Examining the Complexities of Monetary Non-Neutrality on Stock Market Performance

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EC 15: Econometrics

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May 4th, 2023

Abstract

This paper begins by examining the impact of monetary policy on stock market performance during the period from 1969 to 2007. Existing literature discusses the challenges in accurately measuring the effects of monetary policy shocks on economic variables due to endogeneity issues. To overcome these challenges, we utilize Romer and Romer's (2004) shock series as an exogenous measure of monetary policy shocks while employing Òscar Jordà's local projections method to analyze the impulse responses of the S&P 500. Using the original Romer-Romer dataset from years 1969 to 1996, the analysis demonstrates a statistically significant effect on the S&P 500 in the two-to-seven-month range following the monetary policy shock. However, when the dataset is extended to include data up to 2007, the significance diminishes, which we attribute to omitted private sector information bias and statistical inference complications. We are confronted with a new frontier of disentangling monetary shocks from information effects to accurately quantify the impact of each individual factor on stock market performance. While some research has advanced in this direction, a comprehensive understanding remains elusive and warrants further investigation.

Introduction

As the Federal Reserve nears the conclusion of the fastest tightening cycle seen in modern history, the relationship between monetary policy and economic output is once again at the forefront of economic discussion. Conventional understanding says there is an inverse correlation between shifts in monetary policy and economic performance, as rates moving lower and an increase in the money supply stimulates enterprise spending and overall economic growth, while also enhancing equity valuations by lowering the opportunity cost of money. However, upon further research, it becomes clear that this relationship is not always exact. A prime example of this is currently occurring in financial markets, with both interest rates and stock prices trending lower as fear of recession weighs on projections for economic growth and subsequently company earnings. Our paper discusses different methods of measuring monetary policy and its fluctuations, seeking the direct causality of monetary policy shocks on stock performance using the S&P 500 as a proxy.

The challenges in determining the relationship between monetary policy and the economy lie in the countless variables, like inflation and the output gap, that impact both the pricing of financial markets and the Federal Reserve's decisions on monetary policy. The countercyclicality of the Fed's actions, as well as the expansion of anticipatory behavior in financial markets further obscures the direct impact of a monetary policy shock on changes in economic performance. Put simply, naively regressing shifts in monetary policy on changes in economic output would vastly underestimate the true relationship, as the abundance of circumstances the economy finds itself in would bias the correlation to zero. As a result, our research outlines various methods used in past studies to control for factors that cause endogenous moves in both stock and bond markets with the goal of identifying the most accurate and applicable method to use in our regression. Understanding the true impact of monetary policy on the economy would not only make waves in discovering the probable direction of financial markets in different economic environments but would also clarify the proper course of action the Federal Reserve should take to combat exaggerations of the business cycle, keeping the economy at a steady rate of growth.

Literature Review

"Macroeconomic Shocks and their Propagation" Valerie Ramey (2016)

Valerie Ramey discusses the methods and findings of several different papers researching the impact of monetary policy shocks in her chapter of the *Handbook of Microeconomics*, titled "Macroeconomic Shocks and Their Propagation." Ramey begins her discussion by noting the changes that occurred in the preferred measurement of monetary policy, and its fluctuations, during the last few decades of the 20th century. Earlier studies, such as Sims (1972) and Barro (1977 and 1978), used shocks to the supply of money as their marker of overall monetary policy shocks. Their reasoning was founded in the belief that fluctuations in the supply of money contributed in large part to fluctuations in economic output. However, Sims (1980), and Litterman and Weiss (1985), added interest rates to their vector autoregressions with the result being a severely reduced impact of the money supply on output. Ramey asserts that this surprising result paved the way for two rebuttals, with the first being Romer and Romer's 1989 study, which sought to control for public and central bank expectations to determine which shifts in monetary policy were systematic, and which were shocks. The second came from Bernanke and Blinder in 1992, who said that interest and fed funds rates should be the only measures of monetary policy, using Granger-causality tests and variance decompositions of forecast errors to depict that rates were better indicators than the money supply. The culmination of these efforts came in Christiano et al.'s *Handbook of Macroeconomics* chapter, which found that contractionary monetary shocks correlated with noticeable moves lower in economic output.

Ramey uses Christiano et al.'s synthesis of the contemporary literature on monetary policy to exemplify the fact that many specifications used do not hold up in more recent periods of data. This is attributed to the fact that it is significantly more challenging to identify true monetary policy shocks as more rate cycles pass. Romer asserts that the conduct of the Fed has converted to a rather systematic pattern, which makes deviations from expectations increasingly rare. Beyond the explicit shift of the fed funds rate, superior access to information regarding the Fed and the private sector's expectations for the economy have made it easier to predict upcoming policy adjustments, further contributing to a decrease in shocks. Ramey concludes that econometric identification of shocks has become more challenging with time, and that the effects of monetary policy on the economy has subsequently less to do with shocks to the system than ever before. These findings, regarding the trend of decreasing occurrences of monetary policy shocks, shed light on the results of our study and assist at identifying potential next steps for further research.

"A New Measure of Monetary Shocks: Derivation and Implications" Romer-Romer (2004)

In our search for a more refined measure of monetary policy shocks, we utilized Romer-Romer monetary policy shocks from "A New Measure of Monetary Shocks: Derivations and Implications" (2004) by Christina and David Romer. This approach focuses on controlling for current economic conditions such as inflation, unemployment, and the output gap, as well as the central bank's expectations of future economic conditions. For instance, interest rates could drop during a recession, yet the S&P 500 may barely move as the state of the economy is still poor. Furthermore, the central bank could lower interest rates in anticipation of a recession, yet the stock market might remain bullish contemporaneously.

Romer and Romer run an OLS regression to model the Federal Reserve's intended federal funds rate as a function of the initial level of the intended funds rate together with inflation, real output, and unemployment forecasts. This model captures the systematic response of the Federal Reserve to these economic variables. The residuals from this regression represent the changes in the intended federal funds rate around FOMC meetings that are not explained by the systematic response to forecasts of inflation and real growth. Romer-Romer argues that this residual represents a reasonably exogenous measure of monetary policy shocks. To create a monthly series of monetary policy shocks, they assign each residual to the month in which the corresponding FOMC meeting occurred. If there are two meetings in a month, they sum the shocks. If there are no meetings in a month, they record the shock as zero for that month. This transformed series of residuals is their measure of monetary policy shocks. They test the validity of this measure through a vector autoregression (VAR) on real output and inflation. The results of the VAR analysis showed that their measure of monetary policy shocks had statistically significant effects on both real output and the price level. A contractionary monetary policy shock led to a decline in real output and a decrease in the price level, where the response of real output was quite persistent, while the price level responded more gradually. These findings are consistent with the conventional view of the effects of monetary policy on the economy.

Utilizing Romer and Romer's more exogenous monetary policy shocks enables us to examine the causal impact of monetary policy on various economic variables more closely. While Romer and Romer's dataset stops at 1996, we used Johannes Wieland's dataset that extends out to 2007. Our research applies this extended dataset to analyze the S&P 500 and employs the local projections method instead of VARs for ease of interpretation and to reduce vulnerabilities to lag length specification. We also corroborate with additional sources and identify weak points which could be improved upon.

Nakamura and Steinsson's "High Frequency Identification of Monetary Non-Neutrality: The Information Effect" (2018)

Romer and Romer's measure of exogenous monetary policy shocks is not perfect, as discussed in Nakamura and Steinsson's paper, "High-Frequency Identification of Monetary Non-Neutrality." The paper suggests that while Romer and Romer accounted for the information effect of the central bank, they failed to consider the information effect of the private sector regarding the trajectory of the economy and corresponding monetary policy. Nakamura and Steinsson address this limitation by using high-frequency data from federal funds and Eurodollar futures markets to estimate changes in expectations about the funds rate at different horizons. They find unconventional results where output increases with the real interest rate, which they attribute to FOMC announcements affecting private sector beliefs about economic growth and the natural rate of interest. They estimated roughly two-thirds of the response is associated with changes in the natural rate of interest (which is driven by underlying shifts in economic fundamentals like productivity and potential output), and the remaining third is associated with a tightening or easing of real rates relative to the natural rate. This latter third can be classified as a monetary policy shock, as it represents an unexpected deviation from the expected path of fed funds rates. Applying this insight to the S&P 500, they estimated that the S&P 500 fell by 6.5% in response to a policy news shock that raised the two-year nominal rate by one hundred basis points.

Although Nakamura and Steinsson's approach reduces endogeneity concerns further than Romer and Romer's measure, it comes at the cost of statistical significance. Their estimates have very noisy standard errors, making their methodology unsuitable for our research. However, their insights into potential biases in our research results are crucial for contextualizing our findings. Our research extends the literature of Nakamura and Steinsson by examining the evolution of monetary policy shocks over time, focusing on their decreasing magnitude, which we attribute to our omission of the financial markets' anticipatory behavior. Though our research does not directly account for Nakamura and Steinsson's private sector information effect, we were able to corroborate with additional research to sign the bias and enumerate the additional challenges associated with the restrictions of economic models.

Data Description Summary Statistics

We used a dataset of 468 monthly Romer-Romer derived monetary policy shocks from 1969 to 2007 and the corresponding monthly averages in the S&P 500's closing price. The original Romer-Romer dataset stops in 1996, but we used Johannes Wieland's extension to 2007, with the S&P 500 data being sourced from a Bloomberg Terminal. We cleaned the dataset such that the only fields were the date, Romer-Romer monetary shock, and the corresponding price of the S&P 500. The Romer-Romer monetary policy is measured as a percentage and the S&P 500 is measured in nominal U.S. dollars.

Since we are interested in the percentage change in the S&P 500 which corresponded to the percentage change in our shock terms, we created the *log_SP500* field as the differences in logarithms of a value approximates its percentage change. Since we chose a horizon of 24 months to support the local projections method, we also allocated an additional 25 spaces which represent the current value of the S&P 500 subtracted from the value S&P index some *h* months in the future, with *h* ranging from 0 to 24.

We used Romer-Romer's monetary policy shocks as an instrumental variable and a reasonably exogenous measure of unexpected monetary policy shocks and the S&P 500 as a proxy for the performance of the stock market. However, the S&P 500 index does not come without limitations, as the index only represents the largest 500 companies, meaning that it does not reflect the performance of smaller companies that potentially have different reactions to monetary policy shocks. Additionally, the S&P 500 being weighted by market capitalization may overrepresent certain sectors at different points in time. However, due to data constraints and complexity, we settled with the S&P 500 as a reasonably representative measure of the stock market. In doing so, we did not face any significant missing data or sourcing problems.

Model

Considering that monetary policy shocks might have delayed effects on financial markets, we were curious about the persistence and magnitude of these shocks over time. To explore this, we employed Òscar Jordà's local projections method to estimate the impulse response of the S&P 500 index to monetary policy shocks for different time horizons. This enables us to capture the average effect of a monetary policy shock on the S&P 500 index at various points in time after the shock occurs. We opted for the local projections method over traditional VAR models, which are commonly used in this research domain, because it is less sensitive to the choice of lag length. We found that a 24-month horizon was most appropriate for capturing the dynamic effects of shocks on the index over both short and longer-term periods. We anticipate our coefficient estimates to be negative, aligning with the conventional understanding that positive shocks lead to higher interest rates which negatively impacts stock valuations, driving prices lower. Considering that Romer and Romer's original paper demonstrated statistically significant impacts of monetary policy shocks on real output, and that the S&P 500 index is reasonably correlated positively with real output, we expect to observe similarly significant effects in the initial months following a shock. Over time, these effects should gradually diminish to insignificance as other macroeconomic factors affect markets.

The local projections model includes a lagged term to account for the influence of past monetary policy shocks on the current value of the S&P 500 index. For example, if today's monetary policy shock can affect the stock market a year from now, then it is also reasonable to assume that today's prices could be influenced by monetary policy shocks that occurred in the prior year. This approach accounts for both the delayed effects and persistence of monetary policy shocks. We selected an asymmetrical lag time of 12 months relative to the forward horizon.

We also incorporated an autoregressive component in the model, as the value of a variable at a given point in time is influenced by its past values. This component helps account for patterns in the S&P 500 index, such as trends, seasonality, and cycles. For instance, the S&P 500 index may exhibit patterns due to recurring events, like political elections, and other seasonal trends, like tax-loss harvesting. By incorporating the autoregressive component, the model more closely captures the underlying relationships within the data and mitigates the recent momentum of the index itself. We also lagged this term by 12 months.

The specific equation we estimate is:

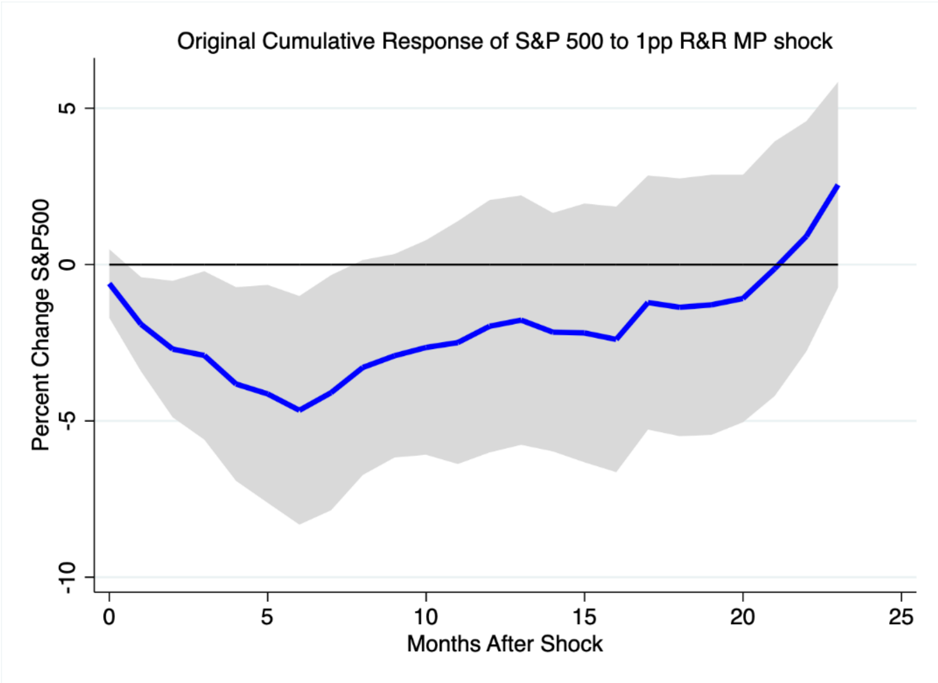
$$\log Y_{t+h} - \log Y_{t-1} = \alpha^h + \beta^h X_t + \sum_{k=1}^{12} \delta_k^h X_{t-k} + \sum_{k=1}^{12} \gamma_k^h \Delta \log Y_{t-k} + u_t^h$$

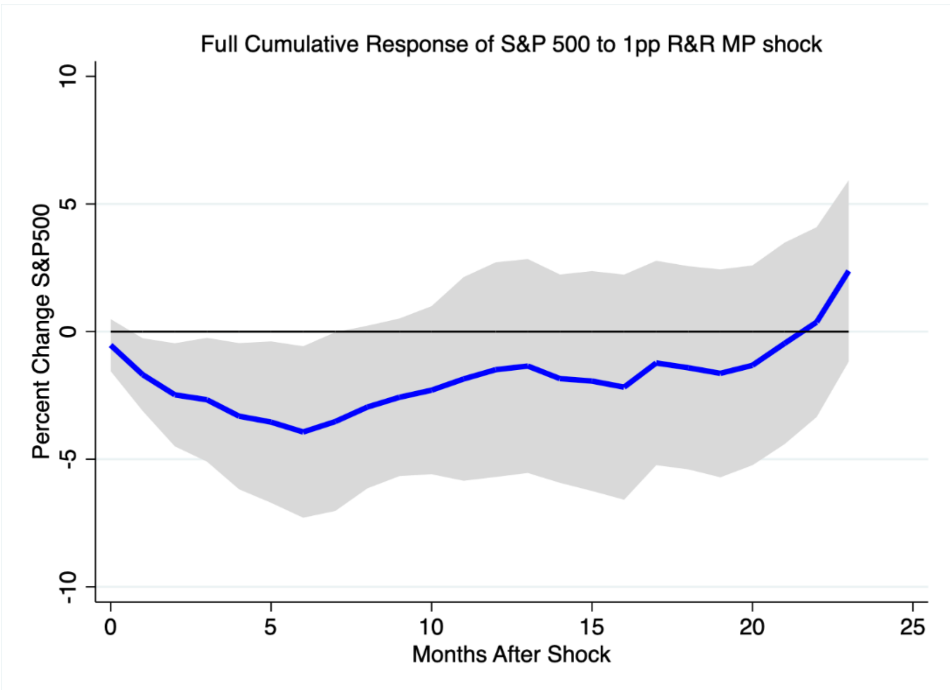
The outcome of interest is the percentage change in the S&P 500 index at time *t* and horizon h, $logY_{t+h} - log\, Y_{t-1}$. The key independent variable is the Romer-Romer measure of a monetary policy shock, in percentage points, at time *t*, X_t.

The control variables include the past 12-month lagged effects of the monetary policy shock, $\sum_{k=1}^{12} \delta_k^h X_{t-k}$, as well as the past 12-month percentage changes in the S&P 500 index,

$\sum_{k=1}^{12}\gamma_k^h \Delta \log Y_{t-k}$. The horizon hyperparameter, h, ranges from 0 to 24 months. The intercept is denoted by α^h and u_t^h is the error term.

Results





The results of our two local projection regressions, using the original Romer-Romer dataset from 1969 to 1996, and the extended dataset from 1969 to 2007, are displayed in the impulse response graphs above. For 25 different horizons, ranging from 0 to 24 months, we estimated 26 parameters (the intercept, shock coefficient, 12 lagging shock coefficients, and 12 autoregressive coefficients). Our primary focus is on the shock coefficient, which indicates the average percentage change in the S&P 500 index associated with a one percentage point Romer-Romer shock, holding all other terms constant. The control variables account for the lagged effects of previous monetary policy and the autoregressive component of the S&P.

The impulse response graph highlights the significance of the shock coefficient, with the blue line representing the point estimate and the gray silhouette outlining the bounds of the 90% confidence interval. For the original dataset, covering 1969 to 1996, significant effects were observed from months two through seven at the 10% level, with half of these months reaching significance at the 5% level. The extended dataset also showed significance at the 10% level for the two-to-seven-month range, although to a lesser degree. This difference is visually evident by the gap between the horizontal line, which represents a zero-percentage change in the S&P 500 index, and the upper bound of the confidence interval. The gap has narrowed with the inclusion of years 1997 to 2007 in the extended dataset.

While the significant inverse relationship in the two-to-seven-month range generally aligns with our initial hypothesis, the reduction in significance upon incorporating the extended dataset raises questions about why the impact of monetary policy shocks appears to have diminished over time. Romer and Romer's control for the central bank's private forecasting model should have mitigated most endogeneity concerns. However, considering Nakamura's argument of the omitted private sector information effect and Ramey's observations on changes in monetary policy implementation, we believe that interpreting the waning effect of monetary policy as a straightforward decrease is misleading and inaccurate.

Nakamura suggests that a change in interest rates consists of two subcomponents: the actual shock in the cost of borrowing and a signaling effect about the future state of the economy. In other words, part of the change in the nominal rate of interest can be attributed to the actual shock, while the other part can be attributed to the change in the natural rate of interest, which is associated with signaling confidence in the future economy. In contrast, our Romer and Romer based measure of monetary policy shocks does not account for this distinction, merging these two distinct effects into a single measure. This oversight dampens our estimates of monetary policy shocks, as the shock portion might display an inverse relationship with the stock market while being partially offset by a change in the natural rate of interest. For instance, nominal rates can rise, which typically hurts stock valuation and prices, but a portion of this increase is due to the natural rate of interest, which signifies stronger confidence in the future state of the economy, and subsequently the stock market. Under this current model, we cannot truly tell whether these well-signaled interest rate changes have greater real effects than monetary shocks or whether they detect asymmetry between a nominal change conducted in anticipation of future policy decisions but perceived as a surprise by financial markets.

Although an ideal solution would have controlled for the information effect used in Nakamura's measure of monetary policy shocks, their measure yielded high standard errors and inconclusive statistical inference. This is exemplified by their high-frequency shock's standard deviation coming out to only around five basis points in later periods of data. This issue extends to Romer and Romer as well, as discussed in Ramey's research. As time progressed into the 21st century, the Fed began conducting monetary policy in a more systematic manner, making their next move more highly anticipated. This results in low magnitudes and variation of monetary policy shocks, which not only makes econometric identification challenging, but inflates the standard error of the regression, rendering statistical inference equally difficult. Lange, Sack, and Whitesell's "Anticipations of Monetary Policy in Financial Markets" investigates this theme of increased efficiency in anticipatory behavior. They used data on interest rates and federal funds future contracts to analyze the correlation between rate markets and the change in the Fed's target rate after a policy decision. They found a positive correlation between interest rate moves and shifts of the Fed's target from 1983 to 1989, starting a month before the policy decision. However, from 1994 to 2000, the correlation became apparent starting two to three months before the decision, indicating an improved ability for markets to predict Fed policy. They attribute this to changes in the Fed's conduct in the 1990s, such as targeting funds rates, increasing public announcements, and providing clearer guidance. This convergence of Fed actions has led to unprecedented predictability, and thus attenuated shock occurrence and magnitudes.

Conclusion:

Our step towards a more refined measure of monetary policy has unveiled additional complexity of the intricate nature between monetary policy shocks and the stock market. While our findings support the conventional inverse relationship, its flawed manifestation in our graphs misleadingly suggests that the effect of monetary policy has diminished over time. This is due to an omission of diminishing monetary shock size and information bias, highlighting the challenges and limitations of our model, as well as other general econometric methods for capturing the true effects of monetary policy. Some, like Valerie Ramey and Christina and David Romer, have turned towards qualitative heuristics such as the narrative-approach and event analysis as a potential solution. While we believe this is a step in the right direction, it does not encompass the quantitative statistical precision we had initially sought after. Others have attempted to disentangle these effects, such as Peter Karadi and Michal Jarociński, in their article "Deconstructing Monetary Policy Surprises—The Role of

Information Shocks," in which they confirmed our assumed directional bias using a structural VAR model, but their advanced methodologies still fall short of quantifying the extent to which the response of the economy can be attributed to each individual factor. Moreover, the fast reactive nature of financial markets further intensifies the difficulty of isolating subcomponent effects. As a result, future research must continue to explore new methodologies beyond the refining of existing ones. Our research aims to contribute to this ongoing endeavor by drawing attention to the work of Nakamura and the insights provided by Karadi and Jarociński, among others, emphasizing the significance of incorporating the intricate dynamics that drive financial markets in response to policy decisions and information shocks.

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