Online Appendix (Not intended for Publication): Federal Reserve Private Information and the Stock Market

Aeimit Lakdawala* Matthew Schaffer†

January 2018

*Department of Economics, Michigan State University, aeimit@msu.edu
†Department of Economics, Michigan State University, schaff37@msu.edu

Stock Price Response to Exogenous and Delphic Shocks: A Conceptual Framework

Consider the stock price S_t that depends on the discount rate r_t (composed of a risk-free rate and an equity premium) and news about future cash flows X_t (adopting the convention that an increase in X_t represents positive news about cash flows). Both these terms in turn depend on (among other things) the exogenous monetary policy shock (e_t) and the interest rate surprise related to revelation of private information by the central bank ($\widehat{\gamma} g(\widehat{\Omega}_{t|t}^{CB} - \widehat{\Omega}_{t|t}^{M})$), what we have labeled the Delphic component. Using the shorthand notation $\widetilde{g}_t \equiv \widehat{\gamma} g(\widehat{\Omega}_{t|t}^{CB} - \widehat{\Omega}_{t|t}^{M})$ we have

$$S_t\left(r_t\left(e_t, \widetilde{g}_t\right), X_t\left(e_t, \widetilde{g}_t\right)\right)$$

Consider the derivative of stock price to the exogenous monetary policy shock

$$\frac{dS_t}{de_t} = \frac{\partial S_t}{\partial r_t}\frac{dr_t}{de_t} + \frac{\partial S_t}{\partial X_t}\frac{dX_t}{de_t}$$

The first term $\frac{\partial S_t}{\partial r_t}$ is the partial derivative of stock prices to discount rates. This derivative is negative based on the idea that a higher discount rate should lower the present value of associated payoff stream and thus lower stock prices. Recall that we define an increase in e_t as representing a contractionary shock to the interest rate in equation 2.2. In conventional models this would imply that the sign of the term $\frac{dr_t}{de_t}$ is also positive. The sign of the product of the first two terms is negative, $(\frac{\partial S_t}{\partial r_t}\frac{dr_t}{de_t}) < 0$. The sign of the third term $\frac{\partial S_t}{\partial X_t}$ is positive by construction based on the convention adopted above that an increase in X_t represents positive news about cash flows. The last term $\frac{dX_t}{de_t}$ captures how an exogenous monetary policy shock affects cash flow news. We expect a contractionary shock to reduce future output and thus imply bad news about future cash flow, i.e. this last term should be negative. Thus the sign of the product of the third and fourth terms is also negative, $(\frac{\partial S_t}{\partial X_t}\frac{dX_t}{de_t}) < 0$. The total response of the stock market to an exogenous shock is the sum of two negative components and thus we should expect β_1 in our regression from equation 2.8 to be negative.

Next consider the response of stock prices to a Delphic shock.

$$\frac{dS_t}{d\widetilde{g}_t} = \frac{\partial S_t}{\partial r_t}\frac{dr_t}{d\widetilde{g}_t} + \frac{\partial S_t}{\partial X_t}\frac{dX_t}{d\widetilde{g}_t}$$

As discussed above, $\frac{\partial S_t}{\partial r_t} < 0$ and $\frac{\partial S_t}{\partial X_t} > 0$. For the private information variables, we will adopt the convention that a positive value for $(\widehat{\Omega}_{t|t}^{CB} - \widehat{\Omega}_{t|t}^{M})$ implies that the Fed's forecast of economic activity is more optimistic than the market's. Based on this convention we would expect that, if the Fed reveals a more optimistic outlook for the economy (e.g. higher inflation forecast) then it is more likely to raise interest rates as a result. In section 4.2 we show from the first step of our empirical estimation that this is indeed the case. Thus a more rosy outlook for the Fed implies an increase in $\widetilde{g}_t$. How does this rise in the Fed's policy tool translate into discount rates? In the conventional model this derivative $\frac{dr_t}{dg_t}$ should be positive. However, there is not much to fall back on in the literature in terms of the effects of Delphic shocks on discount rates. Thus it would be prudent to be uncertain about the sign of $\frac{dr_t}{d\widetilde{g}_t}$.

Finally, what is the sign of $\frac{\partial X_t}{\partial \widetilde{g}_t}$? In conventional models of monetary policy, the typical assumption is that there is no asymmetric information and thus $\widetilde{g}_t$ is always zero. In a setting with asymmetric information a positive value for $\widetilde{g}_t$ can have two effects. It does reflect an increase in the Fed's policy instrument and could thus translate into a contractionary effect on the economy, i.e. bad news about expected future cash flows. However, there is some recent empirical work suggesting that central bank signals can directly affect private sector beliefs about future economic activity. Melosi (2016) builds a model with an explicit signaling channel of monetary policy. The model incorporates a mechanism that could lead agents to expect higher inflation in response to a signal tied to an increase in the interest rate. In a similar vein, Nakamura and Steinsson (2017) sketch a model where the central bank can affect the market's expectations about the natural rate of interest. In their model an increase in interest rate can cause the market to revise upwards their expectation of the natural rate, leading to a rise in economic activity. Finally, in a recent paper Campbell, Fisher, Justiniano, and Melosi (2016) use similarly constructed private information variables and show that the component of the monetary policy surprises that is related to optimistic Fed private information predicts upward revisions of economy activity by forecasters. All these studies suggest that $\frac{dX_t}{d\widetilde{g}_t}$ could be positive. Thus both components of the overall derivative $\frac{dS_t}{d\widetilde{g}_t}$ can reasonably be expected to be either negative or positive. The overall sign of the derivative will depend on the relative strength of the two potentially competing effects.

To summarize, the conceptual framework suggests that we should have a strong prior for β_1 to be negative but there is more uncertainty about the sign of β_2 as it can reasonably be expected to be either positive or negative.

%begintable[htbp]

	BK 1989 - 2002	MP Surprise	Exogenous MP Shock	Delphic Shock
current excess return	-11.01	-13.92	-15.78	-1.53
	(3.72)	(6.86)	(7.20)	(16.14)
future excess return	3.29	8.31	8.65	6.08
	(1.10)	(2.99)	(3.04)	(5.43)
real interest rate	0.77	1.52	1.72	0.18
	(1.87)	(0.80)	(0.82)	(1.90)
dividends	-6.96	-4.09	-5.41	4.73
	(2.35)	(6.18)	(6.40)	(13.84)

Table 1: This table uses the aggregation methodology of Gertler and Karadi (2015) to calculate the response of current excess equity returns and its components to monetary policy shocks. The first column reproduces the BK results estimated on the sample 5/1989 to 12/2002. The remaining three columns use the baseline data sample of 2/1991 to 12/2011. Delta method standard errors are in parentheses

	Exogenous MP	Delphic	Unsch/TP Dum	Exog MP x Unsch/TP	Delphic x Usch/TP
	$\widetilde{\phi}_1$	$\widetilde{\phi}_2$	$\widetilde{\phi}_3$	$\widetilde{\phi}_4$	$\widetilde{\phi}_5$
current excess return	-12.07	-7.88	-0.45	-23.19	46.52
	(8.44)	(17.44)	(1.30)	(20.59)	(44.44)
future excess return	4.87	2.14	-0.05	15.00	17.04
	(3.28)	(5.05)	(0.39)	(6.32)	(15.99)
real interest rate	2.52	1.90	0.07	-2.40	-9.02
	(0.95)	(1.97)	(0.15)	(2.32)	(4.99)
dividends	-4.69	-3.84	-0.42	-10.60	54.55
	(7.05)	(13.76)	(1.05)	(16.59)	(36.37)

Table 2: This table uses the aggregation methodology of Gertler and Karadi (2015) to calculate the response of current excess equity returns and its components to monetary policy shocks interacted with the unscheduled/turning point dummy. The dummy equals 1 on dates for which the FOMC decision was unscheduled or reversed the previous direction of policy. Delta method standard errors are in parentheses.

References

Campbell, J., J. Fisher, A. Justiniano, and L. Melosi (2016): "Forward Guidance and Macroeconomic Outcomes Since the Financial Crisis," in *NBER Macroeconomics Annual 2016, Volume 31*. University of Chicago Press.

Gertler, M., and P. Karadi (2015): "Monetary Policy Surprises, Credit Costs, and Economic Activity," *American Economic Journal: Macroeconomics*, 7(1), 44–76.

Melosi, L. (2016): "Signalling Effects of Monetary Policy," *The Review of Economic Studies*, 84(2), 853–884.

Nakamura, E., and J. Steinsson (2017): "High frequency identification of monetary non-neutrality: the information effect," *Quarterly Journal of Economics, forthcoming*.