Monetary policy with signal extraction from the bond market ☆

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ABSTRACT

Monetary policy is conducted in an environment of uncertainty. This paper presents a model where the central bank uses real time data from the bond market together with standard macroeconomic indicators to infer the current state of the economy more efficiently, while taking into account that its own actions influence the bond market and therefore what it observes. That the central bank uses the information in the term structure to set policy creates a link between the bond market and the macroeconomy that is novel to the literature. The estimated model suggests that there is some information in US yields of maturities of less than 1 year that can help the Federal Reserve to identify shocks to the economy on a timely basis.

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1. Introduction

Hayek (1945) famously argued that market economies are more efficient than planned economies because of markets' ability to efficiently use information dispersed among market participants. In most western economies there is now little planning and almost all prices are determined by market forces without interference from any central authority. However, there is one important exception: the market for short term nominal debt where central banks control interest rates. In the presence of nominal frictions in product or wage markets, this practise can improve welfare by reducing the volatility of inflation and output. Hayek's insight, though formulated in a more general setting of a planned economy, was that even a central bank that shares the objective of the representative agent may not be *able* to implement an optimal stabilizing policy due to incomplete information. In this paper, the central bank would implement an optimal stabilizing policy if it knew the state of the economy with certainty, and any deviation from optimal policy is due only to information imperfections. Under this assumption this paper demonstrates how the central bank can make use of Hayek's insight and use the market for debt of longer maturities as a source of information that makes a more efficient estimation of the state of the business cycle possible, and thus reduces deviations from optimal policy. That this is close to how some central banks think about and use the term structure is illustrated by a quote by the Chairman (then Governor) of the Federal Reserve Board, Ben Bernanke:

> To the extent that financial markets serve to aggregate private-sector information about the likely future course of inflation, data on asset prices and yields might be used to validate and perhaps improve the Fed's forecasts.[1]

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[1] "What Policy Makers Can Learn from Asset Prices", Remarks by Governor Ben S. Bernanke before *The Investment Analysts Society of Chicago*, Chicago, Illinois, April 15th, 2004 (Bernanke, 2004).

The suggestion that the bond market can provide information that is valuable to policy makers is thus not news to the policy makers themselves. Rather, the contribution of the present paper is to provide a coherent framework for analyzing and estimating the interaction between information contained in the term structure and the monetary policy making process. In the model presented below the central bank set interest rates in an uncertain environment, where the yield curve is informative about the state of the economy and thus also informative about the desired interest rate. This has the consequence that the macroeconomy is not independent of the term structure. The only direct effect of interest rates on the macroeconomy is from the expected path of the short rate set by the central bank to aggregate demand, as is standard in the new-Keynesian literature. However, there is also an indirect feedback from rates on longer maturity bonds to the macroeconomy through an information channel. The mechanism is the following. Bonds are traded daily and the affine form of the bond pricing function makes the bond pricing equation with macrofactors formally equivalent to a linear measurement of the state of economy. The term structure can thus be used as a more timely indicator of the state of the economy than collected aggregate information that is available only with delay and sometimes significant measurement error. A movement in the term structure signals a shift in the underlying macrofactors that induces the central bank to re-evaluate what the optimal short term interest rate should be. The shift in the term structure thus feeds into a change in demand through the change in the short term interest rate.

In the present model the policy makers exploit the fact that bond market participants' expectations about the future are revealed by the term structure. As pointed out by Bernanke and Woodford (1997), letting monetary policy react mechanically to expectations may lead to a situation where expectations become uninformative about the underlying state and no equilibrium exists. They further argue that "targeting expectations" by policymakers cannot be a substitute to structural modeling. In the proposed framework below, the information in the term structure is *complementary* to other information and firmly connected to an underlying structural model. Policymakers then avoid the potential pitfalls of a pure "expectations targeting" regime.

There is a large literature on the informational content of the term structure. Mostly, it has focused on whether the term structure, often modeled as the spread between short and long rates, can help predict future outcomes of macrovariables.[2] This literature thus investigates whether the component of the yield curve that is orthogonal to other macrovariables adds predictive power to forecasting models of inflation and GDP growth. A recent paper in this vein is Ang et al. (2006) who find that the short interest rate performs better than any term spread in predicting GDP growth. The negative correlation between the orthogonal component of short interest rates and future output found by Ang et al. is consistent with the findings of the VAR literature on the real effects of monetary policy shocks. In the VAR literature on the transmission mechanism of monetary policy, the monetary policy shocks are defined to be exactly the component of interest rates that is orthogonal to other macrovariables (e.g. Christiano et al., 2001). It is thus not surprising that the previous literature found that including the slope of the yield curve, which will be negatively correlated with the orthogonal monetary policy shock, improves forecasts. This paper deviates from the previous literature on the informational content of the term structure by asking if there is information in the term structure that can be used in the monetary policy process when *the transmission mechanism is assumed to be known and the effect of the short rate is controlled for.*

There are two potentially important types of information that could be revealed by the term structure that the present model is silent about. Goodfriend (1998) discusses the Federal Reserves responses to "inflation scares" in the 1980s, which he defines as increases in the long term yields. He interprets these as doubts by market participants about the Federal Reserve's commitment to fighting inflation. The present paper does not address questions about central bank credibility, but takes a perfectly credible central bank with a publicly known inflation target as given. The model presented here is also not suited to analyzing or interpreting market perceptions of the reasons for a change in the monetary policy stance, as done by Ellingsen and Söderström (2001). The policymakers' relative preferences for stabilizing inflation or the output gap are assumed to be publicly known. In this paper, attention is restricted to what the term structure can tell us about the state of the business cycle.

The practical relevance of any information contained in the term structure is ultimately an empirical question. When bond markets are noisy, observing the term structure is not very informative. In order to quantify the informational content of the term structure the variances of the non-fundamental shocks in the term structure are estimated simultaneously with the structural parameters of the macroeconomy. The estimation methodology is similar to recent work by Hördahl et al. (2006) who estimate the term structure dynamics jointly with a small empirical macro model where the central bank is assumed to be perfectly informed. Hördahl et al. impose only a no arbitrage condition on the pricing of bonds while in this paper the bond pricing function and the dynamics of the macroeconomy are derived from the same underlying utility function. This makes the analysis more stringent, but it comes at the cost of an empirically less flexible bond pricing function.

In the next section a model is presented where the central bank extracts information from the term structure about unobservable shocks while recognizing that its own actions influence the term structure itself. In Section 3 the model is estimated to quantify the potential of the yield curve as a source of information. Section 4 concludes.

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[2] For example Harvey (1988), Mishkin (1990) and Estrella and Mishkin (1998).