

ON THE TARGETING OF SHORT AND LONG TERM INTEREST RATES*

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ABSTRACT

This article is a theoretical reappraisal of the infrequent policy of central banks in targeting interest rates at both short and longer maturities.

1. Introduction

In 2009, the ECB conducted one week, three and six months, and one year, liquidity providing operations at fixed rates. Roughly at the same time, the Fed was pursuing its policies of massive purchases of longer term assets with the objective of lowering rates at those horizons. In September of 2011, the Board announced Operation Twist II, the first having been the controversial policies of the early sixties through which the Fed hoped to raise short rates and lower long rates. The objective of the 2011 policies, was rather to raise medium term rates in exchange for lower long term rates. Other evidence for the ability of a central bank to manipulate rates at different maturities is the US monetary policy of the forties, before the Fed-Treasury Accord in 1951. In order to help finance the war, the Fed agreed to establish a ceiling on the 12 month Treasury certificate, of 2.5%, while it was also targeting the rates on the 90 day Treasury bill at 0.375% annual. Not surprisingly, by 1947, the Fed was holding 97% of the outstanding T-bills.

While there seems to be empirical evidence for the ability of a central bank to conduct operations at other than short run maturities¹, a simple logic seems to fail, raising understandable concerns at operation departments in central banks: Aren't there arbitrage conditions relating rates at different maturities? Under the expectation hypothesis, the long rates are simple averages of the shorter rates. If that is the case, then there are no degrees of freedom in controlling the long rates in addition to the short, as the historical partial failure in controlling rates seems to suggest. On the other hand, the also partial success in controlling those rates requires an explanation. This is what we do in this article, based on work by Adão, Correia and Teles (2010).

Why is it important to understand this? Why shouldn't central banks do business as usual, using short rates and letting the markets pick the long rates? The pressing reason is the zero bound constraint on interest rates. Since 2008, policy rates have been very close to zero in the US, UK, and the Euro area. They were also close to zero in the US in 2003 and 2004, when the policy rate fell down to 1%, and remained there for more than a year. Because people would otherwise hold money, interest rates cannot be lowered significantly below zero. How can then the central bank provide stimulus to a feeble economy? One possibility is to lower the long rates if those are above zero.

* The opinions expressed in the article are those of the authors and do not necessarily coincide with those of Banco de Portugal or the Eurosystem. Any errors and omissions are the sole responsibility of the authors.

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¹ In remarks before the National Economists Club, in 2002, Ben Bernanke, states this: "Historical experience tends to support the proposition that a sufficiently determined Fed can peg or cap Treasury bond prices and yields at other than the shortest maturities".

Interestingly enough, there is virtually no theoretical basis for this ability of a central bank to operate at horizons other than the very short term. With the exception of the paper on which this article is based,² the academic consensus is that there is no role for long term interest rate policy in addition to short term (see Eggertsson and Woodford, 2003, and Woodford, 2005). In this article we use a simple, but very standard, theoretical model to explain why a central bank can indeed control rates at different maturities, so much so that the whole structure could actually be targeted. We also explain that the policies that are able to do this should be closer to the ones recently led by the ECB with a direct target of prices rather than using quantities. It is a feature of the theoretical model that we use, that the demand for the assets is not necessarily pinned down, even when prices are.

The basis for our argument is the well known result that policy on short term interest rates is unable to pin down a unique equilibrium, as first pointed out by Sargent and Wallace (1975). It may do so locally in a neighborhood of a particular steady state (the first paper to show this was McCallum 1981), but there is still a large number of equilibria out of that neighborhood (see Benhabib, Schmitt-Grohe and Uribe 2001, among many others). The targeting of the term structure could reduce the degree of multiplicity.

We use a simple flexible price model, without loss of generality since the results hold also under sticky prices. We show that there are degrees of freedom to target the whole term structure. It follows that if policy is restricted to a target on the short rate, it does not pin down equilibria uniquely, potentially causing significant nonfundamental volatility. This problem is not solved by a Taylor rule on the short rate, which is the standard way in which central banks are seen to operate. Taylor rules are able to isolate one equilibrium, but there are still many equilibria globally so that the same potential nonfundamental volatility is also present there. Finally we show that the supply of assets is not pinned down, even when the prices are, indicating that policy should be implemented directly on prices rather than quantities.

2. Model

The model is the simplest possible. There is a representative household, competitive firms, and a government. Production uses labor only with a linear technology. The economy is cashless which further simplifies the analysis.

In each time period $t = 1, 2, \dots$, there are n possible contingencies. The history of events up to period t is s^t and the initial realization s^0 is given. The variables should be indexed by the history s^t , but for simplicity of notation we index them by t . The exogenous variables, the productivity and government spending, are in general functions of those histories. Otherwise, there is still uncertainty but it's nonfundamental.

Households/producers

The households, which are also producers, have preferences over consumption C_t and leisure L_t , given by

$$U = E_0 \left\{ \sum_{t=0}^{\infty} \beta^t u(C_t, L_t) \right\}.$$

The period-by-period budget constraints are

$$\sum_{j=1}^m B_t^j + E_t Q_{t,t+1} B_{t,t+1} \leq \sum_{j=1}^m R_{t-j}^j B_{t-j}^j + B_{t-1,t} + P_t A_t N_t - P_t C_t - T_t,$$

² As mentioned above, the paper is Short and Long Interest Rate Targets, by Adão Correia and Teles. There is also contemporaneous, independent, work by Magill and Quinzii (2012).

where B_t^j , $j = 1, \dots, m$ are bonds of maturity j paying R_t^j compound interest in period $t+j$; $B_{t,t+1}$ are one period state contingent bonds paying one unit of money in some state at $t+1$. The reason for the conditional expectation E_t is that the prices $Q_{t,t+1}$ are normalized by the probability of occurrence of the state; $N_t = 1 - L_t$ is labor; A_t is productivity, P_t is the price of the good, and T_t are lump sum taxes.

The marginal conditions of the households/producers include

$$\frac{u_C(s^t)}{u_L(s^t)} = \frac{1}{A_t} \quad (1)$$

and

$$\frac{u_C(s^t)}{P_t} = R_t^j E_t \left[\frac{\beta^j u_C(s^{t+j})}{P_{t+j}} \right], j = 1, \dots, m \quad (2)$$

The first conditions, (1), are the intratemporal conditions stating that the marginal rate of substitution between consumption and leisure must be equal to the marginal productivity of labor. The second, (2), are the marginal conditions for the holding of noncontingent bonds with different maturities. One unit of money today buys $\frac{1}{P_t}$ goods with marginal value $u_C(s^t)$. Instead, the same unit can be used to purchase a bond that pays R_t^j units of money j periods ahead, again purchasing $\frac{1}{P_{t+j}}$ goods with marginal value $\beta^j u_C(s^{t+j})$.

Competitive equilibria

An equilibrium in this economy must satisfy the agents marginal conditions (1) and (2). In addition, the government budget constraints at any period t can be written as

$$E_t \sum_{s=0}^{\infty} Q_{t,t+s} [T_{t+s} - P_{t+s} G_{t+s}] = \sum_{j=1}^m R_{t-j}^j B_{t-j}^j + B_{t-1,t}. \quad (3)$$

Finally, markets must clear, so that

$$C_t + G_t = A_t N_t$$

in the goods market, and

$$N_t = 1 - L_t$$

in the labor market.

Summarizing the equilibrium conditions in this simple economy is straightforward. Notice that the intratemporal condition

$$\frac{u_C(s^t)}{u_L(s^t)} = \frac{1}{A_t}$$

and the resource constraint

$$C_t + G_t = A_t(1 - L_t)$$

are two equations in two unknowns determining the quantities $C_t = C_t^*$ and $L_t = L_t^*$ in every date and state. In this model with flexible prices, the allocation is not affected by monetary policy. Price levels,

instead are affected by policy. They must satisfy the intertemporal conditions

$$\frac{u_C(C_t^*, L_t^*)}{P_t} = R_t^1 E_t \left[\frac{\beta^j u_C(C_{t+1}^*, L_{t+1}^*)}{P_{t+1}} \right]. \quad (4)$$

The budget constraint (3) is not a restriction on the price levels, since it can always be satisfied by the choice of the lump sum taxes T_{t+s} , for a $s \geq 0$.

Policy is a target for the short rate

If monetary policy was simply an exogenous target for the short term nominal interest rate, R_t^1 , then the equilibrium conditions restricting the price levels would be summarized by the intertemporal conditions for the one-period bonds

$$\frac{u_C(C_t^*, L_t^*)}{P_t} = R_t^1 E_t \left[\frac{\beta^j u_C(C_{t+1}^*, L_{t+1}^*)}{P_{t+1}} \right]. \quad (4)$$

only. If there was no uncertainty, given an initial price level, the whole path of future price levels would be given by the condition above, going forward. But once we allow for uncertainty, the equations above restrict the conditional average price level, not the actual realization. Suppose that by assumption, we allow for n possible contingencies in each period $t = 1, 2, \dots$. Then for period zero, for example, there is one equation,

$$\frac{u_C(C_0^*, L_0^*)}{P_0} = R_0^1 E_0 \left[\frac{\beta^1 u_C(C_1^*, L_1^*)}{P_1} \right],$$

in n variables, the price level in each of the n possible contingencies. This is the case for every period at each node of the event tree, going forward.

Policy are targets for both short and long rates

Suppose now that there was a target for the two period bond. Then the equilibrium conditions for the two-period bonds

$$\frac{u_C(C_t^*, L_t^*)}{P_t} = R_t^2 E_t \left[\frac{\beta^2 u_C(C_{t+2}^*, L_{t+2}^*)}{P_{t+2}} \right]$$

would be additional restrictions on the equilibrium price level. We can use these conditions, together with (4) from $t+1$ to $t+2$,

$$\frac{u_C(C_{t+1}^*, L_{t+1}^*)}{P_{t+1}} = R_{t+1}^1 E_{t+1} \left[\frac{\beta u_C(C_{t+2}^*, L_{t+2}^*)}{P_{t+2}} \right],$$

to write

$$\frac{u_C(C_t^*, L_t^*)}{P_t} = R_t^2 E_t \left[\frac{\beta u_C(C_{t+1}^*, L_{t+1}^*)}{R_{t+1}^1 P_{t+1}} \right]. \quad (5)$$

Suppose we are again in period zero. We now have two conditions going forward, namely,

$$\frac{u_C(C_0^*, L_0^*)}{P_0} = R_0^1 E_0 \left[\frac{\beta^1 u_C(C_1^*, L_1^*)}{P_1} \right], \quad (6)$$

and

$$\frac{u_C(C_0^*, L_0^*)}{P_0} = R_0^2 E_0 \left[\frac{\beta u_C(C_1^*, L_1^*)}{R_1^1 P_1} \right], \quad (7)$$

If there is a target for both the one period and the two period rates, then there are two equations in n unknowns, the price levels in the n contingencies.

If there was a target for the rate on three period bonds, then the condition

$$\frac{u_C(C_0^*, L_0^*)}{P_0} = R_0^3 E_0 \left[\frac{\beta u_C(C_1^*, L_1^*)}{R_1^2 P_1} \right]. \quad (8)$$

would also apply, adding one more restriction on the price levels in the different contingencies in period one.

And the same principle can be applied to bonds of longer maturities, so that a target for n maturities can solve for the price levels in the n contingencies. The more contingencies there are, the more maturities can be targeted. In the limit, as more contingencies are allowed for, the whole term structure can be targeted.

It is worth noting that since uncertainty can be nonfundamental, there is a sense in which the number of possible contingencies is strictly higher than the number of maturities, so that while the whole term structure can indeed be targeted, that is not sufficient to pin down the price level in every possible contingency.

An interpretation

Why is it, then, that the arbitrage conditions between short and long bonds, do not fully restrict the long rates, given the short rates? The reason is, this model suggests, that for a given policy on the short rates, the price levels are not pinned down. So that the long rates are also not pinned down. Restrictions on both short and long rates help determine, possibly still not uniquely, the price levels in this model.

To see this more clearly, notice that the intertemporal condition above, (5), can be written as

$$\frac{R_t^1}{R_t^2} = E_t \left[\frac{1}{R_{t+1}^1} \right] + \frac{Cov_t \left(\frac{1}{R_{t+1}^1}, \frac{u_C(R_{t+1}^1)}{P_{t+1}} \right)}{E_t \left[\frac{u_C(R_{t+1}^1)}{P_{t+1}} \right]}. \quad (9)$$

Given that, with a target for the short rate, the price level is not pinned down, the covariance above,

$Cov_t \left(\frac{1}{R_{t+1}^1}, \frac{u_C(R_{t+1}^1)}{P_{t+1}} \right)$ is also not pinned down. The term premia are unrestricted, and therefore the term structure can be set by policy.

Zero volatility policies

In the expression (9), above, the covariance in general depends on the process for the price level. However if there was no volatility in the short rate in $t + 1$, R_{t+1}^1 , then the covariance would be zero no matter what. In this case the expectation hypothesis is satisfied and, the long term yield is just the product of the short term ones,

$$R_t^2 = R_t^1 R_{t+1}^1.$$

This knife-edge case does not question the generality of the result, but can still be of interest in explaining the historical episodes in which multiple targets were attempted. Indeed, if a constant target is credible, then the long rate cannot be targeted independently, and attempts at doing so will most surely fail.

On the relative supply of assets

When the monetary policy maker in this model sets a target for the nominal yields it stands ready to buy and sell assets at given prices or rates. How are then the quantities of those assets determined? The equations in the model that determine the quantities are the budget constraints of the government,

$$\sum_{s=0}^{\infty} E_t Q_{t,t+s} [T_{t+s} - P_{t+s} G_{t+s}] = \sum_{j=1}^m R_{t-j}^j B_{t-j}^j + B_{t-1,t}.$$

These conditions have to be satisfied, at each state, in each period, going forward. But they can be satisfied by the choice of lump sum taxes, not necessarily by the net supply of the assets. There are thus multiple such supplies consistent with equilibrium.

Conclusion

Short and long term interest rates can in general be determined independently. When short term rates are close to zero, and long term rates aren't, there is still room for policy to lower the long term rates as well. The way this should be accomplished is with a pure target for interest rates at different maturities, not with policy on the relative supply of assets.

Why is there, then, the strong conviction that short and long term rates cannot be chosen independently? The reason is, most likely, the result of determinacy of equilibria under an interest rate feedback rule, first shown by McCallum (1981). In fact when policy on the short rate is assumed to be undertaken with a Taylor-type rule, under certain conditions, there is a unique equilibrium in the neighborhood of the steady state. If the equilibrium is unique, then the term premia are also unique, and therefore the term structure is uniquely pinned down. This is indeed true locally, but not globally, and, in general, there is nothing within our standard monetary models that selects the local equilibrium, rather than any other one.

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