate, since this may be difficult to make out in practice.

3.3. A price-level targeting rule

A central bank can choose to directly target price level rather than inflation. This rule has all the characteristics of an optimal rule: it is history dependent, but doesn't require the knowledge of hardily observable variables. The authority's target is

$$\tilde{p}_t = p_t^*$$

where $\tilde{p}_t$ is an output-gap adjusted price index. Interest rates are set in accordance with the reaching of this price level target, when possible. Otherwise, when the zero bound binds, interest rates are left at zero and the price level is determined as a consequence, thus missing the target. The goal for the next period is then determined taking into account the deviation from the target of the previous period:

$$p_{t+1}^* = p_t^* + \beta^{-1}(1 + \kappa\sigma^{-1})\Delta_{\mathrm{t}} - \beta^{-1}\Delta_{\mathrm{t-1}}$$

With $\Delta_{\mathrm{t}} = p_t^* - \tilde{p}_t$. This rule works in a way such that when the target is missed, due to the impossibility to adopt a negative interest rate, the target price level for the next period is raised, so that inflation expectations are created. Of course, this may signify that the central bank misses its target for several periods, and even for some time after the real rate has returned positive. Nevertheless, credibility of the central bank is not necessarily compromised: in this case, public announcements are key instruments in the hands of the authority to inform the private sector concerning its future intentions, and reassure the public that, at a certain point in time, it will eventually be able to hit the target. Clearly, it is very important that the central bank proves its commitment to be truthful, demonstrating its capability to reach the announced goal before the disturbance occurs. In fact, under normal circumstances (that is, when the zero bound doesn't bind)

$\Delta_t = 0$ and all the central bank needs to do is undoing the overshooting or undershooting from the target price level.

Surprisingly, and in contrast with a fixed inflation targeting, a simple, fixed price-level targeting rule performs very well, and this is because it mandates the creation of inflation expectations to curb deflation. As a matter of fact, this rule entails a sort of automatic stabilizer, which implicitly takes into account the size of the disturbance that occurred, consequently and proportionately responding to it.

4. QUANTITATIVE EASING

Quantitative easing is the most discussed, either acclaimed or condemned, monetary policy measure taken over the last decade. It is an unconventional practice consisting of the injection of a considerable amount of newly created money into the economy, via the purchase of Treasury bonds from commercial banks and other large financial institutions. It is labeled as "unconventional" since the usual operating target adopted by almost every modern monetary authority is the overnight interest rate, which the bank can observe and move quite easily and effectively. On the contrary, it is not easy to keep the value of aggregate variables, such as money balances, under observation. Besides, a central bank can only directly affect the quantity of base money in circulation, but can't exactly control the money balances (M2) in the economy, which are the actual key variable, but depend on the interaction between supply and demand. Moreover, while the procedure through which short term nominal interest rates come to influence relevant aggregate variables is well known and generally accepted, how the management of the base money affects the economy is still controversial. This is why QE measures are only taken into consideration when the standard tool is unavailable, as in the case of a binding zero bound on interest rates.

When quantitative easing is adopted, the boundary between monetary and fiscal policy becomes almost blurry. A lot more coordination between the government and the central bank is needed, and this is something that not everybody fancies, especially those central banks that have long strived for independence.

Quantitative easing aims at improving credit conditions, relying on the supposition that banks will not hold that money as excess reserves, but will lend it to the public. Thus the expansion of the monetary base should permit to directly affect aggregate demand, even in the event that overnight rates have fallen to zero, and should therefore represent an additional tool in the hands of the policymaker.

To analyze if this is the case, the demand for money will be included in households' utility function and budget constraint, while a specific policy rule for the interest-rate will be defined.

4.1. <u>A proposition of irrelevance for Quantitative Easing</u>

In this framework, it is examined whether Quantitative Easing may positively affect an economy in a deflationary slump. In order to include real money balances, household's utility function (2.1) turns into:

$$E_0 \sum_{t=0}^{\infty} \beta^t \left[u(C_t, M_t/P_t, \xi_t) - v(N_t, \xi_t)\right]$$

Where ξ_t is a vector of exogenous disturbances. The utility function is increasing in real money balances up to a satiation level $\bar{m}(C_t;\, \xi_t)$. The intertemporal budget constraint takes the form

$$E_0 \sum_{t=0}^{\infty} Q_t [P_t C_t + \delta_t M_t] \leq W_t + E_0 \sum_{t=0}^{\infty} Q_t \left[\int_0^1 \Pi_t(i) di + w_t N_t + T_t\right]$$

Where δ_t is the opportunity cost of holding money, W_t is now the value of households' wealth at the beginning of the period and $\Pi_t(i)$ are nominal profits. The first order condition leads to a Euler equation for consumption of the form

$$u_c(Y_t, M_t/P_t\,;\xi_t) = \beta E_t\left[u_c(Y_{t+1}, M_{t+1}/P_{t+1}\,;\xi_t)(1+i_t)\frac{P_t}{P_{t+1}}\right] \qquad (4.1)$$

The equilibrium condition defines a certain level of real money balances:

$$\frac{M_t}{P_t} \geq L(Y_t, i_t; \xi_t)$$

$$i_t \geq 0$$

One of this two inequalities must necessarily hold with equality at any time. When $i_t = 0$, it follows that $L(Y_t, 0; \xi_t) = \bar{m}(Y_t;\ \xi_t)$.

Assume that the central bank's target for short term nominal interest rates takes the form of a Taylor rule, like

$$i_t = \phi\left(\frac{P_t}{P_{t-1}}, Y_t;\ \bar{\xi}_t\right)$$

This rule implies that all the base money that is demanded be supplied at the interest rate that emerges from this formula, which may, under certain circumstances, also be zero. Therefore, when the interest rate is positive, it exists a well defined path for monetary base; otherwise, when $i_t = 0$ there is only a minimum level of base money that must be supplied. The central bank might as well decide to follow a different rule in that case, as quantitative easing mandates. As a result, the base-supply rule takes the form

$$M_t = P_t L\big(Y_t, i_t; \bar{\xi}_t\big)\psi\big(P_t/P_{t-1}, Y_t;\ \bar{\xi}_t\big) \qquad (4.2)$$

Where $\psi(.)$ is a multiplicative factor always greater than or at least equal to one. If $\phi\big(P_t/P_{t-1}, Y_t;\ \bar{\xi}_t\big) > 0$ then $\psi\big(P_t/P_{t-1}, Y_t;\ \bar{\xi}_t\big) = 1$ which means that when the interest rate is positive, the central bank supplies only the money balances that the private sector asks for. On the contrary, if the nominal rate reaches the zero bound, the rule implies that a greater amount of monetary base than is demanded be supplied.

If the central bank decides to realize quantitative easing, it should not only decide the amount of base-money supply (i.e. the value of ψ), but also which kind of assets to buy, in order to carry out the necessary open-market operations. Let's suppose there is a range of k different types of assets for the central bank to buy. Let

$$\omega_t^m = \omega^m(P_t/P_{t-1}, Y_t;\ \bar{\xi}_t) \tag{4.3}$$

be a policy rule following which the central bank determines its portfolio shares, such that the sum of its components is equal to one. The vector ω_t^m depends on the same arguments as ϕ: this means that when the zero lower bound on interest rates is reached the CB might change the set of assets in its portfolio. ω_t^m also shares some components with the function ψ, which implies that modifications of the portfolio shares are related to the kind of purchases induced by the quantitative easing policy.

To close the model, a minimum fiscal policy specification is needed. Assume that the government is financed through taxation, public debt and monetary base. Total government liabilities D_t evolve according to the rule

$$\frac{D_t}{P_t} = d\left(\frac{D_{t-1}}{P_{t-1}}, \frac{P_t}{P_{t-1}}, Y_t;\ \bar{\xi}_t\right)$$

Which implies that real government liabilities in period t depend on the level of real liabilities in the previous period and on other macroeconomic indicators such as gross inflation rate and output, other than exogenous disturbances. Government debt might be issued in a variety of forms, constituting a subset of those securities that are included in the CB's portfolio. Debt management policy can be specified by the function

$$\omega_t^f = \omega^f(P_t/P_{t-1}, Y_t;\ \bar{\xi}_t) \tag{4.4}$$

The government budget constraint takes the form

$$D_t = R'_t \omega_{t-1}^f B_{t-1} - T_t^{cb} - T_t^h$$

Where R'_t is a vector of gross nominal returns of all government securities between period $t-1$ and t; $B_t \equiv D_t - M_t$ are non-monetary government liabilities; $T_t^{cb} = R'_t \omega_{t-1}^m M_{t-1} - M_{t-1}$ are central bank's transfers to the Treasury and T_t^h is the primary budget surplus, i.e. taxes net of transfers to the public, assuming no government purchases.

It can be shown that all the equilibrium values of the real variables are independent from equation (4.2) for money balances M_t, (4.3) for central bank's portfolio shares ω_t^m and (4.4) for government's portfolio shares ω_t^f. In fact all the equilibrium conditions can be expressed in a way that doesn't involve the functions $\psi, \omega^m\ or\ \omega^f$.

Since the utility of additional money balances above the satiation level is nil, when $m \geq \bar{m}(C;\xi)$,

$$u(C,m;\xi) = u[C,\bar{m}(C;\xi);\xi]$$

If one takes the differential of this relation with respect to C, it can be observed that $u_c(C,m;\xi)$ is not determined by the exact level of m either, provided that it is greater than $\bar{m}$. Therefore, optimal condition for consumption (4.1) can be rewritten in a way that doesn't involve the variable M_t/P_t, and hence independently from the function ψ:

$$\lambda\left(P_t/P_{t-1}\,, Y_t;\ \bar{\xi}_t\right) \equiv u_c\{Y_t, L[Y_t, \phi(P_t/P_{t-1}, Y_t;\xi_t);\xi_t];\xi_t\}$$

Since $M_t/P_t = \ L[Y_t, \phi(P_t/P_{t-1}, Y_t;\xi_t);\xi_t]$ whenever u_c depends on the exact level of m. Similarly, $u_m(Y_t, M_t/P_t\,;\xi)$ and profit function Π can be expressed independently from real money balances M_t/P_t.

This implies that quantitative easing is unable to affect the possible equilibrium outcome when the zero bound is a binding constraint, no matter how extensively it is used, or what sort of open market purchases it involves. As long as they are fully credible, the only policy commitments that count are those regarding the specification of the short term nominal interest rate rule and the evolution of government liabilities.

4.2. Other aspects of Quantitative Easing

A quantitative easing policy cannot be compared to a "helicopter drop of money": individuals expect that the policy will be reversed any time soon. On the other hand, things are completely different when a monetary expansion is expected to be permanent. In fact, in this case the function ϕ varies too, and in a way that will become relevant in the future, when the zero lower bound ceases to bind, therefore immediately causing expectations to change.

An often discussed and extensively investigated possibility for monetary policy to react to the zero bound on overnight interest rates is the "portfolio-balance effect", i.e. to try to shift all the term structure through purchases of longer-maturity bonds, in an attempt to reduce long term interest rates and thus stimulate investment and output. But unfortunately, this has no direct effects in this model. In fact, here no assumption of mean-variance preferences of investors is made. The representative household's marginal utility of an additional unit of income depends exclusively on the level of consumption in a certain state of the world, and not on the returns of its portfolio. Besides, consumption is not shifted by any variation in the composition of the portfolio of the private sector, since it only depends on output, which in turn, has been proved not to depend on such factors as $\psi, \omega^m \; or \; \omega^f$.

Still, some stimulating effect might be achieved through the signaling effect that this sort of maneuver has on the public. In fact, long term rates give a clue about future short term rates. To escape from a liquidity trap, it is important that the private sector believes that monetary policy will be accommodating even once out of the trap. If the central bank cannot convince the private sector about its future intention, and therefore long term Treasuries are underpriced, a purchase of those assets by the central bank may have a benefic effect in convincing the public about its serious intention regarding future policy.

Indeed, equilibrium inflation and output do not exclusively depend on the current and past level of the interest rate. The management of the future expected path of interest rates is a key instrument left in the hand of a policymaker facing a liquidity trap, and this is the so-called “policy duration effect”. Even in normal circumstances, when making an investment decision, overnight rates are not so crucial for themselves, as for the indications that they provide concerning future long term rates and the policy stance in general. Given the importance of the management of expectations, it is obvious that the credibility of the central bank plays a major role. In particular, it is vital that the policymaker avoids a purely forward looking approach, which takes into consideration only the possible future evolution of the variables. In that case, in fact, the desirable kind of expectations cannot be achieved, since individuals discount the fact that the authority will pursue a different target as soon as it has the chance to do it.

4.3. **The role of Quantitative Easing in preventing a self-fulfilling deflationary trap**

Despite the irrelevance proposition concerning open market operations, it can be shown how important it can be to raise monetary base above the satiation level under certain circumstances. For example, one may ask whether an equilibrium with permanent deflation would be possible, caused by enduring and self-fulfilling deflation expectations rather than by a consistently negative natural rate. In theory, this actually is a possible equilibrium, but it can be prevented by imposing that the transversality condition on government liabilities be violated. This is possible through a balanced-budget policy, or, more credibly, through a commitment not to allow a negative present value of the public debt and not to contract the monetary base. For example, the central bank can adopt a base money rule of the form

$$M_t = P_t^* \overline{m}(Y_t; \xi_t)$$

When prices begin to fall, monetary base will not be reduced consequently. On the contrary, since it depends on the *target* price level, there will be a monetary expansion, that will contribute to reassure the public about the central bank’s intention to hit the target. Therefore, Quantitative Easing in the context of the optimal commitment serves the functions of both ruling out possible deflationary equilibrium and confirming the bank’s serious undertakings.

The analysis of what monetary policy can do when the economy is in a liquidity trap has shown that it is far from impotent. Nevertheless, Keynes traditionally indicated the way out of a liquidity trap in a countercyclical fiscal policy: therefore, it is interesting to analyze what fiscal policy can do in such circumstances and how this interacts with the description of the optimal monetary policy.

5. FISCAL POLICY

Generally, it is not desirable to use tax policy for stabilization purposes: monetary policy is more rapid and effective in serving this function. Nevertheless, when real disturbances cause the natural rate to be negative, fiscal policy may become useful in this sense.

5.1. Introducing fiscal instruments in the model

The equilibrium condition for output, when government expenditure is included, becomes:

$$Y_t = C_t + G_t$$

The only source of government revenues is assumed to be a tax on sales revenues, of the kind of a VAT, with a rate τ_t and with distorting effects on firm’s pricing decisions. Public debt is assumed to consist exclusively of one period riskless bonds. At the end of the period, it will result:

$$B_t = (1 + i_{t-1})B_{t-1} + P_t s_t$$

where $s_t \equiv \tau_t Y_t - G_t - \zeta_t$ is the primary budget surplus. Government expenditures G_t and government transfers ζ_t are treated as exogenous while τ_t is the relevant fiscal tool. Government surpluses need to satisfy the intertemporal solvency condition

$$b_{t-1}\frac{P_{t-1}}{P_t} = E_0\sum_{t=0}^{\infty} R_t s_t \tag{5.1}$$

with R_t being the stochastic discount factor for real income streams, $R_t \equiv Q_t \frac{P_{t+1}}{P_t}$.

In the steady state, where inflation is zero, public debt is at a constant level $\bar{b}$, output is at its fully-flexible-price level $\bar{Y}$, and the government budget constraint is

$$(1-\beta)\bar{b} = \bar{\tau}\bar{Y} - \bar{G} - \bar{\zeta}$$

$\bar{Y}$, however, is not the potential output given technology conditions, since the presence of a sales tax contributes to create a distortion, and the steady state level of output is thus inefficiently low. The NKPC can be rewritten to include taxation

$$\pi_t = \beta E_t\{\pi_{t+1}\} + \kappa[\tilde{y}_t + \psi\tilde{\tau}_t + u_t]$$

Where $\tilde{\tau}_t \equiv \tau_t - \bar{\tau}$ is the log deviation of the tax rate in period t from its steady state level and u_t is a cost-push disturbance term. An alternative form can be

$$\pi_t = \beta E_t\{\pi_{t+1}\} + \kappa[\tilde{y}_t + \psi(\tilde{\tau}_t - \tilde{\tau}_t^*)] \tag{5.2}$$

With $\tilde{\tau}_t^* \equiv -\psi^{-1}u_t$ representing the tax change needed to offset the cost push shock. Log-linearizing the intertemporal government solvency condition (5.1), one obtains:

$$\tilde{b}_{t-1} - s_b\pi_t - s_b\sigma\tilde{y}_t = -f_t + E_0\sum_{t=0}^{\infty}\beta^t\left[b_y y_t + b_\tau(\tilde{\tau}_t - \tilde{\tau}_t^*)\right] \tag{5.3}$$

Where $\tilde{b}_{t-1}$ measures the fraction of the steady state output represented by the deviation of the real public debt from its steady state level and $s_b \equiv \bar{b}/\bar{Y}$ is a fraction of the steady state output represented by steady state debt. f_t is an exogenous fiscal stress term, b_y and b_τ describe the effect of an increase in output or tax rate on the government budget.

The DIS remains formally an unchanged constraint, still some specifications about the substitutions introduced are needed. The Euler equation for consumption (2.8) takes the form

$$y_t - g_t = E_t[y_{t+1} - g_{t+1}] - \sigma^{-1}(i_t - E_t\pi_{t+1} - \rho)$$

Where g_t represents the percentage change in output required to keep marginal utility of consumption constant, notwithstanding changes in government spending or in the preference parameter. Rewriting this in terms of welfare relevant parameters the same equation as (2.17) is obtained:

$$\tilde{y}_t = E_t\tilde{y}_{t+1} - \frac{1}{\sigma}(i_t - E_t\pi_{t+1} - r_t^n)$$

only that now $r_t^n \equiv \rho + \sigma[(g_t - y_t^*) - E_t(g_{t+1} - y_{t+1}^*)]$ with y_t^* being the target level of output. Every variation in the natural rate of interest is necessarily caused by a shift in one of the exogenous real disturbances that characterize it. More specifically, g_t may vary because of an increase or decrease in government purchases $G_t$or in the consumption preference parameter. Any factor shifting the target level of output y_t^*, such as modifications in the market power, in technology or in preferences, has a consequence on the natural rate as well. Whatever causes a shift in g_t changes y_t^* too, so the overall effect on the natural rate is ambiguous, and in order to make r_t^n negative the disturbance needs to be rather large or persistent. In fact, as long as r_t^n remains non-negative, it is always possible to achieve the policy targets without changing the tax rate. But a disturbance that shifts the natural rate is also likely to affect the fiscal stress term f_t and thus the government budget constraint, or the cost-push term u_t. For now, an assumption is made that the disturbance that affects the natural rate has no consequences on either fiscal stress or the cost-push term.

5.2. <u>Consequences of a binding zero bound for fiscal policy</u>

Assumptions are made of a zero initial public debt, no government purchases and no government transfers: it follows a zero steady-state tax rate. The government solvency condition (5.3) reduces to

$$\tilde{b}_{t-1} = E_0 \sum_{t=0}^{\infty} \beta^t \tilde{\tau}_t \qquad (5.4)$$

In this case, a variation in inflation doesn't affect the government budget, since there is no debt in the steady state, and a variation in output doesn't affect government revenues since tax rate is zero. There is no fiscal stress effect either, both in the case of a variation in the natural rate and target output.

Assume that complete tax smoothing is adopted and fiscal policy follows a simple rule of the form $E_t\tilde{\tau}_T=\tilde{\tau}_t$ for all T>t, where $\tilde{\tau}_t$ is a tax rate chosen to maintain the government solvency condition for an indefinite period of time. (5.4) becomes:

$$\tilde{\tau}_t = (1-\beta)\tilde{b}_{t-1}$$

In the case that monetary policy follows a strict inflation targeting, in any t either $i_t > 0 \; and \; \pi_t = 0$, or $i_t = 0 \; and \; \pi_t < 0$. Hence when the zero bound is binding, the central bank is unable to hit the target and has to accept strong deflation and output fall. Since this has no consequence on government budget, fiscal rule remains unchanged and is unable to counteract the recession. The effect is the same as when only monetary policy was taken into consideration. Thus, simple policies of these kind, although optimal under normal circumstances, produce unsatisfactory outcome in case of a binding zero bound.

5.3. Optimal policy rule

Including the intertemporal government solvency condition (5.4) in the minimization problem, the Lagrangian now takes the form

$\mathcal{L}_0 = E_o \sum_{t=0}^{\infty} \beta^t \left\{ \frac{1}{2}(\pi_t^2 + \lambda \tilde{y}_t^2) + \varphi_{1t}\left[\tilde{y}_t - \tilde{y}_{t+1} - \frac{1}{\sigma} r_t^n - \frac{1}{\sigma}\pi_{t+1}\right] + \varphi_{2t}[\pi_t - \beta\pi_{t+1} - \right.$

κ(yt+ψτt)+φ3tbt−1−τt−βbt

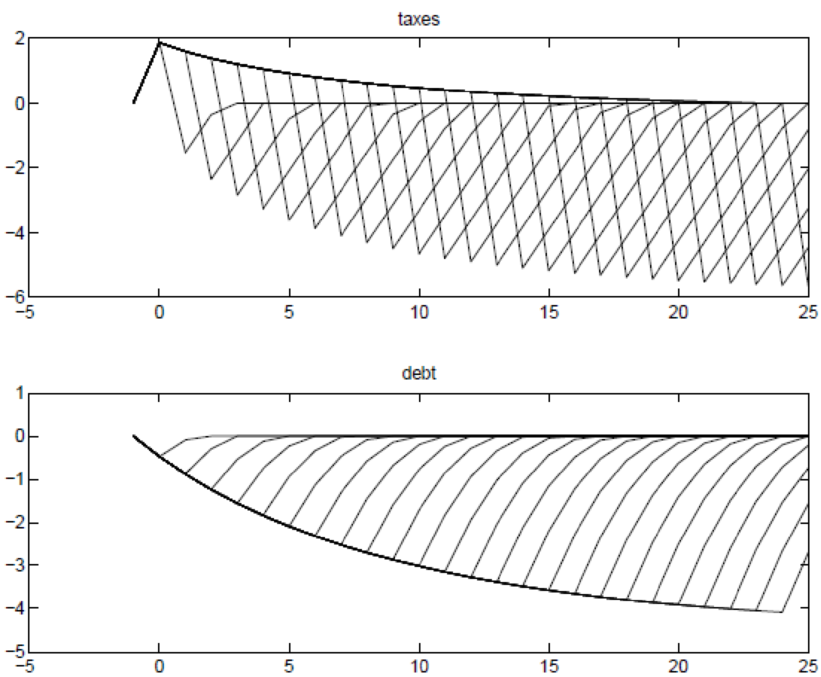
The first order conditions are (3.3)-(3.5), as described above in the text, plus

$$\kappa\psi\varphi_{2t} + \varphi_{3t} = 0 \qquad (5.5)$$

$$\varphi_{3t} = E_t \varphi_{3,t+1} \tag{5.6}$$

The results here are the same as for the monetary policy analysis: optimal fiscal policy is history dependent too. In fact, for a period after the zero bound has ceased to bind, when the economy has come back to a normal state and the authority could effectively achieve its targets, the optimal policy involves a commitment not to behave in this way. Interest rates will be kept at zero for some periods after the natural rate has returned to its normal level, and the tax rate will momentarily differ from the steady state level, thus triggering inflation and an output boom. History dependence is shown by the fact that policy stance, once the disturbance is over, is substantially different from what it would have been if the disturbance had never occurred.

Figure 3: Optimal responses of fiscal variables



SOURCE: G. Eggertsson, M. Woodford (2004), p. 30.

Observing figure 3, one can notice that the fiscal response to this sort of shock is quite interesting and unusual: it involves a tax increase during the liquidity trap, and a tax cut after the economy has returned to normal conditions, so during a period of inflation and output boom. This may seem surprising and counterintuitive, but is in fact a consequence of how taxes are introduced in this model: higher taxes involve higher real marginal costs for producers, and this causes prices to rise, which is exactly what the policymaker wishes for in a period of deflation. In this way, for a given level of output and a given level of inflation expectation, there is a higher inflation rate.

5.4. <u>A generalization of the results: allowing for multiple fiscal tools</u>

Restrictive hypothesis were made about the availability of fiscal instruments: one may ask whether the characteristic of history dependence of the optimal policy depends crucially on these assumptions. It can be shown that even allowing for different forms of public debt other than one-period riskless assets the equilibrium outcome is unaffected.

Assuming that the government can finance itself by issuing whatever sort of state-contingent securities, the value b_{t-1} in not known ex–ante in t-1, but depends on the disturbances realized at date t. The Lagrange multiplier associated with the solvency condition is constant over time according to the FOC (5.6) ($\varphi_{3t+1} = \varphi_{3t}$). If it is assumed that before the disturbance occurs the economy is in a steady state, this multiplier is zero, and will be kept at zero, under an optimal policy, by accordingly varying the amount of the government debt. From optimality condition (5.5), it can be derived that if $\varphi_{3t} = 0$, then $\varphi_{2t} = 0$ as well. The constraint (3.2) associated with the first Lagrange multiplier is thus the only binding one. Given the value of this, the NKPC can consequently be used to determine the evolution of the tax rate, and with this, one can derive the state contingent value of the debt from the intertemporal government budget constraint. However, the result in this case is exactly the same as before, since the previous problem already involved $\varphi_{3t} = \varphi_{2t} = 0$.

Things are substantially unchanged even when assuming multiple forms of taxes. The intertemporal government solvency condition (5.4) does not constitute an obstacle to the evolution of the tax rate (in fact, $\varphi_{3t} = 0$). This means that the VAT tax rate can be used to shift the supply relation in any direction that the policymaker wishes to. This in turn implies that the NKPC is no constraint on the possible path of output level and inflation. Whatever other sort of tax may shift the supply relation (such as a labor tax) has thus the same effect as a VAT and does not alter the equilibrium output. The only relevant constraint is the DIS and, therefore, it is only by introducing a fiscal instrument that has some effects on this relation that the outcome would change. This means finding a tax that can affect consumers' expenditures timing, such as an American style tax. This kind of tax is paid by the public in addition to the posted price, in contrast with a VAT tax, that is already included in the posted price. The two fiscal tools are significantly different because prices are sticky, so it matters whether the price is sticky before or after taxation. Condition (2.6) becomes

$$Q_t = \beta E_t \left\{ \frac{u_c(Y_{t+1} - G_{t+1}; \xi_{t+1})}{u_c(Y_t - G_t; \xi_t)} \frac{P_t(1+\tau_t^s)}{P_{t+1}(1+\tau_{t+1}^s)} \right\}$$

And constraint (3.2) generalizes to

$$\tilde{y}_t \leq E_t \tilde{y}_{t+1} + \frac{1}{\sigma}[r_t^n + E_t \pi_{t+1} + E_t(\tilde{\tau}_{t+1}^s - \tilde{\tau}_t^s)]$$

From this inequality one can perceive that a temporary decline in the natural rate can be undone by an increase in $\tilde{\tau}_{t+1}^s - \tilde{\tau}_t^s$, which means cutting taxes at date t or committing to increase them in the future. In particular, if the authority adjusts the sale tax according to the formula

$$\tilde{\tau}_t^s = \sum_{T=t}^{\infty} E_t[r_T^n - \rho]$$

the zero lower bound happens never to bind, and zero inflation rate and output gap can be achieved by setting $i_t = \rho > 0$ at all times. In this special case, monetary policy doesn't need to be history dependent, simply because the zero bound is never a binding constraint. Furthermore, one can offset the effects of the adjustment of the American-style tax on the government solvency condition with a proper management of the VAT tax rate. This has also the advantage that it counteracts the consequences of the alteration of $\tilde{\tau}_t^s$ on the supply relation, which once an American-style tax is adopted generalizes to:

$$\pi_t = \beta E_t \pi_{t+1} + \kappa[\tilde{y}_t + \psi(\tilde{\tau}_t + \tilde{\tau}_t^s) + u_t]$$

since the American-style tax influences the marginal utility of labor income and hence labor supply. This result can be neutralized by imposing

$$\tilde{\tau}_t = -\tilde{\tau}_t^s$$

Which means that the fiscal pressure on prices remains altogether unchanged, only that it will be differently shared between different type of sales taxes[3].

Although theoretically in this case fiscal policy alone can be used to prevent a liquidity trap, it is highly unlikely that such tools required would be available in practice to the policymaker. First of all, very few nations have a tax of the necessary type, in the American-style fashion; moreover, also in the U.S. where a sale tax of this kind is actually adopted, this is administrated at a local level, from the single states rather than from the federal government, and, therefore, it is not a tool in the hand of the policymaker. Another practical problem is that, in order to make the zero bound never bind, the required change in the tax rate would be very large. Hence an exceedingly high sales taxation would be necessary, in order to allow $\tilde{\tau}_t^s$ never to be negative. Besides, sudden and consistent temporary tax rate alterations should be available.

5.5. Positive steady-state public debt and tax distortions

In case that exists a positive level of public debt, steady-state tax rate is going to be positive: in this more realistic circumstance, any variation in inflation, output and interest rates has an influence on government budget. Thus, it must be taken into account the more general constraint (5.3)

[3] See Feldstein's proposal (2002)

$$\tilde{b}_{t-1} - s_b\pi_t - s_b\sigma\tilde{y}_t = -f_t + E_0\sum_{t=0}^{\infty}\beta^t\left[b_y y_t + b_\tau(\tilde{\tau}_t - \tilde{\tau}_t^*)\right]$$

Instead of (3.3) and (3.4), first order conditions are

$$\pi_t + \varphi_{2t} - \varphi_{2t-1} - \beta^{-1}\sigma^{-1}\varphi_{1t-1} - s_b\varphi_{3t} + s_b\varphi_{3,t-1} = 0$$

$$\lambda\tilde{y}_t + \varphi_{1t} - \kappa\varphi_{2t} - \beta^{-1}\sigma^{-1}\varphi_{1t-1} - s_b\varphi_{3t}[1-\beta(1-\sigma)] + s_b\sigma\varphi_{3,t-1} = 0$$

while the other FOCs are the same as before. Here it is also assumed that there are positive steady-state government transfers.

Supposing that a disturbance of the kind discussed above occurs, the results in the case of a positive-debt economy is qualitatively the same as before. In fact, optimal policy still involves the creation of an inflationary boom once out of the trap, using both monetary and fiscal stimuli. The difference is that, in case of a positive public debt, it is optimal to commit to a higher level of inflation with respect to the zero-debt case, while the natural rate remains negative. This outcome does not come from a discretionary policy that aims at deflating away the value of the nominal public debt. On the contrary, a commitment to such an action is taken before the disturbance occurs, and is thus part of the optimal policy.

So far, it has been assumed that the disturbance that occurred had no consequences on the fiscal stress term. Still, a more realistic situation would be one in which the stochastic event that caused a negative natural rate, would also influence the fiscal stress term. Therefore, it will now be assumed that a disturbance occurs, causing a temporary negative natural interest rate, but such that the target level of output remains unchanged. This can happen, for example, if the rate of time preference momentarily falls. The fiscal stress term in this case can be written as

$$f_t = s_b\sum_{T=t}^{\infty}\beta^{T-t+1}E_t[r_T^n - \rho]$$

Thus, a lower natural rate implies a lower value of fiscal stress than its long-run level. Evidently, this reduction allows for taxes to be increased by less during the shock, and a permanently lower level of taxes and debt is possible. Since taxes are raised not as much as before, output and inflation increase by less. But substantially the evolution of the variables are the same as in the previous case, where more restrictive hypothesis were made.

6. ASSESSING DIFFERENT SUB-OPTIMAL POLICIES

Once it is recognized that optimal monetary and fiscal policy need to be history dependent in case the zero lower bound becomes a binding constraint, it is also interesting to evaluate what degree of distortion different sub-optimal policy commitments would introduce in the equilibrium outcome.

6.1. Purely forward-looking monetary and fiscal policy

In the first section, where only monetary policy was taken into consideration and no fiscal intruments were used for stabilization purposes, it resulted that a forward-looking policy rule would lead to large welfare losses, compared to an optimal rule. Still, when fiscal policy is constrained to be forward looking as well, the result is somewhat different. Let the relevant variables $\{\pi, y, \tau, \Delta b\}$ be defined exclusively by state-contingent exogenous disturbances, independently from the public debt level, with

$$\hat{y}_t \equiv \tilde{y}_t + \psi(1-\beta)\tilde{b}_{t-1}$$

$$\hat{\tau}_t \equiv \tilde{\tau}_t - (1-\beta)\tilde{b}_{t-1}$$

$$\Delta b_t \equiv \tilde{b}_t - \tilde{b}_{t-1}$$

This means that any increase in the initial public debt implies a permanently higher level of debt, a corresponding increase in taxes so as to pay the additional interest on debt and a reduction in output due to the higher tax rate. No other changes would be involved, and this in turn implies that the policy problem is independent from the initial public debt level. The relevant constraints can be rewritten as

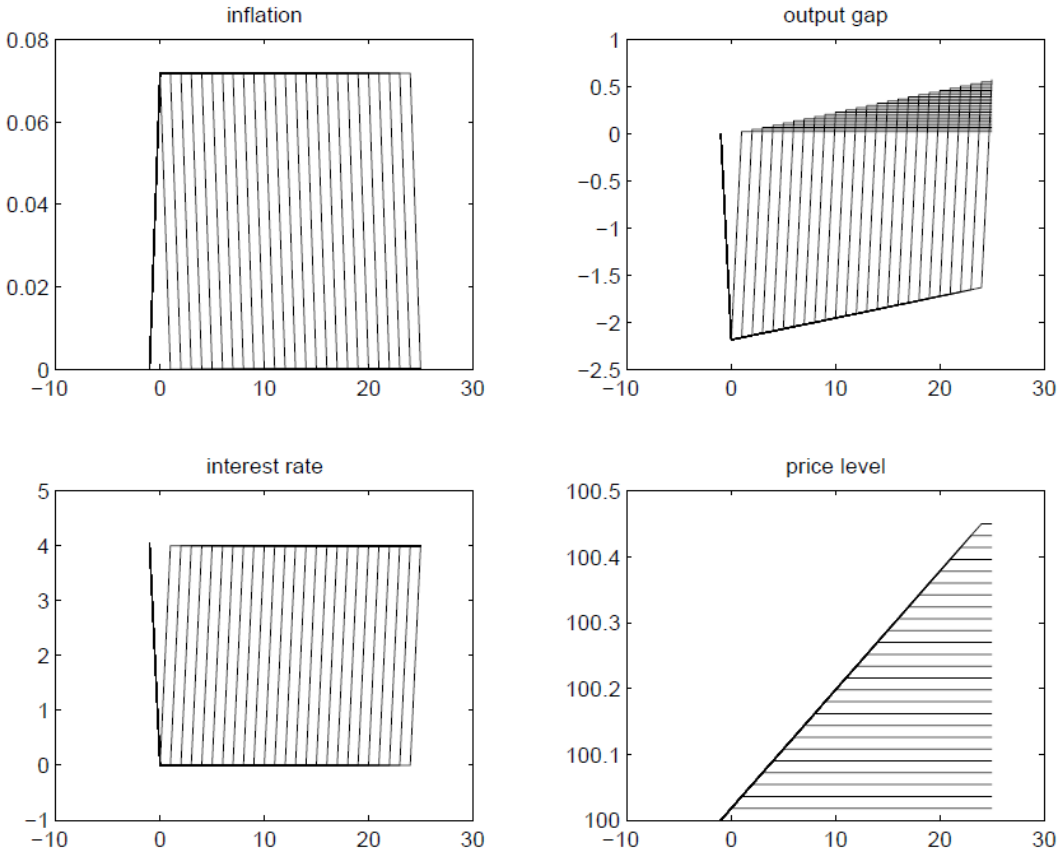
$$\pi_t = \beta E_t \pi_{t+1} + \kappa[\hat{y}_t + \psi(\hat{\tau}_t - \tilde{\tau}_t^*)]$$

$$\Delta b_t = -\beta^{-1}\hat{\tau}_t$$

$$\hat{y}_t \leq E_t \tilde{y}_{t+1} + \frac{1}{\sigma}[r_t^n + E_t \pi_{t+1}] - (1-\beta)\psi \Delta b_t$$

where the evolution path of these variables is exclusively determined by the evolution of the natural rate of interest r_t^n from date t onward. An optimal forward looking policy when the economy is in the normal state mandates the realization of a zero inflation rate by setting the nominal interest rate at the same value as the real rate. It will be that $\bar{\pi} = \bar{y} = \bar{\tau} = \Delta\bar{b} = 0$ and $i = \rho$ as long as $r_t^n = \rho$. This is exactly the policy that will be conducted immediately after the disturbance is over. When the natural rate experiences a fluctuation, so that it no longer results $r_t^n = \rho$, the policymaker can still attain a zero inflation rate provided that the natural rate remains non-negative. If the natural rate becomes negative and the economy falls in a liquidity trap, the forward looking policy involves that taxes be raised during this period, and permanently be lowered later, since public debt has been reduced. Hence, even when fiscal policy is constrained to be purely forward looking, it still tracks the results of the fully optimal rule. In fact, as one can observe looking at figure 4, it still involves the creation of a slight inflation boom, once the zero bound has stopped binding. The outcome is substantially different with respect to the case when complete tax smoothing was assumed. It is evident that, while the constrain to be purely forward looking makes monetary policy completely unable to achieve its stabilization goals, it still leaves some possibilities for fiscal policy to considerably improve the situation.

Figure 4: Policy responses under purely forward looking monetary and fiscal policies



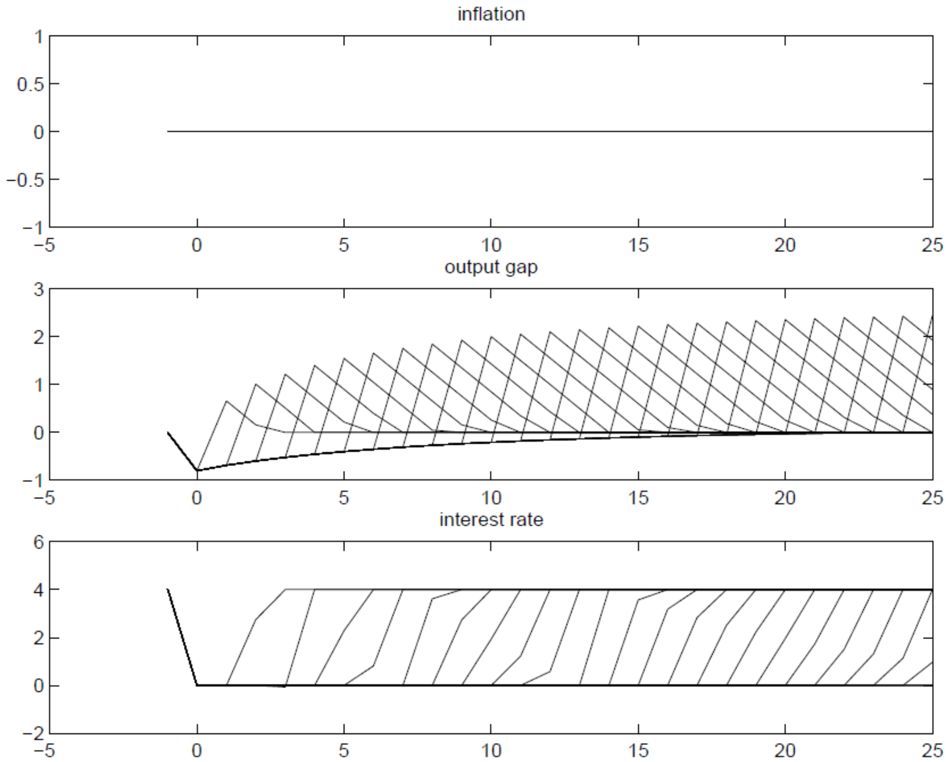
SOURCE: G. Eggertsson, M. Woodford (2004), p. 49.

The use of fiscal policy for stabilization purposes is so effective because the level of the public debt naturally gives some information concerning future policy, and so the way in which fiscal policy is conducted today is a hint of how it will be conducted tomorrow, although the condition for policy rule to be purely forward looking remains inviolate. It is worth mentioning that here the authority is not assumed to re-optimize every period like a discretionary policymaker, but is committed in advance to follow a certain rule. Therefore, if a forward-looking fiscal policy has stimulating effects even in the particular case of a liquidity trap, it is not because people discount the possibility that the policymaker tries to exploit an inflationary surprise once out of the trap. On the contrary, the level of the debt at each point in time is an indication of the size of the taxation in the future. This indication will influence real activities in the future, but expectations about this actually stimulate private spending in the present, helping in mitigating deflation during the shock. Moreover, higher taxes prevent deflation expectations by increasing supply costs: the public knows that if the disturbance continues, tax will continue to stay high, since the authority is committed to such a policy, so the possibility of deflationary expectations is ruled out. Once prices have stopped declining, the private sector will progressively start to perceive the real rate as not so high with respect to the natural rate: the economy can slowly begin to exit the trap. Once again, it clearly emerges the crucial role of communicating to the public the policymaker's commitments, in order to help the private sector formulate correct expectations.

6.2. Forward-looking monetary policy but history-dependent fiscal policy

Assume that monetary policy pursues a strict zero inflation target whenever the zero lower bound makes this an attainable outcome, while fiscal policy is chosen optimally. Supposing that the zero bound comes to bind, the monetary authority can still achieve a zero inflation rate at all times. Fiscal policy will be used to make this possible, but a zero output gap at all times won't be feasible. A positive output gap will be pursued through tax cuts once out of the liquidity trap, and this will curb the negative output gap while the natural rate stays below zero. In order to make the commitment to tax reduction compatible with the government solvency condition, they need to be raised during the liquidity trap. Also in this case optimal fiscal policy happens to be history-dependent. Here the tax reduction after the zero bound has ceased to bind needs to be larger than in the case when both monetary and fiscal policy were chosen optimally, since in this case no inflationary policy can be used to foster the output boom. In general, in this case, output stabilization is not as effective as in the previous case.

Figure 5: Policy responses under optimal fiscal policy but a strict inflation target



SOURCE: G. Eggertsson, M. Woodford (2004), p. 55.

7. REAL LIFE EXAMPLES OF THE LIQUIDITY TRAP

After considering the problem analytically, it is interesting to evaluate the practical solutions and actions undertaken by different countries when they found themselves in circumstances of a liquidity trap.

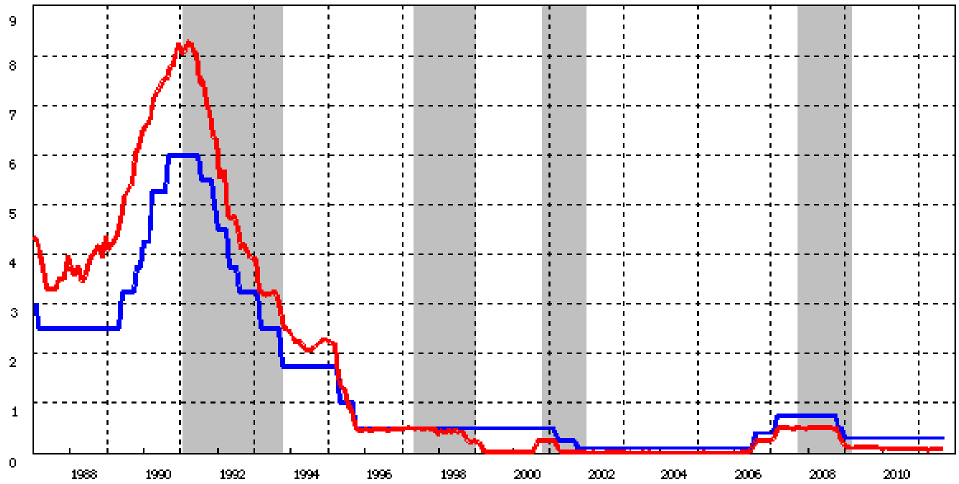
7.1. Japanese Experience

The most notable case of liquidity trap is to be found in the events that happened in Japan from the beginning of the 90s until the middle of the 2000s. This represents the only case of prolonged deflation in an advanced economy since the Great depression.

In 1991 a bubble in the stock and real estate market burst, and together with a weak banking system, this dragged the economy down through a decade of industrial production and GDP slowdowns, with consistent fall in prices. By 1991 the Bank of Japan (BoJ) began to sharply cut the overnight call rate. From above 8% in 1991, it fell to below 1% in 1995, and was finally and reluctantly set at zero by 1999, when the Zero Interest Rate Policy (ZIRP) was started. This move was particularly contentious since it forced the bank to venture into an unfamiliar territory where it lost its standard operational tool (i.e. the rate of interest). By 2000 some hints of recovery seemed to appear, and by August of the same year the BoJ tried to withdraw the policy measure, reversing the call rate to positive values. But that wasn’t a fortunate decision: the economy was still weak, and deflation had not yet been abated, so the withdrawal of the extraordinary policy caused a further deterioration in the economic conditions. From 2001 to 2006 the call rate returned to be stably maintained at zero.

By that time the BoJ had realized that the Japanese recovery would have needed a stronger support and that other unconventional measures needed to be taken.

Figure 6: Japanese call rate (red line) and discount rate (blue line) from 1987 to 2011. Shaded areas indicate periods of recession.



SOURCE: Bank of Japan website, http://www.stat-search.boj.or.jp/ssi/cgi-bin/famecgi2?cgi=$graphwnd_en

So in March 2001 the Quantitative Easing Policy (QEP) was put into practice[4], and the policy target shifted from the overnight call rate to the outstanding balance of banks' current accounts. This was accompanied by unusual open-market purchases, such as an increase in the outright purchases of long-term government bonds, and the exceptional acquisition of stocks held by banks. In order not to make the same mistake as in the year 2000 again, consisting of a bad timing of the exit strategy, the QEP was provided with a precise indication of the condition that ought to be held in order for this action to be withdrawn[5], and this had the positive effect of properly guiding public expectations. The requirement was deemed to be fulfilled in 2006, so that in March the QEP was removed and by July the ZIRP was lifted too.

The efficacy of the BoJ's responses to the crisis is still controversial. The fact that the QEP was implemented together with other stimulating fiscal policy measures makes it

[4] Japanese banks' reserves at the Bank of Japan were increased from ¥5 trillion to ¥35 trillion from 2001 to 2006 and the BoJ's balance sheet expanded from 18% of GDP in 1998 to about 31% of GDP in 2006

5 The QEP would be maintained "until the consumer price index (excluding fresh food) registers stably a zero percent or an increase year on year."

difficult to assess its success alone, and to tell its consequences apart from those of other policy actions. The combination of the ZIRP together with the QEP had the side-effect of deteriorating the functioning of the money market. In fact, in a near-zero rates environment, banks have no incentive to lend, since only transactional costs are barely covered, nor to borrow, as the supply of funds offered by the central bank is sufficient.

Banks' credit to the public did not expand either, as corporate deleveraging pressures prevented the demand for credit to upsurge. The money injected into the economy seemed only to be kept by banks as precautionary reserves, especially at the early stages of the QEP. As a matter of fact, this policy wasn't able to directly and immediately reverse deflation expectations nor stimulate output. But it was more successfully transmitted to the financial markets. Various studies investigated the so-called "policy duration effect" which appeared to stem from the BoJ's policy actions. This consists of the possibility to shift the yield curve relying on the commitment to a future looser stance, adopted to compensate for the inability to further ease monetary policy at present, when interest rates are already at zero. In this way, expectations of the sort encouraged by Woodford and Eggertsson were shaped, and the term structure could be flattened.

A particularly tricky question for the Japanese central bank, when implementing quantitative easing, has been the fear of losing its recently acquired independence (in 1998). When the economy is in a liquidity trap, monetary policy decisions need to be taken in harmony with the fiscal authority: this is what makes a particular policy mix to be well structured and effective, but also, what takes away several degrees of freedom from the central bank's action. Moreover, a bank that only recently gained independence from the Ministry of Finance has all the right reasons to want to demonstrate as convincingly as it can its resolve not to yield to government inflicted inflationary pressures, which is exactly what the expansionary policy mix could imply.

The possibility that quantitative easing operations translate into money-financing of the government debt must therefore be resolutely excluded from the beginning, in order to prevent instability in the government bond market, and so that the central bank's credibility is not compromised.

Related to this issue is the concern relative to the long-term consequences of such loose monetary and fiscal policies, in terms of distortions caused by an overshooting of the inflationary target, but in particular by an excessive increase in public debt, leading to uncertainties regarding the sustainability of its interest burden. In fact, while the BoJ was able to exit from the QEP policy rather smoothly, gradually reducing money supply while at the same time making sure that the trend of public expectations was not reversed, Government debt has proved rather difficult to unwind. But, as shown before, the situation of a liquidity trap implies that the authorities act exactly at the opposite of how one wishes they would act in normal circumstances, so that convincing the public about their recklessness becomes a priority. "Expansionary contraction" does no good, and this is probably one of the few cases in which austerity is not a nifty option.

Nevertheless, the Japanese authorities did not find it easy to carelessly ignore the consequences of their actions, because it is an undeniable concern the fact that if these policies are implemented for too long, they will entail some welfare relevant distortions. Japanese experience wasn't a cyclical downturn. In a post-bubble recession the pre-bubble equilibrium can turn out to no longer be achievable if the crisis is mismanaged.

Therefore, the management of the exit strategy, together with the careful organization of its timing, is fundamental in guaranteeing that the results of the policy are resilient, at the same time preventing the impairment of the long-term equilibrium outcome. This is what the "trade-off between short term pain and long term gain" is all about.

Japan's experience demonstrated the importance of the timing in policy actions: hints of recovery due to temporary stimuli must be clearly told apart from a general and sustained return to growth. What needs to be underlined is that monetary policy, if properly conducted, can be very helpful in mitigating restrictive credit conditions and alleviating the tightness of such constraints, but is not at all sufficient to solve the problem at its roots. Japanese recovery was possible because other structural reforms were concurrently launched, banks progressively disposed of their problem loans and distressed borrowers were restructured. Monetary policy could not lift its expansionary stance before these necessary measures were taken.

7.2. Assessing differences and similarities between the Japanese "Lost Decade" and the current "Great Recession" in the U.S.

Many observers pointed out the analogies of the current situation in America with what happened two decades ago in Japan, in terms of origin of the crisis and policy responses. Of course there are various differences, concerning the features and history of the two central banks, the promptness of their reaction to the shock, the structure of the financial systems, and, most evidently, the length of the crisis.

In terms of policy measures, both the Federal Reserve and the Bank of Japan implemented the quantitative easing, but it is often remarked that while the BoJ concentrated mainly on the expansion of the size of its balance sheet, and thus on the liability side, the Fed is more asset-side oriented, focusing firstly on the composition of the balance sheet. Both the Fed and the BoJ accommodated the increased demand for reserves by purchasing different kinds of assets, but this increased demand stemmed from substantially different circumstances, reflecting the dissimilarities in the two financial systems. While Japanese system is bank-centered, the American is market oriented. What happened in the US is that private financial intermediation became malfunctioning, especially in credit products market related to subprime mortgages. This caused the Fed to concentrate principally on the composition of its balance sheet, trying to make up for the lack in private intermediation. Fed's chairman Ben Bernanke in a 2009 speech called it “Credit Easing”, and it took the form of an emergency operation rather than a natural extension of a zero interest rate policy. A major aim of the credit easing was to reduce uncertainty in the markets, which had reached paroxysmal level. In fact, in the U.S. not only did asset prices go down as they did in Japan, but they also became “toxic”, meaning that it became impossible to trustingly price those assets. This is why for the BoJ it was sufficient to face the accrued banks’ funding liquidity risk, expanding excess reserves, while the Fed needed also to step directly in distressed markets. Clearly this can be judged as a dangerous move for the sustainability of the central bank’s balance sheet, given that many of its purchases involved troubled assets, but it was also a necessary one, in order to wipe out those toxic assets from the economy.

As a matter of fact, the breakdown in the private financial intermediation in the U.S. led to an intensification in the funding liquidity risk as well, and thus to an increased demand for reserve: in the end, in both countries, both the size and the composition of the balance sheet were altered in order to tailor an appropriate policy mix.

Many commentators around the world doubt the efficacy of quantitative easing round one and two in America, but for different reasons. Some claim that the policy response wasn’t large and strong enough: a round three would be needed. Others argue that already round one was a bad, unhealthy idea. And if the first round didn’t work well, why go for a second or a third one? “Inflationistas”[6] worry about the long term consequences of the policies currently implemented by the Fed, accusing it of irresponsibility and lack of foresight, while “Deflationistas” claim that the American central bank has its hands tied up by political pressure, and doesn’t have the courage to respond as resolutely as the crisis requires. In fact, extraordinary monetary policy

[6] “Inflationistas and Deflationistas” in Paul Krugman’s blog on The New York Times, “The Conscience of a Liberal”

measures gave rise to titanic political controversies. A very illustrative example of this is the speech held at the Jackson Hole shortly before the Fed gave information to the public concerning the possibility of a QE3. On this occasion, Governor of Texas Ricky Perry seized the chance to threaten Fed's Chairman Ben Bernanke, asserting that "if this guy prints more money […] we will treat him pretty ugly down in Texas", and explaining that from his point of view "printing more money in this time in America is almost treasonous". Later communications of the Fed made clear that for the time being, no further rounds of quantitative easing are expected. Whether this decision was the result of a thorough analysis of the current economic situation or the negative consequence of political coercion nobody can tell.

A particular feature of the current recession in America, that was absent in the Japanese slump, and that is often pointed out as a case against quantitative easing, is the fear of a currency war. In fact, massive unsterilized expansionary monetary maneuvers depreciate the exchange rate, and this is something that can positively affect exports, and thus output. This circumstance perfectly applied to Japan in the middle of the 2000s, when positive global economic conditions enabled an export-led recovery. But the Dollar in not the Yen, and there are various reasons why this can't happen in the U.S. today. The role of the USD as a reserve currency comes into conflict with the possibility for it to be used as a policy instrument in the national interest. A weak dollar would not be welcomed in the international financial markets, and fears of retaliations are sound and concrete. Moreover, the recent crisis is global, which means that economic conditions are fragile worldwide, thus a "beggar thy neighbor" recovery is simply not viable.

Another remarkable difference between policy actions in Japan and in the US is that no commitment was made on side of the Federal Reserve. In fact, and in contrast with the BoJ, the American central bank didn't declare a goal for target variables such as output growth or inflation rate, nor offered the private sector clear indications on the hoped-for effects of its decisions. This prevented operators in the markets to form the right kind of expectations. It seems trivial, but sometimes just telling what one wishes to obtain from a certain procedure is of great help in actually obtaining it. This is the power of credibility, and what makes policy commitment so influential. But apparently, monetary policy measures taken all over the world were rather episodic and fragmentary, and only very few countries, such as Canada, made explicit commitments.

7.3. The Eurozone and the lack of coordination

It seemed that central bankers in the first place did not know what to expect from their unconventional policy decisions, and that a comprehensive scheme was lacking.

This is all the more so in the European Union, where only unsystematic actions were implemented, but no methodical quantitative easing program were realized. In fact, even if in specific circumstances the European Central Bank (ECB) intervened in the market, no indications of a systematic plan of action were given, in terms of scale, objective and duration. Actually, the ECB rate on main refinancing operations, although lower than usual, were never zero throughout the crisis, so that the central bank preserved some room for maneuver using its standard tool.

Nevertheless, the Eurozone presents some other relevant constrains with respect to the United States of America: although part of a currency area, countries belonging to the Eurozone still maintain many relevant differences in terms of economic and productive structures. In addition to this, European countries' fiscal situation is very heterogeneous, and no coordination can be implemented between the monetary and the fiscal authorities. This is why a properly designed QE program could prove useful also in the EU, helping disentangling the debt crisis risks and dealing with the different monetary policy needs of the dissimilar economies composing the Eurozone. In fact, it is clear to everyone that a policy interest rate that suits Germany's rate of growth, wouldn't apply to Spain or Italy. But since monetary policy management is unified in the hands of the ECB, it is formally impossible to endow different countries with different policy rates. On the other hand, if the quantitative easing was deemed effective and the central bank proceeded to buy government bonds of selected countries, nominal and real interest rates in those countries would go down, thus boosting growth. This is something that the ECB tried to do, but unfortunately, without a clear scheme of where its actions were leading, and only when the situation had already collapsed (see Greek's crisis).

As it happens in the US, there are many contrasting opinions in the Eurozone about the economic circumstances and the necessary steps to take to overcome the downturn. The risk of sovereign debt crisis has induced many economists and politicians to advocate for austerity[7], rather than accommodating policy, without any delay or postponing until the economy recovers. This point of view finds support especially in those countries where the fiscal situation is solid. Although everybody concurs that fiscal profligacy needs to be eventually undone in order to enduringly settle the question, asking for this to happen in a moment of still lingering economic weaknesses, leads the way for many further discussions. The economy cannot undergo an excessive sacrifice in terms of welfare, even if it is only in the short term. Otherwise, the ability of achieving a thorough and stable recovery in the medium run can be compromised.

[7] "Why austerity is only cure for the Eurozone" by Germany's federal minister of finance Wolfgang Schäuble in the Financial Times

8. CONCLUSION

In the first part of this document, many different ways of dealing with a liquidity trap were described. Contrarily from what Mr. Keynes believed in the thirties, monetary policy is not incapable of helping an economy trapped in a zero rate environment. This is encouraging, and proves that eighty years hasn't gone by in vain. But the English economist was right about the importance of fiscal policy in this circumstance: fiscal instruments can greatly improve outcome with respect to what can be achieved using only monetary tools.

An interesting feature of Woodford and Eggertsson's research is the proposition of irrelevance for quantitative easing. In the model presented, there is no role for an increase in the monetary base aimed at boosting output, except for the information that this can give to the public concerning future policy intentions. The fact that quantitative easing policies were so largely implemented throughout the world during the recent crisis, leads the way to the supposition that policymakers may believe this doesn't tell the whole story. It could be that the result of irrelevance crucially depends on some restrictive assumptions made in the model. For example, the paper did not take into account the possible interaction between quantitative easing and fiscal policy, which is assumed not to be used for stabilization purposes. In this way, an increase in the base money has no effect on the government budget constraint. But if it wasn't so, that could involve many consequences, thus bringing about a considerably different result. Moreover, if a different assumption concerning household's utility function was made, again, the result would be different. For example it could depend not only on consumption, but also have mean-variance preferences.

On the other hand, the relatively weak success of the large Quantitative Easing Policy implemented in Japan in the 2000s could constitute a real case against the efficacy of quantitative easing and thus back up the assumptions and conclusion of Eggertsson and

Woodford's model; and it might be that if the monetary authorities have recently turned to Quantitative Easing, it is only because they know no better ways to go.

A Key in the management of a situation of liquidity trap is the harmonization of monetary and fiscal policy. But unfortunately, what the theory indicates as very powerful, is also very difficult to put into practice: coordination between the fiscal and monetary authorities can be a source of several conflicts and difficulties, other than being sometimes actually impossible to implement (see the Eurozone).

Indeed, if it were so easy to fight the possibility of a liquidity trap, an advanced economy such as Japan wouldn't have spent more than 15 years trying to escape from it, nor would a similar scenario be repeated in America in the twenty-first century.

Reassuringly, history also shows that a lot was learned from other nation's previous negative experiences, and in fact, during the recent crisis, the central banks were more prepared to react to the shocks that hit their economies. Their responses were significantly faster and, despite some uncertainty, there was a lot more knowledge of what was going on, what could be expected to work, and what could be tried. A superior capability to decipher the situation, together with a smaller delay in policy actions and the understanding of the role of expectations in achieving future targets, were key to the improved management of the crisis. Advanced economies nowadays, despite the still lingering financial fragilities, have overcome the worst part of the crisis, so this experience simply can't compare with decennial Japanese stagnation.

Yet, much more could have been done, and many fallacies still need to be abated. It is not exclusively a problem of research and study, but also a matter of mind-set, especially when the theory recommends a counterintuitive solution, as in this case. Unfortunately (or providentially), decisions aren't taken solely by economists (if ever they are), and they are not only built on an economic basis, so that sometimes, common sense simply gains the upper hand on models.

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