Discussion Paper Series

RIEB

Kobe University

DP2010-07

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March 5, 2010

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May 2010

Abstract

This paper examines the effects of Japanese monetary policy on equity markets using firm-level data. Our objective is to investigate whether there exist heterogeneous responses of stock returns among firms, and if any, whether firm-specific characteristics associated with the theories of monetary transmission mechanism can account for such heterogeneity. We find that a 1% surprise cut in the call-rate target increases stock returns by 3% on average, but this effect is significantly larger for firms with high capital intensity, low openness, high leverage, high interest payment burden, and low working capital. It is also found that monetary policy had greater effects on equity markets in the recession period of the 1990s than the boom period of the late 1980s.

JEL Classification: E52; E44.

Keywords: Monetary policy; Individual stock returns; Heterogeneity; Event study; Monetary transmission mechanism.

*We would like to thank Ryuzo Miyao, Kazuo Ogawa, and seminar participants at the Japan Society of Monetary Economics held at Kagawa University for many useful comments; Yuzo Honda and Yoshihiro Kuroki for providing some of the data series; and the Zengin Foundation (No.0714) and the JSPS (No.21243027) for financial support.

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1 Introduction

It is well known that monetary policy influences macroeconomic variables such as output and inflation, through its impacts on not only the bank lending market but also the financial and capital markets. Monetary policy shocks to short-term inter-bank markets (e.g., the federal funds market in the U.S. and the call market in Japan) cause changes in longer-term interest rates and asset prices of the financial and capital markets, which in turn affect real economic behavior. Among such financial and capital markets, stock market is one of the most important markets from the viewpoint of monetary policy transmission, and thus some researchers have examined the effects of monetary policy on stock markets.[1]

There are at least three issues with regard to assessing monetary policy effects on equity markets. First, stock prices are influenced by various factors other than monetary policy, for example, movements of GDP and inflation rate, and such factors may be correlated with monetary policy. Second, monetary authorities may simultaneously respond to stock market movements.[2] Third, stock markets have a forward-looking nature, i.e., market participants anticipate in advance the direction and the extent of a policy change before a central bank actually changes its policy stance.

These problems would cause the correlation between the policy rate and the error term if simply regressing stock prices on monetary policy rates by OLS, which yields a bias in the estimator. To eliminate this kind of bias, the literature has often taken an "event-study" approach in which a stock market response is estimated using data only on dates of the policy change. Furthermore, in order to address the third problem described above, the literature has decomposed policy rate movements into the *expected* and *unexpected* (or *surprise*) components, and interpreted a stock price response to the *surprise* component as a true effect of monetary policy on equity market.[3]

[1]Miyao (2002) and Honda et al. (2007) show the importance of stock markets for the monetary policy transmission in Japan.

[2]Rigobon and Sack (2003) find a significant policy response to the stock market in the U.S. Also, Bernanke and Gertler (1999) argue that the Bank of Japan (BOJ) conducted monetary policy in response to the behavior of stock prices in the 1990s.

[3]The literature has adopted two alternative approaches to avoid the problems described above. One is based on the vector autoregressive (VAR) method (see, for example Patelis, 1997; Thorbecke, 1997; Miyao, 2002; Honda et al., 2007). The other method, developed by Rigobon and Sack (2004), is an extension of the event-study approach, which requires a weaker set of assumptions than needed in the event-study.

Bernanke and Kuttner (2005) is one of the most influential work in the literature. They gauge stock market responses to the surprise changes of U.S. monetary policy relying on the event-study approach. The surprise component is defined as the change in the federal funds futures rate on the date of the policy change.[4] They show evidence that a 1% surprise cut in the federal funds rate target leads to a 4% increase in stock prices.

Honda and Kuroki (2006) apply the event-study approach to the Japanese economy. In particular, they identify the dates of the call-rate target changes and the target levels (or ranges) by carefully reading the articles in the Nikkei News Paper. Then, they decompose the call-rate target changes into the expected and surprised components based on the information from the nearest-term three-month Euro-Yen futures market. They find that a surprise decrease in the call rate target of 1% increases stock prices by 3%.[5]

In the above two studies, stock returns are regressed on both expected and surprise components of the policy target-rate changes. They use as a measure of stock returns the growth rates of the *stock price indices* which capture average movements of equity markets. That is, what Bernanke and Kuttner (2005) and Honda and Kuroki (2006) estimated is an *average* reaction of stock returns of all listed firms to a monetary policy shock. However, if there are significant differences in the stock price responses among firms, only estimating the average response is not enough to understand the effects of monetary policy on equity markets. The purpose of this paper is therefore to investigate whether there exist the heterogeneous responses of stock returns among firms, and if any, what firm-specific characteristics can account for such heterogeneity. To this end, we will adopt the event-study approach based on the Japanese *firm-level* data of stock prices, and divide stock price responses into the average and heterogeneous ones. We also try to link the heterogeneity to the firm-specific characteristics associated with the theories of monetary transmission mechanism.

There are at least two theoretical reasons for an occurrence of the heterogeneous response. First, the heterogeneous response would be brought about through the traditional interest rate (or monetary) channel. If demand or supply of a firm's product is sensitive to

[4]This method was first employed by Kuttner (2001). He estimated reactions of the term structure of interest rates to monetary policy surprises.

[5]Honda and Kuroki (2006) also estimated the effects of monetary policy shocks on the term structure of interest rates in Japan.

changes in the interest rate, stock returns of that firm would be more affected by monetary policy. Second, the heterogeneous response could be explained from the viewpoint of the credit channel, particularly the balance sheet channel. In an environment of imperfect information, the premium on external finance would exist reflecting the agency cost if the external finance is not fully collateralized. Then it is more costly to raise funds by external finance than internal finance, implying that the firm faces financial constraints. Since the external finance premium depends inversely on the firm's net worth and since monetary policy affects the net worth, monetary policy would have larger effects on the financially constrained firms than unconstrained firms. In this paper, we will consider these two channels of monetary transmission mechanism as main sources of heterogeneity in stock price reactions.

The most related work to ours is Ehrmann and Fratzscher (2004). They present evidence that individual stock returns react in a highly heterogeneous fashion to U.S. monetary policy shocks. In particular, the U.S. monetary policy affects more strongly the stock returns of firms with low cash flows, small size, poor credit ratings, low debt to capital ratios, high price-earnings ratios, or a high Tobin's q. Our analysis parallels Ehrmann and Fratzscher (2004) in that we extend the analysis of Honda and Kuroki (2006) by using individual stock returns, instead of stock price indices, for the Japanese economy while Ehrmann and Fratzscher (2004) is an extended version of Bernanke and Kuttner (2005) in the same way for the U.S. economy.

However, our study is different from Ehrmann and Fratzscher (2004) in the sense that our firm-characteristic variables, which are used in the regression analysis to account for the heterogeneous response, seem to be more closely related to the concept of the interest rate channel or the balance sheet channel. Firm-characteristic variables used in this paper are the degree of capital intensity and openness of each firm as well as its financial leverage, interest payment burden, short-term debt, working capital, and cash flow. The first two variables are proxies for the determinant of the interest rate channel and the last five variables for the determinant of the balance sheet channel. Most of our firm-characteristic variables are also adopted by either Peersman and Smets (2005) or Dedola and Lippi (2005) or both, although these two studies investigate the monetary policy effects on real output (not on stock markets). Another difference from Ehrmann and Fratzscher (2004) is that we compare reactions of individual stock returns between boom and recession periods. As will be described later, stock price responses are expected to be larger in recessions than booms, on the basis of the theory of either interest rate channel or balance sheet channel. In this paper, we test if this prediction holds true for Japanese monetary policy even in the situations of low interest rate and weak financial system during the 1990s.

As mentioned above, this paper contributes to the literature, that examines monetary policy effects on equity markets, by exploring heterogeneity in the individual stock responses. Our study is also related to two strands of the empirical literature on the Japanese monetary policy. First, Miyao (2000), Fujiwara (2006), and Inoue and Okimoto (2008) show that there was a structural break around the mid 1990s for the Japanese economy and that an impact of monetary policy on macroeconomy became weaker after the break.[6] This paper partially tests whether monetary policy was also ineffective for the stock market during the period. Second, our study contributes to the literature on the balance sheet channel for Japan from the standpoint of equity markets. Ogawa (2000) and Hosono and Watanabe (2002) provide evidence that Japanese monetary policy affects firms' fixed investments through the balance-sheet channel. Suzuki (2004) shows that the quantity and price of bank loans and real output react to monetary policy shocks in such a way as to support the balance-sheet view. Our research complements these previous works by shedding light on the equity market.

The remainder of the paper is organized as follows. Section 2 explains an event-study approach and presents a basic empirical model estimated in this paper. Section 3 describes more detailed specifications of our econometric models, estimates those models by using firm-level data, and presents the results. More specifically, in Section 3.1 we first estimate an *average* response of stock returns to monetary policy surprises by using individual stock returns, and then compare this estimated value with the one reported by Honda and Kuroki (2006). Next we allow for the heterogeneous response of individual stock returns by industries in Section 3.2 and by firm-specific characteristics in Section 3.3. Section 4 tests whether the heterogeneous response of individual stock returns is symmetrical about the firm-specific variables. Section 5 examines whether the effectiveness of monetary policy is

[6] Inoue and Okimoto (2008) also found that a monetary base shock stimulated real output significantly even after the mid 1990s, whereas Fujiwara (2006) found no such significant effect.

different between booms and recessions. Section 6 concludes the paper.

2 Event-Study and A Basic Empirical Model

The "event-study" approach focuses on the days of the policy change to gauge the policy effect. As described in the introduction, looking only at the policy-event days reduces the bias associated with the omitted-variable and simultaneity problems. More formally, as shown by Rigobon and Sack (2004), the OLS estimate of the event-study analysis is consistent as long as the variance of the monetary policy shock is infinitely large compared to the variances of the other shocks on the days of the policy event.[7]

Cook and Hahn (1989) firstly attempt to apply the event-study approach to the analysis of monetary policy effects. They investigate the financial market responses to monetary policy, by regressing changes in market interest rates on changes in the federal funds rate target on the dates of the policy move. In an analogous way, when measuring the stock market response to monetary policy, one might rely on the event-study method and estimate the following equation:

$$\Delta S_t = \alpha + \beta \Delta r_t + \epsilon_t, \tag{1}$$

where Δr_t is the change in the short-term interest rate manipulated by a central bank, and ΔS_t is the rate of change in the stock market price index. The parameter β measures an impact of monetary policy on equity market. Note that, in the event-study, t indicates a date on which the central bank changes its policy rate.

As mentioned in the introduction, however, financial and capital markets are forward-looking in that market participants anticipate the policy change and respond according to their expectations before the monetary authority actually changes its policy rate. For this reason, the use of the *raw* policy rate r_t as a policy indicator may fail to capture the true market response to monetary policy.

To avoid this problem, Kuttner (2001) separates changes in the federal funds rate

[7] Rigobon and Sack (2004) suspect the satisfaction of a set of assumptions required under the event-study, and provide a new identification approach requiring a much weaker set of assumptions than needed under the event-study approach. This paper does not adopt their approach since monetary policy is unlikely to react to individual stock returns, which violates a specification of Rigobon and Sack (2004).

target into *expected* and *unexpected* (or *surprise*) components, which are calculated from the federal funds futures market data. While Kuttner (2001) examines reactions of the yield curve, Bernanke and Kuttner (2005) highlight the stock market responses based on the same decomposition approach. Specifically, the regression equation estimated by Bernanke and Kuttner (2005)

$$\Delta S_t = \alpha + \beta_1 \Delta r_t^e + \beta_2 \Delta r_t^s + \epsilon_t \tag{2}$$

contains as independent variables both the expected and surprise components of the policy rate changes, Δr_t^e and Δr_t^s, in place of the raw policy rate changes Δr_t.

ΔS_t in Eqs.(1) and (2) is the rate of change in the *stock price index*, which captures market average moves of individual stock returns. This implies that we can see only the *average* impact of monetary policy on the equity market. However, monetary policy might have different effects on stock markets across firms. Ehrmann and Fratzscher (2004) allow for such heterogeneity in monetary policy effects. They use firm's individual data of stock returns and estimate a panel data regression model. Following Ehrmann and Fratzscher (2004), we investigate heterogeneity in monetary policy effects in the Japanese case. The basic empirical model used in this paper is given by:

$$\Delta s_{i,t} = \alpha + \beta_1 \Delta r_t^e + \beta_2 \Delta r_t^s + \beta_3 z_{i,t} \Delta r_t^s + \epsilon_{i,t}, \tag{3}$$

where $\Delta s_{i,t}$ is the rate of change in the stock price for firm i on the t-th policy event, and $z_{i,t}$ is the characteristic of firm i on the t-th policy event.

In Eq.(3), individual stock return $\Delta s_{i,t}$ is regressed on the expected change in the policy rate target Δr_t^e, the surprise change Δr_t^s, and the interaction term between the surprise component and the firm-specific characteristic $z_{i,t} \Delta r_t^s$. Our focus of interest is the estimate of β_3, which measures the degree of heterogeneity in monetary policy effects. As will be described in the next section, the basic model (3) is modified a bit in the estimations.

3 Heterogeneity in Monetary Policy Effects

3.1 Average Impact of Monetary Policy

Before analyzing heterogeneity in monetary policy effects, in this subsection we first estimate an *average* impact of monetary policy on equity markets by using data of individual stock returns. Then our results are compared with those reported by Honda and Kuroki (2006) in which two stock price indices, the Nikkei Stock Average and TOPIX, are considered. As will be described below, the comparison shows that individual stock prices and the stock price index yield similar results for the average effect of monetary policy. This ensures that, in the subsequent subsections, we can investigate heterogeneity in monetary policy effects on the basis of firm-level data.

We use data on the surprise and expected components of policy target changes in Japan during the period from August 1989 to March 2001, which was compiled by Honda and Kuroki (2006).[8] According to Honda and Kuroki (2006), 55 policy changes occurred during the period. Thus the number of time dimension in our panel analysis appears to be enough to provide unbiased estimates. The sample period includes the prolonged economic recession in the 1990s as well as a later stage of the bubble economy occurring in the middle 1980s.

We modify the regression models (1) and (2) as follows, respectively:

$$\begin{aligned}\Delta s_{i,t} &= \alpha + \beta \Delta r_t \\ &\quad + \sum_{k=1}^{8} \tau_k MacroNews_{k,t} + \sum_{s=1989}^{1998} \rho_s FiscalYear_{s,t} + \mu_i + \epsilon_{i,t}, \end{aligned} \tag{4}$$

$$\begin{aligned}\Delta s_{i,t} &= \alpha + \beta_1 \Delta r_t^e + \beta_2 \Delta r_t^s \\ &\quad + \sum_{k=1}^{8} \tau_k MacroNews_{k,t} + \sum_{s=1989}^{1998} \rho_s FiscalYear_{s,t} + \mu_i + \epsilon_{i,t}, \end{aligned} \tag{5}$$

where, as defined in the previous section, $\Delta s_{i,t}$ denotes the rate of change in the stock price of firm i on the t-th policy event, Δr_t the raw change in the target policy rate, Δr_t^e the expected component of Δr_t, and Δr_t^s the surprise component of Δr_t.

[8] The data after March 2001 cannot be constructed because the BOJ introduced quantitative easing policies in March 2001 and its operating target was shifted from the call rate to the current account balances held at the bank.

MacroNews is the macroeconomic news dummy taking the value of one if news associated with a certain macroeconomic condition is released and zero otherwise. Honda and Kuroki (2006) assert that there is a need to control for the effects of macroeconomic news on financial and capital markets in the analysis of the Japanese case, since the BOJ usually took several days to adjust the call rate toward a new policy target during the sample period. Following Honda and Kuroki (2006), we include the same set of macroeconomic news dummies in the regression models (4) and (5). The macroeconomic news dummies are as follows: news associated with National Income Accounts (denoted by GDP), the BOJ's Business Survey (Tankan), the Monthly Report on the Labor Force Survey (Unemployment), Indices of Business Conditions, the Index of Industrial Production (IIP), the Consumer Price Index (CPI), and the Wholesale Price Index (WPI). In addition, Honda and Kuroki (2006) control for the possible impacts of announcements and statements made by the governor of the BOJ about economic conditions. Therefore, we also add this announcement dummy variable to *MacroNews*.

Fiscal year dummies, *FiscalYear*, capture the effects of macroeconomic trends or the market's moods in each of the fiscal years. The firm-specific intercept, μ_i, is contained to control for the firm-specific effects that remain stable over the sample period.

For the three types of the policy indicator, Δr_t, Δr_t^e, and Δr_t^s, we use the data reported on Table 1 in Honda and Kuroki (2006). The BOJ did not officially announce its call-rate target until 1998. Thus, Honda and Kuroki (2006) identified the data series for the call-rate target changes, Δr_t, from the articles in the Nikkei News Paper. And then, they used the futures rate to capture the surprise component of the target-rate change Δr_t^s, and calculated the expected component Δr_t^e from the values of Δr_t and Δr_t^s. Specifically, the surprise and expected components of the target-rate cahange are defined as $\Delta r_t^s = r_t^f - r_{t-1}^f$ and $\Delta r_t^e = \Delta r_t - \Delta r_t^s$, respectively, where r_{t-1}^f is the closing rate of the nearest-term Euro-Yen futures contract on the day before the starting date of the policy event, and r_t^f is the closing rate on the end date of the policy event. Δr_t, Δr_t^e, and Δr_t^s are all expressed in terms of percentage change. As mentioned above, Honda and Kuroki (2006) constructed these three variables for the period from August 1989 through March 2001 in which 55 policy shifts occurred.

Stock price data of individual firms are obtained from the stock price CD-ROM published by Toyo Keizai Inc. Stock returns of firm i, $\Delta s_{i,t}$, are calculated as the log difference between the stock price of firm i on the end date of the t-th policy event and its stock price on the day before the starting date of the policy event (multiplied by 100). Our sample is selected from the firms listed on the first or second section of the Tokyo Stock Exchange as of March 2001. However, we exclude finance and insurance companies from the sample. Furthermore, we use only the observations of firms whose accounting period ends in March each year, since we need to avoid a timing problem arising from different accounting periods. These procedures result in 56,774 observations of 1,525 firms in our sample.[9] We estimate Eqs.(4) and (5) by using the fixed effect estimation method with unbalanced panel data.

The left column in Table 1 reports the estimation result for Eq.(4). The estimate of the average impact of the raw call-rate change, β, has a negative sign and is significant. Almost all the dummy variables for macroeconomic news and fiscal year are significant, implying the need of controlling for these effects on individual stock returns.

The right column in Table 1 presents the estimation result for Eq.(5). The average effect of the expected policy change, β_1, is statistically insignificant. On the other hand, the average effect of the surprise component, β_2, is statistically significant and its size is much larger than the impact of the raw call-rate changes. Furthermore, the magnitude of this estimate is close to those reported by Honda and Kuroki (2006) (-2.59 for the Nikkei Stock Average and -2.90 for TOPIX). Therefore, we can replicate the results of Honda and Kuroki (2006) by using individual stock prices, instead of stock price indices.

3.2 Industry Specific Effects

In this subsection, as the first step to examine heterogeneity in monetary policy effects, we allow for cross-industry differences in the stock price reaction. The empirical model is given by the following equation:

$$\begin{aligned}\Delta s_{i,t} &= \alpha + \beta_1 \Delta r_t^e + \sum_{j=1}^{32} \beta_2^j Industry_{j,i} \Delta r_t^s \\ &\quad + \sum_{k=1}^{8} \tau_k MacroNews_{k,t} + \sum_{s=1989}^{1998} \rho_s FiscalYear_{s,t} + \mu_i + \epsilon_{i,t}, \qquad (6)\end{aligned}$$

[9] We also exclude the observations of firms whose leverage ratios, defined in Section 3.3, are below zero.

where $Industry_{j,i}$ is a dummy variable, which takes a value of one if firm i is classified in industry j and zero otherwise. Eq.(6) includes the interaction terms, the product of the surprise component and the industry dummy variable. Thus, the dispersion of coefficients on the interaction terms, β_2^j, measures cross-industry heterogeneity in monetary policy effects on the stock market.

Industry classification includes 32 industry groups, consisting of food, textiles, pulp and paper, chemistry, medicine, oil, rubber, ceramic, steel, nonferrous metal, machine, electric, shipbuilding, automobile, transport equipment, precision equipment, others manufacture, marine, mining, construction, trading, retail, real estate, railway and bus, land transportation, marine transportation, air transportation, warehouse, communications, power, gas, and service industries.

Table 2 provides the empirical result for Eq.(6), sorting 32 industry groups by the estimated magnitude of monetary policy effects. It is likely that there is a large cross-industry difference in stock price reactions. In particular, we point out three remarkable features in the estimation result. First, monetary policy surprises affect stock returns very strongly for the capital-intensive industries such as shipbuilding, railway and bus, power, and gas, which is consistent with the view of the conventional interest rate (or capital cost) channel. Second, monetary policy effects are relatively strong for real estate and construction industries. This may be because these industries had faced financial constraints more severely after the burst of the asset price bubble in the early 1990's. Finally, it is likely that monetary policy affects individual stock returns in different ways across the stage of the production process. The effects are relatively stronger in the upstream industries such as steel, rubber, chemistry, oil, mining, and ceramic, while they are weaker in downstream industries or consumption goods industries such as communications, automobile, service, precision equipment, and electric.

3.3 Firm Specific Effects

This subsection presents an in-depth study of the heterogeneity in monetary policy effects by focusing on the characteristics of individual firms. As described in the introduction, monetary policy could have different effects on individual stock returns through either the interest rate channel or the balance sheet channel. Therefore, we here examine whether the firm-specific characteristics associated with the interest rate or balance sheet channel account for the heterogeneous responses in stock markets.

To this end, the following empirical model is estimated:

$$\Delta s_{i,t} = \alpha + \beta_1 \Delta r_t^e + \beta_2 \Delta r_t^s + \sum_{j=1}^{7} \beta_3^j z_{i,j,t} \Delta r_t^s + \sum_{k=1}^{8} \tau_k MacroNews_{k,t} + \sum_{s=1989}^{1998} \rho_s FiscalYear_{s,t} + \mu_i + \epsilon_{i,t}, \qquad (7)$$

where $z_{i,j,t}$ is the characteristic j of firm i at the t-th policy event. The coefficient β_3^j on the interaction term, the product of the monetary policy surprise and the firm characteristic variable, measures the degree of heterogeneity in monetary policy effects.

In this paper, we use seven types of firm-specific characteristics for the variable $z_{i,j,t}$: capital intensity, openness, financial leverage, interest payment burden, short-term debt, working capital, and cash flow.[10] These variables are also employed by either Peersman and Smets (2005) or Dedola and Lippi (2005) or both, except for cash flow. Cash flow is often considered in the literature that examines the corporate investment with financial constraints (e.g., Fazzari et al. (1988) and Kaplan and Zingales (1997)). Capital intensity and openness are related to the interest rate channel and the remaining variables to the balance sheet channel, although some variables may capture both channels as described below.

Capital intensity is measured as the ratio of tangible fixed assets to the number of employees. The expected sign of β_3 is negative since firms that depend largely on capital in its production process seem to be more affected by monetary policy through changes in the user cost of capital (i.e., through the interest rate channel).

Openness is measured as the ratio of exports to sales volume.[11] It is not clear what sign is expected for openness. Monetary policy would affect the exchange rate through the interest rate channel, leading to greater effects on more open firms. In this case,

[10] In this paper we do not consider the firm's size indicators, such as total assets or the number of employees, which are often used as proxies for the degree of financial constraints in the literature. This is because our data includes only firms that are listed in equity markets, meaning that most of the firms in our sample are very large. We also do not consider the durability dummy Peersman and Smets (2005) and Dedola and Lippi (2005) employ as an indicator of demand sensitivity to the interest rate change, because inclusion of nonmanufacturing industries in our sample makes the classification between durable goods and nondurable goods more difficult.

[11] Import data for each firm is not available in the Nikkei NEEDS data base.

we expect a negative sign for β_3. However, more open firms would be less affected by monetary policy, since it is less exposed to changes in the domestic economy. If this effect dominates the exchange rate effect, then we would obtain a positive sign.

Financial leverage is measured as the ratio of total debt to total capital. It has two opposite aspects as an indicator of the degree of financial constraints. On the one hand, if a high leverage ratio is considered as a relatively strong possibility of bankruptcy, it means that the frim faces severe financial constraints. On the other hand, a high leverage ratio may be a result of high indebtedness capacity, suggesting that it is easier for the firm to obtain additional funds from financial markets. The sign of β_3 is expected to be negative for the former case, but the latter case requires a positive sign.

Interest payment burden is measured as the ratio of interest and discount expenses to sales volume. Firms with a higher interest burden are more sensitive to monetary policy through the usual interest rate channel. In addition, from the viewpoint of the balance sheet channel, monetary policy influences the net worth of firms through changes in interest payments, which induces firms with a higher interest burden to be more sensitive to monetary policy. On the other hand, as with financial leverage, high interest payments may be a signal of high borrowing capacity. In this case, we expect firms with a higher interest burden to be less affected by monetary policy.

Short-term debt is measured as the ratio of short-term debt to total debt. Since long-term rates are not as controllable by monetary policy as short-term rates, firms with higher short-term debt seem to be more sensitive to monetary policy changes. Furthermore, high short-term debt may indicate low capacity to access long-term financial markets if capital markets are imperfect. Thus, based on the theory of balance sheet channel, monetary policy would also have greater effects on firms with higher short-term debt.

Working capital is measured as the ratio of working capital (current assets − [current debt − short term loans]) to total assets. The sign to be expected is also not clear. On the one hand, working capital is an important indicator of the firm's default risk for creditors. Hence, higher levels of working capital make the cost of external finance low, implying that firms with higher working capital are less influenced by monetary policy. On the other hand, working capital is proxy for the short-term financial requirement (see Peersman and Smets (2005)). In this case, monetary policy effects are stronger for firms with relatively higher working capital.

Finally, *cash flow* is measured as the ratio of cash flow (profit + depreciation) to total assets. Firms that are more financially constrained may accumulate higher cash flow for funds for corporate investments because of the difficulty in obtaining external funds.[12] This means that monetary policy would have a larger influence on firms with higher cash flow. However, cash flow may be correlated with firm profitability of the future and thus capture profit expectations of investors. In this case, firms with higher cash flow would be less affected by monetary policy.

Financial data of individual firms are drawn from the Nikkei NEEDS Financial dataset. We construct the firm-specific variables z by subtracting the mean value of the entire observations. The use of demeaned variables makes the coefficient β_2 in Eq.(7) interpretable as the monetary policy effect for a firm with average values of all characteristics, since interaction terms are all zero for such a firm. The firm-specific variables z are entered into Eq.(7) with a lag of one fiscal-year in order to avoid an endogenous problem. For example, for the first policy event on 7-16 August 1989, we use the financial data of individual firms in the fiscal-year 1988.

Table 3 provides some summary statistics of the firm-specific variables (those before subtracting mean values). We can confirm enough dispersion for each firm-specific variable. Table 4 presents the correlations between any two of the firm-specific variables. These correlations are not large, except for the correlation between capital intensity and interest burden. It is worth emphasizing that the correlation between short-term debt and working capital is very low, implying that working capital hardly represents the short-term financial requirement in our sample.

Tables 5 and 6 show empirical results for the estimations of Eq.(7).[13] In Table 5 each of the interaction terms is included separately, while in Table 6 all the interaction terms are entered jointly. The estimated coefficients of the monetary policy surprise, β_2, range from -3.1 to -3.3, which are all close to the value reported in Table 1. This suggests that a

[12] Fazzari et al. (1988) and other many studies on corporate investments interpret the *coefficiant* on the cash flow varable, rather than cash flow itself, as the degree of financial constraint. Kaplan and Zingales (1997) theoretically and empirically show that higher investment sensitivity to cash flow is not necessarily interpreted as evidence that firms are more financially constrained.

[13] When we estimated Eq.(7) with outliers (observations above and below 3σ of each firm-specific variable) excluded from our sample, similar results were obtained. These results are available from the authors upon request.

1% surprise cut in the call-rate target increases stock returns by about 3% for firms with the firm-specific variable equal to its average.

We will see now what characteristics of firms account for the heterogeneous responses of individual stock returns from the estimates of β_3 in Tables 5 and 6. Capital intensity has the expected negative sign and is significant at a 1% level. This implies that firms with larger capital are more sensitive to changes in monetary policy, being consistent with the view of the conventional interest rate channel.

Openness has a positive sign and is significant at a 1% level, suggesting that more open firms are less affected by monetary policy. This result supports the hypothesis that more open firms are less exposed to changes in the domestic economy caused by monetary policy.

Firms with a higher leverage ratio are more sensitive to monetary policy surprises. This result contrasts with the findings of Dedola and Lippi (2005) and Ehrmann and Fratzscher (2004), as well as Peersman and Smets (2005) for boom periods. However, our result seems to be consistent with the Japanese case in the 1990s. Since many firms suffered from excess debt in the period, high leverage might be understood as an indicator of high risk of bankruptcy rather than an indicator of high borrowing capacity.

Firms with a higher interest burden are more affected by monetary policy surprises. This result does not support the hypothesis that a higher interest burden indicates greater borrowing capacity. Rather, our result is consistent with the interest rate channel. It is also consistent with the balance sheet channel in that monetary policy influences the net worth of a firm with a higher interest burden through changes in the policy rate.

In Table 5, the estimate of β_3 for short-term debt has the expected negative sign and is significant at a 5% level. However, the estimate has the positive sign and is insignificant in Table 6. Hence, the evidence for short-term debt is not clear.

Firms with higher working capital are less sensitive to monetary policy surprises. This result implies that working capital plays an important role as an indicator of the firm's default risk for creditors, rather than as an indicator of the short-term financial requirement.

Finally, the estimate of β_3 for cash flow has the positive sign in both tables. However, it is significant at a 10% level in Table 5 and insignificant in Table 6. Thus, the evidence for cash flow is rather weak.

In summary, a surprise decrease in the call-rate target of 1% leads, on average, to about a 3% increase in stock prices, but this effect is significantly larger for firms with high capital intensity, low openness, high leverage, high interest payment burden, and low working capital. It is possible to calculate the degree of such heterogeneous effects based on the result of Table 6. A 1% surprise cut in the call-rate target increases stock returns by 3.3% for an average firm, while such a surprise cut increases stock returns further by 0.47% for a firm with capital intensity of one standard deviation above the average, 0.61% for a firm with financial leverage of one standard deviation above the average, and 0.79% for a firm with interest burden of one standard deviation above the average. On the other hand, the response of stock returns for a firm with openness of one standard deviation above the average is 0.90% less than that of an average firm, and the response of stock returns for a firm with working capital of one standard deviation above the average is 0.59% less than that of an average firm.

4 Asymmetric Heterogeneity

Eq.(7) in the previous section implicitly assumes that heterogeneity in monetary policy effects is *symmetric* around the average value of each firm-specific variable. However, Ehrmann and Fratzscher (2004) found *asymmetric* responses to monetary policy changes. In this section, therefore, we relaxes the symmetric assumption and allows for asymmetric heterogeneity.

To this end, following Ehrmann and Fratzscher (2004), we divide our observations into three groups according to the position in the cross-sectional distribution of each firm-specific variable. We then allow for different coefficients on the interaction terms among the three groups. Specifically, we estimate for each firm-specific characteristic j the following regression model:

$$\begin{aligned} \Delta s_{i,t} &= \alpha + \beta_1 \Delta r_t^e + \sum_{p=l,m,h} \beta_2^p \ z\_dum_{i,j,t}^p \ \Delta r_t^s \\ &\quad + \sum_{k=1}^{8} \tau_k MacroNews_{k,t} + \sum_{s=1989}^{1998} \rho_s FiscalYear_{s,t} + \mu_i + \epsilon_{i,t}, \end{aligned} \tag{8}$$

where $z\_dum^l_{i,j,t}$, $z\_dum^m_{i,j,t}$, and $z\_dum^h_{i,j,t}$ denote dummy variables that take the value of unity if firm i belongs to the low, medium, and high categories of the firm-specific characteristic j, respectively. A firm is defined as the low category if its value of the firm-specific variable is in the bottom 33% (or in the bottom 10%) of the distribution, the high category if it is in the top 33% (or in the top 10%), and the medium category otherwise.

Table 7 provides empirical results for Eq.(8), the upper panel reporting the results for the 33%–67% categorization and the lower panel for the 10%–90% categorization. The results in this table are qualitatively similar to those reported in Table 5: negative reactions of stock returns for high-category firms are larger, in absolute values, than those for low-category firms in regard to capital intensity, financial leverage, interest burden, and short-term debt, while the reverse is true for openness, working capital and cash flow. Such differences between β_2^h and β_2^l are statistically significant for all firm-specific variables.

Asymmetric heterogeneous responses are found, except for financial leverage in the 33%–67% categorization and working capital in the 10%–90% categorization. That is, a difference between β_2^h and β_2^m and the one between β_2^m and β_2^l are not statistically equal for most of the firm-specific variables. For example, for the case of capital intensity in the 33%–67% categorization, a move from the middle category to the high implies about a 2% increase in the stock price reaction, whereas a shift to the low category leads to only a 1% decrease. Those results in Table 7 suggests that, in a future study, we may need to estimate non-linear models rather than linear models to investigate heterogeneity in more detail.

Finally, with regard to short-term debt, monetary policy has significantly weaker effects on low-category firms than on medium- and high-category firms, whereas it has similar effects on the latter two categories. This feature of the asymmetric response for short-term debt may cause the marginal significant estimate on the interaction term in Table 5.

5 Monetary Policy Effects in Expansion and Recession

We have assumed that monetary policy effects are stable over the full sample period. However, there might be structural changes in the magnitude of policy effects depending on economic conditions. In particular, as discussed in Garcia and Schaller (2002) and Peersman and Smets (2005), it is possible that monetary policy has different effects depending on whether the economy is in expansion or recession. In fact, Garcia and Schaller (2002) and Peersman and Smets (2005) provided evidence that monetary policy affected output more strongly in recessions than in expansions. There are at least two explanations for the evidence. The first explanation, which is related to the conventional interest rate channel, is that the short-run aggregate supply curve is convex reflecting a capacity constraint of firms. With the convexity of the aggregate supply curve, a shift of the aggregate demand curve caused by a monetary policy shock generates a larger change of output when output is low (i.e., the economy is in recession) than when it is high (i.e., the economy is in expansion). The second explanation, which is connected with the balance sheet channel, is that financial constraints are more likely to bind in recession than in expansion, since firms' net worth is typically low in recession. When financial constraint binds, fluctuations in firms' net worth lead to fluctuations in external financial premium and thus fluctuations in real activity. Therefore, monetary policy that affects the firms' net worth would have greater effects in recession than in expansion.

In order to examine whether monetary policy has different effects depending on the phases of the business cycle, in this section we split our sample into three subsamples. The first subsample is a *boom* period ranging from the beginning of our sample to the collapse of the asset price bubble (August 1989 – January 1991). The second subsample is a *mild recession* period in which Japanese economy has improved a little from the economic downturn in the 1990s (October 1993 – April 1997 and January 1999 – October 2000). The third subsample is a *recession* period mainly spanning the 1990s, but excluding the second subsample (February 1991 – September 1993, May 1997 – December 1998, and November 2000 – March 2001). Our identification of peaks and troughs of the Japanese business cycle follows the definition given by the Cabinet Office in Japan. However, as noted above, we distinguish economic expansions in the late 1980s from those in the 1990s: The former is defined in this paper as a *boom* reflecting a strong economy under the environment of elevated asset prices. On the other hand, the latter is called a *mild recession* since those expansions were not strong enough to recover the economy from a longstanding recession beginning in the early 1990s. The number of policy events (i.e., the time dimension of our panel data) is 12 for the boom, 23 for the mild recession, and 20 for the recession.

We estimate for each firm-specific characteristic j the following regression equation:

$$\begin{aligned}\Delta s_{i,t} &= \alpha + \beta_1 \Delta r_t^e + \sum_{p=b,mr,r} \beta_2^p \, bc\_dum_t^p \, \Delta r_t^s + \sum_{p=b,mr,r} \beta_3^p \, bc\_dum_t^p \, z_{i,j,t} \Delta r_t^s \\ &\quad + \sum_{k=1}^{8} \tau_k MacroNews_{k,t} + \sum_{s=1989}^{1998} \rho_s FiscalYear_{s,t} + \mu_i + \epsilon_{i,t}, \qquad (9)\end{aligned}$$

where $bc\_dum_t^b$, $bc\_dum_t^{mr}$, and $bc\_dum_t^r$ denote business cycle dummies that take the value of unity if the economy is in boom, mild recession, and recession, respectively. β_2^b, β_2^{mr}, and β_2^r measure average responses of stock returns to monetary policy surprises for each stage of bussines cycle. β_3^b, β_3^{mr}, and β_3^r indicate the degree of heterogeneity in policy effects for each stage of business cycle.

Table 8 reports estimation results for Eq.(9). Three main results are worth noting. First, the average impacts of monetary policy in the mild recession and recession are significantly larger than in the boom (that is, the estimates of β_2^{mr} and β_2^r are greater, in absolute value, than β_2^b for all specifications). Second, on the contrary, the heterogeneous effects of monetary policy are more remarkable in the boom (that is, the estimate of β_3^b is greater, in absolute value, than β_3^{mr} or β_3^r for all specifications). Third, there is no statistically significant difference in the average effects if comparing the mild recession with the recession. For the degree of heterogeneity, although the estimated values of β_3^{mr} and β_3^r appear to be somewhat different, there is also no statistically significant difference between the two estimates, except for openness and short-term debt. To sum up these three results above, monetary policy had larger effects, on average, in the post-1991 period (mild recession and recession periods) than in the pre-1991 period (boom period), while the degree of heterogeneity in monetary policy effects became smaller since the early 1990s.

The evidence of low heterogeneity since the early 1990s seems to be odd, because both interest rate and balance sheet channels predict greater effects in recessions as described above. However, note that the average response, β_2, captures not only the effects associates with the interest rate channel, but also the effects stemming from the balance sheet channel. Thus, we should see the *total effect* (the sum of the average effect and the heterogeneous one), if we would like to determine whether monetary policy has stronger effects in recessions or booms. Table 9 gives the ranges of the total responses of stock returns to a 1% surprise increase in the call-rate target, calculated from the estimates in Table 8. If β_3^p ($p = b, mr$, or r) in Table 8 is negative (positive), the left figure in the corresponding bracket in Table 9 indicates a total response of the firm lying on the 90 percentile (the 10 percentile) of the firm-specific-variable distribution, and the right figure the 10 percentile (the 90 percentile). That is, each range in the table provides a set of the total responses for firms that are in the middle 80% of the firm-specific variable.

Table 9 shows that there is no overlapping portion in the ranges of total effects between boom and recession, or between boom and mild recession. Namely, decreases in the degree of heterogeneity since the early 1990s are trivial relative to the increases in average effects. It is likely that many firms were financially constrained in the post-1991 period. Thus, it is not surprising that a large part of monetary policy effects associated with the balance sheet channel were reflected as the average effect rather than the heterogeneous one in the post-1991 period. Similarly, for the policy effects associated with the interest rate channel, the average effect might dominate the heterogeneous effect in the period.

Miyao (2000), Fujiwara (2006), and Inoue and Okimoto (2008) provided evidence that there were significant effects of the call-rate shocks on macroeconomic variables, such as output and price, during the period from 1975 to the mid 1990s, but that such effects have diminished since the mid-1990s. Combining their results with ours, monetary policy during the 1990s had significant effects at least on equity markets, but it was not large enough to stimulate real economic activity. In other words, investors expected greater effects of monetary policy in the 1990s, but in fact its policy turned out to be ineffective in stimulating Japanese economy. The ineffectiveness for macroeconomy since the mid-1990s may be due to a zero interest rate bound or a weak financial system. Further study would be needed to investigate why Japanese monetary policy had significant effects on equity markets, but no or small effects on macroeconomy in the *lost decade*.

6 Conclusion

This paper has investigated the effects of Japanese monetary policy on equity markets by using *firm-level* data. Our goal was to examine whether there existed the heterogeneous response of stock returns among firms, and if any, what firm-specific characteristics could account for such heterogeneity. To this end, we tried to divide stock price responses into the average and heterogeneous ones, and link the heterogeneous responses to firm-specific characteristics associated with the theory of monetary transmission mechanism. In order to avoid the endogenous problem, this paper adopted the event-study approach with the expected and surprise components of policy-rate changes, which were constructed by Honda and Kuroki (2006).

Several results are obtained and summarized as follows. First, a 1% cut in the call-rate target increases stock returns by about 3% *on average*, which is very close to the estimated value by Honda and Kuroki (2006). Second, there are significant differences in monetary policy effects across industries. Third, the heterogeneous responses of individual stock returns were accounted for by the firm-specific characteristics associated with the theory of monetary transmission mechanism. In particular, monetary policy effects are greater for firms with high capital intensity, low openness, high leverage, high interest payment burden, and low working capital. This suggests that heterogeneity of monetary policy effects in Japan is attributable to both interest rate and balance sheet channels. Fourth, the heterogeneous response of individual stock returns is asymmetric for most of the firm-specific characteristics. This result implies that we may need to estimate non-linear models in a future study to investigate heterogeneity in more detail. Finally, monetary policy effects on equity markets are greater in the recession period of the 1990s than the boom period of the late 1980s. The evidence is consistent with the predictions on the basis of the interest rate channel as well as the balance sheet channel. Moreover, the larger effect in the 1990s is not reflected in the heterogeneous response of stock returns but in the average response.

Ogawa (2000), Hosono and Watanabe (2002), Suzuki (2004) and others found that the balance sheet channel of monetary policy worked in the real side of Japanese economy (e.g., firms' fixed investments or output). Our empirical results partially support their evidence from the viewpoint of equity market. However, it is impossible in our study to determine which channel, balance sheet channel or interest rate channel, is dominant during the 1990s in Japan. In the future, we would like to separate more rigorously the policy effect through the balance sheet channel from the one through the interest rate channel. Honda and Kuroki (2006) (and we) showed that monetary policy had significant effects on Japanese stock markets, even though a large part of their (and our) sample period comprises the low interest rate era in the 1990s. Furthermore, it is found from our analysis that the effect on equity markets is largely attributed to the monetary policy during the recession of the 1990s. Combining evidence shown by Miyao (2000), Fujiwara (2006), and Inoue and Okimoto (2008), it follows that BOJ's monetary policy in the 1990s had impacts at least on equity markets, but that it was not large enough to stimulate real economic activity. Exploring reasons of the phenomenon will be also a topic of our future research.

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Table 1: Average impact of monetary policy on individual stock returns

Variable	**Eq.(4)**	**Eq.(5)**
α	0.504**	0.587**
	(0.090)	(0.090)
β	-1.790**	
	(0.136)	
β_1		-0.130
		(0.224)
β_2		-3.208**
		(0.206)
Dummy for		
Announcement	0.971**	1.017**
	(0.051)	(0.052)
GDP	-3.249**	-3.105**
	(0.116)	(0.119)
Tankan	2.331**	2.037**
	(0.095)	(0.096)
Unemployment	-6.277**	-5.506**
	(0.167)	(0.184)
Business conditions	6.716**	7.170**
	(0.123)	(0.131)
IIP	3.316**	2.904**
	(0.128)	(0.133)
CPI	3.555**	2.941**
	(0.116)	(0.130)
WPI	0.396**	0.258**
	(0.052)	(0.054)
1989	-2.015**	-1.889**
	(0.138)	(0.139)
1990	-1.888**	-1.907**
	(0.114)	(0.113)
1991	-1.713**	-1.282**
	(0.119)	(0.134)
1992	-6.730**	-6.605**
	(0.144)	(0.144)
1993	-0.792**	-0.790**
	(0.110)	(0.110)
1994	-0.160	-0.078
	(0.104)	(0.104)
1995	-2.252**	-2.152**
	(0.119)	(0.120)
1996	-0.021	-0.218†
	(0.113)	(0.116)
1997	-0.549**	-0.540**
	(0.188)	(0.188)
1998	-0.686**	-0.861**
	(0.111)	(0.113)
Obs.	56774	56774
R^2	0.194	0.196

Notes: Values in parentheses are heteroskedasticity robust standard errors. **, *, † indicates significance at the 1, 5, and 10% levels, respectively.

Table 2: Industry-specific effects of monetary policy

Variable		
α	0.582**	(0.090)
β_1	-0.132	(0.224)
β_2^j:		
Shipbuilding	-8.935**	(2.457)
Railway & Bus	-8.642**	(0.769)
Power	-8.606**	(0.551)
Gas	-7.762**	(1.567)
Real Estate	-7.382**	(1.418)
Marine	-6.424**	(1.935)
Marine Transportation	-6.300**	(1.072)
Construction	-5.415**	(0.544)
Medicine	-5.394**	(0.835)
Warehouse	-5.358**	(1.534)
Land Transportation	-5.327**	(1.113)
Pulp & Paper	-5.276**	(1.270)
Steel	-4.803**	(0.952)
Rubber	-4.552**	(1.573)
Chemistry	-4.433**	(0.491)
Oil	-4.414**	(0.964)
Mining	-4.196**	(1.294)
Others Manufacture	-3.798**	(0.858)
Trading	-3.720**	(0.674)
Ceramic	-3.639**	(1.079)
Air Transportation	-3.509**	(0.839)
Food	-3.410**	(0.594)
Retail	-3.328*	(1.387)
Textiles	-3.079**	(0.840)
Transport Equipment	-2.413	(1.532)
Nonferrous Metal	-2.220**	(0.745)
Machine	-1.791**	(0.529)
Communications	-1.594	(2.218)
Automobile	-1.361*	(0.611)
Service	-1.321†	(0.772)
Precision Equipment	-1.267	(1.206)
Electric	0.684	(0.463)
Obs.	56774	
R^2	0.199	

Notes: Values in parentheses are heteroskedasticity robust standard errors. **, *, † indicates significance at the 1, 5, and 10% levels, respectively. The parameter estimates of the macroeconomic news and fiscal year dummies are suppressed.

Table 3: Descriptive statistics of firm-specific variables

Variable	Mean	Std. Dev.	Min	Max
Cap. int.	24.430	52.174	0.076	873.779
Open.	0.094	0.146	0.000	0.997
Lev.	2.908	5.908	0.032	664.571
Int. burden	0.019	0.029	0.000	1.202
Short. debt	0.151	0.139	0.000	0.851
Work. cap.	0.279	0.153	-0.480	0.894
Cash flow	0.046	0.041	-1.082	1.684

Table 4: Cross-correlations of firm-specific variables

	Cap. Int.	Open.	Lev.	Int. burden	Short. debt	Work. cap.	Cash flow
Cap. Int.	1						
Open.	-0.122	1					
Lev.	0.038	0.001	1				
Int. burden	0.417	-0.062	0.158	1			
Short. debt	-0.020	-0.050	0.266	0.179	1		
Work. cap.	-0.229	0.141	-0.134	-0.199	0.065	1	
Cash flow	0.011	-0.025	-0.217	-0.120	-0.251	-0.097	1

Table 5: Firm-specific effects of monetary policy (Separate Estimation)

	Cap. int.	Open.	Lev.	Int. burden	Short. debt.	Work. cap.	Cash flow
α	0.590**	0.586**	0.583**	0.569**	0.588**	0.593**	0.590**
	(0.090)	(0.090)	(0.090)	(0.090)	(0.090)	(0.090)	(0.090)
β_1	-0.127	-0.134	-0.131	-0.090	-0.128	-0.127	-0.130
	(0.224)	(0.224)	(0.224)	(0.224)	(0.224)	(0.224)	(0.224)
β_2	-3.257**	-3.187**	-3.178**	-3.184**	-3.193**	-3.258**	-3.258**
	(0.205)	(0.205)	(0.204)	(0.204)	(0.206)	(0.203)	(0.207)
β_3	-0.021**	7.425**	-0.181**	-47.397**	-2.690*	6.547**	14.066†
	(0.003)	(1.103)	(0.042)	(11.805)	(1.268)	(1.100)	(0.207)
Obs.	56774	56774	56774	56774	56774	56774	56774
R^2	0.196	0.196	0.196	0.197	0.196	0.196	0.196

Notes: Values in parentheses are heteroskedasticity robust standard errors. **, *, † indicates significance at the 1, 5, and 10% levels, respectively. The parameter estimates of the macroeconomic news and fiscal year dummies are suppressed.

Table 6: Firm-specific effects of monetary policy (Joint Estimation)

	Cap. int.	Open.	Lev.	Int. burden	Short. debt.	Work. cap.	Cash flow
α	0.581^{**}						
	(0.090)						
β_1	-0.108						
	(0.225)						
β_2	-3.252^{**}						
	(0.204)						
β_3	-0.009^{**}	6.146^{**}	-0.104^{*}	-27.323^{**}	0.186	6.547^{**}	10.924
	(0.003)	(1.089)	(0.045)	(10.353)	(1.418)	(1.195)	(9.412)
Obs.	56774						
R^2	0.198						

Notes: Values in parentheses are heteroskedasticity robust standard errors. **, *, † indicates significance at the 1, 5, and 10% levels, respectively. The parameter estimates of the macroeconomic news and fiscal year dummies are suppressed.

Table 7: Asymmetric heterogeneity in monetary policy effects

	Cap. int.	Open.	Lev.	Int. burden	Short. debt	Work. cap.	Cash flow
				33%–67% Categorization			
α	0.595**	0.589**	0.581**	0.553**	0.585**	0.592**	0.589**
	(0.090)	(0.090)	(0.090)	(0.090)	(0.090)	(0.090)	(0.090)
β_1	-0.125	-0.137	-0.112	-0.080	-0.127	-0.133	-0.128
	(0.224)	(0.224)	(0.224)	(0.225)	(0.224)	(0.224)	(0.224)
β_2^h	-4.949**	-2.303**	-4.814**	-4.666**	-3.595**	-1.941**	-2.324**
	(0.299)	(0.338)	(0.301)	(0.297)	(0.303)	(0.312)	(0.304)
β_2^m	-3.037**	-3.440**	-3.091**	-3.341**	-3.644**	-3.446**	-3.166**
	(0.305)	(0.292)	(0.297)	(0.291)	(0.310)	(0.306)	(0.296)
β_2^l	-2.073**	-3.882**	-1.375**	-1.382**	-2.316**	-4.366**	-4.351**
	(0.312)	(0.312)	(0.306)	(0.319)	(0.301)	(0.292)	(0.325)
Obs.	56774	56774	56774	56774	56774	56774	56774
R^2	0.197	0.196	0.196	0.197	0.196	0.196	0.196
				10%–90% Categorization			
α	0.591**	0.586**	0.580**	0.559**	0.585**	0.590**	0.589**
	(0.090)	(0.090)	(0.090)	(0.090)	(0.090)	(0.090)	(0.090)
β_1	-0.123	-0.134	-0.124	-0.091	-0.130	-0.126	-0.129
	(0.224)	(0.224)	(0.224)	(0.224)	(0.224)	(0.224)	(0.224)
β_2^h	-6.959**	-0.324	-6.183**	-6.762**	-3.566**	-1.741**	-1.443**
	(0.428)	(0.544)	(0.531)	(0.486)	(0.544)	(0.541)	(0.520)
β_2^m	-3.083**	-3.298**	-3.016**	-3.032**	-3.477**	-3.231**	-3.336**
	(0.220)	(0.248)	(0.221)	(0.214)	(0.231)	(0.223)	(0.220)
β_2^l	-1.408**	-3.881**	-1.040*	-0.327	-1.883**	-4.781**	-4.478**
	(0.535)	(0.312)	(0.521)	(0.589)	(0.392)	(0.519)	(0.646)
Obs.	56774	56774	56774	56774	56774	56774	56774
R^2	0.197	0.196	0.197	0.197	0.196	0.196	0.196

Notes: Values in parentheses are heteroskedasticity robust standard errors. **, *, † indicates significance at the 1, 5, and 10% levels, respectively. The parameter estimates of the macroeconomic news and fiscal year dummies are suppressed.

Table 8: Monetary policy effects in boom, mild recession, and recession

	Cap. int.	Open.	Lev.	Int. burden	Short. debt.	Work. cap.	Cash flow
β_2^b	-1.036**	-0.786*	-0.693*	-0.850*	-0.727*	-1.098**	-1.414**
	(0.346)	(0.345)	(0.346)	(0.344)	(0.351)	(0.340)	(0.360)
β_2^{mr}	-4.388**	-4.438**	-4.438**	-4.489**	-4.428**	-4.422**	-4.472**
	(0.349)	(0.351)	(0.350)	(0.351)	(0.350)	(0.350)	(0.356)
β_2^r	-5.218**	-5.199**	-5.199**	-5.090**	-5.175**	-5.224**	-5.210**
	(0.338)	(0.337)	(0.337)	(0.338)	(0.340)	(0.336)	(0.341)
β_3^b	-0.028**	13.767**	-0.423**	-85.020**	-8.875**	11.459**	55.577**
	(0.007)	(2.449)	(0.069)	(10.983)	(2.207)	(1.840)	(10.323)
β_3^{mr}	-0.017**	2.496†	-0.091†	-25.163*	-2.402	1.887	-4.413
	(0.004)	(1.438)	(0.055)	(11.042)	(1.702)	(1.525)	(12.224)
β_3^r	-0.014**	7.627**	-0.103†	-38.356**	4.650*	5.039**	0.925
	(0.003)	(1.833)	(0.056)	(13.897)	(2.143)	(1.829)	(9.056)
Obs.	56774	56774	56774	56774	56774	56774	56774
R^2	0.198	0.198	0.198	0.198	0.197	0.198	0.198

Notes: Values in parentheses are heteroskedasticity robust standard errors. **, *, † indicates significance at the 1, 5, and 10% levels, respectively. The parameter estimates of intercept, expected change, and the macroeconomic news and fiscal year dummies are suppressed.

Table 9: The ranges of the total responses of stock returns to a 1% monetary tightening

	Boom	Mild recession	Recession
Cap. int.	[-1.344, -0.453]	[-4.810, -4.085]	[-5.550, -4.945]
Open.	[-2.082, 1.357]	[-4.673, -3.979]	[-5.917, -3.794]
Lev.	[-2.199, 0.238]	[-4.699, -4.217]	[-5.493, -4.949]
Int. burden	[-2.621, 0.439]	[-4.907, -4.064]	[-6.459, -4.405]
Short. debt.	[-2.499, 0.615]	[-4.906, -4.065]	[-5.878, -4.249]
Work. cap.	[-3.032, 1.406]	[-4.803, -4.062]	[-6.241, -4.261]
Cash flow	[-2.968, 1.060]	[-4.628, -4.295]	[-5.247, -5.177]

Note: Each range provides a set of the total responses (the sum of the average response and the heterogeneous one) of stock returns to a 1% surprise increase in the call-rate target, for firms that are in the middle 80% of the firm-specific variable.