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Risk aversion, uncertainty, and monetary policy in zero lower bound environments

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HIGHLIGHTS

- We study the interaction between risk aversion, uncertainty, and monetary policy.
- We apply shadow short rates (SRs) as a monetary policy measure in ZLB Environments.
- We show the results of Bekaert et al. (2013) persist even in the ZLB period.
- Our findings suggest the SRs are good proxies for unconventional monetary policy.

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ABSTRACT

Bekaert et al. (2013) show that a lax monetary policy decreases both risk aversion and uncertainty, and that shocks to risk aversion and uncertainty induce changes in monetary policy. We extend their analysis for the pre-crisis period to the post-crisis period by using a "shadow short rate" as a proxy for unconventional monetary policies in zero lower bound environments. We find that the empirical link between monetary policy, risk aversion, and uncertainty found in Bekaert et al. (2013) persists even in the post-crisis period, but the link is uncovered only when the shadow short rates are used to measure the monetary policy stance.

1. Introduction

Bekaert et al. (2013) investigate the dynamic interaction between risk aversion, uncertainty, and monetary policy in a structural vector autoregressive (VAR) framework by decomposing the VIX index into a risk aversion and an uncertainty component. Using the real Fed funds rate as the benchmark measure of the monetary policy stance, they find that lax monetary policy significantly decreases risk aversion and uncertainty. They also show that the results are robust to using alternative measures of monetary policy shocks and using a variety of identification schemes for the VAR.

In this paper, we investigate whether the empirical link between monetary policy and risk aversion in financial markets found in Bekaert et al. (2013) persists even after the Fed funds rate has reached the zero lower bound (ZLB) in 2008. Because the Federal Reserve has relied on unconventional monetary policy tools such as quantitative easing and forward guidance during the ZLB period, conventional proxies for monetary policy such as the real Fed funds rate used in Bekaert et al. (2013) may not adequately capture the overall stance of monetary policy in the ZLB environments. Accordingly, we measure the stance of monetary policy by using a "shadow short rate" in implementing the benchmark VAR in Bekaert et al. (2013) for the ZLB period.

First proposed by Black (1995), the shadow short rate concept allows the effective short rate to be negative when the nominal interest rates are at the ZLB. Bauer and Rudebusch (2016) find that dynamic term structure models (DTSM) based on the shadow short rate concept perform better than conventional DTSMs in forecasting the likely path for future monetary policy. Krippner (2013) and Wu and Xia (2016) advocate using the shadow short rate as an indicator of the monetary policy stance across conventional and unconventional monetary policy environments.

For the period of conventional monetary policy corresponding to the pre-crisis sample period of Bekaert et al. (2013) ending in

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2007, we confirm their findings of the effect of monetary policy on risk aversion and uncertainty not only for the real Fed funds rate, but also for the shadow short rates. For the ZLB period from 2008 to 2015, however, we find the same results as in Bekaert et al. (2013) only when the shadow short rates are used to measure the stance of monetary policy.

We provide corroborating evidence for the empirical link between monetary policy, risk aversion, and uncertainty found in Bekaert et al. (2013): we find that monetary policy significantly affects risk aversion and uncertainty even in the ZLB period when the shadow short rates are used to measure the stance of monetary policy. More broadly, our findings suggest that the shadow short rates can be useful in further investigation of the transmission mechanism of monetary policy shocks operating through changes in risk aversion and uncertainty in financial markets.

2. Measuring risk aversion, uncertainty, and the stance of monetary policy

We decompose the VIX index into a risk aversion and an uncertainty component following Bekaert et al. (2013). First, we obtain an estimate of the expected future realized variance by projecting the future realized variance ($RVAR_t$) onto the squared VIX (VIX^2_{t-22}) and the past realized variance ($RVAR_{t-22}$). Eq. (1) shows the estimated coefficients from the projection using daily data on realized monthly variances, computed using squared 5-minute returns on S&P 500.

$$RVAR_t = -\underset{(0.0002)}{0.00006} + \underset{(0.073)}{0.337}VIX^2_{t-22} + \underset{(0.102)}{0.287}RVAR_{t-22} \quad (1)$$

The sample period is from January 1990 to December 2015, and the standard errors in parentheses are computed using 30 Newey and West (1987) lags. As in Bekaert et al. (2013), we use the fitted value from this projection as the measure of uncertainty (UC), and the difference between the squared VIX (implied variance) and the fitted value (conditional variance) as the measure of risk aversion (RA).

Using these measures of risk aversion and uncertainty, Bekaert et al. (2013) investigate the dynamic interactions between risk aversion, uncertainty, and monetary policy in a VAR framework, focusing on the sample period prior to the global financial crisis (hereafter, GFC) in 2008. We extend their analysis to the period following the GFC by using the shadow short rate (SR) as a measure of the monetary policy stance in the ZLB environments.

We use three versions of the SR proposed by Bauer and Rudebusch (2016), Krippner (2013), and Wu and Xia (2016), which are described in Panel A of Table 1.[1] In addition to these SRs, we use four conventional measures of the monetary policy stance used in Bekaert et al. (2013), which are described in Panel B of Table 1.

3. Structural monetary VAR

Our VAR set-up follows the benchmark VAR in Bekaert et al. (2013) consisting of four variables: proxies for risk aversion and uncertainty (RA_t and UC_t), one of the monetary policy stance measures (MP_t), and the log difference of industrial production (IP_t) as a business cycle indicator. With these four variables collected in the vector $Y_t = [IP_t, MP_t, RA_t, UC_t]'$, the VAR model is specified as follows.

$$AY_t = B(L)Y_{t-1} + \varepsilon_t \quad (2)$$

where A is a 4×4 full-rank matrix, $B(L)$ is a 4×4 lag operator matrix, and $E[\varepsilon_t \varepsilon_t] = I$. We follow Bekaert et al. (2013) in imposing the set of restrictions on the VAR to identify the system based on a standard Cholesky decomposition of the estimate of the variance–covariance matrix.[2]

We implement the above VAR for the pre- and post-GFC periods separately. The pre-GFC period is from January 1990 to December 2007, which corresponds to the period of conventional monetary policy examined in Bekaert et al. (2013). The post-GFC period is from January 2008 to December 2015, corresponding to the period of unconventional monetary policy, i.e., the ZLB period.[3]

We discuss our main results based on impulse-response functions analysis of the impact of monetary policy shocks on risk aversion and uncertainty, and vice versa (i.e. the impact of risk aversion and uncertainty shocks on monetary policy). The results for the pre- and post-GFC periods are illustrated in Figs. 1 and 2, respectively. The figures in each row show the results for each of the seven alternative MP measures, SR(BR), SR(K), SR(WX), RERA, TR, FFR, and M1, but with the same IP, RA, and UC values as described in Table 1.

Figures in rows D–G of Fig. 1 show the interactions between the four traditional MP measures, risk aversion, and uncertainty for the pre-GFC period, which corresponds to the pre-crisis sample period of Bekaert et al. (2013). Contractionary (lax) monetary policy increases (decreases) risk aversion (MP→RA figures in each row) and uncertainty (MP→UC figures in each row) in the medium-run. In addition, positive shocks to risk aversion and uncertainty significantly increase the likelihood of lax monetary policy by the Federal Reserve (RA→MP figures and UC→MP figures in each row). These results in rows D–G of Fig. 1 are broadly similar to the results in Bekaert et al. (2013). Moreover, the results for the three versions of the shadow short rates in rows A–C, display qualitatively similar results in the relation between MP, RA, and UC.

For the post-GFC period shown in Fig. 2, however, neither the impact of monetary policy shocks on risk aversion and uncertainty nor the impact of risk aversion and uncertainty shocks on monetary policy are significant for all of the four traditional monetary policy measures (figures in rows D–G). Moreover, for the RERA and TR measures, the signs are opposite from those for the pre-GFC period (figures D.3, D.4, E.3, and E.4.). When we use the shadow policy rates to measure the monetary policy stance, however, we obtain the patterns that are broadly consistent with the pre-GFC period. Contractionary monetary policy has an immediate negative impact on risk aversion and uncertainty, but the impact is short-lived and statistically insignificant. In the medium run, tighter monetary policy increases both risk aversion (figures A.1, B.1, and C.1) and uncertainty (figures A.2, B.2, and C.2) as in the pre-GFC period. In addition, positive shocks to risk aversion (figures A.3, B.3, and C.3) and uncertainty (figures A.4, B.4, and C.4) have a negative impact on the shadow policy rates, although the impact is relatively short-lived than in the pre-GFC period.[4] While all three versions of the

[1] We use SR(BR) series from 1990 to 2014 downloaded from Michael Bauer's website (http://www.frbsf.org/economic-research/economists/michael-bauer/), and we construct SR(BR) for 2015 using the R code from the same website. SR(K) series for the full sample period are downloaded from Leo Krippner's website (http://www.rbnz.govt.nz/research-and-publications/research-programme/additional-research/measures-of-the-stance-of-united-states-monetary-policy). We construct SR (WX) for our full sample period (including the pre-crisis period) using the Matlab code downloaded from Jing Cynthia Wu's website (https://sites.google.com/site/jingcynthiawu/home). We thank Bauer, Krippner, and Wu for making their data and codes available.

[2] See Bekaert et al. (2013) for details on the restrictions for identifying the system.

[3] The lag of the VAR model is set based on various information criteria (Akaike's information criterion, Schwarz information criterion, Hannan–Quinn criterion, and the final prediction error criterion). We choose the most selected lag length for a given sample period and for a given monetary policy measure.

[4] The identified shocks to risk aversion and uncertainty across specifications are highly correlated and very similar in magnitude. The qualitatively different responses of the shadow policy rates from those of the traditional monetary policy measures in response to shocks to risk aversion and uncertainty (columns 3 and 4 of Fig. 2) largely stem from the differences in the estimated coefficient matrix in the VAR across specifications. These results are not included for brevity but they are available upon request.