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Impact of uncertainty on high frequency response of the U.S. stock markets to the Fed's policy surprises

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ABSTRACT

This paper examines the impact of uncertainty on estimated response of stock returns to U.S. monetary policy surprise. This is motivated by the Lucas island model which suggests an inverse relationship between the effectiveness of a policy and the level of uncertainty in the economy. Using high frequency daily data from the Federal funds futures market, we first estimate the response of S&P 500 stock returns to monetary policy surprises within the time varying parameter (TVP) model. We then analyze the relationship of these time varying estimates with the benchmark VIX index and alternative measures of uncertainty. Evidence suggests a significant negative relationship between the level of uncertainty and the time varying response of S&P 500 stock returns to unanticipated changes in the interest rate. Thus, at higher levels of uncertainty the impact of monetary policy shocks on stock markets is lower. The results are robust to different measures of uncertainty.

1. Introduction

The impact of monetary policy on the real economy has received great attention from policymakers and market participants. This issue becomes even more interesting when one incorporates uncertainty in economic environment into the analysis. The present study explores this relationship between monetary policy effectiveness and uncertainty. We undertake a novel approach to provide evidence supporting the Lucas island model predictions that monetary policy effectiveness is inversely related to the level of economic uncertainty.

In analyzing the impact of monetary policy on the economy, the problems of endogeneity and identification has remained particularly challenging. The problem of endogeneity arises because monetary policy actions not only affects the real economy and asset markets but also events in the economy may influence monetary policy decision making. One widely accepted approach to tackle endogeneity is the use of high frequency data. To the extent stock markets are viewed as a proxy to real economy,[1] researchers have taken advantage of high frequency data to model the response of stock market returns to monetary policy shocks that are identified based on the Federal funds futures markets (Bernanke & Kuttner, 2005; Hausman & Wongswan, 2011; Wongswan, 2009 amongst others).[2]

There is another strand of literature that highlights the role of uncertainty and its impact on effectiveness of stabilization policy and the real economy. The literature on this topic dates back to

[1] Even though stock market prices cannot be directly comparable to real output, several studies have found a strong relationship between stock price changes and anticipated changes in real economic activity (Barro, 1990; Binswanger, 2000; Fama, 1981, 1990; Henry, Olekalns, & Thong, 2004; Schwert, 1990) and the existence of two way Granger causality between these two variables (Neusser & Kugler, 1998; Rousseau & Wachtel, 2000).

[2] Among alternative methods of identification, identification based on the Federal funds futures markets have received widespread attention recently. This is because the Federal funds futures prices are found to be an unbiased predictor of the Fed funds rate and are an efficient measures of the Fed funds rate (Krueger & Kuttner, 1996). Gürkaynak, Sack, and Swanson (2007) also show the superiority of the Fed funds futures price among different market based measures of monetary policy expectations.

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the scholarly work of Lucas (1973) and Ball, Mankiw, and Romer (1988), popularly known as the Lucas island model. The principal idea of this model stems from the existence of imperfect information about the relative importance of aggregate and idiosyncratic shocks. When the economy experiences large shocks to aggregate demand the suppliers would attribute most of the changes in the price of their goods to changes in the general price level. Intuitively, this means the estimated real impact of a demand shock on output is lower for the economy that suffers from higher volatility in the nominal GDP. The Lucas model thus predicts an inverse relationship between the level of economic uncertainty and effectiveness of the policy shock. The literature on the role of uncertainty has broadly found that uncertainty has a strong negative impact on various macroeconomic variables. For example, Ramey and Ramey (1995) finds that countries with higher volatility have lower economic growth. Similar evidence has been found in Romer (1990) and Drechsler and Yaron (2011).

While most of these studies are cross-sectional, we analyze the relationship between uncertainty and policy effectiveness using a time-series approach for a single country – the U.S. This not only avoids problems associated with averaging variables across countries but also it is more appropriate given the international differences in the central bank operating procedures and transmission mechanisms of each country in the world. This paper is an attempt to relate the literature on monetary policy and uncertainty. In particular, we want to examine the role of uncertainty in the effectiveness of monetary policy shocks. In order to do so, we estimate the response of stock returns to monetary policy shocks using a time varying parameter model. After estimating the response coefficient the next important step in understanding the role of uncertainty is to devise an appropriate proxy to capture uncertainty at high frequency. In a widely cited paper, Bloom (2009) shows that stock market volatility index is strongly correlated with various measures of micro- and macro-level uncertainty including bond spreads, disagreement among professional forecasters, and cross-sectional spread of firms profit growth and industry productivity growth. This has lead us to use the volatility in stock market options as a measure of implied aggregate uncertainty.[3] We use the popular VIX index (often referred to as investors *fear gauge*) as a benchmark measure of uncertainty. As a test of robustness, we also consider various alternative measures of volatility in the financial markets to proxy uncertainty.

The results obtained in this paper broadly support predictions of the Lucas island model. We find that at higher levels of uncertainty represented by the benchmark VIX index the time varying response of the stock market to Fed's policy surprises is lower. This negative association is also found across various alternative conditional and unconditional measures of uncertainty used in the paper. According to our estimates, amongst all the measures of uncertainty, the measure of uncertainty in the short term bond market is found to offer highest explanatory power in explaining the response of stock markets to monetary policy surprises. Thus, a depressed sentiment in the financial markets leads to a lower impact of Fed's policy surprises on stock markets and vice versa.

The study contributes to the existing literature on multiple fronts. First, the high frequency daily data used in the study provides more convincing evidence in support of the Lucas island model that higher uncertainty leads to smaller impact of monetary policy shocks. Second, the TVP model used in the study is able to unveil far richer dynamics across time of the impact of monetary policy shocks on stock markets than previous studies that use the fixed coefficient approach.[4] Third, the study considers various measures of uncertainty and the results are robust to all the alternative proxies. Most existing studies mainly focus on the direct impact of uncertainty on economic variables and consider one or only few measures of uncertainty (Baker, Bloom, & Davis, 2011; Bomberger, 1996; Connolly, Stivers, & Sun, 2005).

The rest of the paper is organized as follows. Section 2 provides the literature review on the topic. The data description and various measures of uncertainty are developed in Section 3. In Section 4, we specify the methodology adopted. Section 5 uses TVP model to discuss the time variation in the impact of Fed's policy surprise on stock markets and analyses how these time varying estimates depend on the level of uncertainty, followed by conclusions in Section 6.

2. Literature review

In order to analyze the impact of uncertainty on effectiveness of monetary policy shocks the two main challenging issues are addressing the endogeneity problem and choosing an appropriate proxy for identification of monetary policy shocks. Researchers have often pursued the event study methodology in order to control for the influence of other variables that affect stock markets (Bernanke & Kuttner, 2005; Bomfim, 2003; Cook & Hahn, 1989; Gürkaynak, Sack, & Swanson, 2005). Under this methodology, by looking at a narrow window around the event in question and combining it with high frequency data, one can significantly control for the influence of other variables that affect the stock markets.

The identification of the monetary policy shocks is specifically demanding as one needs to measure expectations of the economic agents. The literature has advocated several methods in order to capture the unexpected changes in monetary policy.[5] Researchers in the recent past have used information from the Federal funds futures data in order to estimate monetary policy shocks. This method is mainly popular because the Fed funds futures rate is found to be an unbiased predictor of the Fed funds rate and is an 'efficient' predictor of the Fed funds future rate (Krueger & Kuttner, 1996 among others). Gürkaynak et al. (2007) also show superiority of the Fed funds futures prices among different market based measures of monetary policy expectations.

Given the superior information content in the Fed futures contracts data, Bernanke and Kuttner (2005) find that a positive monetary policy surprise (as surprise increase in interest rate) is associated with a drop of 1.3 percent in the S&P stock price index.[6] They attribute such negative equity returns response more due to the change in expected future excess returns (the equity premium) and less due to revision of the expectations of discounted future dividends streams and the change in real interest rate.

The study then investigates the role of uncertainty in explaining the time varying responses. This is warranted because the role of uncertainty has always played a central role in understanding the impact of policy on aggregate economic variables. The seminal work of Lucas (1973) and Ball et al. (1988) shows how uncertainty

[3] Leay and Whited (1996) and Bloom, Bond, and Van Reene (2007) also use stock market volatility as a proxy for uncertainty at the firm level in their study.

[4] Most existing studies following Bernanke and Kuttner (2005) have used a fixed coefficient approach. This is in contrast to anecdotal and formal evidence which suggest that the response of stock returns varies over time. See for example Andersen, Bollerslev, Diebold, and Vega (2007) and Campbell, Lo, and MacKinlay (1997).

[5] See Cochrane and Piazzesi (2002), Ellingsen and Soderstrom (2001), Faust, Rogers, Swanson, and Wright (2004), Poole and Rasche (2000) and Rigobon and Sack (2004).

[6] Other studies that have looked further into the response of individual sector stock returns and the impact of volatility include Bredin, Hyde, Nitzsche, and O'reilly (2007) for the impact on REIT industry and Chuliá, Martens, and Van Dijk (2007) that covers the S&P 500 index constituents.

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