Discussion Paper Series A No.760

Impact of US monetary policy spillovers and yield curve control policy

Jouchi Nakajima
(Institute of Economic Research, Hitotsubashi University)

February 2025

Institute of Economic Research
Hitotsubashi University
Kunitachi, Tokyo, 186-8603 Japan

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Jouchi Nakajima†

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Abstract

This study revisits the impact of US monetary policy (MP) spillovers on international bond markets through an empirical analysis of Japanese government bond yields. The analysis investigates how US MP shocks affect the yield curve and the components of expected rates and term premiums. A key insight of this study, supported by the empirical findings, is that the impacts of US MP spillovers on the term premium of domestic yields are muted during the yield curve control (YCC) policy, where the targeted long-term yield is kept within a certain small range. This novel finding implies that the policy is effective in preventing long-term yields from increasing upward pressure from US MP spillovers.

JEL classification: E43, E52, E58, G12

Keywords: Monetary policy; Term premium; Shadow rate; Yield curve control.

* The author is grateful to Hibiki Ichiue, Mototsugu Shintani, Etsuro Shioji, and Yoichi Ueno for their valuable comments and discussions. The views expressed in this paper are those of the author and do not necessarily reflect those of the Bank of Japan. The author gratefully acknowledges financial support from the Ministry of Education, Culture, Sports, Science and Technology of the Japanese Government through Grants-in-Aid for Scientific Research (No. 23H00048, 23H00050), the Hitotsubashi Institute for Advanced Study, and the Research Center for Economic and Social Risks.

† Institute of Economic Research, Hitotsubashi University (E-mail: jouchi.nakajima@r.hit-u.ac.jp)

1. Introduction

In highly connected global financial markets, US monetary policy (MP) actions crucially propel financial trading activities globally and locally through changes in prospects for economic activity and the future course of domestic MP. This international spillover of US MP has been studied from a variety of angles, both theoretically and empirically (e.g., Bruno and Shin, 2015; Rey, 2015; Georgiadis, 2016; Chen et al., 2016; Dedola et al., 2017; Kearns et al., 2023). Most empirical findings in the literature suggest that the impact of US MP spillovers is sizable and comparable to that of domestic MP actions (e.g., Albagli et al., 2019).

In an empirical investigation of spillovers to international bond markets, Gilchrist et al. (2016) identify US MP shocks using high-frequency financial data and analyze their impact on the yields of sovereign bonds issued by other countries. The authors show that yields are highly responsive to unanticipated changes in the Fed's MP stance (see also Hofmann and Takáts, 2015). Using a similar econometric method, Albagli et al. (2019) uncover the significant impact of US MP shocks on the components of domestic yields, risk-neutral (i.e., expected) rates, and term premiums. Previous studies have widely discussed and empirically examined the transmission channels of US MP spillovers, including international portfolio balancing (Lakdawala et al., 2021), foreign exchange rate channels (Albagli et al., 2019), and bank funding channels (Buch et al., 2019; Lindner et al., 2019; Takáts and Temesvary, 2020).

This study provides new insights into US MP spillovers to international bond markets by focusing on the reactions to Japan's government bond yields in two ways. First, prior studies such as Albagli et al. (2019) decompose bond yields into expected rates and term premiums based on a standard affine term-structure model (Adrian et al., 2013), which is subject to significant bias because it ignores the effective lower bound (ELB) of nominal yields. Instead, the current study employs the shadow-rate term structure model proposed by Black (1995), which effectively incorporates the ELB (see also Kim and Singleton, 2012; Christensen and Rudebusch, 2015). Ichiue and Ueno (2013), Imakubo and Nakajima (2015), and other studies show that the biases in the estimates of the expected rates and term premium are sometimes critically sizable, particularly in a low interest rate environment where the short-term interest rates are near the ELB for a considerable time period. We examine the influence of US MP shocks, identified by Nakamura and Steinsson (2018), on Japanese yield components, properly estimated using the shadow-rate model.

Second, we uncover how the reaction of the bond yields to the unexpected change in US MP under a yield curve control (YCC) policy in the domestic MP. The YCC policy, implemented in several countries (such as Australia and Japan), aims to control government bond yields with targets on interest rates that have multiple maturities. The Bank of Japan introduced the YCC policy in September 2016, targeting overnight interest rates at –0.1 percentage points and a 10-year yield of 0%. Until the bank terminated this policy and shifted to a conventional MP framework in March 2024, while the allowance range of the 10-year yield target was altered several times (see Osada and Nakazawa, 2024), the yield curve remained at a historically low level under the YCC policy.

While several studies have analyzed the effectiveness of the YCC policy (e.g., Koeda and Ueno, 2022; Koeda and Wei, 2024; Shiratsuka, 2024a,b; Osada and Nakazawa, 2024), few have investigated the influence of US MP spillovers. To fill this gap, this study provides empirical findings on the impact of US MP shocks on Japanese government bond yields under the YCC policy. As a closely related study, Ichiue (2025) provides an empirical analysis using the 10-year future price of the Japanese government bond and the expectations on inflation and GDP gap from a survey of the economists and financial market participants, showing that Japan's yield was less responsible for the US MP surprises during the YCC compared with the other periods.

The remainder of this paper is organized as follows. Section 2 describes the econometric approach and Section 3 explains the data used for the empirical analysis. Section 4 provides the estimation results for the impact of US MP spillovers during the YCC policy, including several robustness checks, and Section 5 concludes the paper.

2. Estimation methodology

2.1 An econometric framework

To address the impact of US MP spillovers, we consider a simple regression model in line with the specifications in the literature (e.g., Albagli et al., 2019; Kearns et al., 2023):

$$\Delta y_i = \alpha + \beta \mathrm{MPS}_i + \gamma X_i + \varepsilon_i, \tag{1}$$

where y_i is the Japanese government bond yield at a specific maturity; α is a constant term; MPS_t represents US MP shocks; and X_i is the vector of control variables to capture drivers of the bond yields. Our interest is the coefficient β of US MP shocks. We also examine the expected rate and the term premium as the dependent variable y_i, instead of the yield itself.

The index i in Equation (1) refers to the date of the FOMC's announcement of its MP decision, based on which US MP shocks are computed. Specifically, the dependent variable is the change in bond yield at the selected maturity rate from closing time in the Tokyo financial exchange market on the same day as the FOMC's announcement to closing time on the next business day. Due to the time difference between Japan (UTC +9) and US (EST, UTC –5) markets, the dependent variable measures a one-day yield change after the FOMC's announcement, which is usually released at night when the financial market is closed in Tokyo. It is reasonable to consider that Japan's MP decisions and bond yield fluctuations do not significantly affect US MP actions. Under this assumption, Equation (1)—given the timing of the dependent variable as well as MP shocks with a time difference—can properly and effectively estimate the impact of US MP spillovers, thereby avoiding an endogeneity problem.

In the baseline specification, we set X_i as it includes the first lag of the dependent variable (i.e., the change in bond yield from the previous day of the FOMC's announcement on the same day). In the robustness check, we add a financial market volatility index to control for its possible influence on bond yields, following previous studies. Albagli et al. (2019) and others also consider domestic MP actions and the release of official statistics as control variables. In the robustness check, we examine Equation (1) using the sample that excludes the time points when the Bank of Japan's release of its MP decision coincides on the same day as the FOMC's announcement to prevent it from influencing spillovers. As for the release of official statistics, our sample does not include any significant release events that move the financial market. Hence, we do not consider the release of statistics in our analysis.

2.2 Shadow-rate model

We utilize the shadow-rate term structure model to identify which yield component is affected by US MP spillovers: expected rates, term premiums, or both. We employ Black's (1995) model, developed by Ichiue and Ueno (2013), to scrutinize Japanese nominal yields.[1] The appendix documents the details of the model and its estimation method.

Term structure models are typically estimated for monthly data series. However, in our analysis, Equation (1) requires the daily series of expected rates and the term structure, thereby estimating the daily term structure model. Our approach estimates the term structure model for monthly and daily data separately and compares them to confirm that the daily estimates are reasonable. In the next section, we describe the data and estimation outcomes of our term structure model.

3. Data

As the main focus variable, we employ US MP shocks, as identified by Nakamura and Steinsson (2018), on the day of the FOMC's policy announcement. We download the series updated by Acosta et al. (2024). To estimate the components of the yield and compute the independent variable, we use the daily time series of the Japanese government's bond nominal yield, provided by the Ministry of Finance. We use a series of uncollateralized overnight call rates downloaded from the Bank of Japan's website for the short-term policy rate.[2] For the VIX used in the robustness check, we obtain its daily time series from the Federal Reserve Economic Data (FRED) database.

We estimate the shadow-rate model for both monthly and daily data to check the validity of the daily estimates, as discussed above. For the monthly estimation, we take the average of the daily series of data for each month. Our sample period for estimating the shadow-rate model is from January 4, 1995 to December 30, 2024. The sample size is 360 and 7,362 for the monthly and daily series, respectively. Figure 1 depicts the estimated shadow rates, which show that we

[1] While this model is extended to the one for both nominal and real yields by Imakubo and Nakajima (2015), which several previous studies have used (e.g., Kaihatsu et al., 2025), we simply exploit the original model because our analysis focuses on the nominal factors.

[2] Before January 1998, no publicly available daily series exists for uncollateralized overnight call rates. Instead, we use the monthly series of end-of-month figures for all daily figures in our dataset.

obtain a similar pattern of shadow-rate fluctuations in the daily and monthly estimations.[3]

The shadow rate decreased to about –1% in the first half of the 2000s, when the Bank of Japan implemented the quantitative easing policy, with the short-term policy rate facing the zero lower bound. In 2005, the shadow rate became positive, reflecting financial market expectations of the policy rate hike, exiting the zero interest rate policy. After the global financial crisis (GFC), the shadow rate dropped quickly and reached around –2% in 2010 when the Bank of Japan implemented the Comprehensive Monetary Easing policy. The more aggressive quantitative easing policy, the Quantitative and Qualitative Monetary Easing (QQE) policy introduced in April 2013, pushed the shadow rate further down to approximately 3.5%. After the bank carried out the YCC policy in September 2016, shadow rates started rising in a long way to the positive side, reaching a policy rate hike regarding the overnight call rate in March 2024.

Figure 2 plots the estimates of the expected rate and the term premium from the monthly and daily data for selected maturities (at 2, 5, 10, and 20 years). Overall, the monthly estimates are similar to those in the previous literature (Ichiue and Ueno, 2013; Hirata et al., 2024), and more importantly, the daily estimates are quite similar to the monthly ones. The expected rates trended downward in the late 1990s and 2000s, reaching a very low level in the early 2010s for each maturity, and turning up around late 2016 when the Bank of Japan introduced the YCC. While the term premium fluctuated more than the expected rates, it also trended downward in the 2010s, reaching and floating around zero or even negative territory up until the end of 2019. An important finding, which is relevant for the following empirical analysis, is that while the 10-year yield was controlled within a small range during the YCC, the expected rates and the term premiums fluctuated significantly even under the yield control. These estimates suggest that those components may be responsible for the US MP surprises.

Using these estimates as the dependent variable in Equation (1), we estimate the regression coefficients using the ordinary least squares (OLS) method. The regression is run separately for the yield, expected rate, and term premium for 2-, 5-, 10-, and 20-year maturities, which cover

[3] The estimates are available and current on the website: https://sites.google.com/site/jnakajimaweb/yield.

the short-, medium-, and long-term interest rates in the yield curve, respectively. The sample for the baseline regression consists of the dates of the FOMC's announcement from January 1995 to December 2022. The final month of the sample period is when the bank changes the range of the targeted 10-year rates from plus or negative 25 to 50 bps. After this adjustment, the 10-year yield began to fluctuate more flexibly than before. We limit the sample period to December 2022, regarding it as a strict phase of the YCC policy.

4. Empirical analysis

4.1 Baseline results

Table 1 reports the regression results for three sample periods: (a) the full sample; (b) before the YCC policy (i.e., before September 2016); and (c) under the YCC policy, which refers to September 2016 and afterward (up until the end of the sample period, December 2022). The figures in the table are the estimated coefficients of US MP shocks in Equation (1): the impact of US MP spillovers on Japanese yields and their components, expected rates, and term premiums.

For the full sample, the coefficients on the yields are all statistically significant for all maturities at one percent significance level, which indicates that US MP shocks have an impact on Japanese yields; this is consistent with previous studies. Interestingly, the estimates of the expected rates do not show any statistical significance for all maturities. The coefficients of the term premiums are statistically significant, which suggests that the reaction of Japanese yields to US MP shocks is mainly due to the term premium response. The size of its impact is approximately 20 bps, which is comparable to the estimates in previous literature (e.g., Albagli et al., 2019).

Once the estimation samples are divided, the estimates imply a distinct feature of US MP spillovers between the two regimes before and during the YCC policy. Before the YCC, the estimates are the same as those of the full sample. By contrast, during the YCC, the estimated coefficients of the yield and term premiums are not statistically significant. A key point is that the targeted 10-year yield, its term premium, and other maturities are not significantly affected by surprise changes in US MP. This result denotes that US MP spillovers are muted under the

YCC policy. This finding shows that the policy effectively prevents long-term yields from increasing upward pressure due to US MP spillovers.

The coefficient of the expected rates is slightly negative and statistically significant for the 2- and 5-year maturities at five percent significance level. Financial markets may assume that an unexpected tightening of US MP may lead to a headwind in the US economy, which influences the Japanese economy negatively on average. However, the coefficient is not statistically significant for the 10- and 20-year maturities.

4.2 Robustness check

We consider four types of robustness checks for the baseline estimates reported above. First, domestic MP actions may correlate with US MP and influence the domestic yield curve with delays. The FOMC's policy announcement is released on the same day as the bank's policy announcement several times during our sample period. We exclude these samples from the estimation and run a regression to obtain the estimates listed in Table 2. The figures are similar to the baseline results and the pattern of statistical significance is the same; that is, the yield and its term premium respond to the US MP shock before the YCC, but their responses are muted during the YCC.

Second, the baseline results may reflect turbulence in the economy and financial markets during a crisis. To examine this, we exclude samples collected during the challenging GFC period from August to October 2008 and during the early stage of the COVID-19 pandemic from April to September 2020. Table 3 reports the estimation outcomes, which imply that the baseline results are robust.

Third, market sentiment may affect yields and its components in addition to US MP spillovers. We test this assessment by running a regression, including VIX as an additional control variable. Table 4 displays the estimated coefficients of US MP shocks, indicating that the baseline results hold.

Fourth, the expected rates and term premium used in the analysis are smoothed estimates of the state-space representation of the shadow-rate model and its estimation method with the extended Kalman filter. Another choice is a filtered estimate, which is generally more volatile than the smoothed estimate but can avoid a situation where the estimate is smoothed too much. Replacing the smoothed series of the dependent variable with the filtered series, we run the same regression on the baseline result to obtain the predicted coefficients in Table 5. The figures show a slight difference in that the reactions of the expected rates to US MP shocks are also statistically significant for all maturities. The coefficients of the yield and term premiums are still muted in this regression during the YCC period, confirming the robustness of the baseline results.

5. Conclusion

We investigate the reaction of Japanese government bond yields to US MP shocks and compare it between the periods before and during the YCC policy. Using the shadow-rate model of yield curves, we estimate the expected rates and term premium of the yields to exploit them as the dependent variable in our regression analysis to address US MP spillovers. The estimated coefficient of US MP shocks indicates that, while the yield and its term premium are responsible for US MP shocks without the YCC policy domestically, their responses are muted during the YCC policy. This empirical finding suggests that the YCC policy effectively prevents long-term yields from increasing upward pressure resulting from US MP spillovers.

Our study has several limitations. We address one aspect of the YCC effect and not the full range of its policy effectiveness. In addition, we focus only on the simultaneous reactions of domestic yields on the day of MP announcements. Measuring more dynamic effects through broader channels of the YCC is important for both academic and policy discussions; however, this is left to future work. From another perspective, joint modeling of the US MP spillover and Japan’s MP influence with a series of Bank of Japan’s monetary policy surprises, identified by Kubota and Shintani (2022), is of interest, which is also left to future work.

Appendix. Shadow-rate term structure model

Following Ichiue and Ueno (2013), we consider a short-term interest rate, denoted by r_t and defined as

$$r_t = \max\{s_t, \mathrm{ELB}_t\},$$

where ELB_t is the ELB of the short-term interest rate, and s_t is the shadow rate modeled as an affine function of latent factors, represented by $(k \times 1)$ vector $\boldsymbol{X}_t$ as

$$s_t = \rho + \boldsymbol{\delta}'\boldsymbol{X}_t,$$

with $\boldsymbol{\delta} = (\delta_1, \dots, \delta_k)'$ denoting a $(k \times 1)$ vector of coefficients. The factors are modeled as they follow the Gaussian process under the objective P-measure:

$$d\boldsymbol{X}_t = -\boldsymbol{K}^P\boldsymbol{X}_t dt + \boldsymbol{\Sigma}\, d\boldsymbol{B}_t^P$$

where $\boldsymbol{\Sigma} = \{\Sigma_{ij}\}$ is a $(k \times k)$ matrix, and $\boldsymbol{B}_t^{\boldsymbol{P}}$ is a standard k-dimensional Brownian motion.

Let M_t denote the stochastic discount factor. We define the bond price as $P_{t,T}$, and the zero-coupon yield as $y_{t,T}(\boldsymbol{X}_t)$ for T-year maturity at time t. Then, we obtain

$$P_{t,T} = \mathrm{E}_t^P\left[\frac{M_{t+T}}{M_t}\right], \text{ and } y_{t,T}(\boldsymbol{X}_t) = -\frac{1}{T}\log P_{t,T} = -\frac{1}{T}\log\left(\mathrm{E}_t^P\left[\frac{M_{t+T}}{M_t}\right]\right).$$

The stochastic discount factor is modeled by

$$\frac{dM_t}{M_t} = -r_t dt - \boldsymbol{\lambda}_t' d\boldsymbol{B}_t^P,$$

where $\boldsymbol{\lambda}_t$ is the $(k \times 1)$ vector of the market prices of risk, specified by the affine function of the factors as

$$\boldsymbol{\lambda}_t = \boldsymbol{\lambda} + \boldsymbol{\Lambda}\boldsymbol{X}_t,$$

where $\boldsymbol{\lambda} = (\lambda_1, \dots, \lambda_k)'$ is a $(k \times 1)$ vector and $\boldsymbol{\Lambda} = \{\Lambda_{ij}\}$ is a $(k \times k)$ matrix. We obtain the yield under the risk-neutral Q-measure as:

$$y_{t,T}(\boldsymbol{X}_t) = -\frac{1}{T}\log\left(\mathrm{E}_t^Q\left[\exp\left(-\int_0^T r_{t+\tau} d\tau\right)\right]\right).$$

The expected rates are defined by

$$y_{t,T}^{\exp} = \frac{1}{T}\int_0^T \mathrm{E}_t^P[r_{t+\tau}]d\tau,$$

and we define the term premium simply as

$$y_{t,T}^{\mathrm{TP}} = y_{t,T} - y_{t,T}^{\exp}.$$

In our analysis, to make the model parsimonious, following Ichiue and Ueno (2013), we set the number of factors as $k = 2$, and restrict $\delta_1 = \delta_2 = 1$ and $\Sigma_{ij} = 0$ for $i \neq j$ (i.e., $\boldsymbol{\Sigma}$ is a diagonal matrix).

When estimating the model, we discretize it and use maximum likelihood estimation based on its state-space representation. Because the model is non-linear, we employ an extended Kalman filter to compute the model's likelihood given the parameter values. For discretization, we use $h = 1/12$ for monthly data and $h = 1/245$ for daily data.

Following Hirata et al. (2024), we set the ELB in the model as $\mathrm{ELB}_t = 0$ from the beginning of the sample period to November 6, 2008; $\mathrm{ELB}_t = 0.1$ from November 7, 2008 to January 28, 2016; $\mathrm{ELB}_t = -0.1$ from January 29, 2016 to March 18, 2024; and again, $\mathrm{ELB}_t = 0.1$ from March 19, 2024 to the end of the sample period.[4]

[4] Ueno (2017) points out more variability of the ELB, particularly after the negative interest rate policy is introduced in 2016; Ueno proposes an extended model to address it. For simplicity, we use the original model with the setting of the ELB stated here.

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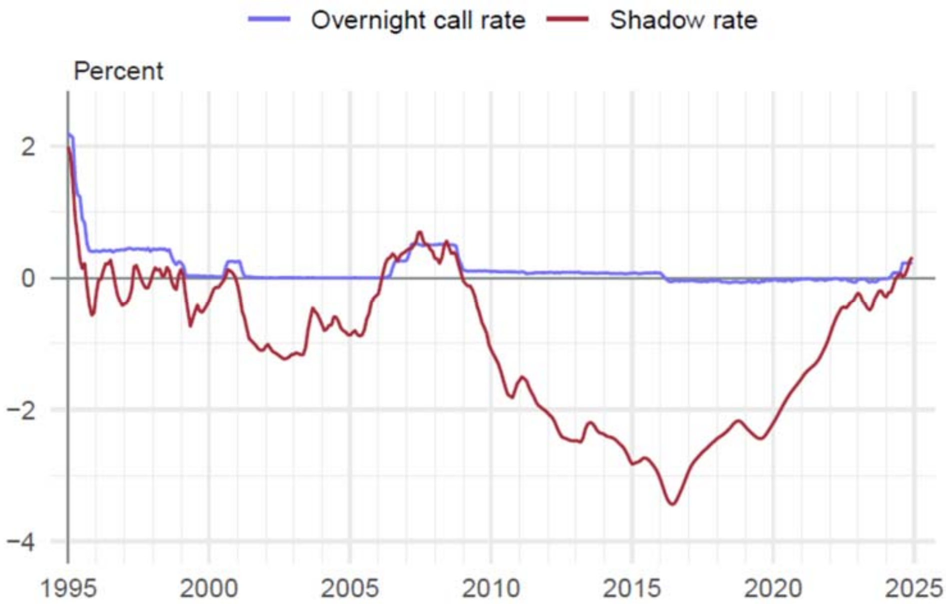
(a) Monthly



(b) Daily

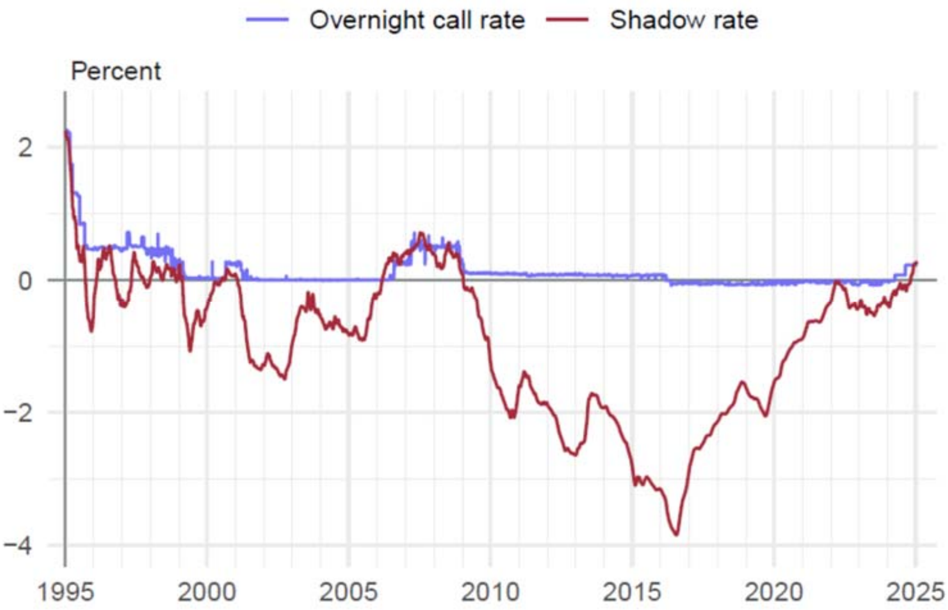
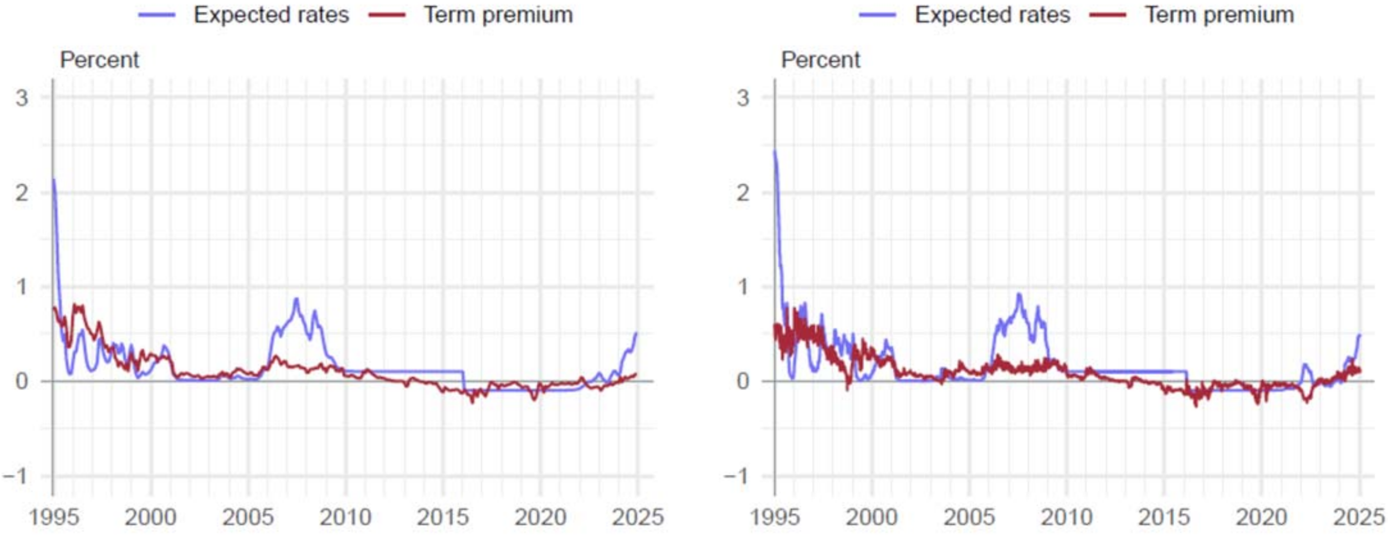


Figure 1: Overnight call rates and estimated shadow rates.

(a) Two-year



(b) Five-year

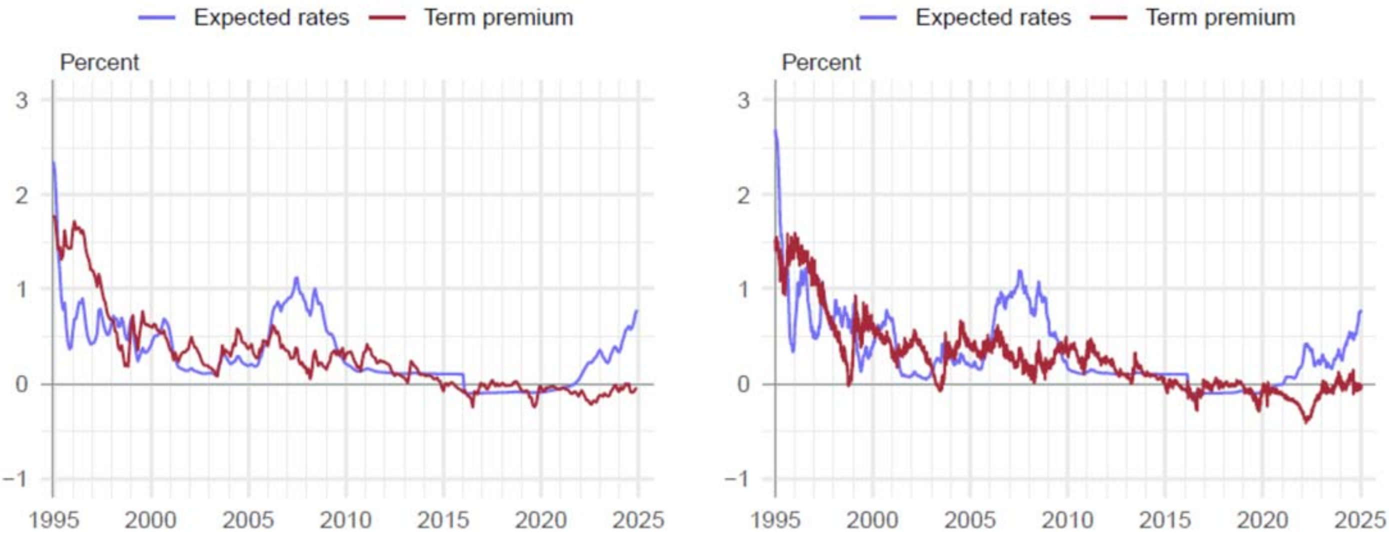
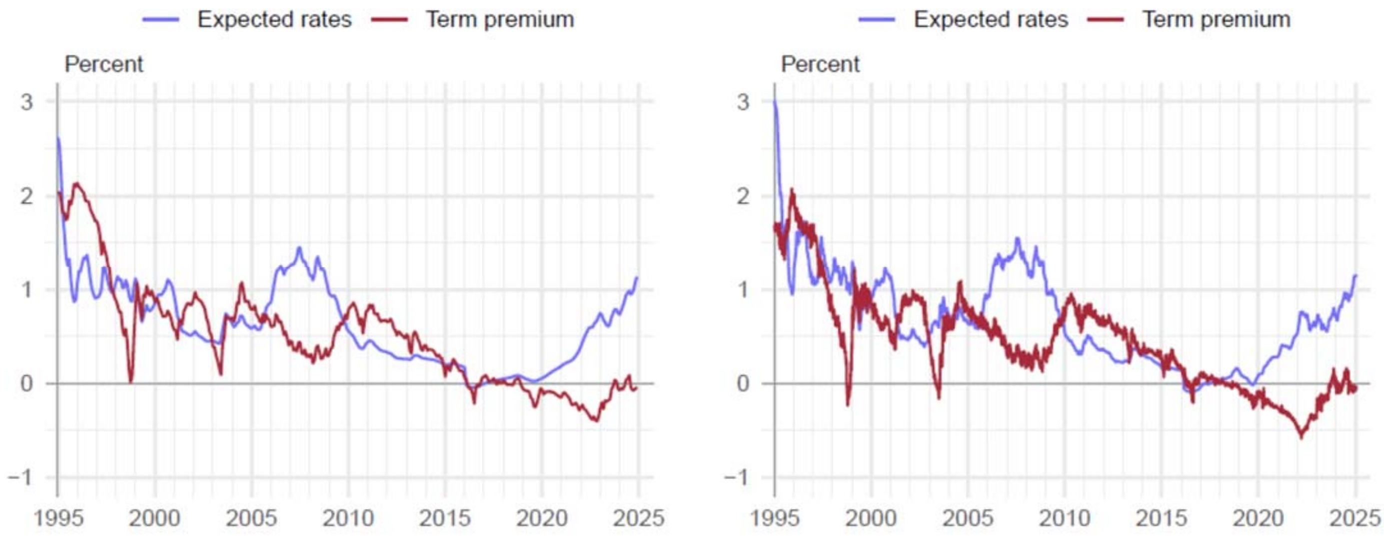


Figure 2: Expected rates and term premium based on monthly (left) and daily (right) data.

(c) Ten-year



(d) Twenty-year

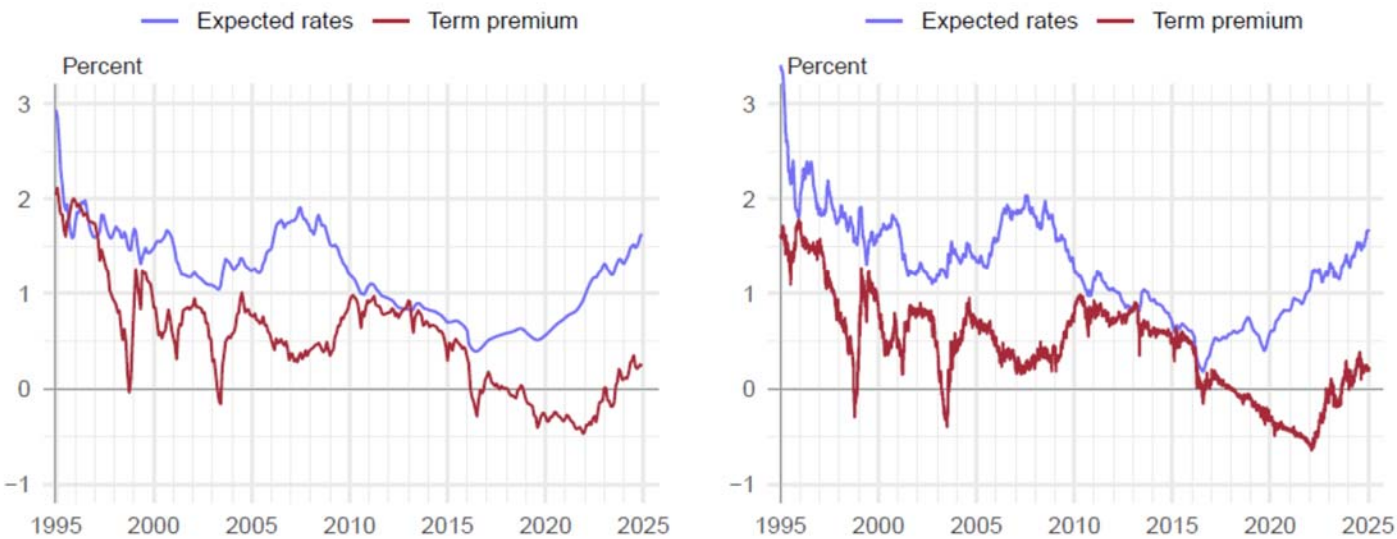


Figure 2. (continued)

(a) Full sample

	2-year	5-year	10-year	20-year
Yield	0.173 **	0.226 **	0.191 **	0.169 **
	(0.049)	(0.067)	(0.064)	(0.063)
Expected rates	-0.003	0.001	0.003	0.003
	(0.004)	(0.005)	(0.005)	(0.004)
Term premium	0.152 **	0.200 **	0.168 **	0.148 **
	(0.043)	(0.061)	(0.059)	(0.059)

(b) Before the YCC policy

	2-year	5-year	10-year	20-year
Yield	0.187 **	0.256 **	0.204 **	0.180 **
	(0.058)	(0.079)	(0.076)	(0.072)
Expected rates	-0.003	0.001	0.003	0.004
	(0.005)	(0.006)	(0.005)	(0.005)
Term premium	0.166 **	0.231 **	0.183 **	0.163 **
	(0.050)	(0.072)	(0.070)	(0.067)

(c) During the YCC policy

	2-year	5-year	10-year	20-year
Yield	0.039	-0.037	0.074	0.081
	(0.074)	(0.092)	(0.091)	(0.139)
Expected rates	-0.006 *	-0.006 *	-0.006	-0.006
	(0.003)	(0.004)	(0.004)	(0.004)
Term premium	0.029	-0.060	0.039	0.027
	(0.073)	(0.090)	(0.091)	(0.136)

Table 1: Estimated coefficients of MP shocks in the regression with standard errors in parentheses. ** and * indicate statistical significance at the 1% and 5% levels, respectively.

(a) Full sample

	2-year	5-year	10-year	20-year
Yield	0.172 **	0.211 **	0.171 **	0.153 *
	(0.053)	(0.071)	(0.068)	(0.066)
Expected rates	-0.004	-0.001	0.001	0.001
	(0.005)	(0.005)	(0.005)	(0.004)
Term premium	0.148 **	0.184 **	0.151 **	0.135 *
	(0.045)	(0.064)	(0.062)	(0.062)

(b) Before the YCC policy

	2-year	5-year	10-year	20-year
Yield	0.187 **	0.243 **	0.183 *	0.166 *
	(0.063)	(0.085)	(0.081)	(0.077)
Expected rates	-0.005	-0.001	0.000	0.001
	(0.006)	(0.006)	(0.006)	(0.005)
Term premium	0.160 **	0.216 **	0.165 *	0.154 *
	(0.054)	(0.077)	(0.075)	(0.071)

(c) During the YCC policy

	2-year	5-year	10-year	20-year
Yield	0.045	-0.050	0.052	0.039
	(0.076)	(0.092)	(0.091)	(0.138)
Expected rates	-0.006 *	-0.006 *	-0.006	-0.006
	(0.003)	(0.004)	(0.004)	(0.004)
Term premium	0.034	-0.072	0.018	-0.015
	(0.075)	(0.091)	(0.091)	(0.135)

Table 2: Robustness check. Regression results are based on the data, excluding the sample where the Bank of Japan's MP announcement coincides on the same day as the FOMC's policy announcement. See also the description in Table 1.

(a) Full sample

	2-year	5-year	10-year	20-year
Yield	0.163 **	0.215 **	0.188 **	0.169 **
	(0.051)	(0.069)	(0.066)	(0.065)
Expected rates	-0.005	-0.001	0.001	0.002
	(0.004)	(0.005)	(0.005)	(0.004)
Term premium	0.145 **	0.194 **	0.170 **	0.153 **
	(0.044)	(0.063)	(0.061)	(0.061)

(b) Before the YCC policy

	2-year	5-year	10-year	20-year
Yield	0.177 **	0.244 **	0.199 **	0.180 **
	(0.060)	(0.081)	(0.078)	(0.074)
Expected rates	-0.005	-0.001	0.001	0.002
	(0.005)	(0.006)	(0.006)	(0.005)
Term premium	0.159 **	0.225 **	0.185 **	0.168 **
	(0.051)	(0.074)	(0.072)	(0.069)

(c) During the YCC policy

	2-year	5-year	10-year	20-year
Yield	0.039	-0.032	0.079	0.088
	(0.077)	(0.094)	(0.094)	(0.144)
Expected rates	-0.006 *	-0.006 *	-0.006	-0.006
	(0.003)	(0.004)	(0.004)	(0.004)
Term premium	0.029	-0.054	0.043	0.035
	(0.076)	(0.093)	(0.094)	(0.141)

Table 3: Robustness check. Regression results are based on the data, excluding the sample during the GFC and the COVID-19 pandemic. See also the description in Table 1.

(a) Full sample

	2-year	5-year	10-year	20-year
Yield	0.173 **	0.218 **	0.183 **	0.158 **
	(0.050)	(0.068)	(0.065)	(0.064)
Expected rates	-0.003	0.000	0.002	0.003
	(0.004)	(0.005)	(0.005)	(0.004)
Term premium	0.151 **	0.193 **	0.162 **	0.140 *
	(0.044)	(0.062)	(0.061)	(0.060)

(b) Before the YCC policy

	2-year	5-year	10-year	20-year
Yield	0.188 **	0.247 **	0.189 **	0.159 *
	(0.060)	(0.082)	(0.078)	(0.074)
Expected rates	-0.004	0.000	0.002	0.003
	(0.005)	(0.006)	(0.006)	(0.005)
Term premium	0.165 **	0.223 **	0.172 **	0.147 *
	(0.051)	(0.074)	(0.072)	(0.069)

(c) During the YCC policy

	2-year	5-year	10-year	20-year
Yield	0.036	-0.039	0.056	0.062
	(0.075)	(0.093)	(0.091)	(0.140)
Expected rates	-0.006 *	-0.006 *	-0.006	-0.006
	(0.003)	(0.004)	(0.004)	(0.004)
Term premium	0.027	-0.060	0.024	0.010
	(0.074)	(0.092)	(0.091)	(0.137)

Table 4: Robustness check. Regression results for the regression, including the VIX as an additional control variable. See also the description in Table 1.

(a) Full sample

	2-year	5-year	10-year	20-year
Yield	0.173 **	0.226 **	0.191 **	0.169 **
	(0.049)	(0.067)	(0.064)	(0.063)
Expected rates	0.038 **	0.043 **	0.044 **	0.042 **
	(0.013)	(0.013)	(0.013)	(0.011)
Term premium	0.117 **	0.170 **	0.138 **	0.120 *
	(0.039)	(0.058)	(0.057)	(0.056)

(b) Before the YCC policy

	2-year	5-year	10-year	20-year
Yield	0.187 **	0.256 **	0.204 **	0.180 **
	(0.058)	(0.079)	(0.076)	(0.072)
Expected rates	0.044 **	0.050 **	0.051 **	0.046 **
	(0.016)	(0.016)	(0.015)	(0.014)
Term premium	0.125 **	0.194 **	0.147 *	0.130 *
	(0.046)	(0.068)	(0.067)	(0.064)

(c) During the YCC policy

	2-year	5-year	10-year	20-year
Yield	0.039	-0.037	0.074	0.081
	(0.074)	(0.092)	(0.091)	(0.139)
Expected rates	-0.007	-0.025 *	-0.026 *	-0.016
	(0.009)	(0.013)	(0.014)	(0.015)
Term premium	0.047	-0.037	0.057	0.036
	(0.072)	(0.089)	(0.087)	(0.131)

Table 5: Robustness check. Estimation results for the regression with the expected rates and term premium are estimated via the filtered procedure (as opposed to being smoothed). See also the description in Table 1.