

Bank of Finland Research Discussion Papers
16 • 2020

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Bank of Finland
Research

Bank of Finland Research Discussion Papers
Editor-in-Chief Esa Jokivuolle

Bank of Finland Research Discussion Paper 16/2020
18 September 2020

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ISBN 978-952-323-348-5, online
ISSN 1456-6184, online

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Monetary Policy and Stock Market Valuation

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Abstract

This paper estimates the effect of the European Central Banks's monetary policy on the term structure of expected stock market risk premia. Expected stock market premia are solved using analysts' dividend forecasts, the Eurostoxx 50 stock index and Eurostoxx 50 dividend futures. Although risk-free rates have decreased after the global financial crisis, the results indicate that the expected average stock market return has remained quite stable at around 9 percent. This implies that the expected average stock market risk premium has increased since the financial crisis. The effect of monetary policy on expected premia is analysed using VAR models and local projection methods. According to the results, monetary policy easing raises the average expected premium. The effect is explained by a rise in long-horizon expected premia.

Keywords: Monetary policy, Stock market, Equity premium

JEL codes: E52, G12

Acknowledgements: I am grateful to Markus Sihvonen, Gene Ambrocio, Jaakko Nelimarkka, Esa Jokivuolle, Jukka Ilomäki, Rasmus Rannikko, Samu Kärkkäinen, Mikael Ahovuo, Hanna Freystätter, Juha Kilponen, Niko Herrala, Juho Alasalmi, Hannu Laurila, Kristian Tötterman and Gregory Moore for their helpful comments and support during this project. This paper represents the views of the author and not necessarily those of the Bank of Finland. Any remaining errors are solely my own responsibility.

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1. Introduction

The value of a stock is the present value of its expected future dividends as noticed by Williams (1938). Hence, the changes in stock prices must be explained by either changes in dividend expectations or changes in discount rates. The discount rate, or (approximately) expected rate of return, can be thought as a sum of a risk-free rate and a risk premium. Theoretically, monetary policy should have an effect on stock prices through the risk-free rates. In addition, monetary policy should affect dividend expectations, for example, through the output or debt interest payments of firms. The effect on the risk premium (not to mention the term structure of risk premia), however, is less clear.

In this paper, I analyse the effect of monetary policy on expected equity premia. First, I solve for the implied expected premium using a dividend discount model and analysts' forecasts for future dividends of the major eurozone stocks that are included in Eurostoxx 50 index. A kindred approach has been used by e.g. Claus and Thomas (2001), Gebhardt, Lee and Swaminathan (2001) and Damodaran (2020). None of these studies, however, provides empirical analysis of the impact of monetary policy on the expected premium. I also combine prices of Eurostoxx 50 dividend futures with analysts' dividend forecasts to calculate short-term horizon-specific expected premia using an approach related to the one applied by Binsbergen, Hueskes, Koijen and Vrugt (2013).¹ Horizon-specific premia make it possible to analyse the impact of monetary policy on the term structure of equity premia. To the best of my knowledge, this issue has not been investigated in the earlier literature.

The effect of monetary policy on the ex-ante premium is interesting as it may give information about the effect on investors' perception of risk. Thus, the issue is highly relevant for the risk-taking channel of monetary policy.² On the other hand, the effect on expected premium may give information about the effect of monetary policy on stock market "bubbles" or mispricing. The reason for this is that the premium captures also the potential bubble component, if one wants to interpret the results in the risk neutral framework of Galí (2014) and Galí and Gambetti (2015). In any case, the variation in the implied expected premium means that stocks are sometimes too expensive or too cheap for an investor whose required premium over the risk-free rate is constant over time (or whose required premium varies less than the expected premium). In this paper, I do not attempt to distinguish whether the variation in implied premium is due to mispricing or variation in the rational risk premium.

¹ Dividend futures have been used recently in many other applications as well. See for example the paper by Gormsen and Koijen (2020).

² See, for example, the paper by Borio and Zhu (2012) about the risk-taking channel of monetary policy.

The effects of monetary policy are analysed with two methods. First, the effects are studied in a VAR model in which monetary policy stance is measured using the shadow rate proposed by Kortela (2016). The monetary policy shock is identified using sign restrictions. Second, the effects are studied using local projections, where changes in the overnight indexed swap (OIS) rates around ECB Governing Council announcements are used as a proxy for monetary policy shocks.³

The results show that the average expected premium has increased considerably since the global financial crisis. This change is explained by the change in long-horizon expected premia. The VAR results show that monetary policy easing has had a positive impact on the expected average premium. Specifically, a negative shock to the shadow rate is estimated to increase average expected premium persistently. Instead, the results show that monetary policy easing temporarily decreases short-term expected premia. This means that expansionary monetary policy steepens the slope of the term structure of risk premia. The local projection results are in line with the VAR results.

The results also comport with the findings of Bernanke and Kuttner (2005), who note that expansionary monetary policy generates an immediate rise in equity prices followed by a period of lower-than-normal excess returns. This is in line with my results concerning the effect on short-horizon ex-ante premia. However, Bernanke and Kuttner (2005) do not study the effect on the long-run excess returns.⁴ My results show that effect on long-horizon expected premia has a different sign. This effect on long-horizon premia seems to more than offset the effect on short-horizon premia.

As to the policy implications, “leaning against the wind” policies appear to be fairly ineffective when it comes to the stock market. Contractionary monetary policy increases the short-term premia temporarily, but decreases long-horizon premia persistently. The effect on average expected premium is negative. Thus, monetary policy tightening actually makes stocks expensive relative to the expected stream of dividends. The results provide no evidence that expansionary monetary policy causes stock market bubbles and support earlier findings that portfolio rebalancing to equities has not been a strong monetary policy channel in the euro area (see Kojien, Koulischer, Nguyen and Yogo, 2017).

³ Intraday OIS-rate changes are obtained from the EA-MPD:

https://www.ecb.europa.eu/pub/pdf/annex/Dataset_EA-MPD.xlsx?afecc88fe2e29c7abcdee5670b6d0f68.

⁴ Bernanke and Kuttner (2005) report the response of excess returns in Figure 6 of their paper. They study the effect roughly two years after the shock.

The remainder of the paper is as follows. Section 2 represents the theoretical framework in which the effects of monetary policy are assessed. Section 3 explains the empirical methods. Section 4 shows the results. Section 5 concludes.

2. Monetary policy and equity premia

In this paper I use two approaches to solve for the ex-ante premia. The first approach is related to the papers by Claus and Thomas (2001), Gebhardt, Lee and Swaminathan (2001) and Damodaran (2020). The second relates to the paper by Binsbergen et al. (2013).

For the first approach, I assume that expected dividends, D_t , grow at constant rate, g , after the period n , and that the discount rate, r , is the same for all the horizons. Then, the value of a stock at time 0 can be expressed as:

$$P_0 = \frac{D_1}{1+r} + \frac{D_2}{(1+r)^2} + \dots + \frac{D_n + \frac{D_{n+1}}{r-g}}{(1+r)^n}. \quad (1)$$

The discount rate, $r = r^{risk-free} + r^{excess}$, that is constant over discounting horizons, is approximately the expected average annual rate of return that an investor would receive, if he or she bought the stock at price P_0 and held it forever. If the market price of the share and the dividend expectations are known, r can be solved numerically period after period.

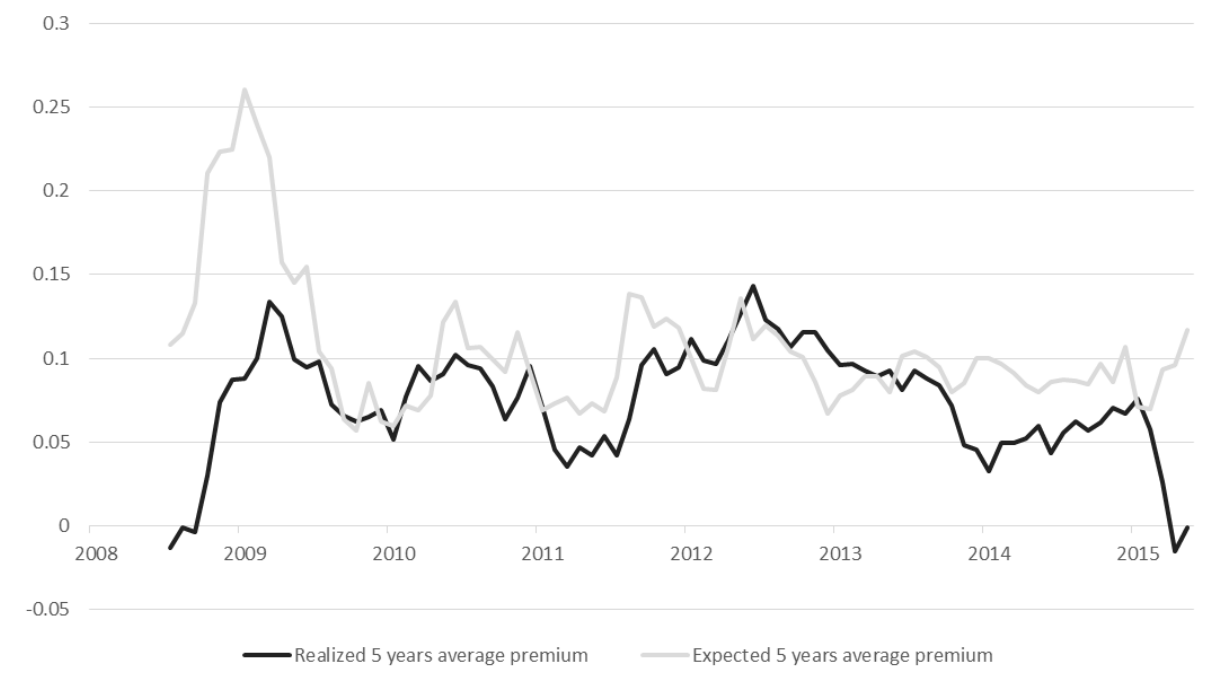
However, it has been shown empirically that expected premia differ across discounting horizons (Binsbergen, Brandt, and Koijen, 2012; Binsbergen et al., 2013; Binsbergen and Koijen, 2017). To assess this, I apply a separate approach that relies on the prices of dividend futures. Dividend futures are contracts that allow one to buy the dividends of a specific year. The cash flows are paid at the end of the year. Therefore, the price of the dividend future at time 0 that matures after h years is given by (see also Wilkens and Wimschulte, 2010)⁵:

$$P_{0,h}^{future} = \frac{D_h}{\prod_{i=1}^h (1+r_i^{future})}. \quad (2)$$

The discount rate, $r_i^{future} \approx r_i^{excess}$, because the cash flows are paid at the maturity. This means that the future contract does not tie up money. Thus, the buyer of the future receives the risk-free return in excess to the return of the future contract. The price of the dividend future, considering the dividends of the next 12 months, is $P_{0,1}^{future} \approx \frac{D_1}{1+r_1^{excess}}$. Accordingly, the price of the future considering the dividends 12 to 24 months ahead is $P_{0,2}^{future} \approx \frac{D_2}{(1+r_1^{excess})(1+r_2^{excess})}$

⁵ Continuous time notation is used by Binsbergen et al. (2013).

Figure 1. Expected and realized stock market premia of Eurostoxx 50 index. The expected premia are based on analysts' dividend forecasts, Eurostoxx 50 dividend futures and application of equation (2). More details are given in Section 3. The realized return is calculated from log-differences of Eurostoxx 50 gross return index, which takes into account paid dividends. The German 1-year yield is used as the risk-free rate measure.



and so forth. Therefore, knowing the prices and the dividend expectations, one can solve horizon-specific expected premia beginning from r_1^{excess} .

Why should we care about the expected premia as we can look at the actual realized stock market premia? Ex-ante and ex-post premia are related as stock market returns are predictable (e.g. Cochrane, 2008), but the two may sometimes differ considerably. Figure 1 shows the development of expected 5-year average stock market premium based on equation (2) together with the realized stock market premium.⁶ For example, during the financial crisis of 2008 investors anticipated a roughly 20 percent premium. Yet, the actual realized premia were much lower, because dividend forecast were too optimistic. Thus, ex-post premia after the financial crisis tell little about stock market valuation during the financial crisis.

What determines the size of the stock market premium? There is a large body of literature on the equity premium puzzle. Consumption-based models suggest that the expected premium should be determined by investors' risk aversion and the covariance between premium and consumption growth (e.g. Cochrane, 2011). On the other hand, if investors are risk-neutral, then any implied premium would mean mispricing. For example, Galí (2014) and Galí and Gambetti

⁶ Details about empirical implementation are given in Section 3.

(2015) use the risk-neutrality assumption and interpret all deviations from risk-free return as a bubble.

When it comes to the effect of monetary policy on stock prices, there are many empirical papers documenting that expansionary monetary policy increases the prices of stocks (e.g. Patelis, 1997; Bernanke and Kuttner, 2005). Theoretically, this is not entirely clear. Monetary policy can affect equity prices through the dividend expectations, expected risk-free rates or expected premia. The effect of expansionary monetary policy on the dividend expectations is probably positive, because expansionary monetary policy can be expected to increase output and firms' earnings. Expansionary policy probably lowers the risk-free rates, but it is also possible that the effect is totally different. Central bank's rate cut can increase risk-free rates, if people think that the rate cut eventually increases inflation. As for the expected premium, the sign of the effect is unclear.

Gust and López-Salido (2014) show theoretically that expansionary monetary policy lowers the premium in a DSGE model where asset and goods markets are segmented. When it comes to quantitative easing, one channel through which it could affect the expected premium is portfolio balance channel (Tobin, 1958; Tobin, 1969). Investors who have sold their assets to the central bank rebalance their portfolios into riskier assets, which lowers their expected returns. The evidence for such portfolio rebalancing to equities is not very supportive.⁷

Theoretically, it is also possible to argue that monetary policy easing actually increases the expected premium. If one assumes that there exists mispricing like Galí (2014) and Galí and Gambetti (2015), then the sign of the response is ambiguous. Galí and Gambetti (2015) provide some evidence that expansionary monetary policy may actually decrease the potential stock market bubble. This means that monetary policy easing increases the expected premium implied by dividend discount model (see Galí and Gambetti, 2015, p. 250-252).

3. Empirical approach

3.1 Expected premia

To solve the expected premium, I use equations (1) and (2). First, I apply equation (1) to the Eurostoxx 50 stock market index and analysts' consensus forecasts for future dividends. Given the stock market index and aggregated dividend forecasts, I solve the expected annual rate of return, r , at the aggregate level. Further, the variation in expected return can be divided into

⁷ Joyce, Liu and Tonks (2017) find that the quantitative easing in the United Kingdom has not led to portfolio rebalancing to equities. Koijen et al. (2017) find similar results for the euro area.

variation in risk-free rate and stock market premium using some proxy for the risk-free rate. As a proxy for the risk-free rate, I use Germany's 10-year government bond yield following Claus and Thomas (2001), Gebhardt et al. (2001) and Damodaran (2020). The reason for using a long rather than a short rate is that the rate should represent the average expected risk-free rate. All these data are from Bloomberg and cover the period from 06/2006 to 04/2020.

From Bloomberg, I obtain year-specific dividend forecasts. I calculate the 12- and 24-month-forward dividend expectations (D_1 and D_2) as a weighted average of year-specific forecasts.⁸ Additionally, analysts' forecast average earnings per share growth rate after 3–5 years. I assume that dividend payout ratio remains constant meaning that earnings per share growth rate can be used to calculate dividends: D_3 , D_4 , D_5 and D_{5+1} .⁹ I assume that the expected long-run dividend growth rate, g , equals the historical average of the analysts' expected earnings per share growth rate in the sample (4.5 percent).

With these assumptions, the only unknown variable in equation (1) is r . This variable can be solved for every month in the sample. Subtracting Germany's 10-year government bond yield, I get an estimate for the expected average annual stock market premium in a given month. The developments of the expected rate of return and expected premium are presented in Figure 2.

In the sample, the average expected premium, r^{excess} , is 7.3 percent and the average expected return, r , is 9.0 percent. These results are in line with the previous estimates based on a similar methodology.¹⁰ Notably, the expected rate of return for equities has remained rather stable since the 2008 financial crisis, even as risk-free rates have declined substantially. This means that the expected premium over the risk-free rates has increased considerably since the crisis.

As was discussed earlier, expected returns probably differ across discounting horizons. To solve the period-specific expected premia, I apply equation (2) to the prices of Eurostoxx 50 dividend

⁸ For example, I calculate the 12-months-ahead dividend forecast in April 2020 as follows: $(8 * \text{Dividend forecast for the year 2020} + 4 * \text{Dividend forecast for the year 2021})/12$.

⁹ As the data about the average future earnings per share growth rate are rather noisy, I use a 12-month moving average to smooth the series. In addition, I remove clearly unrealistic extreme values (values below -30 percent and greater than 30 percent).

¹⁰ Claus and Thomas (2001) and Gebhardt et al. (2001) find that the average expected premium has been around 3 percent. However, recent estimates by Damodaran (2020) for the S&P 500 are quite similar to my results. The estimates for the S&P 500 suggest that the expected premium can deviate from its long-run average for many years. The expected premium in the United States was quite high during the 1970s and quite low during the 1990s (consistently with the results of Claus and Thomas (2001) and Gebhardt et al. (2001)). After the financial crisis, the expected premium has been very high in the United States and has exhibited an upward trend like in Europe.

Figure 2. Solved expected rate of return and expected premium. The variables are solved applying equation (1) to Eurostoxx 50 stock market index and analysts' consensus forecasts in the period from 06/2006 to 04/2020.

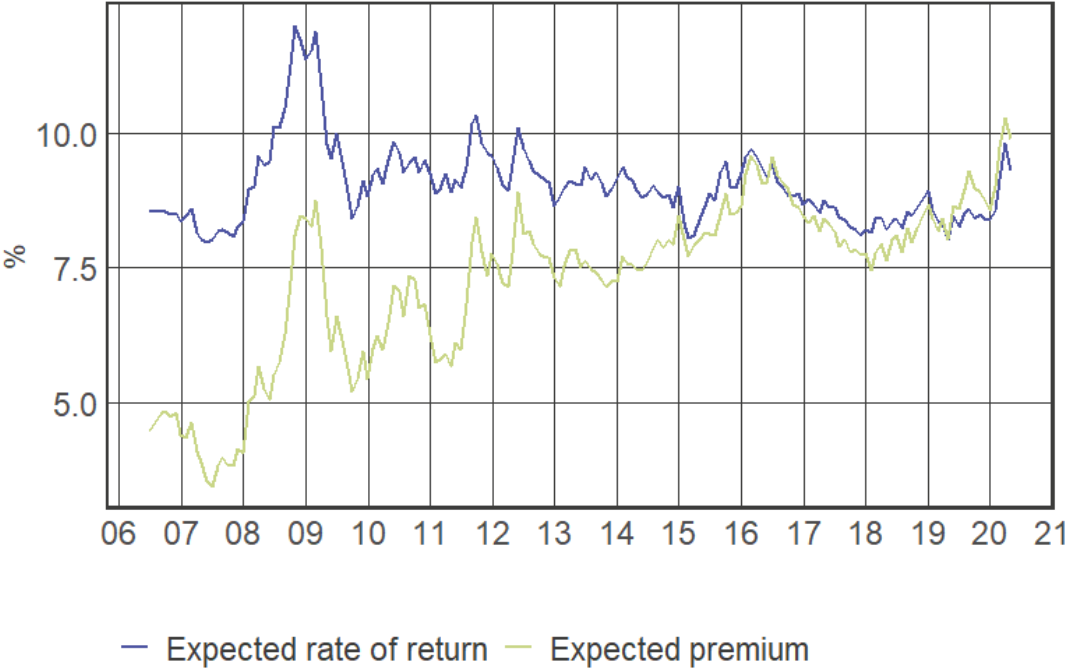


Figure 3. Year-specific expected premia implied by Eurostoxx 50 dividend futures and analysts' dividend forecast from 7/2008 to 4/2020.

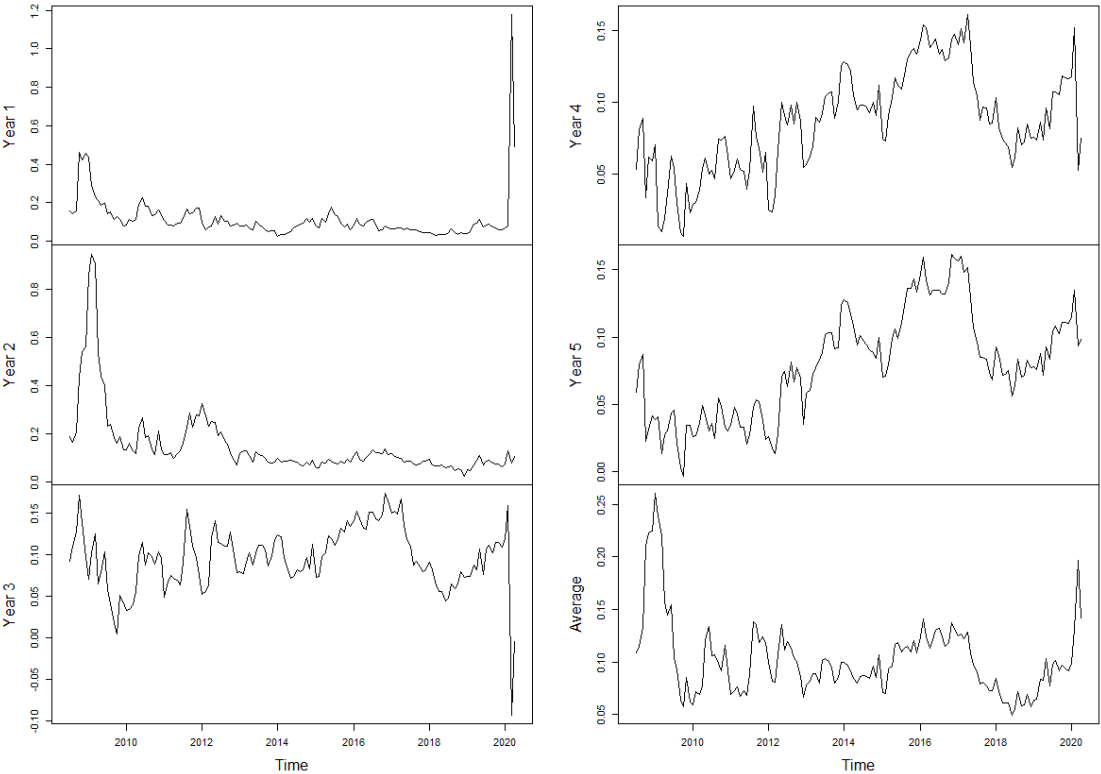


Table 1. Summary statistics of the year-specific expected premia implied by Eurostoxx 50 dividend futures and analysts' dividend forecast. The observation period runs from 7/2008 to 4/2020.

	Year 1	Year 2	Year 3	Year 4	Year 5
Mean	0.11	0.15	0.10	0.09	0.08
Median	0.09	0.11	0.10	0.09	0.08
SD	0.12	0.15	0.04	0.04	0.04

futures and analysts' dividend forecasts. A bit similar approach is used by Binsbergen et al. (2013).¹¹ I calculate the prices of 1, 2, 3, 4 and 5 years ahead dividend futures by taking the weighted average of the observed future prices.¹² Then, I calculate the implied expected premia for every horizon beginning from the 12-month discounting horizon. The data about the dividend futures are from 7/2008 to 4/2020 and have been collected from Bloomberg. The solved expected premia are shown in Figure 3. Key summary statistics appear in Table 1.

The results support the findings of Binsbergen et al. (2012) and Binsbergen et al. (2013). The variation in the expected premium is related mostly to the near future. The standard deviation of the year 1 premium is 0.12 and the standard deviation of the year 5 premium is 0.04. Year 1 premia on average are also higher than year 5 premia. The slope of the premium curve seems to be pro-cyclical as well. The premium for the year 2 has been the highest and the most volatile in this sample. This result is largely driven by the financial crisis, during which the year 2 premium reacted most strongly. This situation has been quite different during the covid-19 crisis. In May 2020, the year 1 premium climbed to 118 percent, even as the year 2 premium remained at 8 percent.

One can also see that the premia of the years 4 and 5 exhibit similar upward trend as the premium implied by equation (1). Thus, these results are in line with the earlier conclusion that the average expected premium has increased after the financial crisis. Further, the results suggest that the rise in average premium is mainly driven by long-horizon expected premia.

3.2 VAR model

I start with an analysis of the effects of monetary policy using VAR models, where the stance of monetary policy is measured using the shadow rate proposed by Kortela (2016). The shadow rate permits analysis of the overall effect of monetary policy during a time when policy rates

¹¹ The key difference between this paper and the paper by Binsbergen et al. (2013) is that Binsbergen et al. (2013) use regression based dividend forecasts instead of analysts' forecasts.

¹² For example, I calculate the price of the 1-year-ahead dividend future in April 2020 as follows: $(8 * \text{Price of the future maturing in 2020} + 4 * \text{Price of the future maturing in 2021})/12$.

have been close to their effective lower bound. The baseline model includes year-over-year changes in $\log(\text{Industrial production})$ and $\log(\text{Harmonised Index of Consumer Prices})$, the level of expected equity premium and the shadow rate. Industrial production and inflation are included as the monetary policy decisions are affected by the changes in real activity and price stability. The model includes two lags. As an estimate for expected premium, I consider the premium implied by equation (1) and the year-specific premia implied by dividend futures and equation (2). The data about industrial production and consumer prices are from Eurostat. The data cover the period from 06/2006 to 04/2020 with the exception of horizon-specific premia that are not available before 7/2008.

I identify monetary policy shock using sign restrictions and the rejection method of Rubio-Ramirez, Waggoner and Zha (2010).¹³ The model is estimated with an uninformative Jeffrey's prior. I assume that negative monetary policy shock increases the growth in industrial production and consumer prices. These sign restrictions are assumed to hold the first nine months. The effect on shadow rate itself is also restricted negative for the first nine months. These restrictions are consistent with for example the results by Bernanke, Boivin, and Eliasziw (2005) and Wu and Xia (2016).

3.3 Local projections

Second, I use intraday OIS-rate changes around the time of ECB Governing Council announcements as a proxy for monetary policy shocks. These OIS-rate changes are obtained from EA-MPD.¹⁴ I use change in the median quote from the 13:25-13:35 window before the press release to the median quote in the 15:40-15:50 window after the press conference. Assuming these changes represent exogenous variation in the ECB's monetary policy, one can assess the effect of monetary policy on different premia by estimating the following model for different horizons:

$$r_{t+h}^{excess} = \alpha_h + \gamma_h(L)r_{t-1}^{excess} + \beta_h \text{Surprise}_t + \epsilon_{t+h} \quad (3)$$

In the model, α_h is a constant, $\gamma_h(L)$ is a lag-polynomial, ϵ_{t+h} is an error term and Surprise_t is the OIS-rate change. EA-MPD covers surprise changes in many different maturities. In this paper, the aim is not to distinguish between conventional and unconventional policies.

¹³ I use the MATLAB toolbox by Ferroni and Canova (2020).

¹⁴ I assume that the value of the shock was zero if there was no announcement during the month. If there were two announcements, I calculate the average of the two.

Therefore, I use the average of available intraday OIS-rate changes as the monetary policy shock.¹⁵

4. Results

4.1 VAR results

Figures 4, 5 and 6 show the impulse responses to a negative shadow rate shock in three models with different expected premia.¹⁶ In Figure 4, the premium is the one implied by equation (1). In Figure 5, the premium is the premium for the year 1 implied by dividend futures and equation (2). In Figure 6, the premium is for the year 5.

The responses of industrial production and consumer prices comport with the literature (e.g. Bernanke et al., 2005). The effects on growth rates are first positive, and then negative after about 20 months. The effects of the shock disappear after about five years. The responses of short-term and long-term premia have opposite signs. Expansionary monetary policy lowers the short-term expected premium temporarily (Figure 5), while the responses of long-run average expected premium and year 5 premia are positive and persistent (Figure 6). The response of average premium is positive, indicating long-horizon premia drive the response (Figure 4).

The response of the year 1 premium is consistent with the evidence based on realized returns presented in Bernanke and Kuttner (2005). Notably, the effect on discounting dividends in the remote future suggests that expansionary monetary policy makes the long-run dividend stream more risky or reduces the size of the stock market bubble in line with the results of Galí (2014) and Galí and Gambetti (2015). One explanation for the results is also that analysts' dividend expectations, and thus, implied expected premia are not rational (Greenwood and Shleifer, 2014). It is also possible that monetary policy affects long-run expected premium somehow through expected inflation (e.g. Modigliani and Cohn, 1979; Schotman and Schweitzer, 2000).

¹⁵ I use OIS_1W, OIS_1M, OIS_3M, OIS_6M, OIS_1Y, OIS_2Y, OIS_3Y because those are available for the whole period (06/2006–04/2020).

¹⁶ Some robustness checks are provided in Appendix A.

Figure 4. The impulse response functions to a one standard deviation negative shock to the shadow rate in the model in which the premium is the long-run average expected premium implied by equation (1). Sign restrictions are imposed on DlogIP, DlogHICP and SR. The shaded area represents the 68 % confidence interval. The number of lags is 2.

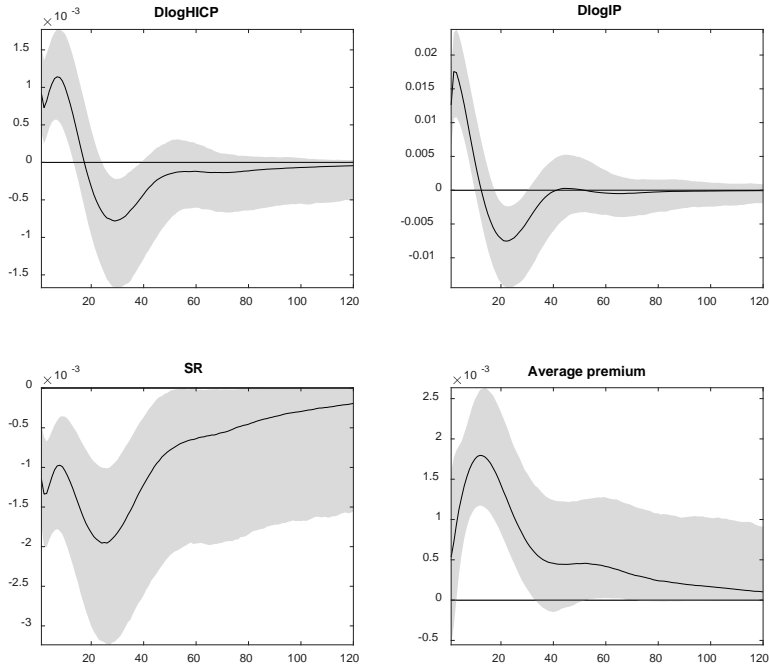


Figure 5. The impulse response functions to a one standard deviation negative shock to the shadow rate in the model in which the premium is the year 1 premium implied by equation (2) and dividend futures. Sign restrictions are imposed on DlogIP, DlogHICP and SR. The shaded area represents the 68 % confidence interval. The number of lags is 2.

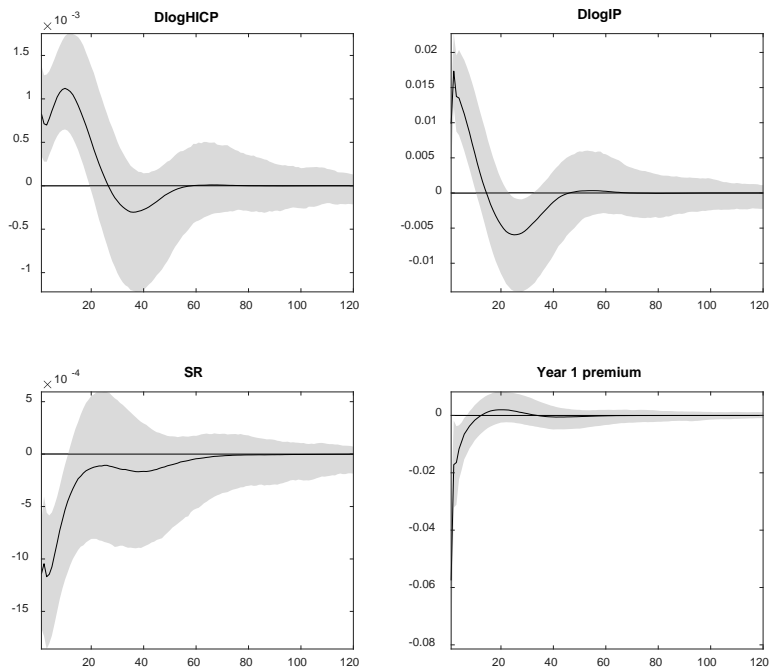


Figure 6. The impulse response functions to a one standard deviation negative shock to the shadow rate in the model in which the premium is the year 5 premium implied by equation (2) and dividend futures. Sign restrictions are imposed to $DlogIP$, $DlogHICP$ and SR . The shaded area represents the 68 % confidence interval. The number of lags is 2.

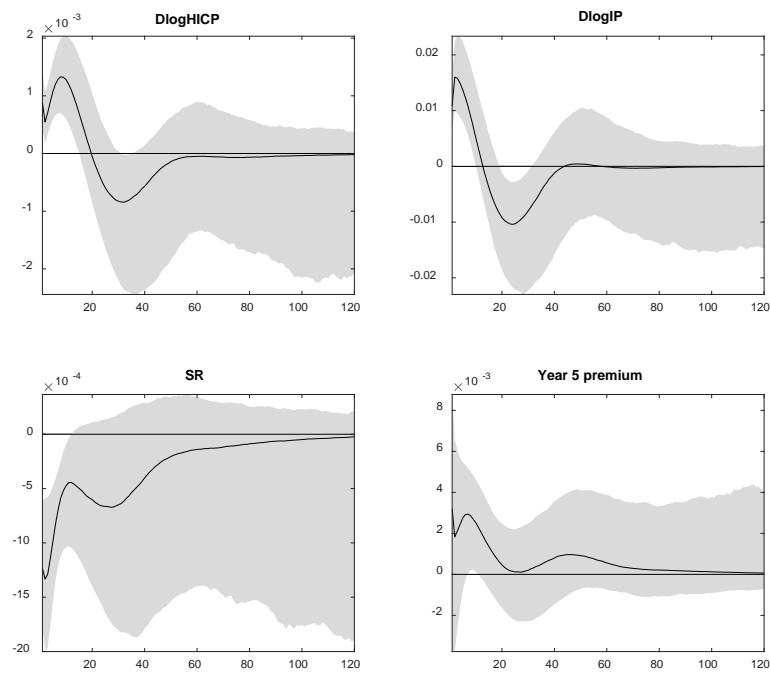


Figure 7. The local-projection-based impulse response function of the long-run average expected premium implied by equation (1). The number of lags in the model is 3.

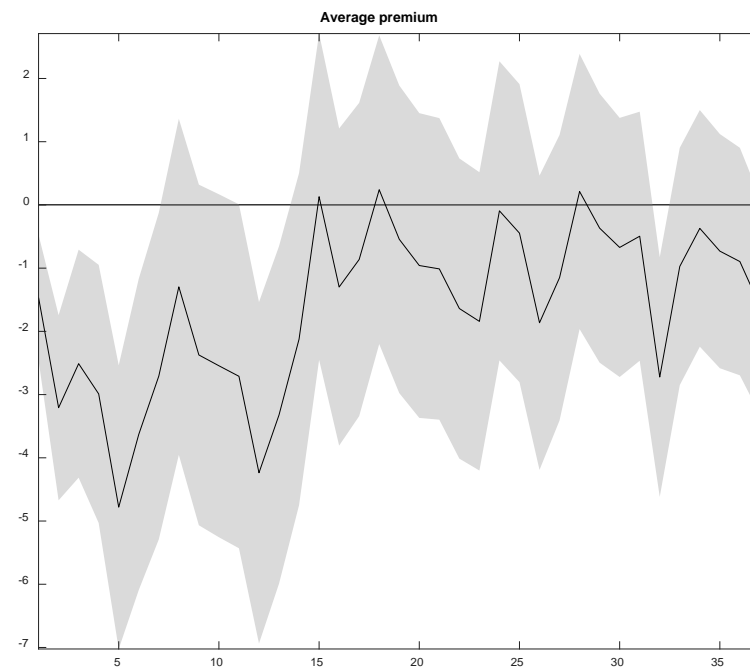


Figure 8. The local-projection-based impulse response function of the expected year 1 premium implied by equation (2). The number of lags in the model is 3.

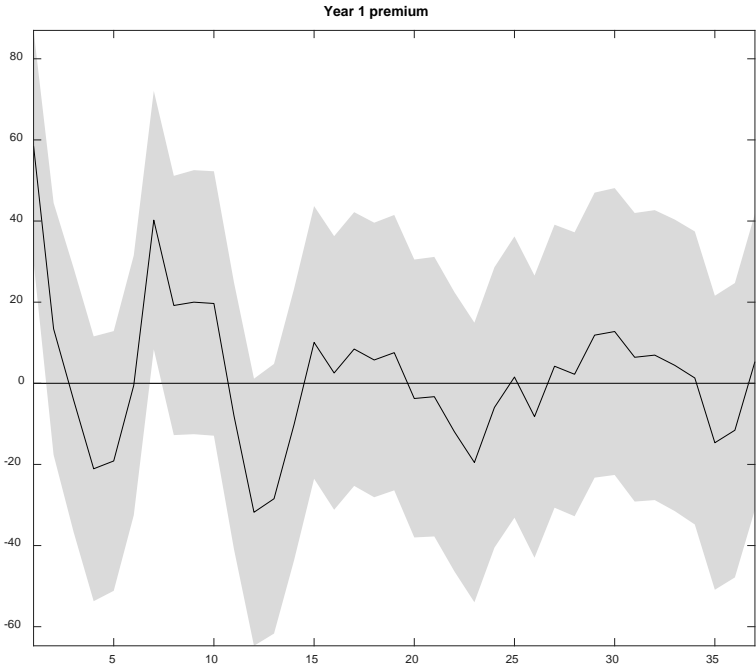
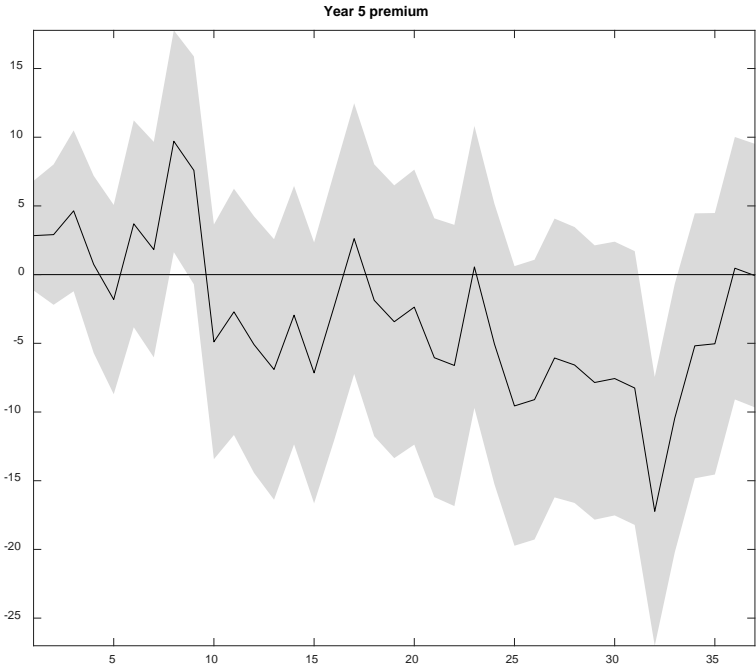


Figure 9. The local-projection-based impulse response function of the expected year 5 premium implied by equation (2). The number of lags in the model is 3.



4.2 Local projection results

Figure 7 shows the estimated response of expected long-run average premium implied by equation (1) to monetary policy tightening.¹⁷ The sign of the response agrees with the VAR results. A rate hike seems to make stocks expensive in comparison to the expected stream of dividends. Figures 8 and 9 report the estimated responses of the year 1 and the year 5 premia. As in the previous section, the year 1 premium reacts immediately, but the effect is short-lived. The response of the year 5 premium is also in line with the earlier VAR results.

5. Conclusions

Interest rates have declined considerably since the global financial crisis, yet the expected average stock market return has remained quite stable at around 9 percent. This implies that expected average stock market premium has increased remarkably. This rise is mainly explained by the premia over a discounting horizon of four years.

These results may seem unintuitive as the prices of stocks have risen, and ratios like price-to-earnings have been historically high. However, high price-to-earnings ratios do not necessarily mean that stocks are expensive, because the value of a stock is the present value of its *expected future dividends*.

When it comes to the role of monetary policy, the results show that monetary policy easing decreases short-horizon required premia, but increases longer-horizon premia. The effect on expected average premium is positive, i.e. expansionary monetary policy lowers the prices of stocks in relation to the expected dividend stream.

These results may raise more questions than provide answers. They suggest that the effect of monetary policy on stock market valuation is a puzzle that has not been solved yet.

¹⁷ Some robustness checks are provided in Appendix B.

References

- Bernanke, B.S., Boivin, J. and Eliasziw, P. (2005). Measuring the effects of monetary policy: a factor-augmented vector autoregressive (FAVAR) approach. *Quarterly Journal of Economics*, 120(1), 387-422.
- Bernanke, B.S. Kuttner, K.N. (2005). What explains the stock market's reaction to Federal Reserve policy? *Journal of Finance*, 60(3), 1221-1257.
- Binsbergen, J., Brandt, M. and Koijen, R. (2012). On the timing and pricing of dividends. *American Economic Review*, 102(4), 1596-1618.
- Binsbergen, J., Hueskes, W., Koijen, R. and Vrugt, E. (2013). Equity yields. *Journal of Financial Economics*, 110(3), 503-519.
- Binsbergen, J.H. and Koijen, R.S. (2017). The term structure of returns: Facts and theory. *Journal of Financial Economics*, 124(1), 1-21.
- Borio, C. and Zhu, H. (2012). Capital regulation, risk-taking and monetary policy: a missing link in the transmission mechanism? *Journal of Financial Stability*, 8(4), 236-251.
- Claus, J. and Thomas, J. (2001). Equity premia as low as three percent? Evidence from analysts' earnings forecasts for domestic and international stock markets. *Journal of Finance*, 56(5), 1629-1666.
- Cochrane, J.H. (2008). The dog that did not bark: A defense of return predictability. *Review of Financial Studies*, 21(4), 1533-1575.
- Cochrane, J.H. (2011). Presidential address: Discount rates. *Journal of Finance*, 66(4), 1047-1108.
- Damodaran, A. (2020). *Equity Risk Premiums: Determinants, Estimation and Implications – The 2020 Edition*. NYU Stern School of Business.
- Ferroni, F., Canova, F. (2020). A hitchhiker guide to empirical macro models. Mimeo, working paper.
- Galí, J. (2014). Monetary policy and rational asset price bubbles. *American Economic Review*, 104(3), 721-52.
- Galí, J. and Gambetti, L. (2015). The effects of monetary policy on stock market bubbles: Some evidence. *American Economic Journal: Macroeconomics*, 7(1), 233-57.
- Gebhardt, W.R., Lee, C.M. and Swaminathan, B. (2001). Toward an implied cost of capital. *Journal of Accounting Research*, 39(1), 135-176.
- Greenwood, R., and Shleifer, A. (2014). Expectations of returns and expected returns. *The Review of Financial Studies*, 27(3), 714-746.
- Gormsen, N. J., and Koijen, R. S. (2020). Coronavirus: Impact on stock prices and growth expectations. University of Chicago, *Becker Friedman Institute for Economics Working Paper*, (2020-22).

- Gust, C. and López-Salido, D. (2014). Monetary policy and the cyclical risk. *Journal of Monetary Economics*, 62, 59-75.
- Joyce, M.A., Liu, Z. and Tonks, I. (2017). Institutional investors and the QE portfolio balance channel. *Journal of Money, Credit and Banking*, 49(6), 1225-1246.
- Koijen, R.S., Koulischer, F., Nguyen, B. and Yogo, M. (2017). Euro-area quantitative easing and portfolio rebalancing. *American Economic Review*, 107(5), 621-27.
- Kortela, T. (2016). A shadow rate model with time-varying lower bound of interest rates. Bank of Finland Research Discussion Paper 19/2016.
- Modigliani, F. and Cohn, R.A. (1979). Inflation, rational valuation and the market. *Financial Analysts Journal*, 35(2), 24-44.
- Patelis, A.D. (1997). Stock return predictability and the role of monetary policy. *Journal of Finance*, 52(5), 1951-1972.
- Rubio-Ramirez, J., Waggoner, D.F. and Zha, T. (2010). Structural vector autoregressions: Theory of identification and algorithms for inference, *Review of Economic Studies*, 77, 665-696.
- Schotman, P.C. and Schweitzer, M. (2000). Horizon sensitivity of the inflation hedge of stocks. *Journal of Empirical Finance*, 7(3-4), 301-315.
- Tobin, J. (1958). Liquidity preference as behavior towards risk. *Review of Economic Studies*, 25(2), 65-86.
- Tobin, J. (1969). A general equilibrium approach to monetary theory. *Journal of Money, Credit and Banking*, 1(1), 15-29.
- Wilkins, S., and Wimschulte, J. (2010). The pricing of dividend futures in the European market: A first empirical analysis. *Journal of Derivatives & Hedge Funds*, 16(2), 136-143.
- Williams, J.B. (1938). *The Theory of Investment Value*. Cambridge, MA, Harvard University Press.
- Wu, J.C. and Xia, F.D. (2016). Measuring the macroeconomic impact of monetary policy at the zero lower bound. *Journal of Money, Credit and Banking*, 48(2-3), 253-291.

Appendix A

Figure A1 shows the results after increasing the number of lags to 4. Otherwise, the model is as in the baseline analysis. The results remain almost the same. Figure A2 shows the results, when HICP and industrial production are in log-levels. The signs restrictions are still imposed for periods 1 to 9. The results are robust to using levels instead of differences.

Figure A1. The impulse response functions to a one standard deviation negative shock to the shadow rate in the model in which the premium is the long-run average expected premium implied by equation (1). Sign restrictions are imposed on $D\log IP$, $D\log HICP$ and SR . The shaded area represents the 68 % confidence interval. The number of lags is 4.

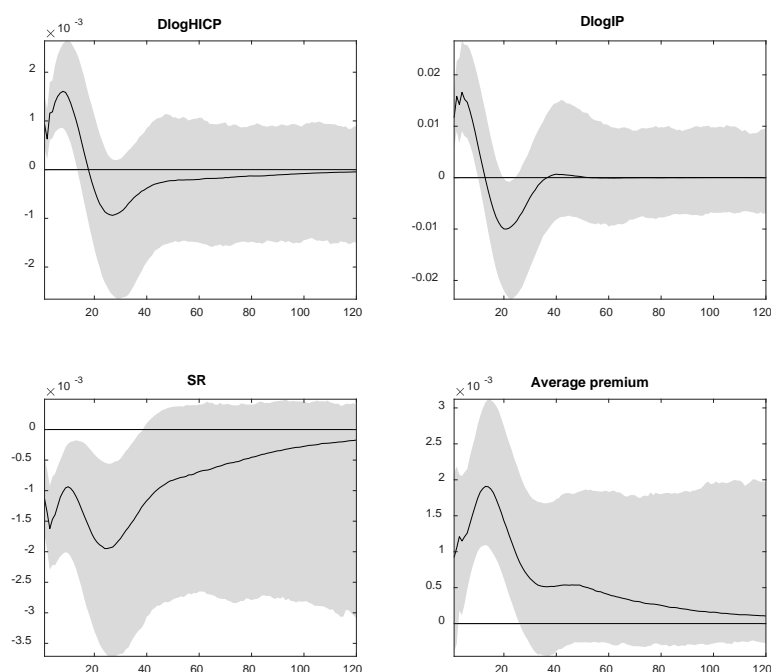
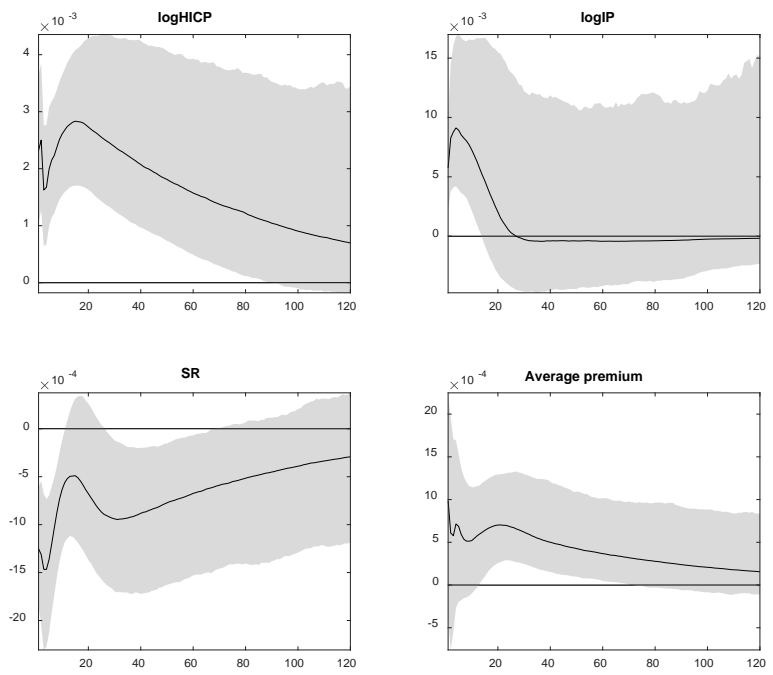


Figure A2. The impulse response functions to a one standard deviation negative shock to the shadow rate in the model in which the premium is the long-run average expected premium implied by equation (1). Sign restrictions are imposed on logIP, logHICP and SR. The shaded area represents the 68 % confidence interval. The number of lags is 3.



Appendix B

Figures B1 and B2 show how adding more lags of the endogenous variable in equation (3) affects the results. In Figure B1, the number of lags is 6, and in Figure B2, it is 9. The results remain qualitatively the same.

Figure B1. The local-projection-based impulse response function of the long-run average expected premium implied by equation (1). The number of lags in the model is 6.

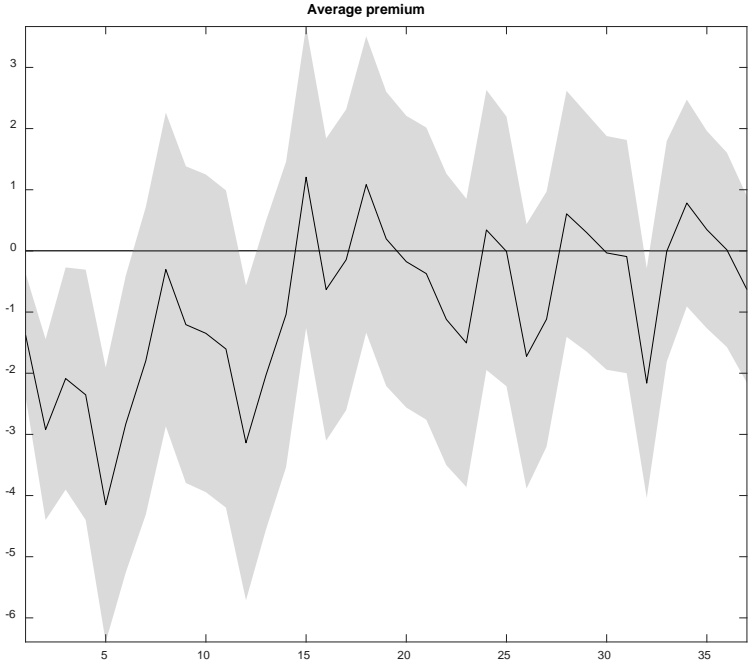
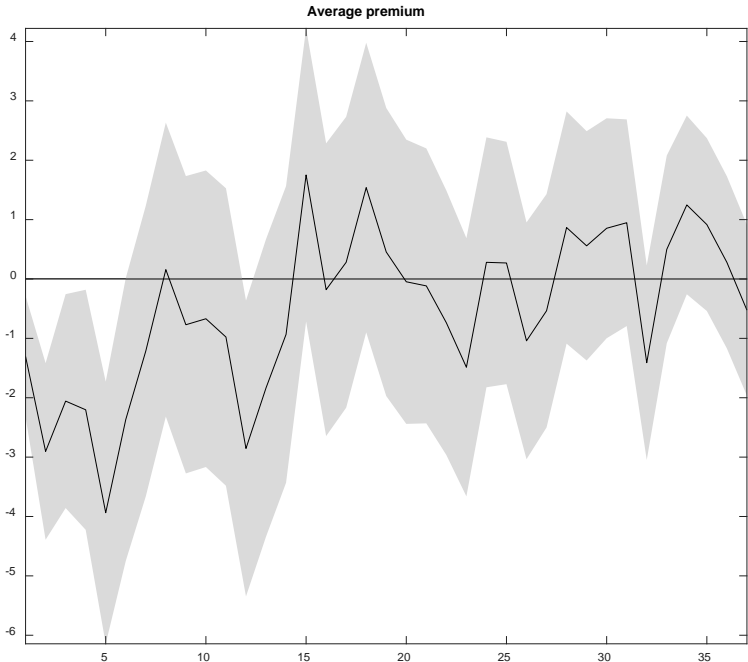


Figure B2. The local-projection-based impulse response function of the long-run average expected premium implied by equation (1). The number of lags in the model is 9.



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