Irving Fisher Committee on
Central Bank Statistics

BANK FOR INTERNATIONAL SETTLEMENTS

Eighth IFC Conference on *"Statistical implications of the new financial landscape"*

Basel, 8–9 September 2016

Inflation outlook and business conditions of firms: evidence from the Tankan Survey[1]

Kouki Inamura, Kazunori Hiyama and Kyosuke Shiotani,
Bank of Japan

[1] This paper was prepared for the meeting. The views expressed are those of the authors and do not necessarily reflect the views of the BIS, the IFC or the central banks and other institutions represented at the meeting.

Inflation Outlook and Business Conditions of Firms: Evidence from the *Tankan* Survey

Kouki INAMURA, Kazunori HIYAMA and Kyosuke SHIOTANI[1]

Research and Statistics Department, Bank of Japan

Abstract

In March 2014, the Bank of Japan introduced a survey on the inflation outlook of firms -- general prices and output prices -- in its Short-term Economic Survey of Enterprises in Japan (*Tankan*). The *Tankan* survey covers over 10,000 sample enterprises, as well as the overall corporate activity in a number of various survey items, and therefore, it provides us with detailed and credible data on both the inflation outlook and business environment of firms for more than two years since the introduction.

In this paper, we investigate the relation between the inflation outlook of firms and their business conditions, and analyze the changes in expectations using micro data. We find that current changes in output prices and input prices have a larger impact on firms' inflation outlook than business conditions or supply-demand measures. And the decline in commodity prices is also likely to exert a certain influence on the recent decline in firms' general price expectations.

1. Introduction

The standard New Keynsian Phillips curve models (Clarida, Gali, and Gertler (1999) or Woodford (2003), for example) define inflation outlook as an important determinant of actual inflation. For central banks that employ target inflation rates like the Bank of Japan (BOJ), understanding and monitoring the inflation outlook is crucial for achieving the targets.

More specifically, the inflation outlook of enterprises are thought to influence actual inflation rates because prices of products and employees' wages are determined based on firms' views per se regarding the inflation outlook. Until recently, little was known about their formulation process, what affects their inflation outlook or which type of enterprise has higher (or lower) ones, due to limited availability of data on the inflation outlook of enterprises. In recent years, however,

[1] The views expressed here are those of the authors and do not necessarily represent those of the Bank of Japan. The authors are responsible for any errors or omissions.

some empirical researches have been conducted based on a large set of sample survey data on firms. Bryan, Meyer and Parker (2015) use data from the Federal Reserve Bank of Atlanta's *Business Inflation Expectations Survey* and point out that the inflation outlook of firms has greater heterogeneity compared to the outlook by professional forecasters, due to the idiosyncratic cost structure that firms face when setting prices. Coibion, Gorodnichenko and Kumar (2015) use survey data of firms' macroeconomic beliefs in New Zealand. They find that the average inflation outlook is much higher than those of professional forecasters and that the dispersion in the outlook can be explained largely by difference in firms' incentive to collect and process information on prices.

In March 2014, the BOJ introduced a survey on the mid- to long-term inflation outlook of firms as part of the *Tankan* ("Short-term Economic Survey of Enterprises in Japan"), which is one of the important information sources for the BOJ in assessing the Japanese economy and highly appreciated across a wide spectrum of entities. We consider that data obtained from the *Tankan* survey are valuable for examining the inflation outlook of firms. First, its sample size is enormous. There are 10,862 sample firms (as of the June 2016 survey). Secondly, its data are based on a panel structure. The response rate is extremely high, consistently over 99%, with sample firms responding on an ongoing basis. Thirdly, it contains various survey items covering overall corporate activity.

In this paper, we investigate the effects of firms' business environment on their inflation outlook. And we examine the factors behind the recent decline in the inflation outlook of firms in the *Tankan* survey.

The remainder of the paper is organized as follows. Section 2 provides a detailed description of the survey on inflation outlook in the *Tankan* since the March 2014 survey. Section 3 depicts the relation among survey items, including the inflation outlook, by using the Bayesian network, one type of machine learning techniques. In Section 4, we estimate the random-effects ordinal probit regression to assess the impact of each survey item on the business environment. Section 5 evaluates the contribution of changes in the business environment to the recent decline in the inflation outlook. Section 6 concludes.

2. A Description of the Survey on the Inflation Outlook of Firms

With the absence of surveys on inflation outlook of firms in Japan, the BOJ introduced a two-section survey on the inflation outlook of firms in March 2014 (Table 1). The survey on "Output Prices" asks firms about their expectations on the rate of price change relative to the current level with respect to their mainstay domestic products and services. The survey on "General prices" asks firms about their expectations for the annual percentage change in general prices as measured in the consumer price index. Firms are asked to provide their forecasts over the horizon of one year, three years, and five years. Sample firms can choose either the "Don't know" or "Don't have a clear view" option when they find it difficult to choose any one of the indicated inflation figures.

Figure 1 depicts the average inflation outlook since the March 2014 survey, which is the weighted average by response in percentage terms. The average inflation outlook of all firms rises gradually as the forecasting horizon increases. The difference in the average inflation outlook among firm size is comparatively large, with that of small firms higher than that of large firms, and the inflation outlook for output prices of nonmanufacturing firms higher than that of manufacturing firms. The difference among industries is subtle for general prices, while it is large for output prices. Turning to changes in the time-series data, we see that the inflation outlook started to decrease gradually from the March 2014 survey through the June 2015 survey, and eventually showing a steeper decline from the September 2015 survey to the most recent survey. This trend is more apparent for general prices.

Figure 2 shows the contribution of each option to the change of the average inflation outlook for general prices. A decrease in the number of respondents of "4% or higher" and that of "around 2%" cause the recent decline. We consider a continuous decrease of "4% or higher" to be a learning process for respondents, that is, firms -- which had only little interest in the inflation outlook for general prices -- started to take a close interest in the *Tankan* survey since the inflation for general prices in Japan was far lower than their outlook in news reports and other sources, and thereby, initiating them to make reasonable responses. On the other hand, the recent decrease of the "around 2%" cohort probably indicates some sort of decline in firms' inflation expectations. We also see from Figure 3 that the recent decline in output prices is mainly attributable to the decreases of the "around 5%" and "around 10%" cohorts.

As for the percentage of respondents choosing from options "Don't Know" or "Don't have a clear view," Figure 4 shows that the share for the "Don't Know" option changed only slightly, with a majority of respondents choosing the "uncertainty about the future" option since they do not have a clear view on general price inflation expectations.

3. Bayesian Network Analysis

To investigate the relationship between the inflation outlook and business conditions of firms, we first use the Bayesian network approach.[2] The Bayesian network is a probabilistic graphical model that represents a set of variables and their probabilistic independence. It can be used to examine causal relationships and can represent these relationships graphically, which allows us to understand complex situations easily (see Appendix).

Together with the aforementioned questionnaire about outlook for output and general prices in 1, 3 and 5 years' forecast horizons, our dataset for this Bayesian network approach contains information on respondents': (1) judgment on several

[2] Although the graphical models in this analysis are technically referred to as chain graphs since these graphs have both directed and undirected edges as a result of a search by the algorithm, we call them the Bayesian network here in this paper for convenience.

business environments at the time of the survey (referred to as "actual"); and (2) that in three months hence (referred to as "forecast"), for each of the business environments described in Table 2 in Appendix.

For samples of the Bayesian network analysis, we use data of the March 2014 survey to June 2016 survey. We choose from a group of respondents that answer all of the items in Table 2 for each survey and exclude samples whose option is "Don't know" in the outlook for output prices and whose options are "Don't have clear view for uncertainty over the future outlook is high", "Don't have clear view for not really conscious of inflation fluctuations because they should not influence the strategy of the institution", or "Don't have clear view for other reasons" in the outlook for general prices. To identify an optimal Bayesian network, we use the Fast-IAMB algorithm, a kind of constrained-based algorithm (see Yaramakala and Margaritis [2005]). We apply some constraints: domestic supply-demand and input price judgments are exogenous, and there is no directional link from the forecast to the actual result of the same judgment.

The results of the optimal Bayesian network obtained from the algorithm are presented in Figures 5a to 5f. Collectively, these figures show that there are strong linkages among real-based judgments (business conditions, domestic supply and demand, production capacity, and employment conditions) and among price judgments (output prices, input prices, and inflation outlook). However, the link between real-based judgments and price judgments is relatively weak mainly in longer forecast horizons. We also find that these judgment items can be divided into a "real-based category" and a "price category," with the inflation outlook belonging to the price category.

Regarding the outlook for general prices, the actual result of input prices, forecast for input prices, forecast for output prices, and forecast for employment conditions are all linked in the Bayesian network. In addition to these judgments, there is a directional link from the actual result of output prices to the outlook for output prices. We interpret this result as to provide evidence that although the inflation outlook is a survey that shows firms' judgments on their mid- to long-term inflation expectations, it is affected by current price movements that firms are facing, and firms also see labor market conditions or wage trends as important determinants for future inflation rates.

4. Results of Probit Estimation

Next, we use the following regression in order to examine the statistical significance and the size of effect of each judgment on the inflation outlook. Since firm-level data on the inflation outlook in the *Tankan* survey are not continuous variables, we estimate in the form below:

$$\pi_i^* = \beta_0 + \beta_1 manu_{it} + \beta_2 Large_{it} + \beta_3 Small_{it} + \beta_4 LN(Employ_{it}) + \sum_k \theta_k D_{kit} + \sum_t \rho_t \delta_t + \varepsilon_{it}$$

where π_i^* is a latent variable measuring the inflation outlook of firm i; $manu_{it}$, $Large_{it}$, and $Small_{it}$ are dummy variables for nonmanufacturing, large and small firms, respectively; $Employ_{it}$ is the number of employees at firm i in survey t.; D_{kit} is the dummy for each option in the judgment survey items; and δ_t is the dummy for each survey period. Given the panel structure of the data sets and the ordinal nature of the dependent variable, we proceed by estimating the random-effects ordinal probit regression.

The results of the regression appear in Table 3. Firstly, the dummy for small enterprises and the number of employees are statistically significant for both the output price and general price outlook, and the dummy for nonmanufacturing is also significant particularly for the output price outlook. Inflation expectations of firms become higher as the firm size becomes smaller.

The input price and output price judgments show a strong correlation with the inflation outlook. Particularly for the output price outlook, the coefficients of the output price judgment -- actual results and forecasts alike -- are large and statistically significant. For the general price outlook, forecasts of the input price judgment and output price judgment are essential. These results coincide with the Bayesian network analysis.

As for other judgments, forecasts of business conditions and domestic supply-demand conditions correlate with the output price outlook. In terms of the long-term outlook for general prices, the forecast of employment conditions and the actual result of production capacity are statistically significant. These results suggest that firms' projections for product or industry growth affect their long-term outlook for output prices, and their projections for labor market conditions affect their long-term outlook for general prices.

We see from dummies for each survey period that all dummies are statistically significant after the September 2015 survey and that the outlook decreases with the passage of time. The result that the coefficients of dummy variables for general prices are larger than those for output prices implies that firms take account of information other than their own business environment when asked about their general price outlook in the *Tankan* survey.

5. Recent Decline in the Inflation Outlook and Business Environment of Firms

As discussed above, the current change in input and output prices that firms are now facing and will do so in the near future significantly affects their inflation outlook. Figure 6 shows the distribution of the inflation outlook based on the input price, output price, and business condition judgments. For example, the distribution illustrated for respondents choosing the "1. Rise" option for the forecast of the output price judgment differs from that for respondents choosing the "3. Fall" option. In contrast, the distribution of respondents choosing the "1. Favorable" option for the business conditions judgment shows a picture similar to that of other judgments.

For this reason, it is highly probable that changes in firms' judgments on price change have a certain influence on the recent decline in their inflation outlook. We see from Figure 7 that the DIs of input price and output price judgments have decreased sharply since the September 2015 survey, indicative of a decline in commodity prices including oil prices.

Figure 8 shows the contributions of each judgment and time dummy to changes in the latent variables π_i^* from the June 2015 survey to the June 2016 survey. Changes in options of output price and input price judgments have a comparatively large contribution relative to those of other judgment options, to changes in the latent variable, especially in terms of the outlook for output prices. On the other hand, the time dummy accounts for a large share both in the outlook for output prices and that of general prices.

Similarly, we estimate the contributions of output and input price judgments to the decline in the inflation outlook using results obtained from the Bayesian network analysis. To simulate the inflation outlook, we calculate the distributions of the inflation outlook using options of output and input judgments in the June 2015 survey, and then change only the constituent ratios of each option and convert them into the June 2016 survey. In other words, we simulate the inflation outlook taking account of changes in the output and input price judgments in the June 2016 survey and on the condition that distributions of the inflation outlook for respondents who answers specific combination of output and input price judgments do not change. Table 4 shows the contribution of changes in the price judgment to the inflation outlook: it accounted for over 45% for the output price outlook, while it was in the range of 15-20% for the general price outlook. We conclude that the decline in the output price outlook is largely accompanied by the current fall in output prices and input prices. However, a larger part of the decline in the general price outlook cannot be explained by these movements and it is likely that their macroeconomic views have also played a part for the recent decline in the general price outlook.

6. Conclusion

In this paper, we examined the relation between firms' inflation outlook and their business environment using micro data of the *Tankan* survey. We also analyzed the recent decline in the inflation expectation. To sum up the major characteristics, we found that current changes in output prices and input prices have a larger effect on firms' inflation outlook than business conditions or other supply-demand measures. Small enterprises tend to have a higher inflation outlook than large enterprises. And the decline in commodity prices may have a certain influence on the recent decline in firms' inflation outlook, especially for output prices.

References

Bank of Japan, 2013, "Planned Revisions of the *Tankan* Survey – Review of survey items, including the introduction of a survey on Inflation Outlook of Firms –," Research and Statistics Department, *BOJ Reports & Research Papers*.

Bryan, Michael F., Brent H. Meyer and Nicholas B. Parker, 2015, "The Inflation Expectations of Firms: What Do They Look Like, Are They Accurate, and Do They Matter?," *Federal Reserve Bank of Atlanta Working Paper*.

Clarida, Richard, Jordi Gali, and Mark Gertler, 1999, "The Science of Monetary Policy: A New Keynesian Perspective," *NBER Working Paper*, 7147.

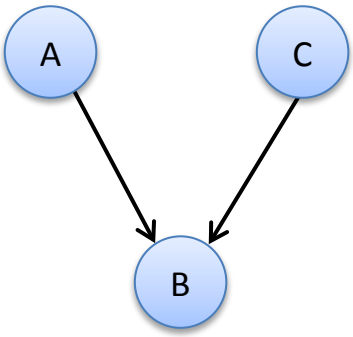
Coibion, Olivier, Yuriy Gorodnichenko and Saten Kumar, 2015, "How Do Firms Form Their Expectations? New Survey Evidence," *NBER Working Paper*, 21092.

Woodford, Michael, 2003, "Interest and Prices: Foundations of a Theory of Monetary Policy," *Princeton University Press*, 2003.

Yaramakala, Sandeep and Dimitris Margaritis, 2005, "Speculative Markov Blanket Discovery for Optimal Feature Selection," *In Proceedings of the Fifth IEEE International Conference on Data Mining*, 809-812.

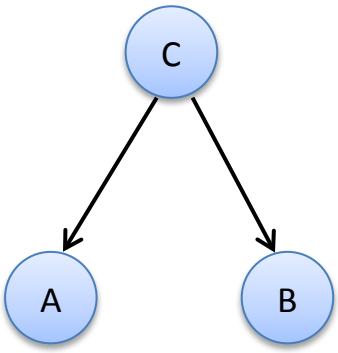
Appendix: Concept and Structure of Bayesian Network

A Bayesian network (BN) consists of nodes, a set of variables, and links that represent probabilistic or causal relationships among nodes. Here, for instance, we show a causal model. For a case where "A" and "C" are the causes of "B," we illustrate a graphical expression of the model as well as the joint distribution of the nodes below:



$$P(A, B, C) = P(B|A, C)\, P(A)\, P(C)$$

The following example in figure below shows the graphical expression and joint distribution that "A" is related to "B," but is not the direct cause of "B," while "C" is the cause of "A" and "B."



$$P(A, B, C) = P(A|C)\, P(B|C)\, P(C)$$

As illustrated above, we construct a joint distribution for the BN model given its probabilistic structure.

One of the goals of the Bayesian network analysis is to find the best model based on information criteria or other statistical measures. Since the structure of the BN is generally unknown, we need to learn about them from data. We faced various difficulties in this process due to the fact that there are many directional links among nodes and that the optimal network must be chosen from a vast number of competitive networks. For this reason, a rich set of research methods exists for the learning algorithms of BN.

Overview of the New Survey on Inflation Outlooks of Firms

Table 1

Survey Items		"Outlook for Output Prices" (rate of price change relative to the current level) "Outlook for General Prices" (annual % change)
Forecast horizon		1 year ahead, 3 years ahead, 5 years ahead
Sample Firms		Equivalent to the sample firms of the current ***Tankan*** ("The Short-term Economic Survey of Enterprises in Japan") (10,862 firms as of June 2016)
Questionnaire	Outlook for Output Prices	[Question] Relative to the current level, what are your institution's expectations of the rate of price changes in your mainstay domestic products or services for one year ahead, three years ahead, and five years ahead, respectively? Please select the range nearest to your own expectation from the options below.
		[Options] Rate of change relative to the current level 1. around +20% or higher (+17.5% or higher) 2. around +15% (+12.5 to +17.4%) 3. around +10% (+7.5 to +12.4%) 4. around + 5% (+2.5 to + 7.4%) 5. around 0% (−2.5 to +2.4%) 6. around − 5% (−7.5 to −2.6%) 7. around −10% (−12.5 to −7.6%) 8. around −15% (−17.5 to −12.6%) 9. around −20% or lower (−17.6% or lower) 10. Don't know.
	Outlook for General Prices	[Question] What are your institution's expectations of the annual % change in general prices (as measured by the consumer price index) for one year ahead, three years ahead, and five years ahead, respectively? Please select the range nearest to your own expectation from the options below.
		[Options] In annual % rate change 1. around +6% or higher (+5.5% or higher) 2. around +5% (+4.5 to +5.4%) 3. around +4% (+3.5 to +4.4%) 4. around +3% (+2.5 to +3.4%) 5. around +2% (+1.5 to +2.4%) 6. around +1% (+0.5 to +1.4%) 7. around 0% (−0.5 to +0.4%) 8. around −1% (−1.5 to −0.6%) 9. around −2% (−2.5 to −1.6%) 10. around −3% or lower (−2.6% or lower) ※If you have no clear views on general prices, please select one of the three following reasons. 11. Uncertainty over the future outlook is high 12. Not really conscious of inflation fluctuations because they should not influence the strategy of the institution. 13. Other

Variables used in the Bayesian Network Analysis

Table 2

Respondents are asked to choose one alternative among three as the best descriptor of prevailing conditions, excluding seasonal factors, at the time of the survey and three months hence.

Business Conditions	Judgment of general business conditions of the responding enterprise, primarily in light of individual profits. [1) Favorable. 2) Not so favorable. 3) Unfavorable.]
Domestic Supply & Demand Conditions for Products and Services	Judgment of domestic supply and demand conditions for major products and services in the industry of the responding enterprise. Judgment in light of movements of goods, customers, and order arrival is included. Judgment including overseas conditions is also acceptable when it is difficult to exclude them. [1) Excess demand. 2) Almost balanced. 3) Excess supply.]
Production Capacity	Judgment of excessiveness, adequacy, or shortage of production capacity or business equipments of the responding enterprise, excluding a shortage caused by temporary conditions such as a closure of a factory due to regular repairs. [1) Excessive capacity. 2) Adequate. 3) Insufficient capacity.]
Employment Conditions	Judgment of excessiveness, adequacy, or shortage of the number of employees at the responding enterprise. [1) Excessive employment. 2) Adequate. 3) Insufficient employment.]
Change in Output Prices	Judgment of changes in the yen-based selling prices of major products and services provided by the responding enterprise. [1) Rise. 2) Unchanged. 3) Fall.]
Change in Input Prices	Judgment of changes in the yen-based purchasing prices of main raw materials, processing fees for subcontractors, and/or prices of main purchasing merchandise paid by the responding enterprise. [1) Rise. 2) Unchanged. 3) Fall.]

Ordered Probit Regression Result

Table 3

Ordinal dependent variable:		Output Prices			General Prices		
		1 year ahead	3 years ahead	5 years ahead	1 year ahead	3 years ahead	5 years ahead
Enterprise Size	Large	0.046	0.012	-0.087	-0.383	0.023	-0.620
		(1.560)	(0.482)	(-3.035)	(-7.790)	(0.760)	(-14.273)
	Small	0.106	0.150	0.077	0.063	0.150	0.069
		(4.637)	(7.318)	(3.248)	(2.854)	(6.421)	(2.524)
Industries (Nonmanufacturing)		0.124	0.157	0.163	-0.068	0.011	0.023
		(6.197)	(8.794)	(8.168)	(-3.373)	(0.517)	(0.853)
Business Conditions (Actual)	Favorable	0.015	-0.006	-0.036	0.069	0.035	0.046
		(0.851)	(-0.302)	(-1.690)	(4.318)	(1.869)	(2.093)
	Unfavorable	0.041	0.018	0.016	0.000	-0.039	-0.029
		(1.919)	(0.819)	(0.659)	(-0.020)	(-1.722)	(-1.141)
Business Conditions (Forecast)	Favorable	0.110	0.057	0.078	0.051	0.062	0.036
		(5.476)	(2.786)	(3.320)	(2.846)	(2.971)	(1.525)
	Unfavorable	-0.109	-0.050	-0.045	-0.012	-0.017	-0.002
		(-4.937)	(-2.131)	(-1.681)	(-0.604)	(-0.708)	(-0.073)
Domestic Supply & Demand Conditions (Actual)	Excess Demand	0.156	0.043	0.093	0.035	0.011	0.051
		(5.067)	(1.344)	(2.538)	(1.238)	(0.336)	(1.343)
	Excess Supply	0.011	0.025	0.037	0.049	0.037	0.040
		(0.435)	(0.964)	(1.161)	(2.179)	(1.403)	(1.312)
Domestic Supply & Demand Conditions (Forecast)	Excess Demand	0.085	0.164	0.112	0.039	0.050	0.011
		(2.634)	(4.836)	(2.911)	(1.297)	(1.480)	(0.292)
	Excess Supply	-0.024	-0.057	-0.035	0.031	-0.005	0.009
		(-0.956)	(-2.205)	(-1.140)	(1.385)	(-0.197)	(0.282)
Production Capacity (Actual)	Excessive	0.001	0.028	0.034	-0.020	-0.010	0.081
		(0.029)	(0.732)	(0.730)	(-0.622)	(-0.269)	(1.873)
	Insufficient	0.038	0.005	0.074	0.029	0.085	0.113
		(1.289)	(0.158)	(2.158)	(1.122)	(2.853)	(3.263)
Production Capacity (Forecast)	Excessive	-0.046	-0.110	-0.130	0.031	-0.020	0.016
		(-1.253)	(-2.948)	(-2.926)	(0.947)	(-0.539)	(0.372)
	Insufficient	-0.016	-0.013	-0.051	0.017	0.033	0.003
		(-0.581)	(-0.493)	(-1.563)	(0.703)	(1.155)	(0.077)
Employment Conditions (Actual)	Excessive	-0.022	-0.048	-0.075	0.026	0.026	-0.006
		(-0.682)	(-1.478)	(-1.968)	(0.909)	(0.778)	(-0.154)
	Insufficient	-0.004	-0.016	-0.022	0.027	-0.040	-0.033
		(-0.216)	(-0.813)	(-0.939)	(1.574)	(-2.000)	(-1.434)
Employment Conditions (Forecast)	Excessive	-0.055	-0.046	0.011	-0.060	0.000	-0.031
		(-1.750)	(-1.422)	(0.282)	(-2.153)	(0.010)	(-0.806)
	Insufficient	0.004	0.036	0.019	0.025	0.061	0.095
		(0.210)	(1.885)	(0.863)	(1.477)	(3.137)	(4.214)
Change in Output Prices (Actual)	Rise	0.299	0.136	0.126	0.109	0.025	0.030
		(13.521)	(5.490)	(4.270)	(5.312)	(1.019)	(1.071)
	Fall	-0.312	-0.316	-0.189	-0.046	-0.034	-0.058
		(-12.823)	(-11.370)	(-5.765)	(-2.073)	(-1.305)	(-1.893)
Change in Output Prices (Forecast)	Rise	0.706	0.473	0.460	0.178	0.167	0.161
		(34.298)	(21.219)	(17.711)	(9.554)	(7.548)	(6.316)
	Fall	-0.798	-0.763	-0.735	-0.041	-0.071	-0.016
		(-33.495)	(-28.839)	(-22.920)	(-1.940)	(-2.841)	(-0.542)
Change in Input Prices (Actual)	Rise	0.178	0.068	0.099	0.189	0.064	0.006
		(10.061)	(3.714)	(4.624)	(12.013)	(3.422)	(0.282)
	Fall	0.005	0.021	0.115	-0.131	-0.055	0.022
		(0.173)	(0.627)	(3.028)	(-4.719)	(-1.649)	(0.564)
Change in Input Prices (Forecast)	Rise	0.108	0.138	0.121	0.165	0.151	0.172
		(6.272)	(7.853)	(5.896)	(10.822)	(8.471)	(8.157)
	Fall	-0.165	0.097	0.097	-0.084	-0.080	-0.097
		(-4.779)	(2.534)	(2.288)	(-2.676)	(-2.168)	(-2.234)
Log (Employment)		-0.040	-0.021	-0.019	-0.075	-0.041	-0.071
		(-6.594)	(-3.620)	(-2.837)	(-10.525)	(-5.727)	(-8.407)
Jun. 2014 Survey		-0.002	0.035	0.050	0.052	-0.025	-0.048
		(-0.093)	(1.580)	(1.999)	(2.743)	(-1.137)	(-1.891)
Sep. 2014 Survey		-0.007	-0.007	0.045	0.069	-0.030	-0.050
		(-0.340)	(-0.321)	(1.821)	(3.645)	(-1.346)	(-1.966)
Dec. 2014 Survey		-0.044	-0.013	0.008	-0.038	-0.044	-0.080
		(-2.022)	(-0.595)	(0.306)	(-1.994)	(-1.983)	(-3.151)
Mar. 2015 Survey		-0.041	-0.008	0.022	-0.069	-0.088	-0.097
		(-1.921)	(-0.348)	(0.896)	(-3.631)	(-3.935)	(-3.824)
Jun. 2015 Survey		-0.058	-0.013	0.002	-0.085	-0.121	-0.138
		(-2.698)	(-0.595)	(0.083)	(-4.485)	(-5.402)	(-5.442)
Sep. 2015 Survey		-0.148	-0.074	-0.060	-0.284	-0.242	-0.226
		(-6.787)	(-3.335)	(-2.372)	(-14.815)	(-10.757)	(-8.880)
Dec. 2015 Survey		-0.199	-0.132	-0.103	-0.431	-0.339	-0.307
		(-9.052)	(-5.919)	(-4.096)	(-22.298)	(-14.978)	(-12.008)
Mar. 2016 Survey		-0.236	-0.193	-0.163	-0.692	-0.544	-0.496
		(-10.670)	(-8.592)	(-6.450)	(-35.317)	(-23.858)	(-19.201)
Jun. 2016 Survey		-0.293	-0.250	-0.220	-0.851	-0.643	-0.558
		(-13.202)	(-11.159)	(-8.706)	(-43.211)	(-28.168)	(-21.648)
Number of Observations		75,670	55,240	40,510	65,410	46,100	35,320

Note:

The random-effects ordinal probit estimates are based on data of the *Tankan* survey. t-statistics are shown in parentheses. Shaded variables are statistically significant at the 5-percent level.

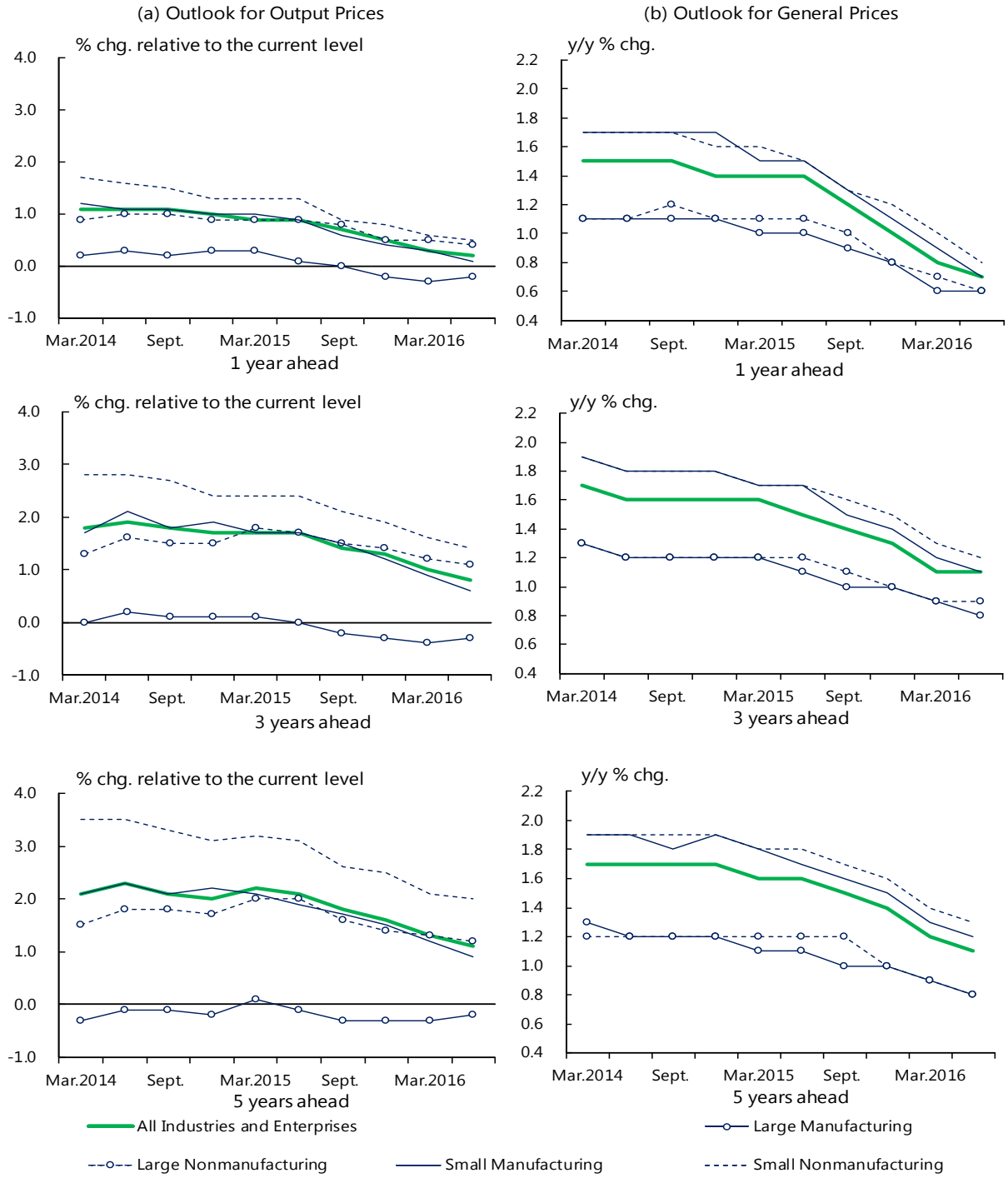
Simulation Result

Table 4

	Output Price			General Price		
	1 year ahead	3 years ahead	5 years ahead	1 year ahead	3 years ahead	5 years ahead
(A) June 2015 Survey Result	0.910	1.745	2.073	1.353	1.536	1.585
(B) Simulation Result	0.600	1.332	1.605	1.265	1.455	1.500
(C) June 2016 Survey Result	0.264	0.852	1.133	0.726	1.064	1.137
Contribution of "Change in Prices DI" ((A-B)/(A-C))	47.9%	46.2%	49.8%	14.2%	17.1%	18.9%

Weighted Average of Firms' Inflation Outlook

Figure 1



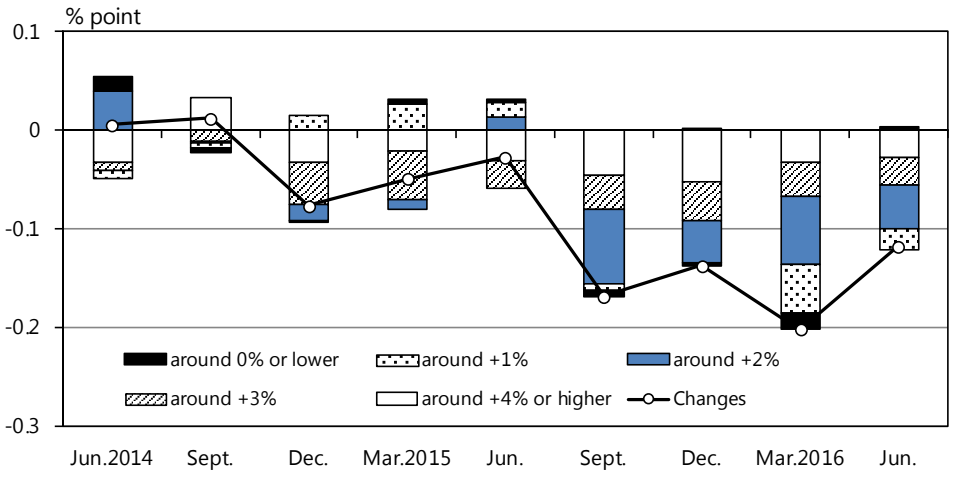
Source: Bank of Japan

Notes:

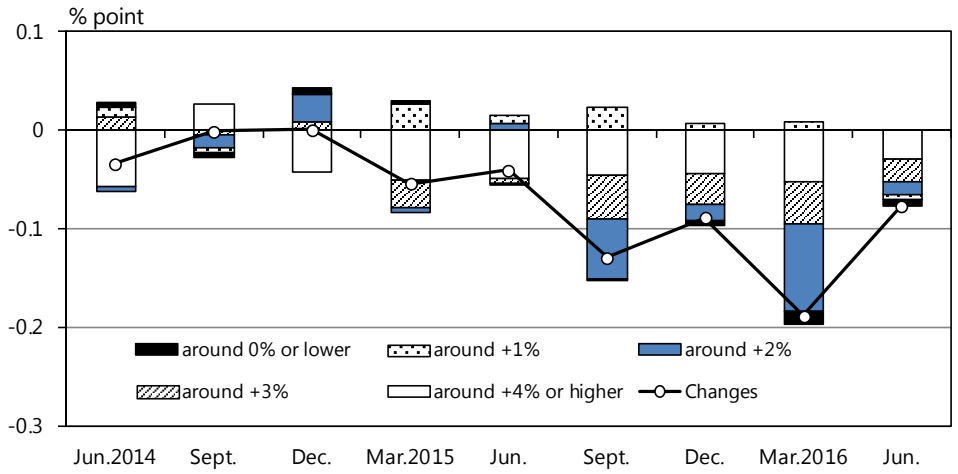
Weighted average of firms' inflation outlook is calculated excluding "Don't know." Response numbers are rounded for calculation purposes: for example, "around +15%" and "around +20% or higher" are rounded to +15% and +20%, respectively.

Contribution of Each Option to the Average Outlook for General Prices

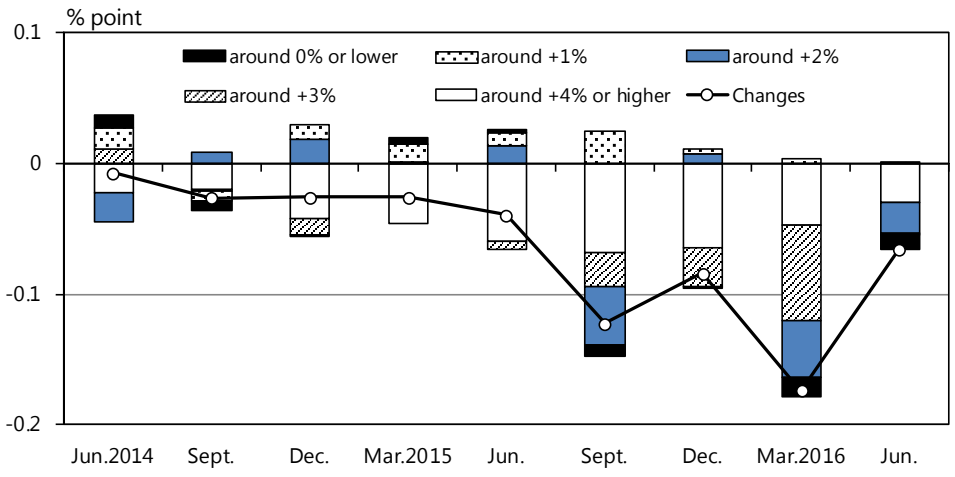
Figure 2



1 year ahead



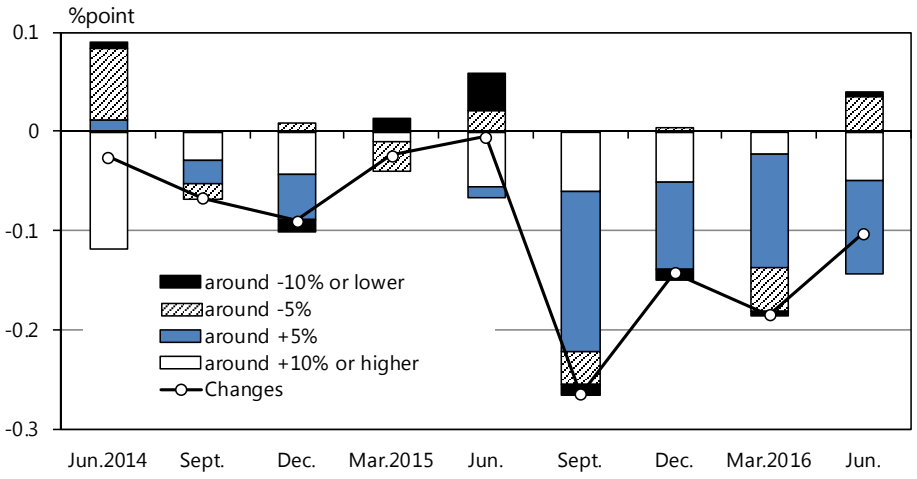
3 years ahead



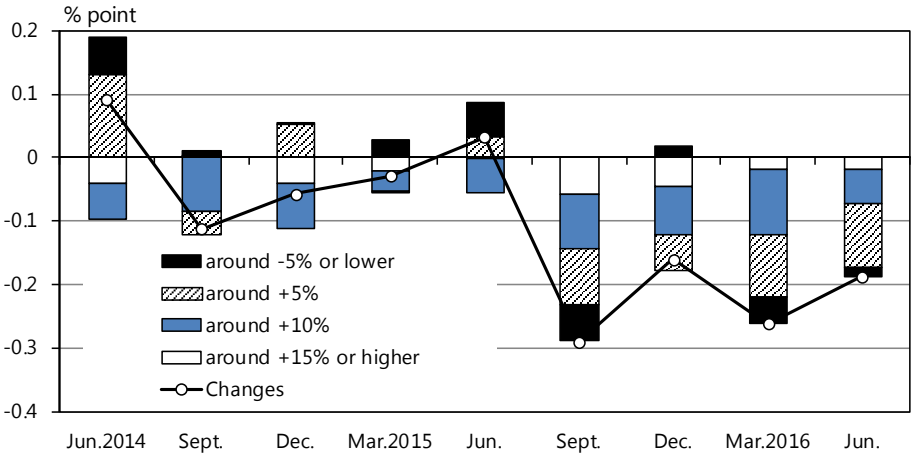
5 years ahead

Contribution of Each Option to the Average Outlook for Output Prices

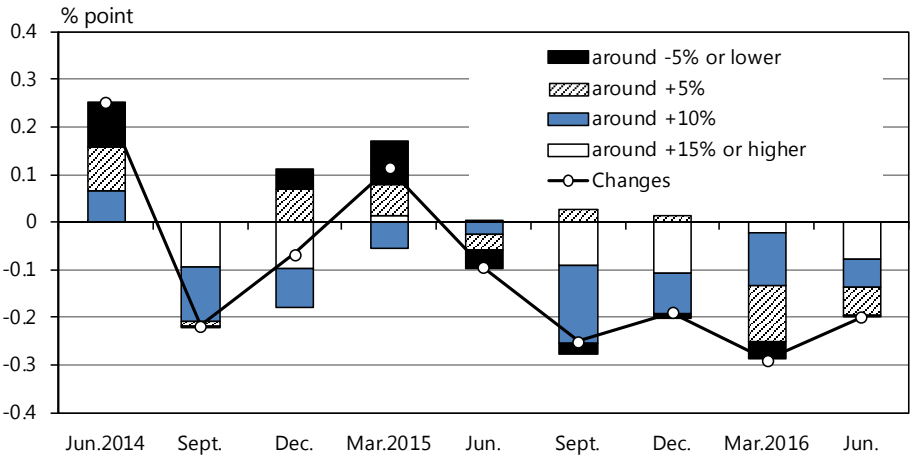
Figure 3



1 year ahead



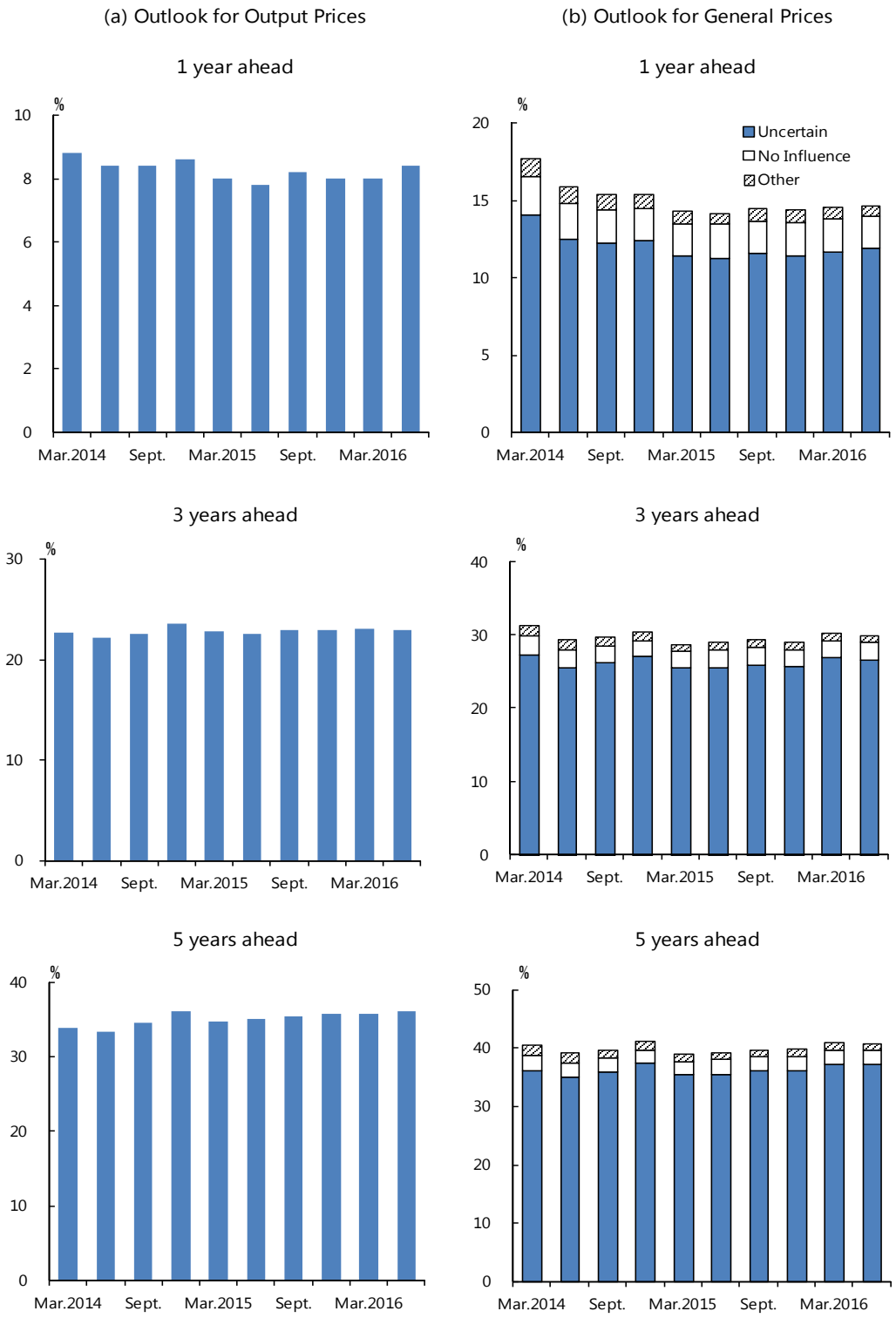
3 years ahead



5 years ahead

Percentage of Respondents Choosing "Don't Know"

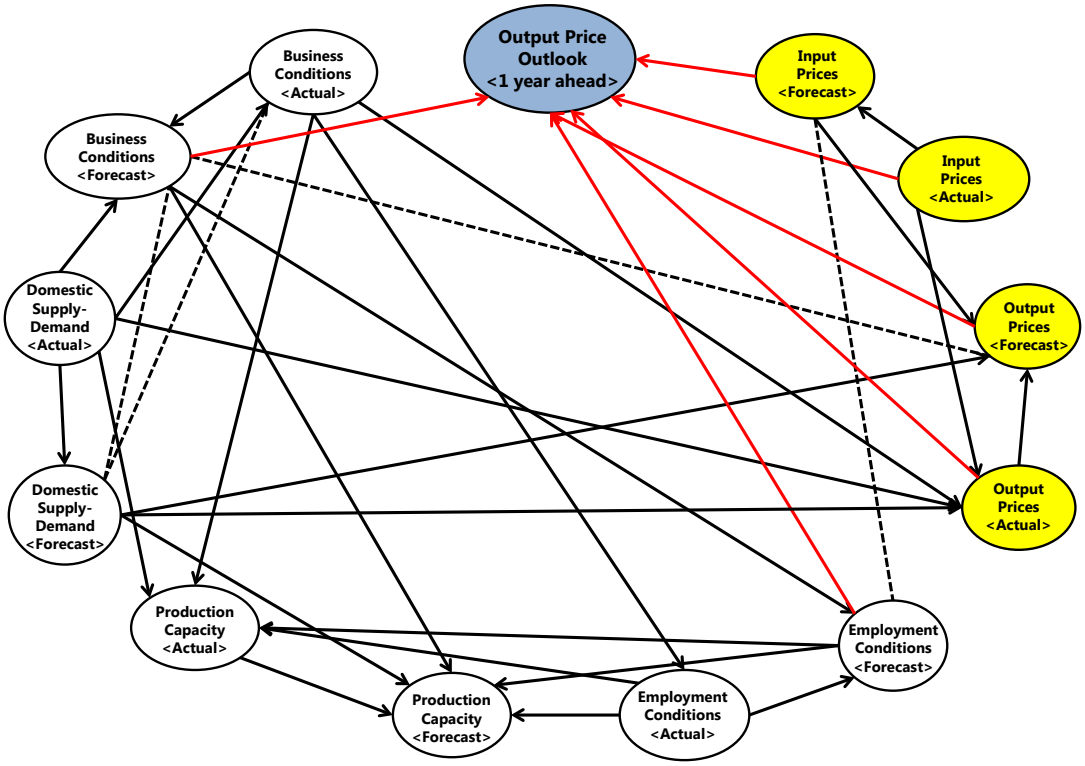
Figure 4



Note:
In outlook for general prices, "Uncertain," "No influence" and "Other" correspond to "Don't have clear view for uncertainty over the future outlook is high," "Don't have clear view for not really conscious of inflation fluctuations because they should not influence the strategy of the institution" and "Don't have clear view for other reasons," respectively.

Result of Bayesian Network Analysis

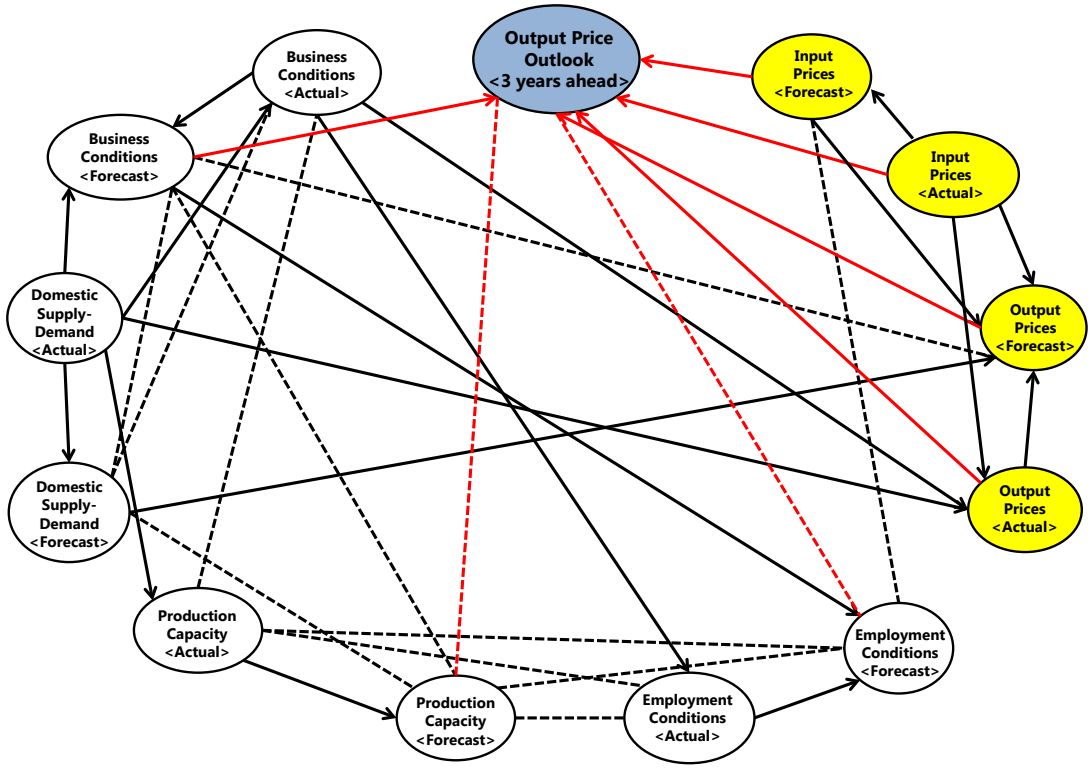
Figure 5a



Note: Arrows represent direct relationships and dotted lines indicate indirect relationships.

Result of Bayesian Network Analysis

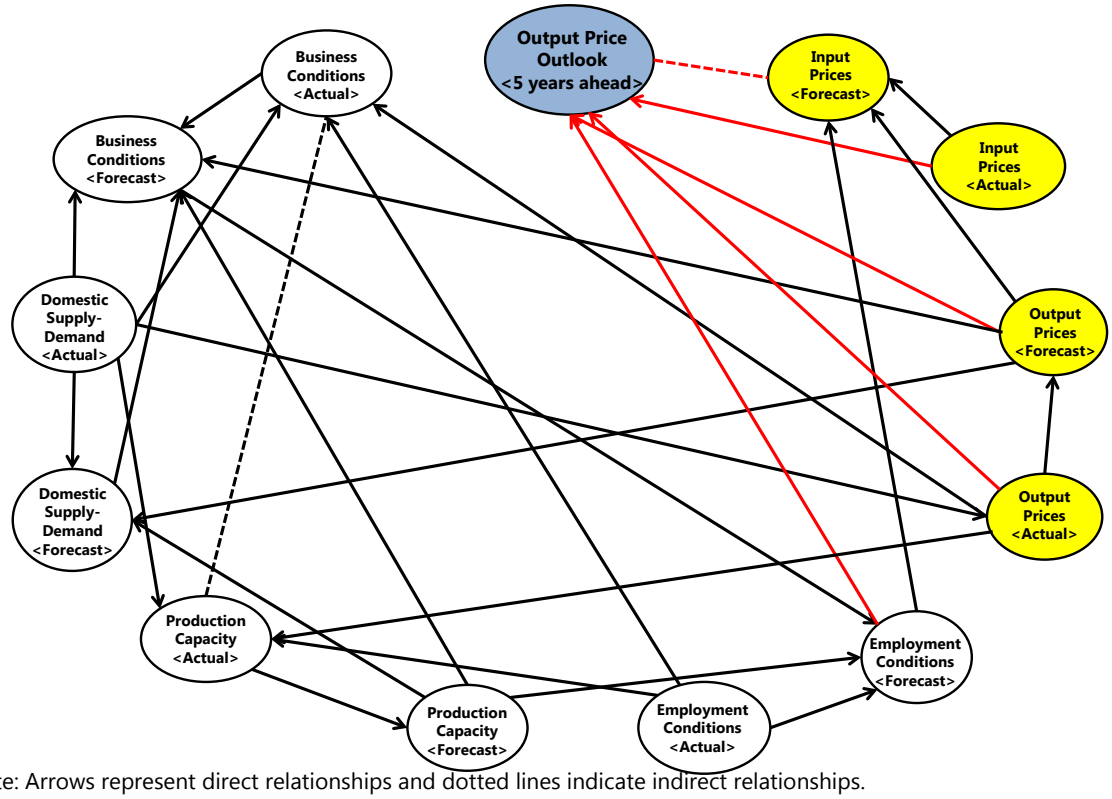
Figure 5b



Note: Arrows represent direct relationships and dotted lines indicate indirect relationships.

Result of Bayesian Network Analysis

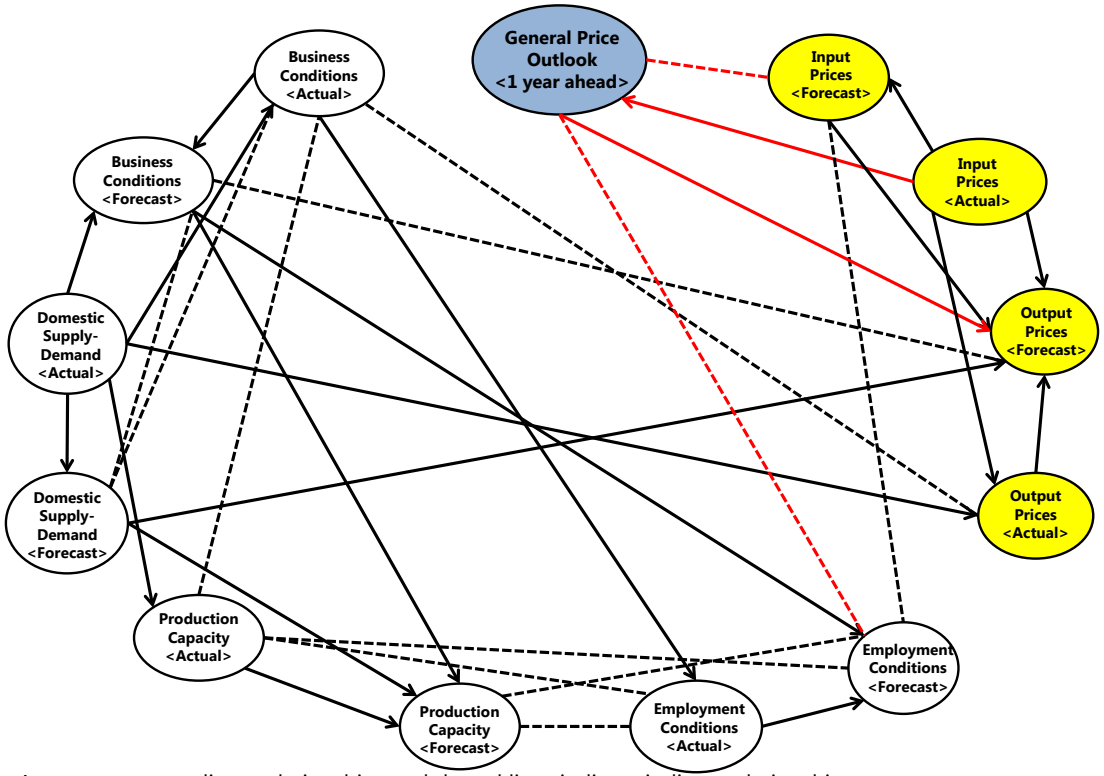
Figure 5c



Note: Arrows represent direct relationships and dotted lines indicate indirect relationships.

Result of Bayesian Network Analysis

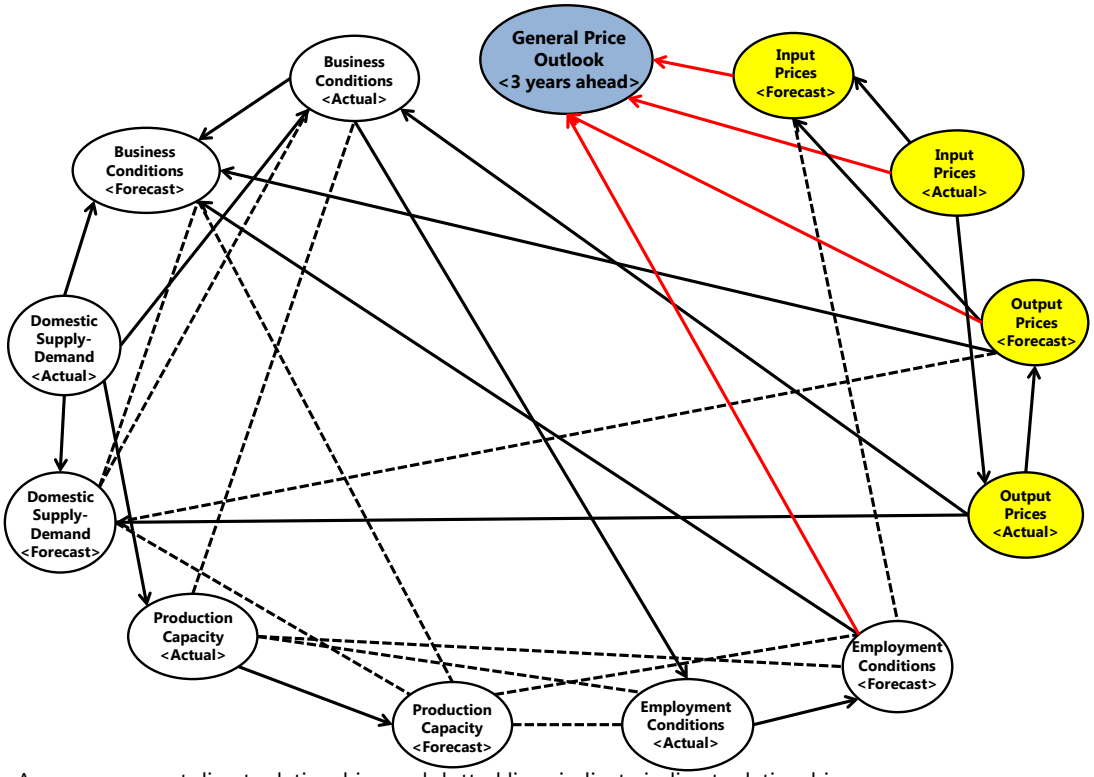
Figure 5d



Note: Arrows represent direct relationships and dotted lines indicate indirect relationships.

Result of Bayesian Network Analysis

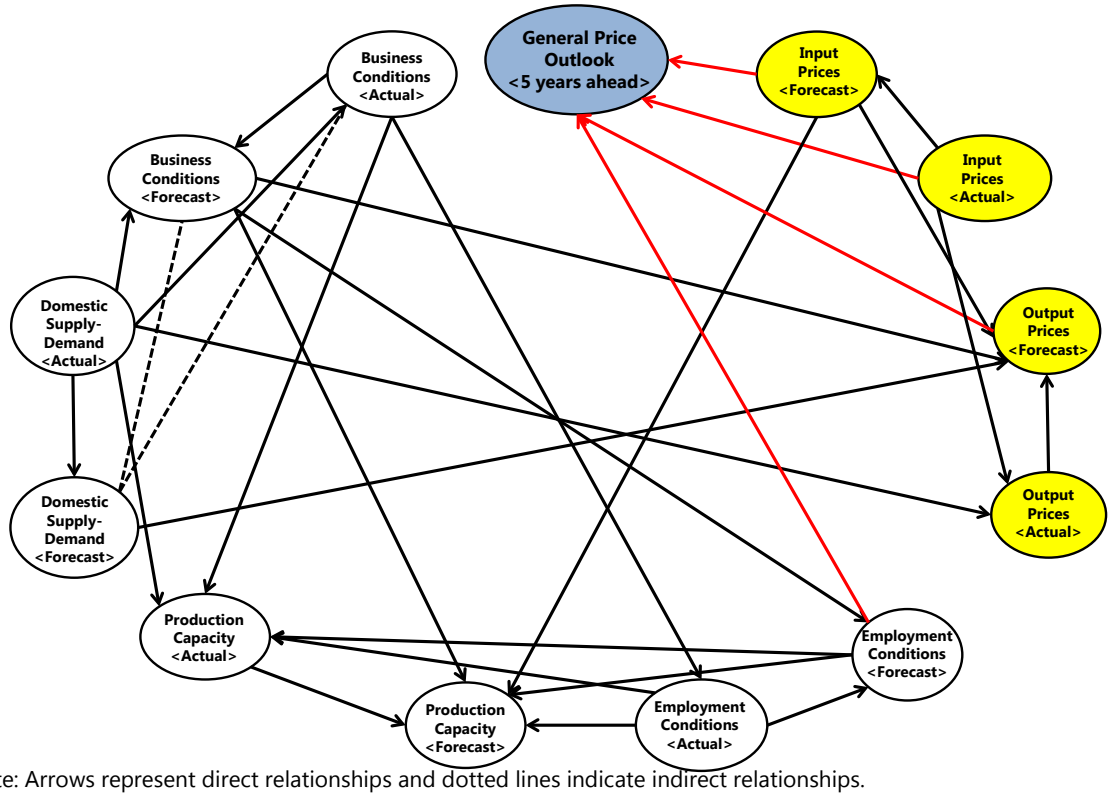
Figure 5e



Note: Arrows represent direct relationships and dotted lines indicate indirect relationships.

Result of Bayesian Network Analysis

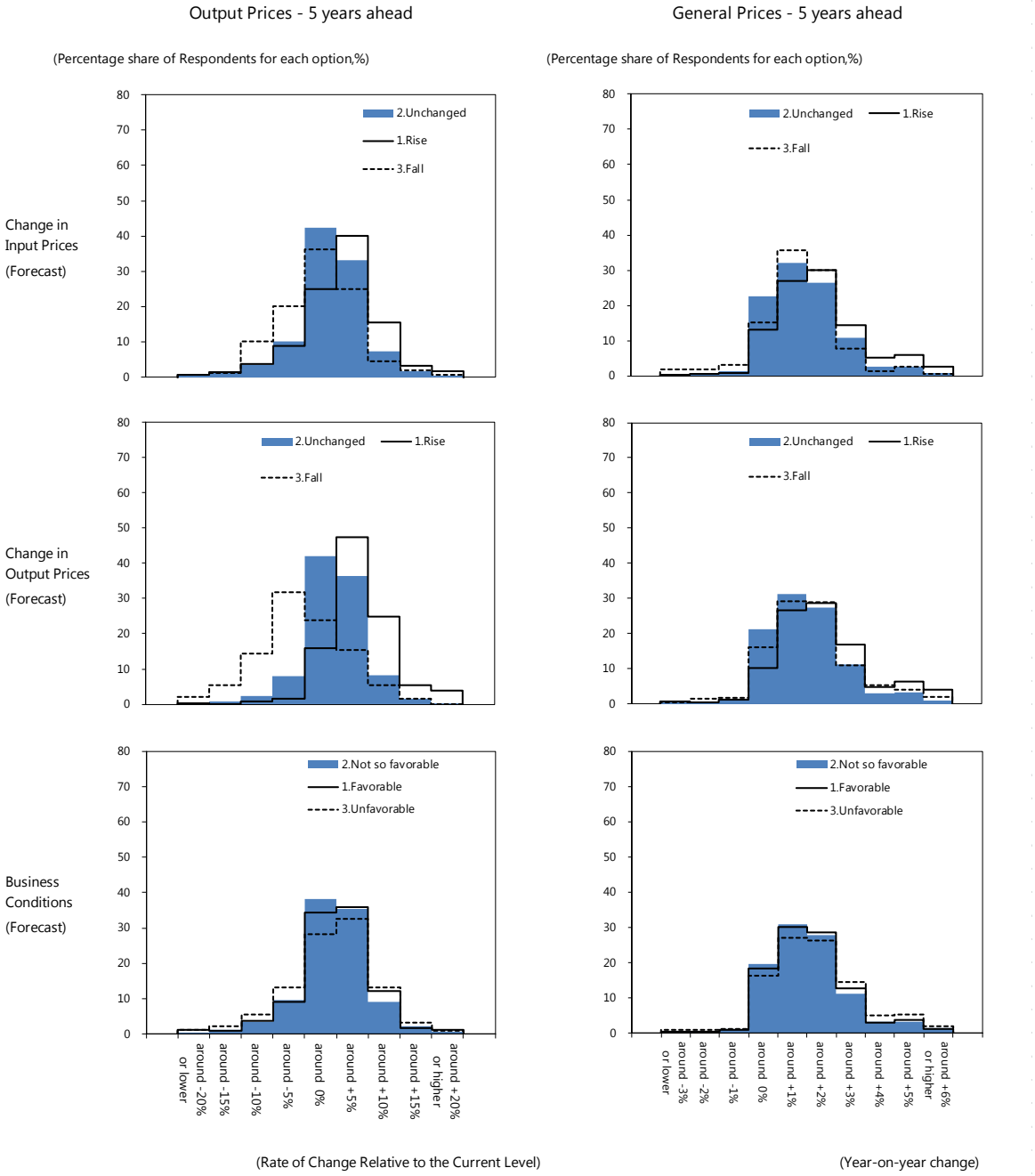
Figure 5f



Note: Arrows represent direct relationships and dotted lines indicate indirect relationships.

Distribution of "Inflation Outlook of Enterprises" Figure 6

[All Enterprises / All industries]
Previous projection: June 2015 survey

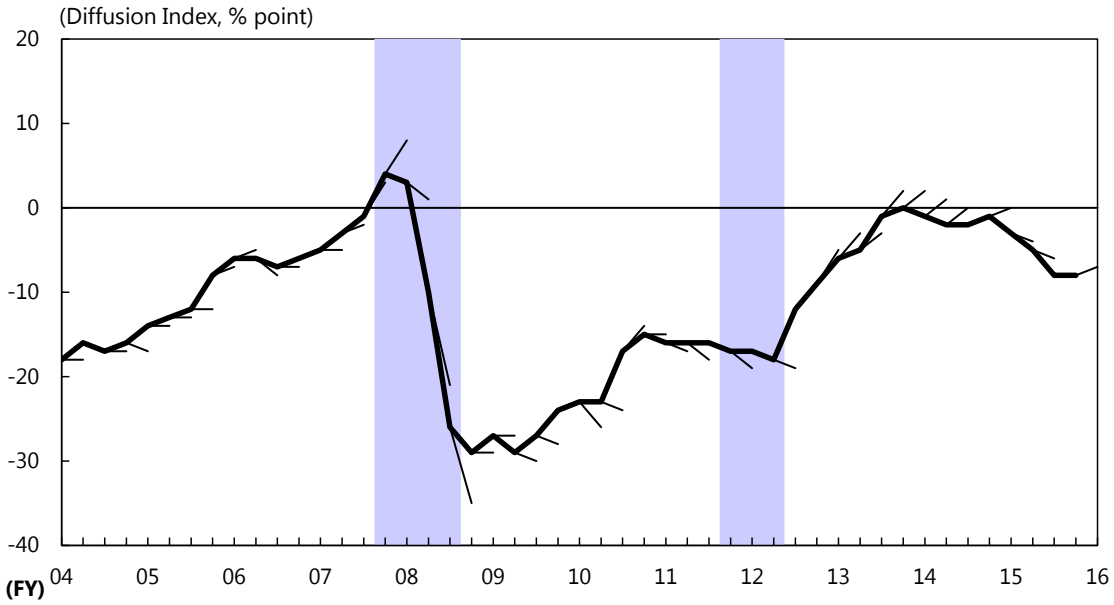


Note: "Don't know" option for output prices and "Don't have clear views" option for general prices are not shown here.

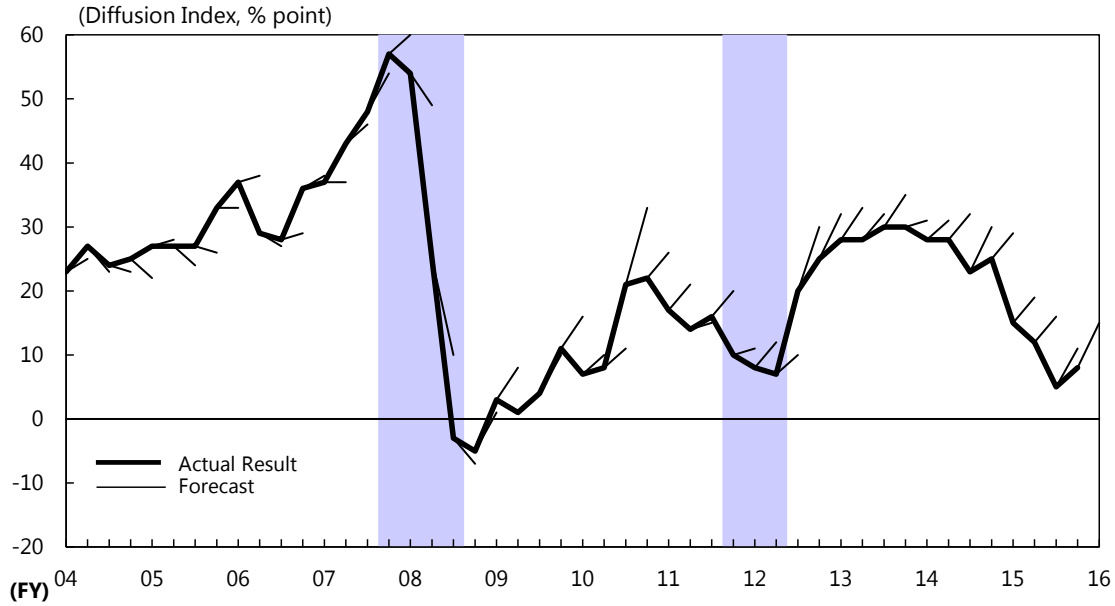
Actual Result and Forecast of Price Changes

Figure 7

Output Prices (All Industries and Enterprises)



Input Prices (All Industries and Enterprises)

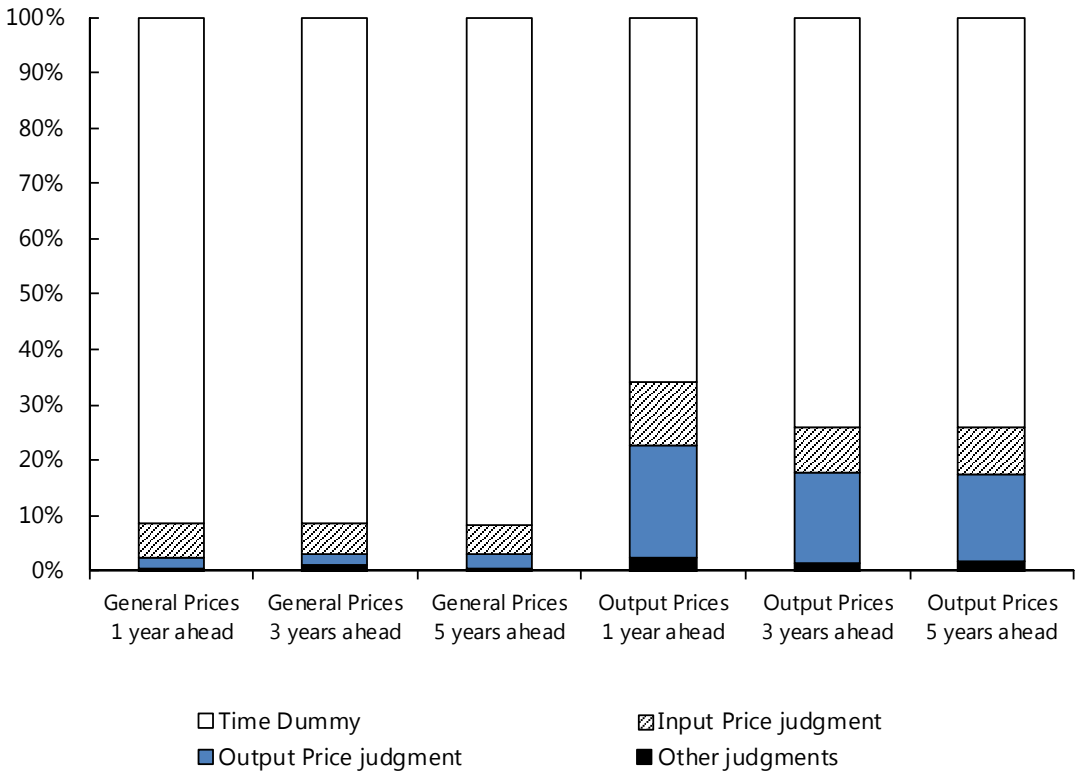


Notes: 1. Diffusion Index of "Rise" minus "Fall" is calculated from the judgment survey items "Change in Output Prices" and "Change in Input Prices."

2. Shaded areas indicate periods of recession.

Effect of Change in Judgments to the Latent Variable

Figure 8



Notes:

Here we estimate the contributions of each judgment and time dummy to the inflation outlook, using coefficients obtained from the ordinal probit regression and share of respondents for each judgment. Changes in the inflation outlook between the June 2015 and June 2016 surveys are roughly expressed in the following way. The above charts show the effect of each judgment and time dummy on changes in the inflation outlook in percentage terms.

$$\pi^*_{i_{201606}} - \pi^*_{i_{201506}} = \sum_k \theta_k (D_{ki201606} - D_{ki201506}) + \sum_t \rho_t (\delta_{201606} - \delta_{201506})$$

Other judgments consist of "Business Conditions," "Domestic Demand-Supply Conditions," "Production Capacity" and "Employment Conditions."

Irving Fisher Committee on
Central Bank Statistics

BANK FOR INTERNATIONAL SETTLEMENTS

Eighth IFC Conference on *"Statistical implications of the new financial landscape"*

Basel, 8–9 September 2016

Inflation outlook and business conditions of firms: evidence from the Tankan Survey[1]

Kazunori Hiyama,
Bank of Japan

[1] This presentation was prepared for the meeting. The views expressed are those of the author and do not necessarily reflect the views of the BIS, the IFC or the central banks and other institutions represented at the meeting.

BANK OF JAPAN

INFLATION OUTLOOK AND BUSINESS CONDITIONS OF FIRMS -- EVIDENCE FROM THE *TANKAN* SURVEY --

Kazunori HIYAMA

Research and Statistics Department

Bank of Japan

Motivation

- **What we want to know**

  : How the inflation outlook is determined

- **What kind of data available in the *Tankan* survey**

  : (i) Judgments of the inflation outlook (introduced in 2014)

  (ii) Judgments of the overall corporate activity

  - Business conditions, production capacity, etc.

- **What we do**

  : Analyzing the relationships between the inflation outlook and other judgment survey items

- **What we use in analyses**

  : (i) Ordered Probit Regression (Quantitative Analysis)

  (ii) Bayesian Network Analysis (Knowledge Discovery in Databases)

Conclusion

- **What we found by our analyses**

: (i) Judgments of **actual and near future output/input price affect firms' inflation outlook**.

(ii) Judgment survey items related to **business environments** have **little direct effect** on the inflation outlook.

(iii) Firms probably see labor market conditions as an important determinant for future inflation rates.

(iv) There are still unknown determinants of the inflation outlook.

- **Implication of our analyses**

: The *Tankan* survey is useful to understand how the inflation outlook is determined. Analyzing more details of the inflation outlook is a future work.

Overview of the *TANKAN*

High Response Rate

- 99.7% (Sample enterprises: 10,862 as of June 2016)

Various Survey Items

- Judgment items (13 items)
- Quantitative data (10 items)
- Inflation outlook (2 items)

Major judgment items related to business environment <Horizons: Recently and 3 month hence>	Inflation outlook <Horizons: 1,3,5 years>
Business Conditions	Outlook for Output Prices ➢ Options: Rate of change relative to the current level from -20% to 20% in 5% increments and "Don't know"
Domestic Supply & Demand Conditions	
Production Capacity	
Employment Conditions	Outlook for General Prices ➢ Options: Annual % rate changes from -3% to +6% in 1% increments and "Don' t have clear views"
Change in Output Prices	
Change in Input Prices	

Results of Ordered Probit Regression

- We examine the size of effect of each judgment on the inflation outlook.
  - Almost all the coefficients of price judgment and time dummy show statistical significance.

Explanatory variables	Options	Coefficients	
		Output Prices (3 years ahead)	General Prices (3 years ahead)
Change in Output Prices (Actual)	Rise	**0.136**	0.025
	Fall	**-0.316**	-0.034
Change in Output Prices (Forecast)	Rise	**0.473**	**0.167**
	Fall	**-0.763**	**-0.071**
Change in Input Prices (Actual)	Rise	**0.068**	**0.064**
	Fall	0.021	-0.055
Change in Input Prices (Forecast)	Rise	**0.138**	**0.151**
	Fall	**0.097**	**-0.080**

Note 1: We also added judgments related to business environments, time dummy, enterprise size, and industry as explanatory variables.

Note 2: Bold letters indicate statistical significance at the 5-percent level.

The Contribution to Inflation Outlook (Probit Regression)

- Judgments related to business environments have only little effect on the inflation outlook.
- The contribution of price judgment to output price outlook is higher than that to general price outlook.

◆ Contribution of each judgment from Jun. 2015 to Jun.2016

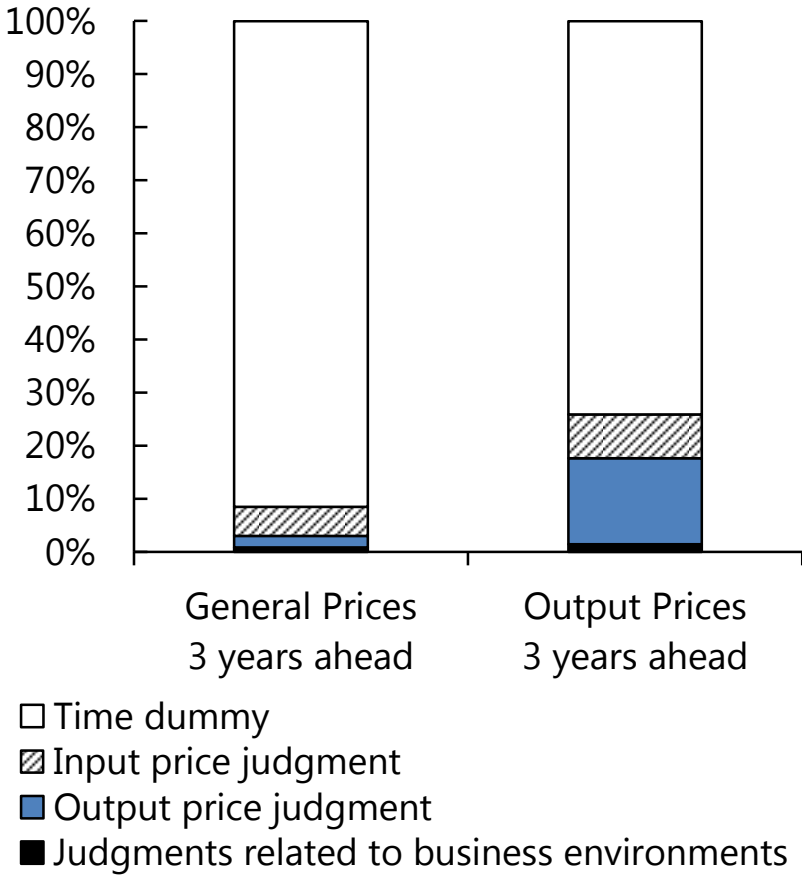
<Estimation method>

Coefficient of certain judgment item in the probit estimation

×

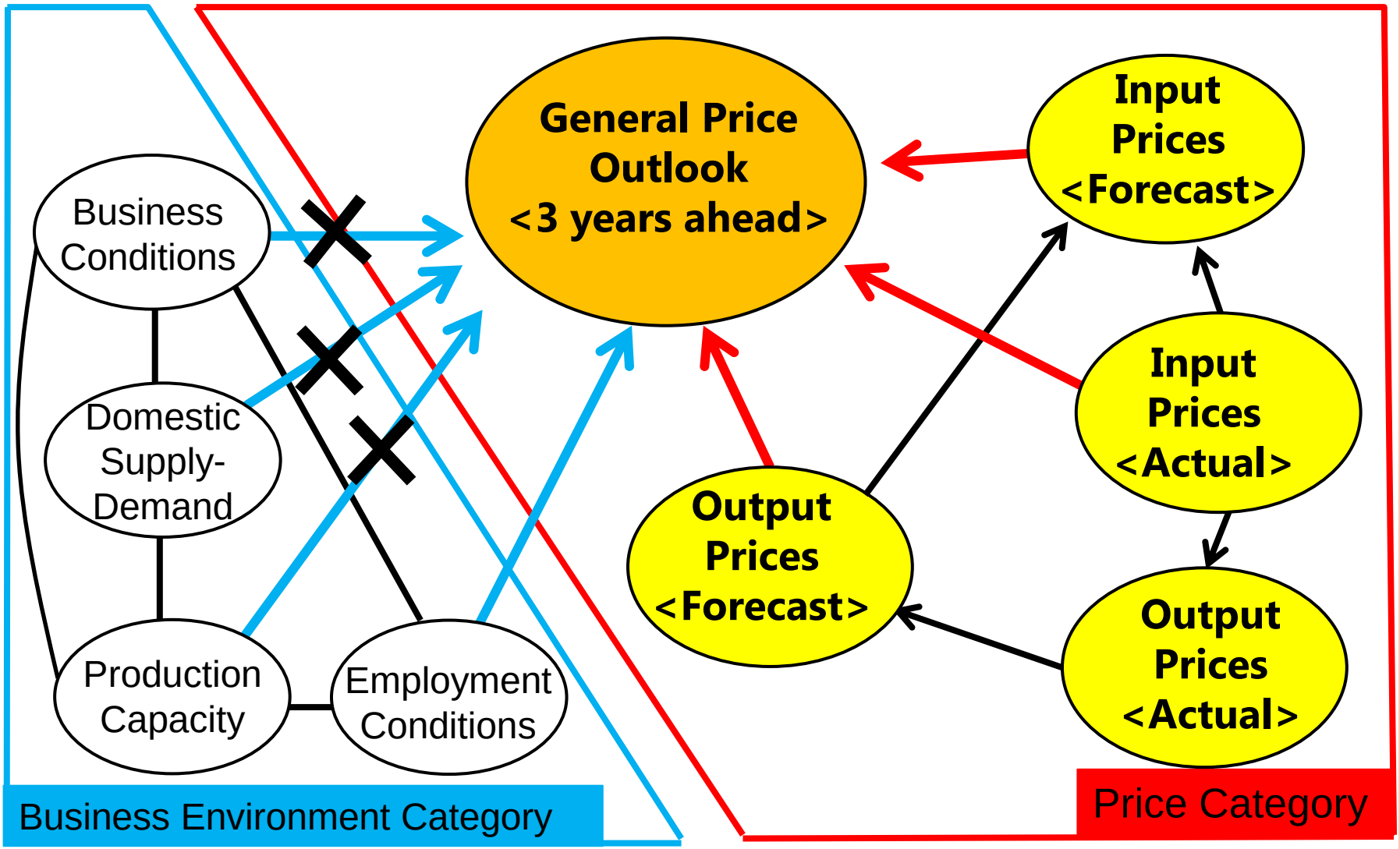
Change in share of respondents on certain judgment between Jun.2015 and Jun.2016

Change in Inflation outlook (the latent variable) between Jun.2015 and Jun.2016



Bayesian Network Analysis

- Judgment survey items and inflation outlook can be divided into “Business Environment Category (Real-based Category)” and “Price Category”.



The Contribution to Inflation Outlook (Bayesian)

- Input/output price judgments determine over 50% of output price outlook, but only less than 20% of general price outlook.

< Example of Calculation: General Price Outlook (3 years)>

$\sum_{ij} w_{ij201606} \times X_{ij201506}$ (C)

Change in share of respondents of price judgment is only considered.

$$\text{Contribution} = \frac{(C)-(A)}{(B)-(A)}$$

$$= \frac{\sum_{ij}(w_{ij201606} \times X_{ij201506}) - \overline{X}_{201506}}{\overline{X}_{201606} - \overline{X}_{201506}}$$

	Output Price 3 years ahead	General Price 3 years ahead
(A) AIO in Jun. 2015	1.742 %	1.541 %
(B) AIO in Jun. 2016	0.852 %	1.064 %
(C) Simulation	1.279 %	1.459 %
Contribution of " Change in Prices DI"	52.0 %	17.2 %

$\overline{X}_t$: Average of inflation outlook (AIO) in survey t. t is Jun. 2015 or Jun. 2016.
i: Choice of price judgment, "1.Rise", "2.Unchanged", and "3.Fall".
j: Output Prices <Forecast>, Input Prices <Actual>, Input Prices <Forecast>.
w_{ijt}: Share of respondents which chose certain choice i of price judgment j in survey t, where $\sum_{ij} w_{ijt} = 1$.
X_{ijt}: AIO of respondents choosing certain choice i of price judgment j in survey t.