RIETI Discussion Paper Series 16-E-014

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The Research Institute of Economy, Trade and Industry
http://www.rieti.go.jp/en/

RIETI Discussion Paper Series 16-E-014
February 2016

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Abstract

This study, using data from a representative quarterly business survey in Japan, constructs measures of business uncertainty and presents empirical findings about the time-series properties of business uncertainty measures, and runs simple regressions to analyze the relationship between these measures and companies' investments. The analysis results show, first, that business uncertainty heightened at the time of the collapse of Lehman Brothers, but the effect of an increase in the consumption tax rate in 2014 on business uncertainty was small. Second, manufacturing and small companies tend to face higher business uncertainty than non-manufacturing and large companies. Third, we detect a negative association between business uncertainty and investments. Finally, the uncertainty measures constructed from micro data of the business survey have an advantage over the forecast errors calculated from the publicly available aggregated data. These results suggest the importance of maintaining a stable macroeconomic environment and of avoiding unpredictable conduct of economic policies.

Keywords: Uncertainty, Prediction error, Investment
JEL Classifications: E22, E32, E37, E66

* I am grateful to Yoshiyuki Arata, Yasuo Goto, Hiroshi Ikari, Yohei Kobayashi, Keisuke Kondo, Atsushi Nakajima and the seminar participants at RIETI for their helpful comments and suggestions. I also would like to thank Kyousuke Shiotani and the staffs of Research and Statistics Department, Bank of Japan (BOJ) for processing and providing order-made data of the Short-Term Economic Survey of Enterprises in Japan (the Tankan survey). The figures included in this paper are calculated by the author using data provided by the BOJ, which are not necessarily the same with the figures published by the BOJ. Any errors are my own. This research is supported by the JSPS Grants-in-Aid for Scientific Research (B, 26285063, 26590043).

Business Uncertainty and Investment: Evidence from Japanese companies

1. Introduction

The Japanese economy has experienced various uncertainty shocks in recent years, such as the global financial crisis (2008), the Great East Japan Earthquake (2011), and the transfer of political power between the Liberal Democratic Party and the Democratic Party (2009, 2012). In other advanced countries, especially the US, the mechanisms of the Great Moderation—the period of reduced volatility of business cycle fluctuations from the mid-1980s—were studied extensively until the global financial crisis. However, recently, researchers have diverted their attention to macroeconomic volatility and uncertainty, and accordingly, both theoretical and empirical analyses on policy uncertainty have been advancing rapidly.[1]

Theoretically, because of irreversibility and adjustment costs of investment, economic uncertainty has a negative effect on investment, because firms avoid taking action and prefer to "wait and see" in uncertain circumstances (Bernanke, 1983; McDonald and Siegel, 1986; Pindyck, 1991). This is referred to as the option value of waiting. Recent empirical studies generally support the theoretical prediction that uncertainty has negative effects on equipment investment (Leahy and Whited, 1996; Guiso and Parigi, 1999; Ghosal and Loungani, 2000; Ogawa and Suzuki, 2000; Bloom *et al*., 2007; Baum *et al*., 2010; Bontempi *et al*., 2010; IMF, 2012; Kang *et al*., 2014; Kellogg, 2014; Arslan *et al*., 2015), R&D investment (Bloom, 2007; Caggese, 2012), and hiring of employees (Ono and Sullivan, 2013; Ghosal and Ye, 2015).[2] Bloom (2009), Bachmann *et al*. (2013), and Leduc and Sill (2013) use macroeconomic time-series data to analyze the effects of uncertainty on GDP, industrial production, and employment, and find large negative effects of uncertainty on these macroeconomic variables.

In past empirical studies, various measures of uncertainty have been developed and employed, specifically, 1) volatility of stock prices (Bloom *et al*., 2007; Bloom, 2009; Carriere-Swallow and Cespedes, 2013), 2) distribution of stock price forecasts (Ben-David *et al*., 2013), 3) cross-sectional dispersion/disagreement of forecasts by professional economists (Driver and Moreton, 1991; Dovern *et al*., 2012), 4) unexplained portion of macroeconomic variables

[1] Davis and Kahn (2008) survey the literature on the Great Moderation. Studies on the Japanese economy include Kimura and Shiotani (2009) and Ko and Murase (2013). The work most closely related to this study is Campbell (2007), who analyzes volatility and uncertainty during the Great Moderation.

[2] Carruth *et al*. (2000), Bloom (2014), and Jurado *et al*. (2015) provide good surveys of the literature.

derived from econometric models (Jurado *et al*., 2015), 5) subjective uncertainty in forecasting (Boero *et al*., 2008; Clements, 2008; Morikawa, 2013), 6) dispersion of companies' forecast errors (Bachmann *et al*., 2013; Arslan *et al*., 2015), and 7) frequency of newspaper articles regarding policy uncertainty (Baker *et al*., 2015; Gulen and Ion, 2016).

If the purpose of the analysis is to measure the uncertainty that economic agents (companies or households) face and to investigate the relationships between uncertainty and investment or consumption, the ideal measure is the point forecast and its probability distribution of individual companies or households (Pesaran and Weale, 2006). However, in reality, such data for individual companies or households rarely exist.[3]

Among the alternative proxies of uncertainty, this study, following Bachmann *et al*. (2013) and Arslan *et al*. (2015), adopts 1) ex ante dispersion/disagreement of companies' forecasts and 2) ex post companies' forecast errors as measures of economic uncertainty. In creating these measures, we utilize company-level information from a nationally representative quarterly business survey in Japan: the Short-Term Economic Survey of Enterprises in Japan ("Tankan" survey) conducted by the Bank of Japan (BOJ). This study is the first attempt to employ micro-level information from this survey. After constructing these uncertainty measures in quarterly frequency from 2004 to 2014, we first observe the time-series properties of business uncertainty and differences between industry and by firm size. Then, we empirically analyze the relationship between business uncertainty and investment.

The novelty of this study is, first, while past studies using company survey data (Bachmann *et al*., 2013; Arslan *et al*., 2015) focus only on the manufacturing sector due to data constraints, our study covers both manufacturing and non-manufacturing sectors and makes a comparison between sectors. Second, we analyze the differences among large, medium, and small companies.[4] Third, in addition to uncertainty over business conditions, we analyze uncertainties over production capacity and employment conditions.

The major findings of this study are as follows. First, uncertainty over business conditions was greatly heightened amid the collapse of Lehman Brothers and the Great East Japan Earthquake, but there was only a small effect on business uncertainty of an increase in the consumption tax rate in 2014, which was an anticipated event. Second, manufacturing and small companies tend to show higher business uncertainty than non-manufacturing and large companies do. Third, we detect evidence of a negative association between business uncertainty

[3] There are surveys for professional forecasters that ask about both point forecast and probability distribution (e.g., SPF in the US and SEF in the UK). However, such survey types for companies or households are rare, with some exceptions, such as Guiso *et al*. (1992), Guiso and Parigi (1999), Bontempi *et al*. (2010), Morikawa (2013), and Coibion *et al*. (2015).

[4] Ghosal and Loungani (2000) is a rare study investigating the different impacts of uncertainty on investment by large and small companies.

and companies' investment projections. Fourth, the uncertainty measures constructed from micro data of the business survey have an advantage over the forecast errors calculated from the publicly available aggregated data.

The rest of this paper is structured as follows. Section 2 explains the data used in this study and the method of analysis. Section 3 reports the descriptive findings on the movements of business uncertainty, including differences by industry and company size. Section 4 presents regression results on the relationship between uncertainty and companies' investments. Section 5 concludes with policy implications.

2. Data and Methodology

This study uses originally compiled quarterly data from the micro data of the Tankan survey. This order-made data from the Tankan survey were obtained through the procedures determined by the Statistics Act. The sample period of this study is 42 quarters from the first quarter of 2004 (the March survey) to the third quarter of 2014 (the September survey).

The Tankan is a nationally representative business survey in Japan.[5] The purpose of the survey is to provide an accurate picture of business trends in Japan and to contribute to the appropriate implementation of monetary policy. The survey is conducted quarterly in March, June, September, and December and the number of sample companies is about 11,000. The survey covers both manufacturing and non-manufacturing companies. The sample companies are categorized into large companies (capital of 1 billion yen and more), medium-sized companies (capital of 100 million yen to 999.99 million yen), and small companies (capital of 20 million yen to 99.99 million yen). Major survey items are divided into "judgments" (e.g., business conditions, supply and demand conditions for products and services, production capacity, employment conditions, financial position, and lending attitude of financial institutions) and "semiannual and annual projections" (e.g., sales, operating profits, and fixed investments).

This study uses originally compiled data for companies' judgment of business conditions, production capacity, and employment conditions, as well as projections of fixed investments. More specifically, business conditions in the Tankan survey are "general business conditions of the responding enterprise, primarily in light of individual profits." Production capacity is "excessiveness, adequacy, or shortage of production capacity or business equipment of the responding enterprise, excluding a shortage caused by temporary conditions such as a closure of

[5] The details of the Tankan survey (survey method, coverage, survey items, etc.) are described on the website of the BOJ (http://www.boj.or.jp/en/statistics/outline/exp/tk/extk03.htm/).

a factory due to regular repairs." Employment conditions are "excessiveness, adequacy, or shortage of the number of employees at the responding enterprise." All the judgment items are multiple-choice style. In the case of the judgment of business conditions, the choices are 1) favorable, 2) not so favorable, and 3) unfavorable. The choices for production capacity and employment conditions are 1) excessive, 2) adequate, and 3) insufficient. All these items ask about the current and forecast conditions for the next quarter. We requested the BOJ to compile the cross-tabulations of the judgment of the current condition in the current survey and the forecast judgment in the previous quarter. By this cross-tabulation, we obtain a 3×3 matrix of the number of companies for each quarter. Details of the matrix are explained below.

This study, following Bachmann *et al*. (2013), calculates three measures of business uncertainty: 1) forecast dispersion (*FDISP*), 2) forecast error dispersion (*FEDISP*), and 3) mean absolute forecast error (*MEANABSFE*). *FDISP* is calculated as equation (1) indicated below.[6] This measure is a simple dispersion (disagreement) using only ex ante forecast judgments.

$$FDISP = [(\text{Ratio of "favorable"}) + (\text{ratio of "unfavorable"}) - (\text{ratio of "favorable"} - \text{ratio of "unfavorable"})^2]^{(1/2)} \quad (1)$$

The measures of *FEDISP* and *MEANABSFE* are both based upon ex post forecast errors of individual companies calculated from two consecutive surveys. Since the judgments are categorical, we first define forecast errors, as indicated in Table 1. If a company's current judgment is the same as the forecast judgment made in the previous survey, "0" is assigned to the company. If the current judgment improves (deteriorates) by one unit compared with the forecast judgment, "+1" ("−1") is assigned to the company. When the improvement (deterioration) is two units, "+2" ("−2") is assigned. *FEDISP* is calculated simply as the standard deviation of these forecast errors. On the other hand, *MEANABSFE* is the mean of the absolute value of the forecast errors.

At first glance, these two uncertainty measures resemble each other, but their natures are different. Intuitively, *FEDISP* exhibits a large value when the number of companies making upward errors and the number of companies making downward errors are both large. However, if, for example, all companies make a one-unit upward revision, the value of *FEDISP* is zero. On the other hand, *MEANABSFE* is large when a lot of companies make erroneous forecasts regardless of the sign of the errors. If, for example, all companies make upward errors, then the value of *MEANABSFE* is large, but the value of *FEDISP* is small. However, in practice, these

[6] The German IFO Business Climate Survey used in Bachmann *et al*. (2013) asks about "change" of domestic production activities and the choices are "increase," "roughly stay the same," and "decrease." On the other hand, the Japanese Tankan survey asks about the "level" of business conditions.

two measures exhibit similar movement, as shown in Section 3.

It should be noted that *FEDISP* and *MEANABSFE* indicate business uncertainty at the time of forecasting. For example, the values of these measures using forecast judgment at the March survey and realized judgment at the June survey indicate business uncertainty at the time of the March survey. All these uncertainty measures are independent from the levels and direction of the changes in business conditions and are symmetric for both improvement and deterioration. In some cases, the overall business conditions improve but the uncertainty increases while in other cases, the overall business conditions deteriorate but the uncertainty decreases.

We calculate *FDISP*, *FEDISP*, and *MEANABSFE* for the judgments of business conditions, production capacity, and employment conditions. In calculating uncertainty measures for production capacity and employment conditions, the numbers of companies choosing "insufficient," "adequate," and "excessive" are used instead of the numbers of companies choosing "favorable," "not so favorable," and "unfavorable."

In Section 3, we observe the time-series properties of these uncertainty measures, paying attention to various events, such as the collapse of Lehman Brothers and the raising of consumption tax rate. Then, we calculate correlation coefficients among these measures and their relationships with the economic policy uncertainty (EPU) index based on frequency of newspaper articles regarding policy uncertainty (Baker *et al*., 2015).[7] In addition, we calculate these measures by industry (manufacturing and non-manufacturing) and by size class (large, medium, and small) and observe the differences by these company characteristics.

In Section 4, we analyze the relationship between the business uncertainty measures and companies' investment plans. Specifically, we run simple regressions in which the measures of business uncertainty are used as the main explanatory variables and the revision rates of investment plans (changes from the previous quarter) are used as the dependent variable. In these regressions, the revision rates of investment plans are pooled for the 1st- and 2nd-half fiscal years of the June survey, the 2nd-half fiscal year of the September survey, and the 2nd-half fiscal year of the December survey.[8] The figures of investment plans are calculated from the published Tankan data by industry and by size class. The projected investment revision rate sometimes shows extremely large values when, for example, some companies with small investment in the previous year increase their investment significantly. In addition, there is asymmetry in which upward revisions have no upper limit, but −100% is the lower bound in downward revisions. In order to avoid the confounding effect of the outliers and to treat increase and decrease symmetrically, we convert the investment values to logarithmic form to calculate

[7] Baker *et al*. (2015) describe the details of constructing the EPU index. Recently, the EPU index for Japan has begun to be published (http://www.policyuncertainty.com).

[8] Since the March survey is the first survey of the investment projection for the next fiscal year, the revision rate of investments is unavailable.

the revision rate of investment projections ($\Delta lnINV_{t, t-1}$).

The key explanatory variables (*Uncertainty*) are *FDISP*, *FEDISP*, and *MEANABSFE* defined earlier in this section. In addition to these three alternative uncertainty measures constructed from the judgment data of individual companies, we calculate a measure using the aggregated diffusion index (DI: the ratio of "favorable" minus the ratio of "unfavorable") of the Tankan survey (*DI_ABSFE*). *DI_ABSFE* is the absolute difference between the DI of the current judgment in the current survey and the DI of forecast judgment made in the previous quarter. The purpose of using this alternative uncertainty measure is to verify whether we can obtain similar results from publicly available data for business conditions.

Since the objective of the analysis is to extract the pure effects of uncertainty after controlling for the change in the level of business conditions, change in the actual business conditions from the previous quarter ($BC_{t, t-1}$) and the expected change in business conditions ($BC^{e}_{t+1,t}$) are used as explanatory variables. These variables are calculated from the aggregated DI.

Since the data cover a relatively short period for a quarterly time-series analysis, we construct cell-level data by industry*size class in order to obtain a sufficiently large sample for the estimation. To be more specific, we use pooled data for the six categories (industry*size) in the estimations and a dummy for non-manufacturing industry (*Non-manufacturing Dummy*); in addition, the dummies for medium and small companies (*Size Dummies*) are included as control variables. To control for the difference in the time horizons of the investment projection, dummies for the length of the time horizon (*Planning Horizon Dummies*) are included in the estimation. For example, the planned investment for the 1st-half fiscal year at the June survey and those for the 2nd half fiscal year at the December survey are treated as "0 quarter ahead." Similarly, the 2nd-half fiscal year projection at the September survey is "1 quarter ahead" and the 2nd-half fiscal year projection at the June survey is "2 quarters ahead." We use "1 quarter ahead" and "2 quarters ahead" dummies in the estimations. Finally, in order to control for the seasonal effect, a dummy for the 2nd-half fiscal year (*Second Half*) is included in the regressions.

To summarize, the baseline OLS equation to be estimated can be expressed as follows.

$$\begin{aligned} \Delta lnINV_{t, t-1} &= \alpha + \beta_1 Uncertainty_t + \beta_2 BC_{t, t-1} + \beta_3 BC^{e}_{t+1,t} \\ &\quad + \beta_4 Planning\ Horizon\ Dummies + \beta_5 Second\ Half\ Dummy \\ &\quad + \beta_6 Non\text{-}manufacturing\ Dummy + \beta_7 Size\ Dummies + \varepsilon \end{aligned} \qquad (2)$$

Our main interest is the sign and size of the estimated coefficient (β_1) for uncertainty. In addition to the baseline estimation using measures of uncertainty over business conditions, we use uncertainty measures for production capacity as an alternative. In this case, *FDISP*, *FEDISP*, *MEANABSFE*, and *DI_ABSFE* are calculated from judgments over production capacity

("excessive," "adequate," and "insufficient"), and change in the actual production capacity from the previous quarter ($CC_{t,\,t-1}$) and the expected change in production capacity ($CC^{e}_{t+1,t}$) are used as explanatory variables.

It should be mentioned that business uncertainty might be an endogenous variable in explaining investment projections. There is unlikely to be reverse causality in which investment projection causes uncertainty, but some omitted variables may affect both investment projection and business uncertainty. Therefore, the result of the regression should be interpreted as the association between these two variables and not necessarily as an indication of causality.

3. Uncertainty over Business Conditions

In this section, we present facts about the time-series properties of the uncertainty measures, correlations among alternative uncertainty measures, and differences by company characteristics (industry and size class).

First, we observe the difference between 1) the net forecast error calculated from the publicly available business conditions DI (*DI_ABSFE*) and 2) the gross forecast error obtained from our originally compiled data (*MEANABSFE*). For example, when there is an equal number of companies that revise their actual condition from the expected condition one unit upward and one unit downward, the net forecast error (*DI_ABSFE*) is zero, but the gross forecast error (*MEANABSFE*) is nonzero unless all companies make no revision.

The result of the calculation for business conditions is depicted in Figure 1. There are large gross forecast errors behind the relatively small net forecast errors at the aggregated level. For example, the net forecast errors are almost zero at March and June in 2006, but both absolute figures of upward and downward errors exceed 10 percentage points and the gross forecast errors are more than 20 percentage points. Even at times of negative forecast errors at the aggregate level, a lot of companies unexpectedly improve their business conditions. On the contrary, even at times of positive surprise at the aggregate level, business conditions of a large number of companies unexpectedly deteriorate. In Figure 1, the band of the shaded area corresponds to the *MEANABSFE* defined in Section 2. We observe similar pictures by industry and size class (not reported in figures).

Next, the movements of the *FEDISP* are indicated in Figure 2 by industry. It is evident that this uncertainty index increased in the periods of the global financial crisis and the Great East Japan Earthquake. On the other hand, the increase of uncertainty was small after the announcement of the quantitative and qualitative monetary easing policy under "Abenomics." Similarly, there was a small effect on business uncertainty of an increase in the consumption tax

rate in 2014, which was an anticipated event. During the long business upturn in the middle of the 2000s, the uncertainty index was low and stable. Comparing by industry, manufacturing companies exhibit higher levels of business uncertainty than non-manufacturing companies throughout the sample period. This difference can be interpreted as manufacturing companies always being affected by global economic fluctuations and exchange rate movements, even in normal times.

FEDISP by size class is depicted in Figure 3. Throughout the sample period, smaller companies generally exhibit higher business uncertainty, but an exception is the period of the global financial crisis. Regarding the relationship with the macroeconomic business cycle, the *FEDISP* is relatively high in recessionary periods. Splitting the sample period into boom and recession, the mean *FEDISP* is 0.519 in the boom period and 0.505 in the recession. Although the difference is quantitatively small, it is statistically significant at the 5% level.

Figure 4 compares the movements of *FDISP*, *FEDISP*, and *MEANABSFE*. *FEDISP* and *MEANABSFE*, which both use information of ex post forecast errors, show a similar pattern. However, *FDISP*, which uses only information about ex ante disagreement of forecasts, shows a different pattern. The correlation coefficients between these uncertainty measures are shown in Table 2. *FEDISP* and *MEANABSFE* are highly correlated (0.993). *FEDISP* has a positive relationship with *FDISP*, but the correlation coefficient is very small (0.107). In addition, Table 2 reports the correlation coefficients of these three measures with the economic policy uncertainty index for Japan (*EPU-J*) based on the frequency of newspaper articles regarding policy uncertainty and with forecast error calculated from the published DI (*DI_ABSFE*). *FEDISP* and MEANABSFE have weak positive correlations with EPU-J (0.286 and 0.279, respectively), but *FDISP* negatively correlates with EPU-J (−0.392). Finally, *DI_ABSFE* has a relatively high correlation with *FEDISP* and *MEANABSFE* (around 0.6), but is negatively correlated with *FDISP* (−0.192).

Even though we measure the movements of *FEDISP* by industry and size class in Figures 2 and 3, we formally test the statistical differences between industries and size classes for all uncertainty measures by pooling the six categories (industry*size) of the data. The result is presented in Table 3. Irrespective of the measures, manufacturing companies and small and medium companies face higher business uncertainties than non-manufacturing and large companies do. The differences are statistically significant at the 1% level.

Uncertainties (*FEDISPs*) over business conditions, production capacity, and employment conditions for all industries and size classes are depicted in Figure 5. The average level of uncertainties is the highest for business conditions and the lowest for production capacity, but the three measures generally move together. At the time of the heightened uncertainty during the global financial crisis, increases in the uncertainty measures for production capacity and

employment conditions lagged one quarter relative to the measure for business conditions.

Table 4 shows the correlation coefficients between the three uncertainty measures (*FDISP*, *FEDISP*, and *MEANABSFE*) using companies' judgment of their production capacity. Different from the measures for business conditions, *FDISP* has relatively higher correlations with *FEDISP* and *MEANABSFE* (around 0.6). Table 5 indicates the statistical differences between industries and size classes for all uncertainty measures by pooling the six categories (industry*size) of the data. Similar to the findings from uncertainties over business conditions, manufacturing companies and small and medium companies exhibit higher uncertainties than non-manufacturing and large companies do, irrespective of the measures used, with the exception of *DI_ABSFE*.

Tables 6 and 7 present the results using companies' judgment over employment conditions. In this case, *FDISP* is highly correlated with *FEDISP* and *MEANABSFE* (correlation coefficients of around 0.75). The differences by industry are statistically significant but quantitatively small, although uncertainty over employment conditions is significantly higher for small and medium companies than for large companies (Table 7). This result indicates that small and medium companies often underestimate or overestimate their future employment conditions, suggesting instability of jobs in these companies from the viewpoint of workers.

The correlations among uncertainties over business conditions, production capacity, and employment conditions are shown in Table 8. Although all these uncertainties are positively correlated with each other, the strengths of the correlation coefficients differ by the choice of the uncertainty measures. Considering the two measures based on ex post forecast errors (*FEDISP* and *MEANABSFE*), correlations between business conditions and production capacity and between production capacity and employment conditions are strong, but the correlation coefficients between business conditions and employment conditions are relatively small.

4. Uncertainty and Investment

This section reports regression results on the association between the measures of business uncertainty and the revision rate from the previous quarter's investment projection. The purpose is to test the negative effect of uncertainty on companies' investments. As explained in Section 2, we pool 10 years of data for six categories of industry*size (large manufacturing, medium manufacturing, small manufacturing, large non-manufacturing, medium non-manufacturing, and small non-manufacturing). The dependent variable of the estimates is the revision rates of investment projection for the 1st- and 2nd-half fiscal years of the June survey and for the 2nd-half fiscal year of the September and December surveys.

We use four alternative uncertainty measures (*FDISP, FEDISP, MEANABSFE*, and *DI_ABSFE*) as the main explanatory variable. Some other variables, such as the change in the actual business conditions from the previous quarter and the expected change in business conditions, are used as controls in order to abstract pure uncertainty effects. Our baseline estimations employ measures of uncertainty over business conditions, but we also use uncertainty over production capacity as an alternative, and compare the results. In addition, we run separate regressions by industry and size class to observe the differences by company characteristics.

Major variables and their summary statistics are presented in Table 9. We confirm that all the uncertainty measures (*FDISP, FEDISP, MEANABSFE*, and *DI_ABSFE*) have a certain amount of time-series variations.

The regression results using uncertainty measures for business conditions as explanatory variables are shown in Table 10. The coefficients for uncertainty measures are all negative and significant, and the statistical significance levels are 1% for the measures of ex post forecast errors (*FEDISP* and *MEANABSFE*) and 5% for the measure of ex ante forecast dispersion (*FDISP*) (columns (1)–(3) of Table 10). The results suggest that when business uncertainty is heightened, investment projection tends to be revised down, or that the amount of upward revision tends to be small.

Even if we use forecast errors calculated from the aggregated publicly available DI (*DI_ABSFE*) as the explanatory variable, the estimated coefficient of this variable is negative (column (4) of Table 10). However, the size of the coefficient is relatively small and its statistical significance is only marginal (10% level). These results suggest that measures using ex ante forecast disagreement and ex post forecast errors at the micro level contain valuable information to assess the effect of business uncertainty on investments. These findings are consistent with the results of Bachmann *et al*. (2013) using company-level data in Germany.

In order to interpret the quantitative magnitude of business uncertainty, we calculate the relationship between a one-standard deviation larger uncertainty and the rate of downward revision of investment projection in percentage terms. The results are −1.6 (*FDISP*), −2.7 (*FEDISP*), and −2.5 (*MEANABSFE*) percentage points (−0.9 percentage points for *DI_ABSFE*). Since the mean and standard deviation of the revision rate are 5.6 and 6.7 percentage points, respectively, the impact of uncertainty on investment plans is non-negligible.

Unexpectedly, the coefficients for the change in the level of business conditions ($BC_{t,\,t-1}$) and the expected change in business conditions ($BC^{e}_{t+1,\,t}$) are both insignificant and often exhibit the wrong sign. Among other control variables, dummies for medium and small companies are negative and highly significant, which reflects the pattern of the Tankan survey that investment projections of small and medium companies tend to be revised upward as the quarters pass.

When adding a dummy for the collapse of Lehman Brothers (a dummy for the surveys conducted in September and December 2008), the estimated coefficients for uncertainty measures become somewhat smaller, but the statistical significance levels are unaffected. This result indicates that the abovementioned results presented in Table 10 are not driven by this one-time extraordinary event.[9]

Table 11 shows regression results for the subsamples of manufacturing and non-manufacturing companies. In the table, we report only the coefficients for the uncertainty measures. The coefficients for *FEDISP* and *MEANABSFE* are both negative and significant for both sectors. Although the size of the coefficients is somewhat larger for manufacturing than that for non-manufacturing sector, the association of a one-standard deviation larger uncertainty with revision rate of investment projection is remarkably similar (about −3.5 percentage points), because the size of the standard deviation of uncertainty is larger in the non-manufacturing sector. The coefficients for the measure of forecast disagreement (*FDISP*) are insignificant for both sectors.

It is a widely known fact that the patterns of revision in investment projections differ by company size. Regression results for the subsamples divided by company size are indicated in Table 12. The coefficients for *FEDISP* and *MEANABSFE* are negative and significant, irrespective of the size classes, although for small companies, the size of the coefficients is small and the significance level is low. The quantitative relationship between a one-standard deviation higher uncertainty and revision rate is the largest for medium-sized companies (about 6 percentage points) and the lowest for small companies (about 2 percentage points). Similar to the results by industry, the coefficients for the measure of forecast disagreement (*FDISP*) are insignificant for all size classes.

Tables 13–15 show the regression results using uncertainty over production capacity, instead of uncertainty over business conditions, as the explanatory variable. The estimation results for all industries and size classes are reported in Table 13. In these cases, the coefficients for *FDISP*, *FEDISP*, and *MEANABSFE* are all negative and significant at the 1% level, and the size of the coefficients is larger than that obtained using uncertainty over business conditions (columns (1)–(3) of Table 13). A one-standard deviation higher capacity uncertainty is associated with revisions of investment projections of −5.6 percentage points (*FEDISP*), −4.6 percentage points (*FEDISP*), and −3.9 percentage points (*MEANABSFE*). On the other hand, if we use forecast errors calculated from the aggregated DI (*DI_ABSFE*) as the explanatory variable, the estimated coefficient of this variable is negative but statistically insignificant (column (4) of Table 13).

[9] Even if we take the uncertainty in the previous quarter into account, the results are essentially unaltered. Specifically, when we include the lagged uncertainty measures as additional explanatory variables, the coefficients for the current uncertainty are still negative and significant.

Similar to the finding using uncertainty over business conditions as the explanatory variable, the coefficients for the change in the level of production capacity ($CC_{t, t-1}$) and the expected change in production capacity ($CC^{e}_{t+1, t}$) are both insignificant. These results confirm that uncertainty measures using ex post forecast errors calculated from the micro data contain valuable information to assess the effect of uncertainty on investments.

Separate estimation results for manufacturing and non-manufacturing companies are reported in Table 14, which indicate that uncertainty over production capacity is related to the downward revision of the investment projection irrespective of the industries. Different from the results using uncertainty measures of business conditions as the explanatory variable, the coefficients for *FDISP* are statistically significant for both industries.

Finally, Table 15 shows regression results for the subsamples divided by company size. Again, the coefficients for *FEDISP* and *MEANABSFE* are all negative and significant at the 10% level at least, although the size of the coefficients is small for small companies. In addition, the coefficients for *FDISP* are significantly negative, with the exception of medium-sized companies.

In summary, measures of business uncertainty over business conditions or production capacity have negative associations with planned investment, after accounting for the change in the level of business conditions ($BC_{t, t-1}$) or production capacity ($CC_{t, t-1}$), expected change in business conditions ($BC^{e}_{t+1, t}$) or production capacity ($CC^{e}_{t+1, t}$), and some other control variables. When uncertainty is heightened, companies tend to revise their investment projection downward. Among the variants of uncertainty measures, the statistical significance is generally higher when using the measures of ex post forecast errors (*FEDISP* and *MEANABSFE*). The uncertainty measures using ex post forecast errors calculated from the micro data have an advantage over the forecast errors calculated from the aggregated, publicly available DI (*DI_ABSFE*) in evaluating the effect of business uncertainty on investments.

5. Conclusion

This study, using an originally compiled dataset from the Tankan survey (BOJ), a representative quarterly business survey in Japan, constructs measures of business uncertainty, and presents empirical findings about the movement of business uncertainty and its relationship with companies' investments. This is the first study to construct and analyze business uncertainty taken from the micro data of the Tankan survey.

The major findings of this study can be summarized as follows. First, business uncertainty was heightened amid the collapse of Lehman Brothers and the Great East Japan Earthquake, but

there was limited effect on business uncertainty of an increase in the consumption tax rate in 2014, which was an anticipated event. Second, manufacturing and small companies tend to show higher uncertainty over business conditions and production capacity than non-manufacturing and large companies. Third, we detect suggestive evidence of a negative effect of business uncertainty on companies' investment. When business uncertainty heightens, companies revise their investment projections downward. Finally, the uncertainty measures constructed from ex post forecast errors using micro data of the business survey have an advantage over the forecast errors calculated from the publicly available aggregated data. These results suggest that maintaining a stable macroeconomic environment and avoiding unpredictable conduct of economic policies are essential for promoting private investments.

Although this study presents several new findings on business uncertainty, the analyses have many limitations. First, since we cannot directly observe companies' real-time uncertainties for the future, such as the probability distribution of individual companies' forecasts, the uncertainty measures constructed from ex post forecast errors in this study are still proxies of the true subjective uncertainty. Second, the available data are limited to about 10 years, which is a relatively short period to conduct quarterly time-series analysis. As a result, the survey period does not cover, for example, Japan's financial crisis in the late 1990s. Third, the regressions to analyze the effects of business uncertainty on investments use cell-level data, because we cannot directly use the micro data of the Tankan survey. Although we run regressions by pooling industry*size data to overcome these limitations, the sample size was still not large enough to obtain precise results. Finally, business uncertainty may be an endogenous variable in explaining investment projections, but we have not dealt with this potential endogeneity explicitly.

References

Arslan, Yavuz, Aslihan Atabek, Timur Hulagu, and Saygin Sahinoz (2015), "Expectation Errors, Uncertainty, and Economic Activity," *Oxford Economic Papers*, Vol. 67, No. 3, pp. 634–660.

Bachmann, Rudiger, Steffen Elstner, and Eric R. Sims (2013), "Uncertainty and Economic Activity: Evidence from Business Survey Data," *American Economic Journal: Macroeconomics*, Vol. 5, No. 2, pp. 217–249.

Baker, Scott R., Nicholas Bloom, and Steven J. Davis (2015), "Measuring Economic Policy Uncertainty," NBER Working Paper, No. 21633.

Baum, Christopher F., Mustafa Caglayaan, and Oleksandr Talavera (2010), "On the Sensitivity of Firms' Investment to Cash Flow and Uncertainty," *Oxford Economic Papers*, Vol. 62, No. 2, pp. 286–306.

Ben-David, Itzhak, John R. Graham, and Campbell R. Harvey (2013), "Managerial Miscalibration," *Quarterly Journal of Economics*, Vol. 128, No. 4, pp. 1547–1584.

Bernanke, Ben S. (1983), "Irreversibility, Uncertainty, and Cyclical Investment," *Quarterly Journal of Economics*, Vol. 98, No. 1, pp. 85–106.

Bloom, Nicholas (2007), "Uncertainty and the Dynamics of R&D," *American Economic Review*, Vol. 97, No. 2, pp. 250–255.

Bloom, Nicholas (2009), "The Impact of Uncertainty Shocks," *Econometrica*, Vol. 77, No. 3, pp. 623–685.

Bloom, Nicholas (2014), "Fluctuations in Uncertainty," *Journal of Economic Perspectives*, Vol. 28, No. 2, pp. 153–176.

Bloom, Nick, Stephen Bond, and John van Reenen (2007), "Uncertainty and Investment Dynamics," *Review of Economic Studies*, Vol. 74, No. 2, pp. 391–415.

Boero, Gianna, Jeremy Smith, and Kenneth F. Wallis (2008), "Uncertainty and Disagreement in Economic Prediction: The Bank of England Survey of External Forecasters," *Economic Journal*, Vol. 118, July, pp. 1107–1127.

Bontempi, Maria Elena, Roberto Golinelli, and Giuseppe Parigi (2010), "Why Demand Uncertainty Curbs Investment: Evidence from a Panel of Italian Manufacturing Firms," *Journal of Macroeconomics*, Vol. 32, No. 1, pp. 218–238.

Caggese, Andrea (2012), "Entrepreneurial Risk, Investment, and Innovation," *Journal of Financial Economics*, Vol. 106, No. 2, pp. 287–307.

Campbell, Sean D. (2007), "Macroeconomic Volatility, Predictability, and Uncertainty in the Great Moderation: Evidence from the Survey of Professional Forecasters," *Journal of Business and Economic Statistics*, Vol. 25, No. 2, pp. 191–200.

Carriere-Swallow, Yan and Luis Felipe Cespedes (2013), "The Impact of Uncertainty Shocks in Emerging Economies," *Journal of International Economics*, Vol. 90, No. 2, pp. 316–325.

Carruth, Alan, Andy Dickerson, and Andrew Henley (2000), "What Do We Know about Investment under Uncertainty?" *Journal of Economic Surveys*, Vol. 14, No. 2, pp. 119–153.

Clements, Michael P. (2008), "Consensus and Uncertainty: Using Forecast Probabilities of Output Declines," *International Journal of Forecasting*, Vol. 24, No. 1, pp. 76–86.

Coibion, Oliver, Yuriy Gorodnichenko, and Saten Kumar (2015), "How Do Firms Form Their Expectations? New Survey Evidence," NBER Working Paper, No. 21092.

Davis, Steven J. and James A. Kahn (2008), "Interpreting the Great Moderation: Changes in the Volatility of Economic Activity at the Macro and Micro Levels," *Journal of Economic Perspectives*, Vol. 22, No. 4, pp. 155–180.

Dovern, Jonas, Ulrich Fritsche, and Jiri Slacalek (2012), "Disagreement among Forecasters in G7 Countries," *Review of Economics and Statistics*, Vol. 94, No. 4, pp. 1081–1096.

Driver, Ciaran and David Moreton (1991), "The Influence of Uncertainty on UK Manufacturing Investment," *Economic Journal*, Vol. 101, pp. 1452–1459.

Ghosal, Vivek and Prakash Loungani (2000), "The Differential Impact of Uncertainty on Investment in Small and Large Businesses," *Review of Economics and Statistics*, Vol. 82, No. 2, pp. 338–349.

Ghosal, Vivek and Yang Ye (2015), "Uncertainty and the Employment Dynamics of Small and Large Businesses," IMF Working Paper, No. 15-4.

Guiso, Luigi, Tullio Jappelli, and Daniele Terlizzese (1992), "Earnings Uncertainty and Precautionary Saving," *Journal of Monetary Economics*, Vol. 30, No. 2, pp. 307–337.

Guiso, Luigi and Giuseppe Parigi (1999), "Investment and Demand Uncertainty," *Quarterly Journal of Economics*, Vol. 114, No. 1, pp. 185–227.

Gulen, Huseyin and Mihai Ion (2016), "Policy Uncertainty and Corporate Investment," *Review of Financial Studies*, Vol. 29, No. 3, pp. 523–564.

International Monetary Fund (IMF) (2012), *World Economic Outlook*, October.

Jurado, Kyle, Sydney C. Ludvigson, and Serena Ng (2015), "Measuring Uncertainty," *American Economic Review*, Vol. 105, No. 3, pp. 1177–1216.

Kang, Wensheng, Kiseok Lee, and Ronald A. Ratti (2014), "Economic Policy Uncertainty and Firm-Level Investment," *Journal of Macroeconomics*, Vol. 39, pp. 42–53.

Kellogg, Ryan (2014), "The Effect of Uncertainty on Investment: Evidence from Texas Oil Drilling," *American Economic Review*, Vol. 104, No. 6, pp. 1698–1734.

Kimura, Takeshi and Kyosuke Shiotani (2009), "Stabilized Business Cycles with Increased Output Volatility at High Frequencies," *Journal of the Japanese and International Economies*, Vol. 23, No. 1, pp. 1–19.

Ko, Jun-Hyung and Koichi Murase (2013), “Great Moderation in the Japanese Economy,” *Japan and the World Economy*, Vol. 27, pp. 10–24.

Leahy, John V. and Toni M. Whited (1996), “The Effect of Uncertainty on Investment: Some Stylized Facts,” *Journal of Money, Credit, and Banking*, Vol. 28, No. 1, pp. 64–83.

Leduc, Sylvain and Keith Sill (2013), “Expectations and Economic Fluctuations: An Analysis Using Survey Data,” *Review of Economics and Statistics*, Vol. 95, No. 4, pp. 1352-1367.

McDonald, Robert and Daniel Siegel (1986), “The Value of Waiting to Invest,” *Quarterly Journal of Economics*, Vol. 101, No. 4, pp. 707–727.

Morikawa, Masayuki (2013), “What Type of Policy Uncertainty Matters for Business?” RIETI Discussion Paper, 13-E-076.

Ogawa, Kazuo and Kazuyuki Suzuki (2000), “Uncertainty and Investment: Some Evidence from the Panel Data of Japanese Manufacturing Firms,” *Japanese Economic Review*, Vol. 51, No. 2, pp. 170–192.

Ono, Yukako and Daniel Sullivan (2013), “Manufacturing Plants' Use of Temporary Workers: An Analysis Using Census Microdata,” *Industrial Relations*, Vol. 52, No. 2, pp. 419-443.

Pesaran, M. Hashem and Martin Weale (2006), “Survey Expectations,” in Graham Elliott, Clive W. J. Granger, and Allan Timmermann (eds.) *Handbook of Economic Forecasting, Vol. 1*, Amsterdam: Elsevier, pp. 715–776.

Pindyck, Robert S. (1991), “Irreversibility, Uncertainty, and Investment,” *Journal of Economic Literature*, Vol. 29, No. 3, pp. 1110–1148.

Table 1 Calculation of Ex Post Forecast Errors

		Realized (ex post) business conditions		
		1. Favorable	2. Not so favorable	3. Unfavorable
Forecast (ex ante) business conditions	1. Favorable	0	-1	-2
	2. Not so favorable	1	0	-1
	3. Unfavorable	2	1	0

Table 2 Correlation Coefficients among Uncertainty Measures

	FDISP	*FEDISP*	*MEANABSFE*	*EPU-Japan*	*DI_ABSFE*
FDISP	1.000				
FEDISP	0.107	1.000			
MEANABSFE	0.117	0.993	1.000		
EPU-Japan	-0.392	0.286	0.279	1.000	
DI_ABSFE	-0.192	0.584	0.640	0.375	1.000

Note: *FDISP*, *FEDISP*, *MEANABSFE*, and *DI_ABSFE* are calculated for all industry and all size classes.

Table 3 Comparison of Mean Business Uncertainty by Industry and by Size Classes

A. By Industry

	(1) Manufacturing	(2) Non-manufacturing	(3) Diff.	
FDISP	0.563	0.541	0.022	***
FEDISP	0.526	0.488	0.038	***
MEANABSFE	0.264	0.231	0.033	***
DI_ABSFE	0.046	0.039	0.006	

B. By Size

	(1) Small and Medium	(2) Large	(3) Diff.	
FDISP	0.576	0.505	0.071	***
FEDISP	0.522	0.475	0.047	***
MEANABSFE	0.261	0.219	0.042	***
DI_ABSFE	0.043	0.040	0.003	

Note: ***:P<0.01, **: P<0.05, *: P<0.1.

Table 4 Correlation Coefficients among Measures of Uncertainty over Production Capacity

	FDISP	*FEDISP*	*MEANABSFE*	*DI_ABSFE*
FDISP	1.000			
FEDISP	0.651	1.000		
MEANABSFE	0.625	0.991	1.000	
DI_ABSFE	-0.084	0.482	0.545	1.000

Note: *FDISP*, *FEDISP*, *MEANABSFE*, and *DI_ABSFE* are calculated for all industry and all size classes.

Table 5 Comparison of Mean Uncertainty over Production Capacity by Industry and by Size Classes

A. By Industry

	(1) Manufacturing	(2) Non-manufacturing	(3) Diff.	
FDISP	0.467	0.376	0.092	***
FEDISP	0.388	0.302	0.086	***
MEANABSFE	0.145	0.089	0.056	***
DI_ABSFE	0.023	0.013	0.010	***

B. By Size

	(1) Small and Medium	(2) Large	(3) Diff.	
FDISP	0.454	0.357	0.097	***
FEDISP	0.368	0.300	0.068	***
MEANABSFE	0.131	0.090	0.041	***
DI_ABSFE	0.019	0.016	0.002	

Note: ***:P<0.01, **: P<0.05, *: P<0.1.

Table 6 Correlation Coefficients among Measures of Uncertainty over Employment Conditions

	FDISP	*FEDISP*	*MEANABSFE*	*DI_ABSFE*
FDISP	1.000			
FEDISP	0.775	1.000		
MEANABSFE	0.754	0.987	1.000	
DI_ABSFE	0.494	0.660	0.602	1.000

Note: *FDISP*, *FEDISP*, *MEANABSFE*, and *DI_ABSFE* are calculated for all industry and all size classes.

Table 7 Comparisons of Mean Uncertainty over Employment Conditions by Industry and by Size Classes

A. By Industry

	(1) Manufacturing	(2) Non-manufacturing	(3) Diff.	
FDISP	0.468	0.480	-0.013	*
FEDISP	0.426	0.414	0.013	*
MEANABSFE	0.176	0.165	0.011	**
DI_ABSFE	0.027	0.020	0.007	**

B. By Size

	(1) Small and Medium	(2) Large	(3) Diff.	
FDISP	0.505	0.412	0.093	***
FEDISP	0.453	0.354	0.099	***
MEANABSFE	0.195	0.122	0.073	***
DI_ABSFE	0.025	0.020	0.005	

Note: ***:P<0.01, **: P<0.05, *: P<0.1.

Table 8 Correlation Coefficients among Uncertainties over Business Conditions, Production Capacity, and Employment Conditions

A. *FDISP*

	Business condition	Production capacity	Employment condition
Business condition	1.000		
Production capacity	0.291	1.000	
Employment condition	0.298	0.455	1.000

B. *FEDISP*

	Business condition	Production capacity	Employment condition
Business condition	1.000		
Production capacity	0.660	1.000	
Employment condition	0.383	0.796	1.000

C. *MEANABSFE*

	Business condition	Production capacity	Employment condition
Business condition	1.000		
Production capacity	0.657	1.000	
Employment condition	0.380	0.819	1.000

D. *DI_ABSFE*

	Business condition	Production capacity	Employment condition
Business condition	1.000		
Production capacity	0.019	1.000	
Employment condition	0.101	0.882	1.000

Note: *FDISP, FEDISP, MEANABSFE*, and *DI_ABSFE* are calculated for all industry and all size classes.

Table 9 Summary Statistics for Full Sample

A. Business Conditions

Variable	Obs	Mean	Std. Dev.	Min	Max
FDISP	390	0.551	0.045	0.447	0.653
FEDISP	390	0.507	0.041	0.403	0.634
MEANABSFE	390	0.247	0.037	0.158	0.360
DI_ABSFE	390	0.045	0.037	0.000	0.220
$BC_{t,t-1}$	378	0.000	0.071	-0.338	0.156
$BC^{e}_{t+1,t}$	384	-0.015	0.046	-0.211	0.179
$\Delta lnINV_{t,t-1}$	306	0.055	0.065	-0.338	0.269

B. Production Capacity

Variable	Obs	Mean	Std. Dev.	Min	Max
FDISP	390	0.422	0.073	0.279	0.561
FEDISP	390	0.345	0.061	0.215	0.487
MEANABSFE	390	0.117	0.040	0.045	0.270
DI_ABSFE	390	0.018	0.024	0.000	0.219
$CC_{t,t-1}$	378	0.000	0.035	-0.088	0.271
$CC^{e}_{t+1,t}$	384	-0.015	0.014	-0.063	0.056
$\Delta lnINV_{t,t-1}$	306	0.055	0.065	-0.338	0.269

Table 10 Estimation Results for Revision Rates of Investment Plan

	(1)		(2)		(3)		(4)	
FDISP	-0.3495	**						
	(0.1618)							
FEDISP			-0.6782	***				
			(0.1723)					
MEANABSFE					-0.6851	***		
					(0.1714)			
DI_ABSFE							-0.2490	*
							(0.1369)	
$BC_{t,t-1}$	0.0066		-0.0505		-0.0545		0.0245	
	(0.0750)		(0.0768)		(0.0771)		(0.0700)	
$BC^{e}_{t+1,t}$	-0.0106		-0.0388		-0.0639		-0.0755	
	(0.1629)		(0.1580)		(0.1591)		(0.1579)	
Non-manufacturing	0.0242	***	0.0046		0.0076		0.0302	***
	(0.0079)		(0.0104)		(0.0097)		(0.0081)	
Medium	0.0471	***	0.0513	***	0.0481	***	0.0280	***
	(0.0129)		(0.0108)		(0.0104)		(0.0098)	
Small	0.0555	***	0.0647	***	0.0595	***	0.0221	**
	(0.0189)		(0.0135)		(0.0125)		(0.0086)	
R-squared	0.1125		0.1540		0.1532		0.1112	
Number of observations	252		252		252		252	

Notes: OLS estimates with robust standard errors in parentheses. ***:P<0.01, **: P<0.05, *: P<0.1. Explanatory variables include dummies for the length of the time horizon and a dummy for the second fiscal year.

Table 11 Estimation Results for Revision Rates of Investment Plan by Industry

	(1) Manufacturing		(2) Non-manufacturing	
FDISP	-0.3208		-0.3341	
	(0.2695)		(0.2703)	
FEDISP	-0.6876	***	-0.4776	*
	(0.1944)		(0.2509)	
MEANABSFE	-0.6879	***	-0.5072	**
	(0.1909)		(0.2597)	
DI_ABSFE	-0.2708	**	-0.3623	
	(0.1160)		(0.2711)	

Notes: OLS estimates with robust standard errors in parentheses. ***:P<0.01, **: P<0.05, *: P<0.1. Explanatory variables include the change in the level of business conditions ($BC_{t,\ t-1}$), expected change in business conditions ($BC^{e}_{t+1,\ t}$), dummies for the length of the time horizon, a dummy for the second fiscal year, and size dummies.

Table 12 Estimation Results for Revision Rates of Investment Plan by Size

	(1) Large		(2) Medium		(3) Small	
FDISP	-0.2376		-0.2526		0.2042	
	(0.2421)		(0.3166)		(0.3382)	
FEDISP	-0.6274	***	-0.7496	**	-0.4021	*
	(0.1833)		(0.3102)		(0.2144)	
MEANABSFE	-0.6484	***	-0.8142	**	-0.3827	*
	(0.1863)		(0.3244)		(0.2168)	
DI_ABSFE	-0.4616	**	-0.3655		-0.2911	
	(0.1856)		(0.2572)		(0.2307)	

Notes: OLS estimates with robust standard errors in parentheses. ***:P<0.01, **: P<0.05, *: P<0.1. Explanatory variables include the change in the level of business conditions ($BC_{t,\ t-1}$), expected change in business conditions ($BC^{e}_{t+1,\ t}$), dummies for the length of the time horizon, a dummy for the second fiscal year, and a non-manufacturing dummy.

Table 13 Uncertainty over Production Capacity and Revision Rates of Investment Plan

	(1)		(2)		(3)		(4)	
FDISP	-0.7869	***						
	(0.1573)							
FEDISP			-0.7639	***				
			(0.1397)					
MEANABSFE					-0.9945	***		
					(0.2417)			
DI_ABSFE							-0.2378	
							(0.2611)	
$CC_{t,t-1}$	-0.2846		-0.0977		0.0104		-0.0679	
	(0.2253)		(0.2362)		(0.2402)		(0.2400)	
$CC^{e}_{t+1,t}$	0.0764		0.5567		0.5567		0.3618	
	(0.3929)		(0.4231)		(0.4242)		(0.4512)	
Non-manufacturing	-0.0389	**	-0.0352	**	-0.0252	*	0.0295	***
	(0.0157)		(0.0138)		(0.0147)		(0.0078)	
Medium	0.0878	***	0.0690	***	0.0604	***	0.0309	***
	(0.0172)		(0.0134)		(0.0139)		(0.0109)	
Small	0.1217	***	0.0966	***	0.0816	***	0.0290	**
	(0.0217)		(0.0177)		(0.0184)		(0.0126)	
R-squared	0.1888		0.1819		0.1733		0.1053	
Number of observations	252		252		252		252	

Notes: OLS estimates with robust standard errors in parentheses. ***:P<0.01, **: P<0.05, *: P<0.1. Explanatory variables include dummies for the length of the time horizon and a dummy for the second fiscal year.

Table 14 Uncertainty over Production Capacity and Revision Rates of Investment Plan by Industry

	(1) Manufacturing		(2) Non-manufacturing	
FDISP	-0.6852	***	-0.5796	**
	(0.2089)		(0.2758)	
FEDISP	-0.5322	***	-0.6415	**
	(0.1519)		(0.2749)	
MEANABSFE	-0.6670	***	-1.2522	**
	(0.2052)		(0.5697)	
DI_ABSFE	-0.6721	***	0.7499	
	(0.2138)		(1.0059)	

Notes: OLS estimates with robust standard errors in parentheses. ***:P<0.01, **: P<0.05, *: P<0.1. Explanatory variables include the change in the level of business conditions ($BC_{t,\,t-1}$), expected change in business conditions ($BC^{e}_{t+1,\,t}$), dummies for the length of the time horizon, a dummy for the second fiscal year, and size dummies.

Table 15 Uncertainty over Production Capacity and Revision Rates of Investment Plan by Size

	(1) Large		(2) Medium		(3) Small	
FDISP	-0.5024	**	-0.4027		-0.7471	***
	(0.2078)		(0.2507)		(0.2615)	
FEDISP	-0.5389	***	-0.6376	**	-1.0213	***
	(0.1626)		(0.2863)		(0.3458)	
MEANABSFE	-0.7475	***	-0.7526	**	-1.1747	**
	(0.2322)		(0.3270)		(0.5052)	
DI_ABSFE	-0.9679	***	-0.1548		0.8233	
	(0.2909)		(0.4023)		(0.7811)	

Notes: OLS estimates with robust standard errors in parentheses. ***:P<0.01, **: P<0.05, *: P<0.1. Explanatory variables include the change in the level of business conditions ($BC_{t,\ t-1}$), expected change in business conditions ($BC^{e}_{t+1,\ t}$), dummies for the length of the time horizon, a dummy for the second fiscal year, and a non-manufacturing dummy.

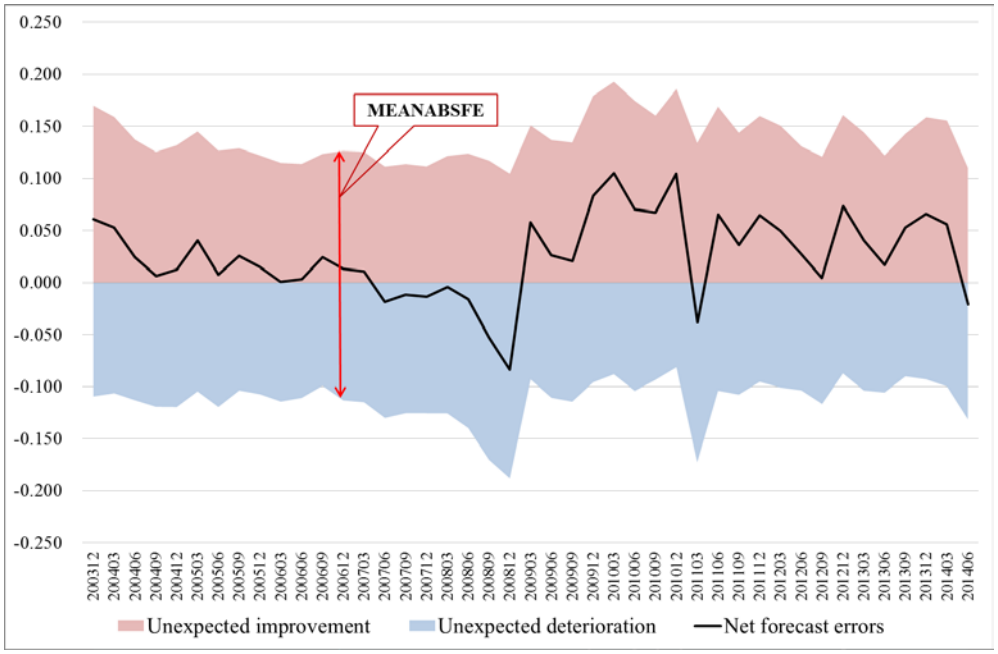

Figure 1 Gross and Net Forecast Errors

Note: Gross forecast errors (*MEANABSFE*) and net forecast errors (*DI_ABSFE*) are calculated for all industries and all size classes.

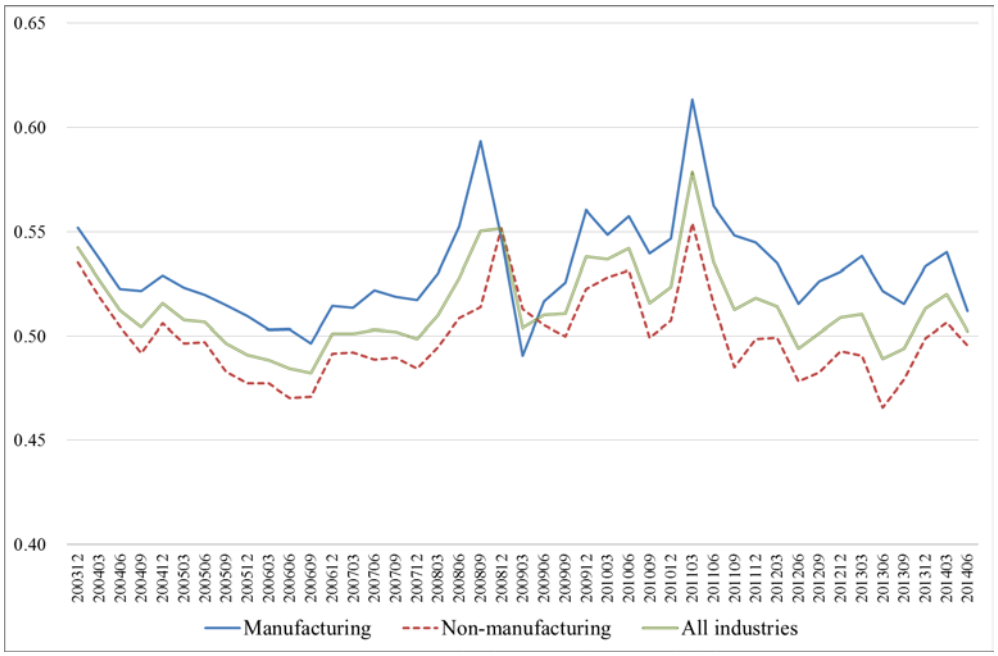

Figure 2 Movements of Forecast Error Dispersions (*FEDISP*) by Industry

Note: Forecast error dispersions (*FEDISP*) are calculated for all size classes.

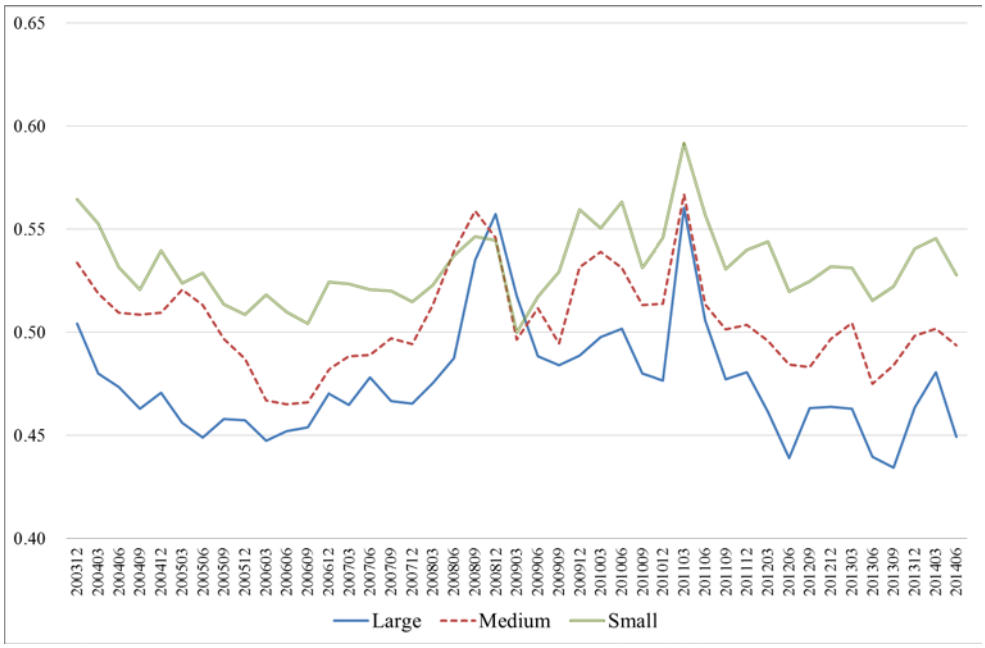

Figure 3 Movements of Forecast Error Dispersions (*FEDISP*) by Company Size

Note: Forecast error dispersions (*FEDISP*) are calculated for all industries.

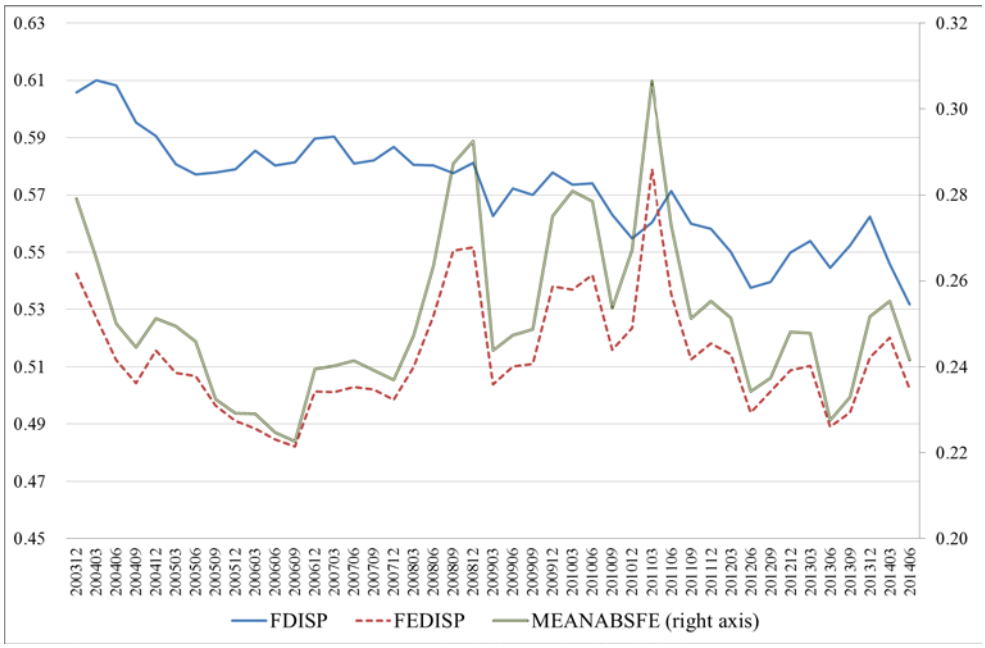

Figure 4 Movements of Three Different Uncertainty Measures

Note: *FDISP*, *FEDISP*, and *MEANABSFE* are calculated for all industries and all size classes.

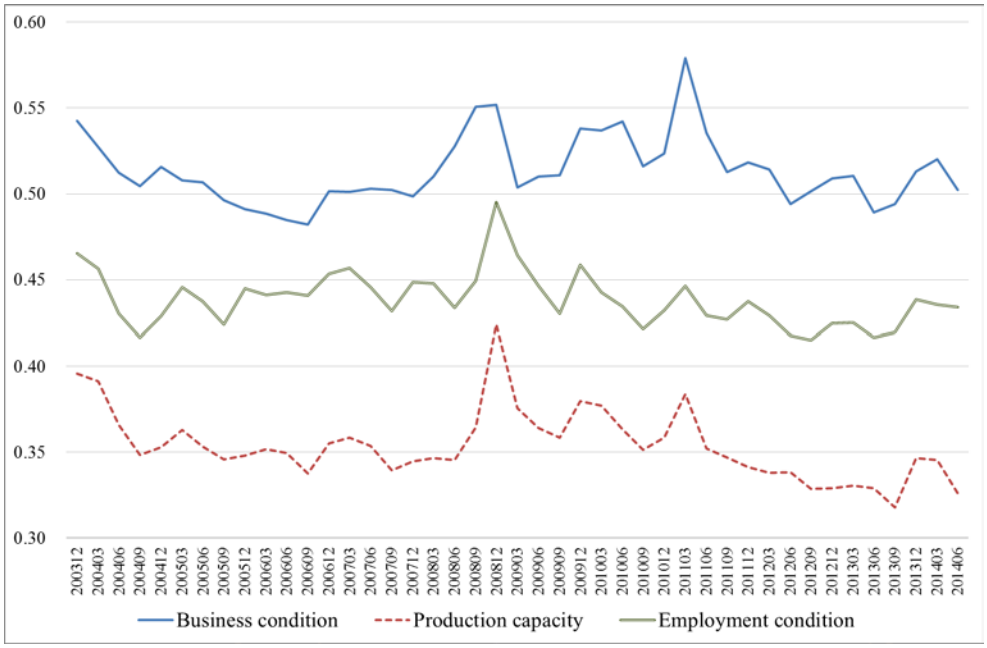

Figure 5 Uncertainties (FEDISP) over Business Conditions, Production Capacity, and Employment Conditions

Note: Forecast error dispersions (*FEDISP*) are calculated for all industries.