# INVESTMENT SENSITIVITY: THE LEVEL EFFECTS OF INTEREST RATE AND UNCERTAINTY

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## ABSTRACT

*This paper shows that corporate investment sensitivity to interest rates is substantially influenced by the absolute level of interest rates and the uncertainties faced by firms. Using Korean data, we find that when the market interest rate is sufficiently low, interest rate variation has no effect on a firm's investment decisions. In addition, the sensitivity of corporate investment to the interest rate weakens when a firm is characterized by high performance uncertainty. Our study implies that under low market interest rates and uncertainty, monetary easing does not stimulate investment as expected. These results indicate that uncertainty must be eliminated and normal market interest rates must be recovered for monetary policy to be effective.*

**Keywords:** Level Effect, Investment Sensitivity, Interest Rate, Uncertainty, Monetary Easing, Financial Crisis.

**JEL Classification:** D22, E43.

## INTRODUCTION

In theory, a decrease in interest rates incentivizes corporate investment by reducing the cost of corporate finance. However, the sensitivity of corporate investment to interest rates is not fixed and is expected to vary with changes in the funding market and/or the future prospects of a company. In this study, we examine the sensitivity of corporate investment to interest rates based on the level of the overall market interest rate and/or depending on the degree of uncertainty a company faces. We expect to generate useful knowledge regarding the current stagnation of corporate investment at low interest rates.

Since the global financial crisis, low interest rates have been sustained on a global basis. In line with this global trend, the Korean central bank (the Bank of Korea) has maintained low interest rates in recent years through several interest rate cuts. As shown in <Figure 1>, the Bank of Korea's target interest rate has dropped 1.75% from 3.25% in 2012 to 1.50% in 2015, and this rate has maintained its downward trend since 2012. Traditional macroeconomic theory predicts that such low interest rates will reduce the cost of corporate finance and promote corporate investment as a result. However, in contrast to this theoretical prediction, Korea's gross domestic investment ratio – defined as the ratio of gross domestic capital formation to gross national disposable income – has continued to drop since 2012. In fact, <Figure 1> shows that the gross domestic investment ratio declined from 33.70% in the first quarter of 2012 to 28.10% in the first quarter of 2015.



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## LITERATURE REVIEW

This pattern implies that the effects of the low interest rate on corporate investment may have diminished recently. In this light, we examine the causes of investment insensitivity to the interest rate. Because low interest rates have been the norm since the global financial crisis and in light of the high uncertainty of the global economy, we anticipate that the already low interest rates and the high uncertainty faced by firms may be related as the cause of the current paradox. However, the literature has not investigated variations in corporate investment sensitivity to interest rates. Using Korean firm data, we investigate whether the sensitivity of investment to interest rates varies with the market interest rate and the uncertainty a firm confronts. The advantages of Korean data are as followings.

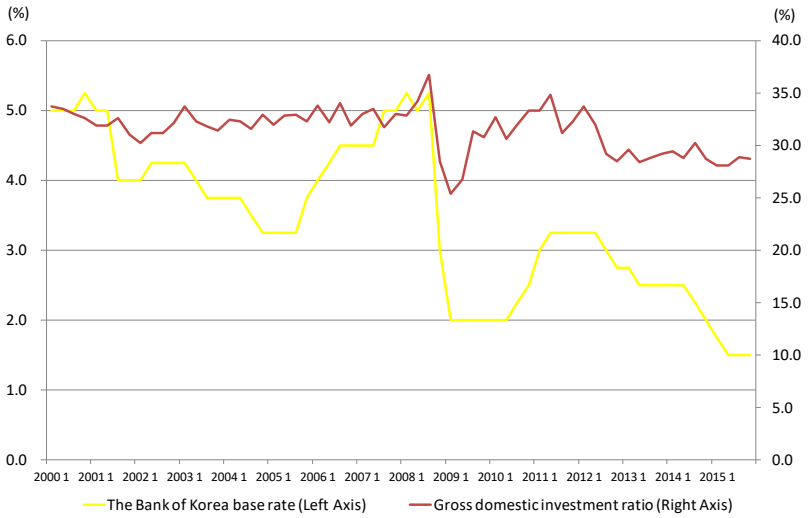


**FIGURE 1**
**THE BANK OF KOREA BASE RATE AND GROSS DOMESTIC INVESTMENT RATIO**

The empirical results show that when the market interest rate is low, corporate investment sensitivity to the interest rate is also low, which is consistent with Shape and Suarez (2015). In addition, we test whether uncertainties faced by firms are related to the sensitivity of investment to the interest rate. To measure the uncertainties faced by individual firms, we construct a forward-looking uncertainty measure using analysts' earnings forecast dispersion. We find that high uncertainty mitigates the sensitivity of corporate investment to the interest rate.

This study thus offers useful insights for both academia and policy makers. First, rather than ignoring the effects of interest rates or emphasizing the role of other factors in determining corporate investment, this study documents that corporate investment sensitivity to interest rates varies based on the applicant's economic situation. Thus, it has meaningful implications with regard to why investment can be stagnant even when interest rates are low. Second, this result is also important to the monetary policy authority that sets target interest rates. The results imply that when uncertainty is high or the current interest rate is sufficiently low, monetary easing may not be as effective as expected. Third, the results indicate that uncertainty should be eliminated and normal market interest rates must be recovered for monetary policy to markedly affect investment.



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Previous studies have noted that the sensitivity of investment to funding costs may not be stable. Chirinko (1993) derives the elasticity of investment with respect to the user cost of capital and demonstrates that the short-run effects of changes in the user costs of capital on investment are not as strong as the long-run effects. Coulibaly and Millar (2007) derive demand elasticity related to user costs for small open economies, which differs from other studies documenting insignificant estimates from U.S. data.

However, another line of research has found that the long-term investment elasticity of all-in-user costs may not be higher because high uncertainty – and asymmetric adjustment costs – may lead managers to defer irreversible decisions (such as investment) until more explicit information is available (Dixit, 1991). In addition to the interest rate, other components of the user costs of capital have been highlighted in other studies. Philippon (2009) examines the role of the bond market's q, which may be a combined measure of the real interest rate and the credit spread, and finds that it outperforms the usual q for investment decisions because the credit spread can reflect both the bond market's ability to represent future economic fundamentals (such as profits and default probabilities) and user costs of capital. Aastveit et al. (2013) investigate the effects of monetary policy on the real economy under conditions of uncertainty. Using stock price volatility as a proxy of business uncertainty, these authors find that the sensitivity of investment to interest rates may decrease under high uncertainty because the uncertainty can help managers postpone irreversible investment decisions. Recently, Sharpe and Suarez (2015) produce survey data from U.S. CFOs and find that if interest rates are low enough, CFOs may not set up additional investment plans despite the decline in interest rates. These results suggest that there may be a nonlinear relationship between interest rates and the investment decisions of individual firms.

In spite of the doubts regarding interest rates as a determinant of investment, the macroeconomic literature has long discussed the effects of interest rates on investment. These studies take different perspectives from those studies that regard interest rates as a measure of user costs of capital in that monetary policy is emphasized as a means of controlling the economy. As part of the bank lending mechanism, the common view in economics is that monetary policy affects deposits, which are the source of bank loans. Bernanke and Blinder (1988) document this bank lending channel of monetary policy. Tightening monetary policy incentivizes bank deposits to leave the banking system and leads banks to reduce their loan volume. Walsh (2010) also indicate that central banks can directly adjust banks' deposits by regulating reserves and the monetary multiplier mechanism. Other studies highlight an alternative monetary policy transmission mechanism using bank portfolio rebalancing (Kishan & Opiela 2006; Ehrmann et al., 2001), as such rebalancing may influence households' optimal savings and investment decisions. In any event, central banks can play a crucial role in incentivizing banks to change loans by tightening the money supply and increasing banks' funding costs. Central bank monetary policy with interest rate adjustments affects macroeconomic activity through various channels. Disyatat (2011) shows that monetary policy influences bank lending, but the effect varies based on the soundness of banks' balance sheet and their risk perception. Apergis et al. (2012) establish an endogenously determined policy interest rate that is estimated from the central bank's monetary policy rule. These authors examine the bank lending channel to consider how central bank policy affects both deposits and the loan supply of commercial banks, in addition to household consumption. Recently, Apergis and Christou (2014) find that the effects of monetary policy weaken when the policy rate approaches the zero lower bound, which is in line with the recent economic downturns of the EU since the global financial crisis. These



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authors further find that the effects of monetary policy on bank loans becomes ineffective below a critical interest rate level and completely ineffective as the policy rate approaches the zero lower bound. Gaiotti et al. (2014) support this result with firm-level micro data. As individual firms have different levels of leverage, each firm pays different interest expense based on their liabilities. Thus, changes in monetary policy may have different effects on each firm because an increase in the interest rate increases the marginal production costs of highly leveraged firms.

Our study departs from previous studies for the following reasons. Because the interest rate is a key variable in monetary policy, we investigate the effects of interest rates on firm investment. However, following the previous literature questioning the effects of the interest rate and introducing other important determinants of investment, we consider other factors that influence firms' investment. We attempt to find the cause of the interruption of the interest rate effect by examining the current economic situation in the wake of the global financial crisis. Thus, the sensitivity of investment to interest rates is generally more observable in microeconomic data because it provides sufficient sample size for both low- and high- interest rate periods.

## METHODOLOGY

### Model Specification

We divide the main sample into two groups based on the market interest rate and the sample firms' performance uncertainty to examine the effects of the current interest rate and uncertainty on the sensitivity of corporate investment to interest rates. Based on previous research, we find that the following characteristics (along with the interest rate) are the main factors involved in determining firm investment.

First, if a firm is exposed to high performance uncertainty, its management is expected to defer decisions involving new investment projects. Undertaking a new investment can be very costly and difficult to reverse.

Second, a firm's leverage may affect corporate investment decisions. There may be two ways in which leverage affects corporate investment. First, interest is payable based on previously established terms and conditions, regardless of a firm's performance. Second, high leverage may act as a financial constraint that can dampen corporate investment. Highly leveraged firms must operate under high default risk because even a small external shock can cause capital impairment.

Third, another important factor for a firm is its Tobin's Q. Tobin's Q is defined as the market value of total assets divided by the replacement cost of those assets. Thus, a high Tobin's Q indicates that the capital market has a high evaluation of the value of firm relative to its asset replacement value.

Fourth, we expect that a firm's investment is also a function of its performance expectations. If a firm expects its future performance to improve, the expected profits related to current investment may also increase. Such a firm is more likely to increase investment to reap future profitable outcomes (Malkiel et al. 1979; Gennaioli et al. 2015).

Following this line of logic, we establish the following regression model. We additionally include the proportion of short-term debt to total debt because when financing investments, a firm is expected to use long-term as opposed to short-term debt.

$$Inv_{i,t+1} = \beta_0 + \beta_1 Loanrate_{i,t} + \beta_2 Disp_{i,t} + \beta_3 Lev_{i,t} + \beta_4 Q_{i,t} + \beta_5 Saler_{i,t} + \beta_6 Shortshare_{i,t} + \varepsilon_{i,t}$$



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**Table 1**
**DEFINITION OF KEY VARIABLES**

| Variables | Descriptions |
|---|---|
| $Inv_{i,t+1}$ | Investment, measured as the growth rate of a firm's tangible assets from year *t* to year *t+1;* |
| $Loanrate_{i,t}$ | The loan interest rate, measured as interest rate expenses for the sum of short-term bond, short term loan, the current portion of long-term liability, firm bond, long-term loan and financial lease liability during year *t*; |
| $Disp_{i,t}$ | Earnings uncertainty, estimated as analyst operating income forecast dispersion for year *t+1* at the end of year *t*; |
| $Lev_{i,t}$ | Leverage, measured as the ratio of liabilities to total assets at year *t;* |
| $Q_{i,t}$ | Tobin's Q, measured as the market value of total assets (sum of market capitalization and liability) divided by total assets at year *t*; |
| $Saler_{i,t}$ | Sales growth rate expectation, estimated as analysts' sales forecast growth rate for year *t+1* at the end of year *t*; |
| $Shortshare_{i,t}$ | Share of short-term debt to total debt, measured as the sum of short-term bond, short-term loan and current portion of long-term liability to the sum of short-term bond, short-term loan and current portion of long-term liability, firm bond and long-term loan at the end of year *t*; |

The sample data were constructed from Fnguide, a database of Korean listed companies, over the period ranging from 2004 to 2014. As this study primarily relies on firm-level data, we use analysts' operating income and sales forecasts to provide forward-looking estimations of firm financial information because the regression model requires firm-level uncertainty and firm-level expected sales growth rates, which are not directly observable with firm-level historical financial data.

## RESULTS AND DISCUSSION

### Empirical Results

Before investigating the sensitivity of corporate investments to interest rates, the reliability of the basic model must be assessed by comparing the multiple regression results with the expected signs. Industry and year fixed effects are included in the model. In addition, we estimate clustered standard errors by firm and year, following Petersen (2009).[1] Table 3 (baseline) presents the multiple regression results. Consistent with our expectations, Loanrate (*Loanrate*) and uncertainty (*Disp*) are significantly negatively related to corporate investment (*Inv*). In addition, Tobin's Q (*Q*) and expectations of sales growth rate (*Saler*) are positively related with corporate investment. These results are consistent with previous research predicting that higher interest rates and/or higher uncertainty will reduce corporate investment, whereas higher Tobin's Q and higher sales expectations lead to increased corporate investment. These results imply that our model is properly constructed.

To examine the effects of low interest rates on the sensitivity of corporate investment to interest rates, we test whether the interest rate sensitivity of corporate investment changes based on the market interest rate by dividing our sample into two groups. First, we separate the sample period into high interest rate periods (2004, 2006-2008) and low interest rate periods (2005, 2009-2014) based on the Korean money market rate (the Korean call rate). Second, we divide the sample period into a pre-crisis period (2004~2007) and a post-crisis period (2010~2014) because the market interest rate has been low in the wake of the global financial crisis. In addition, we re-estimate our model in each subgroup and examine the changes in the sensitivities of corporate



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investment to interest rates.

$$Inv_{i,t+1} = \beta_0 + \beta_1 Loanrate_{i,t} + \beta_2 Disp_{i,t} + \beta_3 Lev_{i,t} + \beta_4 Q_{i,t} + \beta_5 Saler_{i,t} + \beta_6 Shortshare_{i,t} + \varepsilon_{i,t}$$

**Table 3**
**CORPORATE INVESTMENT AND THE INTEREST RATE BASED ON THE CALL RATE BEFORE AND AFTER FINANCIAL CRISIS**

| | | Division based on call rate level | | Division before and after global financial crisis | |
|---|---|---|---|---|---|
| ***Dep Variable :*** | **Baseline** | **High call rate** | **Low call rate** | **Before** | **After** |
| $Loanrate_{i,t}$ | -0.150** | -0.159*** | -0.134 | -0.110** | 1.186 |
| | (0.065) | (0.054) | (0.564) | (0.050) | (1.409) |
| $Disp_{i,t}$ | -0.167*** | -0.216** | -0.096** | -0.179*** | -0.097** |
| | (0.056) | (0.091) | (0.038) | (0.069) | (0.041) |
| $Lev_{i,t}$ | -0.090 | -0.046 | -0.141* | -0.027 | -0.087 |
| | (0.116) | (0.234) | (0.081) | (0.233) | (0.090) |
| $Q_{i,t}$ | 0.035** | 0.056*** | 0.029 | 0.045*** | -0.001 |
| | (0.016) | (0.011) | (0.026) | (0.005) | (0.036) |
| $Saler_{i,t}$ | 0.354*** | 0.470** | 0.177 | 0.478*** | 0.101 |
| | (0.128) | (0.205) | (0.117) | (0.185) | (0.126) |
| $Shortshare_{i,t}$ | -0.048 | 0.018 | -0.130*** | -0.024 | -0.088* |
| | (0.034) | (0.023) | (0.049) | (0.048) | (0.049) |
| *Constant* | 0.114* | 0.024 | 0.209** | 0.041 | 0.003 |
| | (0.061) | (0.107) | (0.088) | (0.124) | (0.033) |
| *N of Obs* | 1,003 | 501 | 502 | 506 | 377 |
| *R-sq* | 0.1653 | 0.2016 | 0.1956 | 0.2451 | 0.2082 |

The second and third columns in Table 3 show the results divided by the money market rate. Consistent with our expectations, *Loanrate* has a significantly negative effect on corporate investment only in the high interest rate condition. Conversely, corporate investment is not sensitive to the interest rate when the money market rate is low. However, performance uncertainty is significantly negatively correlated with corporate investment regardless of the market interest rate. We compare the sensitivity of corporate investment to interest rates across the pre- and post-crisis periods in the fourth and fifth columns. The results are similar to prior cases in which the sample is divided by the market interest rate. *Loanrate* has significant negative effects on corporate investment only in the pre-crisis period, whereas corporate investment becomes insensitive to interest rates following the global financial crisis. These results suggest that interest rate changes may have limited effects on corporate investment when the overall market interest rate is low.

In Table 4, corporate investment responds to interest rates when performance uncertainty is low (third column). However, under high performance uncertainty, corporate investment does not react to the level of the interest rate. Instead, under high performance uncertainty, investment tends to respond to uncertainty itself, to stock market valuations (Tobin's Q) and to sales growth rate expectations, which represent the company's future outlook. These results imply that changes in interest rates may not be effective at facilitating investment by a firm that is facing high performance uncertainty.

$$Inv_{i,t+1} = \beta_0 + \beta_1 Loanrate_{i,t} + \beta_2 Disp_{i,t} + \beta_3 Lev_{i,t} + \beta_4 Q_{i,t} + \beta_5 Saler_{i,t} + \beta_6 Shortshare_{i,t} + \varepsilon_{i,t}$$



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**Table 4**
**CORPORATE INVESTMENT AND INTEREST RATE BASED ON UNCERTAINTY**

| | | Division based on performance uncertainty | |
|---|---|---|---|
| ***Dep Variable :*** | **Baseline** | **High uncertainty** | **Low uncertainty** |
| $Loanrate_{i,t}$ | -0.150** | 0.011 | -0.295** |
| | (0.065) | (0.194) | (0.146) |
| $Disp_{i,t}$ | -0.167*** | -0.193*** | 0.968 |
| | (0.056) | (0.056) | (0.737) |
| $Lev_{i,t}$ | -0.090 | -0.103 | -0.092 |
| | (0.116) | (0.154) | (0.181) |
| $Q_{i,t}$ | 0.035** | 0.042*** | 0.042 |
| | (0.016) | (0.006) | (0.039) |
| $Saler_{i,t}$ | 0.354*** | 0.190** | 0.554* |
| | (0.128) | (0.097) | (0.295) |
| $Shortshare_{i,t}$ | -0.048 | -0.001 | -0.073 |
| | (0.034) | (0.025) | (0.079) |
| *Constant* | 0.114* | 0.156* | -0.032 |
| | (0.061) | (0.091) | (0.162) |
| *N of Obs* | 1,003 | 502 | 501 |
| *R-sq* | 0.1653 | 0.2251 | 0.2557 |

## CONCLUSION

Following the global financial crisis, central banks have cut target interest rates to stimulate economic growth and to prevent recession. This monetary easing is expected to encourage corporate investment by decreasing firms' funding costs and to augment economic recovery over the long run. However, this study implies that the low interest rate policy may not be as effective as expected for stimulating the real economy because the effects of interest rate changes may vary depending on the current market interest rate level and firm uncertainty. Thus, if interest rates have been low enough and firms have been exposed to high uncertainty after global financial crisis, monetary easing may have limited effects on corporate investment. In addition, the results also imply that the uncertainty in the economy must be eliminated before monetary policy can lead corporate investment.

## END NOTES

1 In a panel dataset, the residuals may be correlated across firms and time, implying that the OLS standard errors can be biased. Petersen (2009) solve this problem by clustering standard errors by firm and time (two-way clustering). We follow this process.

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