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Households' Wage Growth Expectations Formation: The Linkage with Price Inflation Expectations*

Takuji Kondo† Yuki Takahashi‡ Kosuke Takatomi§

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Abstract

This paper quantitatively investigates how closely Japanese households' wage growth expectations are linked with their price inflation expectations, using microdata from Japanese household surveys. The estimation results reveal that the linkage between wage growth expectations and price inflation expectations has strengthened in recent years. We further find that heterogeneity in the degree of linkage across households is statistically significantly related to the labor market conditions of individual households – such as labor market tightness and labor mobility – as well as their income levels and labor union membership status. Japan's labor market has been experiencing a gradual shrinking of the room for additional labor supply partly due to population aging. Such structural factors may have contributed to the recent strengthening of the linkage. This paper also examines how the strengthening of the linkage affects households' spending attitudes. We find that households with a stronger link tend to maintain relatively stronger spending attitudes even during periods of rising prices, as their expected real income declines are more limited. These findings suggest the importance of wage growth expectations being appropriately linked to price inflation expectations for sustaining consumption and achieving sustainable economic growth.

JEL Classification Code: D12, D84, E21, E24, E31

Keywords: Price Inflation Expectations, Wage Growth Expectations, Wage Bargaining Power, Household Spending Attitude, Survey Data

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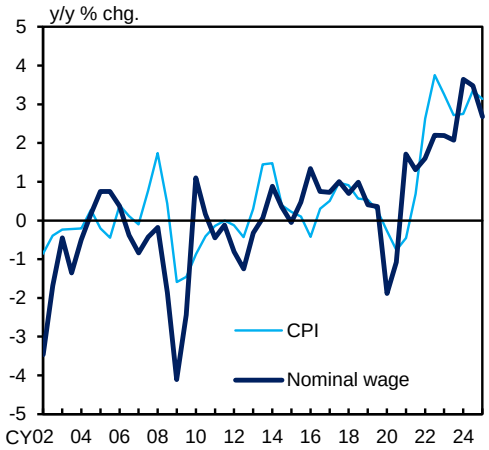
1 Introduction

In modern macroeconomics, households' wage and income expectations play a crucial role in making their spending decisions (Mankiw, 2022). Based on this understanding, a large body of research has studied the formation mechanism of households' wage and income expectations.

More recently, an increasing number of studies in major economies have focused on the relationship between households' price inflation expectations and their wage growth expectations. In the United States and Europe, households' price inflation expectations rose markedly following the COVID-19 pandemic. Under these circumstances, academics and policymakers have discussed how these shifts in price inflation expectations affect the formation of households' wage expectations and their spillovers to wage negotiations and, in turn, sales prices (Kugler, 2025; Coibion and Gorodnichenko, 2025).

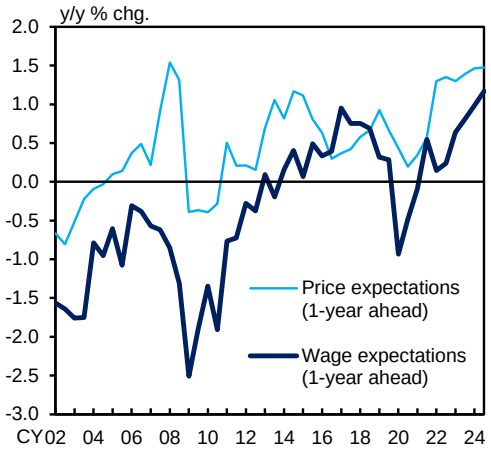
In Japan as well, households' price inflation expectations appear to be on an upward trend. Figure 1 shows actual consumer price inflation and nominal wage growth, while Figure 2 shows households' expectations for both. These figures indicate that households' price inflation expectations have gradually been revised upward as actual price inflation rates have risen since the COVID-19 pandemic. Wage growth expectations have also been revised upward in line with rising price inflation expectations. Under these circumstances, actual nominal wage growth has also been rising moderately.

Figure 1. Actual consumer price inflation and nominal wage growth



Note: CPI figures exclude the effects of consumption tax hikes. Nominal wages from CY 2016 onwards are based on continuing observations following the sample revisions.
Sources: Ministry of Internal Affairs and Communications; Ministry of Health, Labour and Welfare.

Figure 2. Households' expected consumer price inflation and nominal wage growth



Note: Estimated by applying the modified Carlson-Parkin method to the 5-choice qualitative responses regarding future price and wage expectations from the Workers Survey, using the actual values shown in Figure 1 as reference. The estimation incorporates adjustments for the level shift resulting from the expansion of the survey's coverage area.
Sources: Ministry of Internal Affairs and Communications; Ministry of Health, Labour and Welfare; RENGO-RIALS.

This paper quantitatively investigates the relationship between households' price inflation

expectations (hereafter price expectations) and their wage growth expectations (hereafter wage expectations), using microdata from Japanese household surveys regarding the outlook for wages and prices. First, we examine how closely the expectations that "wages will rise" are linked with the expectations that "prices will rise." Second, we analyze what factors may influence the degree of linkage, using detailed information on individual survey respondents' attributes. Third, we examine how the degree of linkage affects households' spending attitudes in order to explore its macroeconomic implications.

A growing body of papers for the United States and Europe have already examined factors that influence the degree of linkage between households' wage expectations and price expectations (see the next section for details). These studies have discussed the possibility that various determinants of workers' wage bargaining power influence the degree of linkage. Specifically, factors such as workers' income levels (Hajdini et al., 2023; Aprigliano and Di Nino, 2024), labor union membership status (BIS, 2022; Suthaharan and Bleakley, 2022), labor market tightness (Jain, Kostyshyna and Zhang, 2024; Buchheim, Link and Möhrle, 2024), and job-change rates (Pilossoph and Ryngaert, 2024) have been pointed out as factors that may influence the degree of linkage by shifting workers' wage bargaining power. Furthermore, recent research discusses the possibility that the level of price inflation expectations at each point in time also influences the degree of linkage (Aprigliano and Di Nino, 2024). In this paper, we examine the roles of these factors in the formation of wage expectations among Japanese households.

The main findings of this paper can be summarized in the following three points. First, the estimation results reveal that the linkage between wage expectations and price expectations among Japanese households has increased in recent years. Second, we find that heterogeneity in the degree of linkage across households is statistically significantly related to the labor market conditions of individual workers – such as labor market tightness and labor mobility – as well as their income levels and labor union membership status. In Japan, labor market conditions have become prone to tightening partly due to population aging. Such structural factors may have contributed to the recent strengthening of the linkage. Third, we confirm that households with a stronger link between wage expectations and price expectations tend to maintain relatively stronger spending attitudes during periods of rising prices, as their expected real income declines are more limited. These results suggest the importance of wage growth expectations being appropriately linked to price inflation expectations for sustaining consumption and achieving sustainable economic growth.

The contribution of this paper to the literature is twofold. First, to the best of our knowledge, this is the first study to investigate the formation mechanism of Japanese households' wage expectations, including analyses on the linkage with price expectations and the impact of potential factors which may influence the degree of linkage. Second, we comprehensively

examine the impact of a wide range of factors identified as potential determinants of the degree of linkage between wage expectations and price expectations in the literature. This analysis is made possible by using a long-running dataset – such as the Workers Survey conducted by Japan's Trade Union Confederation (RENGO) – that includes rich information on respondents' attributes. The Workers Survey contains not only standard demographic information such as respondents' gender and age but also other types of information including labor union membership status. This paper analyzes the impact of such factors on the degree of linkage. Furthermore, our dataset is constructed using microdata covering an extended period of approximately 25 years since 2001. This allows us to investigate shifts in the degree of linkage before and after the COVID-19 pandemic. Empirical studies using such long-running household surveys remain limited even globally. In this respect, our study – using data outside the United States – can be considered a contribution to the literature.

The remainder of this paper is structured as follows. Section 2 reviews existing literature on the formation mechanism of households' wage expectations. Section 3 describes the dataset used in this paper. Section 4 presents the analytical framework and empirical results and discusses their implications. Section 5 summarizes the main findings and implications of the paper and discusses remaining challenges.

2 Related literature

A growing body of research, particularly for the United States and Europe, has examined the linkage between wage expectations and price expectations. In Japan, there remain relatively fewer studies focusing on the linkage between both expectations, partly due to the limited availability of microdata on expectations. Nevertheless, studies on the relationship between actual wage growth and price inflation have already accumulated.

This section first reviews discussions on the linkage between wage expectations and price expectations, primarily focusing on research for the United States and Europe. Then, we provide an overview of research regarding the linkage between actual wage and price developments in Japan. We also discuss the relationship of our paper with these studies.

Discussions on the linkage between wage expectations and price expectations

In the United States and Europe, research on the linkage between wage expectations and price expectations has intensified since the 2020s, particularly following the significant inflation surge. These studies argue that the following factors may affect the degree of linkage: (1) determinants of workers' wage bargaining power (e.g., workers' income levels, labor union membership status, and macro labor market conditions); and (2) other factors (e.g., the level of price inflation expectations at each point in time, and sociodemographic attributes other than

income levels). This subsection provides an overview of the existing literature discussing the impact of these factors.

Some studies have pointed out that determinants of workers' wage bargaining power – such as income levels, labor union membership status, and macroeconomic labor market conditions – may influence the degree of linkage between wage expectations and price expectations. For instance, Hajdini et al. (2023) report that high-income earners – who are likely to be high-skilled workers – tend to exhibit a stronger pass-through from price expectations to income expectations, based on a randomized controlled trial (RCT) conducted among households in the United States. The importance of income levels has also been pointed out in Aprigliano and Di Nino (2024), using data from the euro area. Furthermore, BIS (2022) and Suthaharan and Bleakley (2022) suggest that higher unionization rates and more centralized wage negotiations may increase the degree of linkage. Also, Jain, Kostyshyna and Zhang (2024) discuss the potential impact of labor market tightening on the degree of linkage, using survey data from Canadian households. Specifically, the authors conducted a regression including the interaction term with factors which can affect the degree of linkage between wage expectations and price expectations. The estimation results reveal that regions with lower unemployment rates and tighter labor market conditions exhibit a stronger link. Buchheim, Link and Möhrle (2024) – using European (German) data – also report similar findings. Moreover, Pilossoph and Ryngaert (2024) – using a U.S. household survey – suggest that labor mobility (job-change rates) in the labor market may also influence the degree of linkage.

Other studies argue that the level of price inflation expectations may also affect the degree of linkage between wage expectations and price expectations. Aprigliano and Di Nino (2024) – using the ECB's Consumer Expectations Survey – report that the pass-through from price expectations to income expectations tends to decrease when the level of price inflation expectations is remarkedly high. When households expect extremely high inflation, they may anticipate a stagflationary economic downturn in the future. This mechanism may dampen the rise in income expectations. Also, some papers argues that sociodemographic attributes other than income levels – such as age and gender – may influence the degree of linkage, but no clear consensus has been reached yet. For example, Jain, Kostyshyna and Zhang (2024) – covering Canadian households – find that middle-aged individuals (35–54 years old) and women tend to show a stronger link. On the other hand, Aprigliano and Di Nino (2024) – covering European households – report that age groups with a stronger link vary across countries. Hajdini et al. (2023) also report a stronger link for men, rather than for women, in the United States.

Compared to discussions on the linkage between wage expectations and price expectations for households in the United States and Europe, there are only a few studies covering Japan in terms of expectations. Ito and Kaihatsu (2016) – using the Workers Survey in Japan– report that

wage expectations rose gradually in line with an increase in price expectations, following the adoption of large-scale monetary easing in 2013 by the Bank of Japan (BOJ). Jinnai et al. (2021) and Mineyama and Tokuoka (2025) – using data up to 2018 from the Japan Household Panel Survey on Consumer Preferences and Satisfaction conducted by Osaka University – report that higher price expectations led to higher income expectations. However, these studies have not used post-pandemic data, and they have not analyzed what factors may affect the degree of linkage between wage expectations and price expectations in Japan. In this regard, this paper adds some new analyses.

Discussions on the linkage between actual wage and price developments in Japan

As pointed out in the previous subsection, there are only a few papers discussing the linkage between wage expectations and price expectations in Japan. However, the relationship between actual wage and price developments has been analyzed in many studies.

In the literature focusing on the pre-pandemic period, many studies have pointed out that the linkage between wage growth and price inflation was not necessarily clear. For instance, Muto and Shintani (2020) estimate a New Keynesian Wage Phillips Curve with time-varying parameters, using data up to 2013, and examine the linkage between wage growth and price inflation. The estimation results reveal that the degree of "inflation indexation" – the impact of price inflation on wage growth – became stronger through the early 1970s. However, the degree of the indexation fell into a downward trend and finally reached a level close to zero by the 2010s. Furthermore, Hoshi and Kashyap (2021) examine the linkage between wage growth and price inflation by estimating a vector autoregression (VAR) model and an unobserved component (UC) model, using data up to 2018. The authors report that the linkage disappeared around 1998.

However, recent studies using post-pandemic data suggest that the linkage between wages and prices may be strengthening. For example, Hoshi and Kashyap (2025) extends the dataset used in Hoshi and Kashyap (2021) up to 2023 and re-examines the linkage. The authors report the possibility that the degree of linkage has begun to recover since 2019. Ueno (2024) examines the relationship between trends in industry-level wage growth and item-level price inflation, using a UC model approach. The results indicate that the degree of linkage has been recovering to some extent since the COVID-19 pandemic, particularly between wages in the non-manufacturing sector and prices in services. The author argues that this may partly reflect the growing tendency to take price developments into account in wage negotiations and significant tightening in labor market. Ozaki et al. (2024) examines the relationship by estimating a time-varying parameter VAR (TVP-VAR) model including macro variables. The authors have reported that while pass-through from price inflation to wage growth was not observed in the

2010s, it has become statistically significant as of 2023. Nakamura et al. (2024) applies the Bernanke and Blanchard (2025) approach to Japanese data and argues that wage growth since the 2020s has partly been driven by price expectations, as well as actual increases in prices for items such as food prices. More recently, Adachi et al. (2026) points out that labor supply constraint shocks – which exert upward pressure on both wages and prices – have increased and their contribution has expanded since the COVID-19 pandemic, based on the authors' empirical analysis using a VAR model.

In recent years, a growing number of studies in Japan have suggested a strengthening link between actual wage growth and price inflation. We examined whether this tendency can be confirmed in the context of expectations for wages and prices.

3 Data

This section provides an overview of the dataset used in the empirical analysis in the following sections.[1] We use microdata from two types of Japanese household surveys. The first is the "Questionnaire Survey on Work and Life of Workers (Workers Survey)" conducted by the Japanese Trade Union Confederation Research Institute for Advancement of Living Standards (RENGO-RIALS). The number of respondents in the most recent survey is approximately 4,200.

The key features of the Workers Survey are the long time span of the available data and the rich information on respondents' attributes. This survey has been conducted on a semi-annual basis (in April and October) since 2001. The survey collects detailed information on respondents' attributes, including their prefecture of residence, age, gender, income level, labor union membership status, and employment type. The survey asks respondents about their current and future outlooks for economic conditions, wages, and prices. Such datasets – combining a long time series with rich household-level information – are limited internationally, with only a few examples, including the University of Michigan's "Survey of Consumers" in the United States. In this paper, we use qualitative responses about one-year ahead wage and price expectations,[2] in addition to respondents' attributes.

Some studies have pointed out that the level of price inflation expectations is a potential determinant of the degree of linkage between wage expectations and price expectations. However, the Workers Survey does not collect quantitative responses about wage and price expectations. To address this, we complementarily use the "Opinion Survey on the General

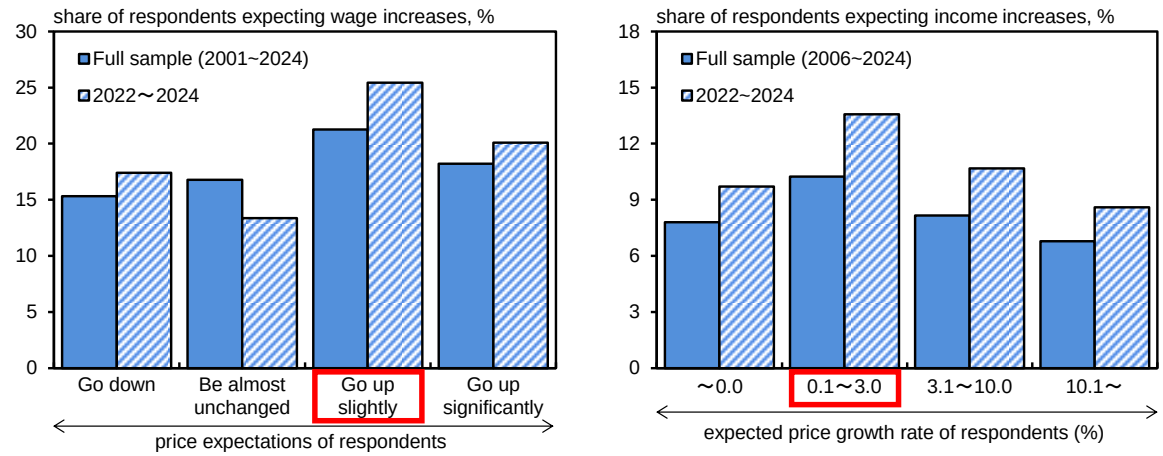
[1] For details on the data, see Appendix A.

[2] For example, the survey question regarding price expectations asks, "Do you think that prices one year from now will rise or fall compared to the present?" and requires respondents to select from six choices: "will go up significantly," "will go up slightly," "will remain almost unchanged," "will go down slightly," "will go down significantly," and "unknown." For the analysis, we treat "unknown" responses as missing values and use the remaining five choices.

Public's Views and Behavior (Opinion Survey)," which the BOJ conducts quarterly among 4,000 respondents. The Opinion Survey collects not only qualitative but also quantitative responses about one-year ahead price inflation expectations and wage expectations. This allows us to analyze the impact of the level of price inflation expectations. Furthermore, the Opinion Survey asks about households' spending attitudes, which also allows us to analyze households' spending behavior.

Finally, we provide a brief overview of the data. Figure 3 shows the share of respondents expecting wage or income increases by their price expectations in the Workers Survey and the Opinion Survey, respectively. The share of respondents expecting wage increases is highest when respondents expect a moderate increase in prices ("prices will go up slightly") in the Workers Survey and when respondents expect moderate positive inflation (+0.1 ~ +3.0%) in the Opinion Survey. This tendency appears to have been strengthening since the 2020s. These results suggest that the linkage between wage expectations and price expectations in Japan has been strengthening, particularly in recent years.

Figure 3. Percentage of respondents expecting wage or income increases by price expectations



Note: Figures in the left panel are calculated using the sample restricted to the Greater Tokyo area and Kansai area to ensure consistency in the data collection regions (the survey areas have been expanded over time).

4 Empirical analysis

This section first examines how closely Japanese households' wage expectations are linked with their price expectations. We then analyze what factors affect the degree of linkage. Finally, we investigate how the degree of linkage affects households' spending attitudes.

4.1 Estimation of the degree of linkage between wage expectations and price expectations

First, we examine the relationship between wage expectations and price expectations among

Japanese households. Specifically, we estimate a linear probability model in which wage expectations are the dependent variable,[3] while price expectations are the explanatory variable as shown in Equation (1). The model is estimated by OLS. The model specification is based on some existing studies which analyze the impact of price expectations on wage expectations and households' behavior (e.g., Buchheim, Link and Möhrle, 2024; Jain, Kostyshyna and Zhang, 2024; Lieb and Schuffels, 2022).

$$W_{i,t}^{e} = \alpha + \beta\, \pi_{i,t}^{e} + \boldsymbol{X}_{\boldsymbol{i,t}}'\, \gamma + \varepsilon_{i,t} \qquad (1)$$

$W_{i,t}^{e}$ represents the wage expectations (one year ahead) of worker i at time t, and $\pi_{i,t}^{e}$ represents the price expectations (one year ahead) of worker i at time t. Both $W_{i,t}^{e}$ and $\pi_{i,t}^{e}$ are binary variables that take a value of 1 if the respondent selected "will increase / go up significantly" or "will increase / go up slightly," and 0 otherwise. The coefficient β on $\pi_{i,t}^{e}$ can be interpreted as indicating that workers who expect prices to rise have a probability of expecting their own wages to rise that is $\beta \times 100$ percentage points higher than those who do not expect prices to rise. In this paper, we treat this β as the degree of linkage. The vector of control variables $\boldsymbol{X}_{\boldsymbol{i,t}}$ includes dummy variables for worker i's outlook for economic conditions, anxiety about unemployment over the next year, sociodemographic attributes such as gender, income level and age, prefecture dummy variables, and survey year dummy variables. $\boldsymbol{X}_{\boldsymbol{i,t}}$ is intended to control for various factors other than price expectations in the formation of nominal wage expectations – specifically, the determinants of real wage expectations. α is a constant term, and $\varepsilon_{i,t}$ is an error term.

Table 1 shows the estimation results for the full sample in column (1) and for divided sample periods in columns (2) through (4). The full sample results suggest the existence of a statistically significantly positive link between wage expectations and price expectations among Japanese households in the long run. Furthermore, the split sample results suggest that this link has strengthened further since the COVID-19 pandemic.[4]

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[3] The linear probability model (LPM) is a linear regression model used when the dependent variable is a binary variable taking a value of 0 or 1. As an alternative approach for such cases, in Appendix B.1, we conduct estimations using a probit model and confirm that the results are broadly similar to those of the LPM.

[4] This paper focuses on the extent to which the expectation that "wages will rise" is linked with the expectation that "prices will rise." From this perspective, Equation (1) uses wage expectations as the dependent variable and price expectations as an explanatory variable. OLS estimates of models such as Equation (1) may be biased due to endogeneity arising from omitted variables and simultaneity. In this case, however, such biases can be considered limited, taking into account the following reasons. First, our models include various control variables – such as sociodemographic attributes and expectations for macroeconomic conditions. This likely addresses concerns about omitted variable bias. Second, the Workers Survey and the Opinion Survey collect respondents' expectations about

Table 1. Estimation results of the degree of linkage

Dependent variable: wage expectations				
	(1)	(2)	(3)	(4)
Inflation expectations (β)	0.0513***	0.0139**	0.0609***	0.1203***
	(0.0034)	(0.0055)	(0.0050)	(0.0089)
Constant (α)	0.1972***	0.2378***	0.2113***	0.0957***
	(0.0174)	(0.0163)	(0.0192)	(0.0224)
Observations	60,189	22,075	27,549	10,565
Adj. R-squared	0.1061	0.1043	0.1089	0.1248
Estimation period	Oct. 2001 - Oct. 2024	Oct. 2001 - Oct. 2013	Apr. 2014 - Oct. 2021	Apr. 2022 - Oct. 2024

Note: *** and ** indicate significance at the 1 and 5 percent levels, respectively. Figures in parentheses indicate robust standard errors.

4.2 Determinants of workers' wage bargaining power and their impact on the degree of linkage

Existing studies for the United States and Europe have pointed out that various determinants of workers' wage bargaining power may influence the degree of linkage between wage expectations and price expectations, as discussed in Section 2. This section examines how these determinants relate to the degree of linkage between wage expectations and price expectations in Japan, using data from the Workers Survey.

Workers' attributes

First, we examine how workers' attributes – such as income levels and labor union membership status – affect the degree of linkage between wage expectations and price expectations. Specifically, we estimate linear probability models in which wage expectations are the dependent variable, while price expectations, dummy variables for each attribute, and their interaction terms serve as explanatory variables, as shown in Equations (2) and (3). The models are estimated by OLS.

$$W_{i,t}^{e} = \alpha + \beta_1 \pi_{i,t}^{e} + \beta_{2M} MID_{i,t} + \beta_{2H} HID_{i,t} + \beta_{3M} (\pi_{i,t}^{e} \cdot MID_{i,t}) + \beta_{3H} (\pi_{i,t}^{e} \cdot HID_{i,t}) + \boldsymbol{X}_{\boldsymbol{i,t}}' \gamma + \varepsilon_{i,t} \quad (2)$$

$$W_{i,t}^{e} = \alpha + \beta_1 \pi_{i,t}^{e} + \beta_{2U} UMD_{i,t} + \beta_{3U} (\pi_{i,t}^{e} \cdot UMD_{i,t}) + \boldsymbol{X}_{\boldsymbol{i,t}}' \gamma + \varepsilon_{i,t} \quad (3)$$

their own wages and income, whereas they ask about general macroeconomic price expectations. Therefore, simultaneity biases due to reverse causality from wage expectations to price expectations are unlikely to occur. Furthermore, we also estimate the model using an instrumental variable method, which is robust to endogeneity, in Appendix B.2. The results remain consistent with the OLS estimates and confirm the linkage between wage expectations and price expectations.

The middle-income dummy (MID) takes a value of 1 for workers with an annual income of 2 million to 5.99 million yen, the high-income dummy (HID) takes a value of 1 for workers with an annual income of 6 million yen or more, and the union membership dummy (UMD) takes a value of 1 for workers who are members of a labor union. As in the previous section, $W_{i,t}^{e}$ and $\pi_{i,t}^{e}$ are binary variables regarding wage expectations and price expectations, respectively. $\boldsymbol{X_{i,t}}$ is a vector of control variables including dummy variables for worker *i*'s outlook for economic conditions and anxiety about unemployment over the next year, as well as sociodemographic attributes such as gender, income level, and age, along with prefecture dummy variables and survey year dummy variables.[5]

Table 2 shows the estimation results for Equations (2) and (3). Figure 4 shows the degree of linkage for each worker attribute, based on the estimation results (β_1, β_{3M}, β_{3H}, and β_{3U}) in Table 2. These results suggest that workers with relatively strong wage bargaining power – such as high-income earners, who are presumably high-skilled, and labor union members – tend to show a stronger link.[6] These findings are consistent with existing studies for other countries (Hajdini et al., 2023; Aprigliano and Di Nino, 2024; BIS, 2022; Suthaharan and Bleakley, 2022).

[5] In Equation (2), where dummy variables for income levels are explicitly included as explanatory variables, income group dummies are excluded from $\boldsymbol{X_{i,t}}$.

[6] Appendix C discusses differences in the degree of linkage across other attributes of workers not mentioned here, such as age, gender, employment-based firm size and industry.

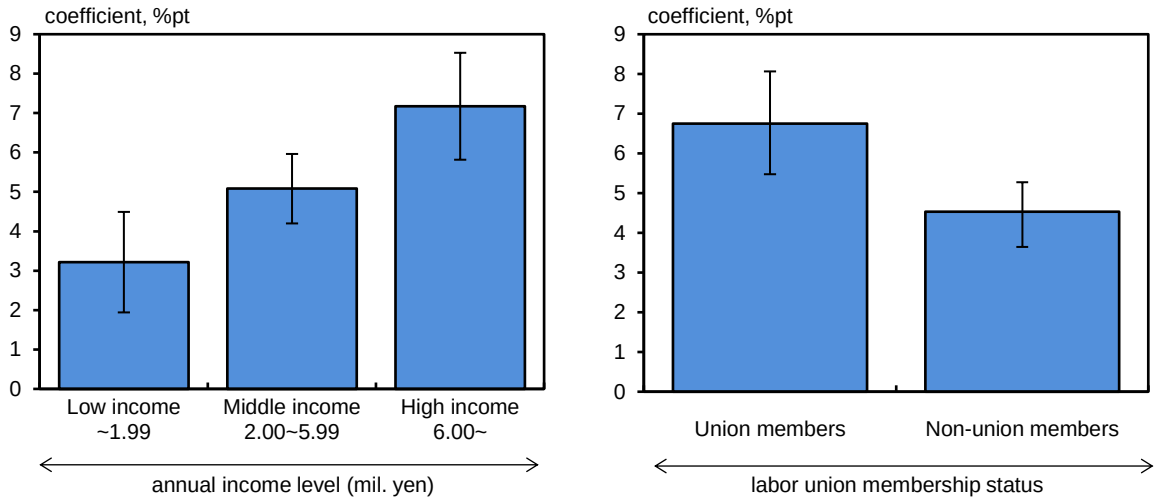
Table 2. Estimation results of the degree of linkage by worker attribute

Dependent variable: wage expectations		
	(1)	(2)
	Income level	Union membership status
Inflation expectations (β_1)	0.0322***	0.0453***
	(0.0065)	(0.0038)
Middle income dummy (β_{2M})	0.0115*	
	(0.0066)	
High income dummy (β_{2H})	0.0161**	
	(0.0079)	
Inflation expectations	0.0186**	
× Middle income dummy (β_{3M})	(0.0077)	
Inflation expectations	0.0395***	
× High income dummy (β_{3H})	(0.0094)	
Union membership dummy (β_{2U})		0.0143**
		(0.0060)
Inflation expectations		0.0222***
× Union membership dummy (β_{3U})		(0.0075)
Constant (α)	0.2109***	0.1947***
	(0.0178)	(0.0175)
Observations	60,189	60,189
Adj. R-squared	0.1063	0.1072
Estimation period	Oct. 2001 - Oct. 2024	

Note: ***, **, and * indicate significance at the 1, 5, and 10 percent levels, respectively. Figures in parentheses indicate robust standard errors.

Figure 4. Estimation results of the degree of linkage by worker attribute

A. Income level B. Labor union membership status



Note: Based on the results in Table 2. The bands in the figure represent 95 percent confidence intervals.

Labor market conditions

Second, we examine how labor market conditions of individual workers – such as labor market tightness and labor mobility – affect the degree of linkage between wage expectations and price

expectations. We estimate linear probability models in which wage expectations are the dependent variable, while price expectations, proxies of labor market conditions and their interaction terms are explanatory variables as shown in Equations (4) and (5). The models are estimated by OLS.

$$W_{i,t}^{e} = \alpha + \beta_1 \, \pi_{i,t}^{e} + \beta_{2T} \, LT_{i,t} + \beta_{3T} \, (\pi_{i,t}^{e} \cdot LT_{i,t}) + \boldsymbol{X}_{\boldsymbol{i,t}}' \, \gamma + \varepsilon_{i,t} \tag{4}$$

$$W_{i,t}^{e} = \alpha + \beta_1 \, \pi_{i,t}^{e} + \beta_{2M} \, LM_{i,t} + \beta_{3M} \, (\pi_{i,t}^{e} \cdot LM_{i,t}) + \boldsymbol{X}_{\boldsymbol{i,t}}' \, \gamma + \varepsilon_{i,t} \tag{5}$$

We use the following labor market condition indicators: V/U ratio by prefecture of residence (from the Employment Referral Statistics; including part-time workers, calculated as active job openings divided by active job applicants) as proxies of labor market tightness (LT);[7] and the job-change ratios by gender and age group (based on the Labour Force Survey, calculated as the number of job changes between regular employees in the past year divided by the number of regular employees in the previous year) as proxies of labor mobility (LM).[8] As in the previous sections, $W_{i,t}^{e}$, $\pi_{i,t}^{e}$, and $\boldsymbol{X}_{\boldsymbol{i,t}}$ represent the wage expectations, price expectations, and the vector of control variables, respectively.

Table 3 shows the estimation results for Equations (4) and (5). Figure 5 shows the degree of linkage by labor market situation based on the estimation results (β_1, β_{3T}, and β_{3M}) in Table 3. These estimation results suggest that the linkage between wage expectations and price expectations tends to be stronger for workers living in prefectures with higher labor market tightness and for those in demographic groups with higher labor mobility, as these factors may enhance their wage bargaining power. These findings are consistent with existing studies (Buchheim, Link and Möhrle, 2024; Jain, Kostyshyna and Zhang, 2024; Pilossoph and Ryngaert, 2024).

[7] The average V/U ratio across prefectures at the end of the sample period (the July-September quarter of 2024) is 1.2 with a maximum of 1.8 and a minimum of 0.9. Appendix B.3 confirms the robustness of the results using an alternative indicator of labor market conditions instead of the V/U ratio.

[8] The data are available from the October-December quarter of 2011. We use the data from the January-March quarter of 2012 in our estimation. The average job-change ratio across attributes at the end of the sample period (the July-September quarter of 2024) is 3.3 percent, with a maximum of 5.2 percent and a minimum of 0.9 percent. Since the job-change ratio is on a regular-employee basis, we conducted our estimation using only the sample of regular employees. Thus, the estimated degree of linkage may be larger than one using the full sample (see Appendix B.3).

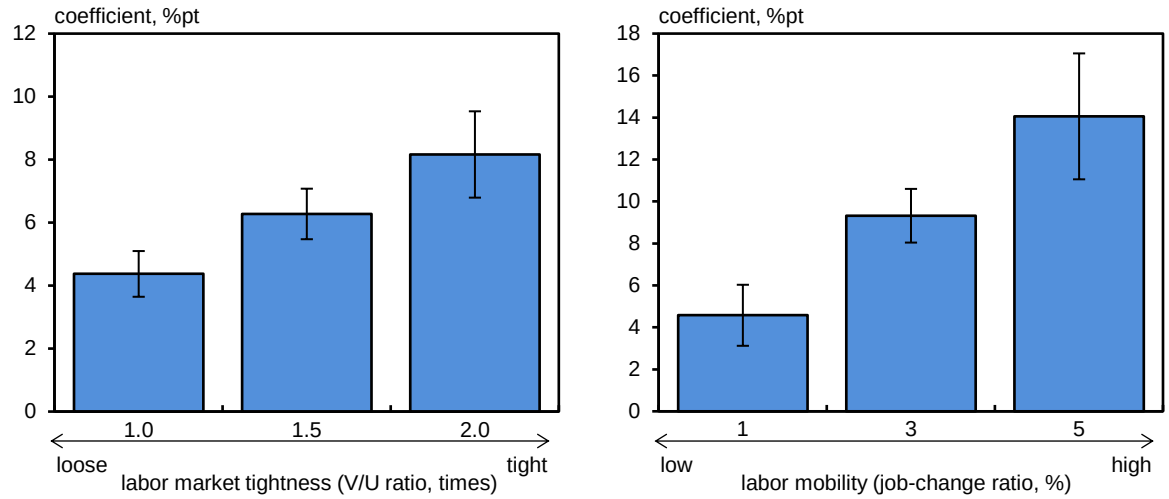
Table 3. Estimation results of the degree of linkage by labor market conditions

Dependent variable: wage expectations		
	(1)	(2)
	Labor market tightness	Labor mobility
Inflation expectations (β_1)	0.0058	0.0222*
	(0.0095)	(0.0118)
V/U ratio (β_{2T})	-0.0154	
	(0.0148)	
Inflation expectations	0.0379***	
× V/U ratio (β_{3T})	(0.0075)	
Job-change ratio (β_{2M})		0.0196***
		(0.0046)
Inflation expectations		0.0237***
× Job-change ratio (β_{3M})		(0.0051)
Constant (α)	0.2186***	0.1603***
	(0.0178)	(0.0236)
Observations	60,189	30,829
Adj. R-squared	0.1065	0.1288
Estimation period	Oct. 2001 - Oct. 2024	Apr. 2012 - Oct. 2024

Note: *** and * indicate significance at the 1 and 10 percent levels, respectively. Figures in parentheses indicate robust standard errors.

Figure 5. Estimation results of the degree of linkage by labor market conditions

A. Labor market tightness B. Labor mobility

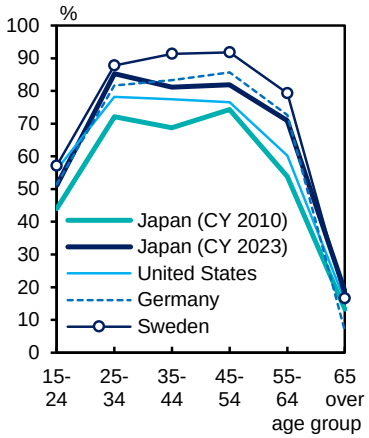


Note: Based on the results in Table 3. The bands in the figure represent 95 percent confidence intervals.

Japan has undergone population aging. Even so, labor supply growth has been sustained partly due to rising labor force participation among women and seniors. However, the labor force participation rate for women has already reached levels comparable to other advanced economies (Figure 6), and its growth is expected to slow down. The increase in labor force participation among seniors has also been slowing down, as the baby boomer generation born in the late 1940s reaches 75 years of age (Figure 7; Bank of Japan, 2024b). Labor market mobility has been increasing in recent years, as the labor market has become structurally more

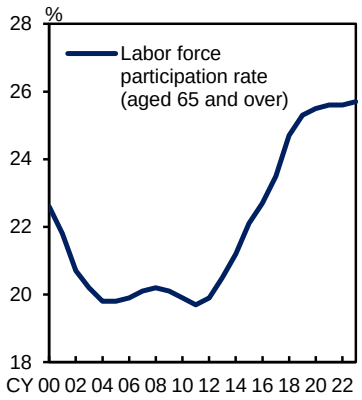
prone to tightening compared to the past (Figure 8). Under these circumstances, competition for human resources among firms is expected to intensify further (Ikeda et al., 2025). Such structural shifts in the labor market have likely contributed to the recent rise in the degree of linkage between wage expectations and price expectations, and they may continue to do so.

Figure 6. Labor force participation rates of women



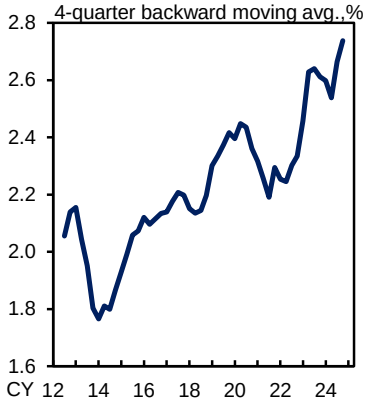
Note: All data except for Japan are as of 2023.
Source: OECD.

Figure 7. Labor force participation rates of seniors



Source: Ministry of Internal Affairs and Communications.

Figure 8. Job-change ratio of regular employees



Note: Figures are calculated as the number of job changes among regular employees in the past year divided by the number in the previous year. Based on the Labour Force Survey.
Source: Ministry of Internal Affairs and Communications.

4.3 Impact of the level of price inflation expectations on the degree of linkage

This section examines how the level of price inflation expectations affects the degree of linkage between wage expectations and price expectations, using data from the Opinion Survey – which collects respondents' quantitative price expectations. Additionally, we apply the same analytical method to microdata from the University of Michigan's "Survey of Consumers" in the United States (hereafter the Michigan Survey)[9] to better understand the features of the estimation results for Japan from a Japan-U.S. comparative perspective. It should be noted that these surveys collect households' qualitative expectations regarding income instead of wages. Accordingly, the analysis in this section technically estimates the degree of linkage between income expectations and price expectations.

The analysis proceeds as follows. First, we split respondents expecting positive inflation into the three categories depending on the levels of expectations in each survey round and assign the following dummies to each group: (1) a low-level dummy (LLD); (2) a medium-level dummy (MLD); and (3) a high-level dummy (HLD). In the Japanese data, respondents who

[9] The estimation period is from January 1984 to December 2024. Repeated cross-sectional data are used. See Appendix A for details of the data.

expect inflation of 0.1-3.0% are classified as (1), 3.1-10.0% as (2), and 10.1-20.0% as (3). In the U.S. data, respondents who expect inflation of 1.0-3.0% are classified as (1), 4.0-5.0% as (1), and 6.0-20.0% as (3). Respondents who expect inflation of 0% or less are classified as the reference group to which no dummy variable is assigned.

Next, we estimate the degree of linkage between income expectations and price inflation expectations by the level of price inflation expectations, using these dummy variables. Specifically, we estimate linear probability models in which the dummy variable for income expectations ($I^e_{i,t}$) is the dependent variable, while the dummy variables for each level of price inflation expectations ($LLD_{i,t}$, $MLD_{i,t}$, and $HLD_{i,t}$) are explanatory variables, as shown in Equation (6). The models are estimated by OLS. Coefficients β_L, β_M, and β_H can be interpreted as indicating that "the samples assigned to each dummy have a probability of expecting an income increase that is $\beta_L \times 100$, $\beta_M \times 100$, and $\beta_H \times 100$ percentage points higher, respectively, than those that answered with price inflation expectations of 0% or less (the reference group)". It should be noted that $\boldsymbol{X_{i,t}}$, as in the previous sections, is a vector of control variables including dummy variables for respondents' outlook for economic conditions and anxiety about unemployment over the next year, as well as sociodemographic attributes such as gender, income group, and age, along with prefecture dummy variables and survey year dummy variables.

$$I^e_{i,t} = \alpha + \beta_L\, LLD_{i,t} + \beta_M\, MLD_{i,t} + \beta_H\, HLD_{i,t} + \boldsymbol{X'_{i,t}}\,\gamma + \varepsilon_{i,t} \qquad (6)$$

Table 4 shows the estimation results for Japan and the United States for Equation (6). Figure 9 shows the degree of linkage by the level of price inflation expectations based on the estimation results in Table 4. The results suggest that the degree of linkage in both Japan and the United States is higher for households expecting moderate price increases, while the degree of linkage for households expecting sharp price increases is close to zero. These tendencies suggest that households may associate extremely high inflation with a future economic downturn and consequently expect a slowdown in income growth, as argued by Aprigliano and Di Nino (2024). These results indicate the importance of price expectations being anchored at a moderately positive level in order to avoid a decrease in real income expectations caused by an increase in price expectations.[10]

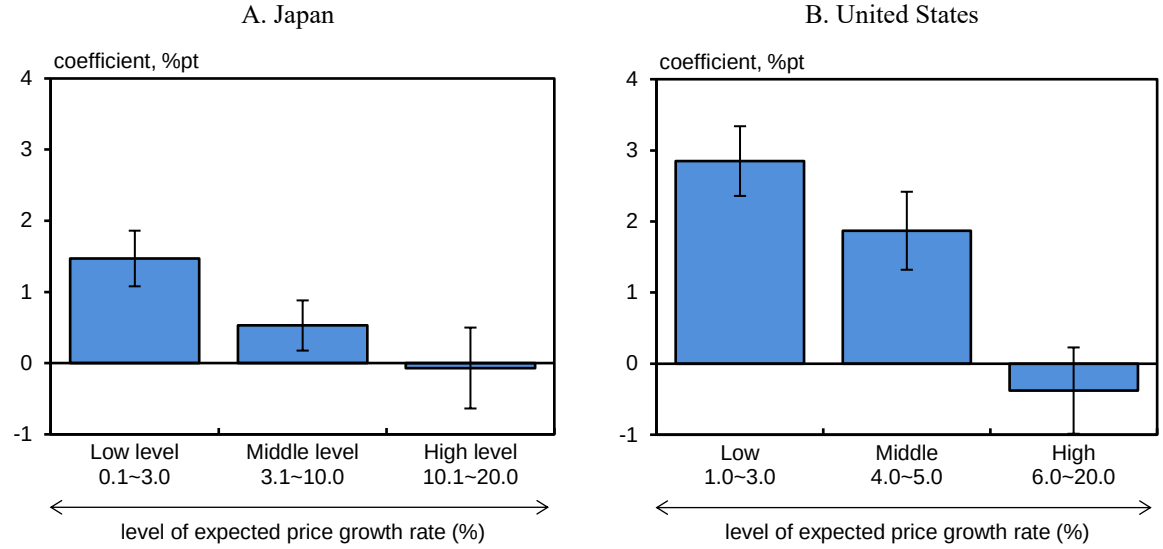
[10] Gautier, Savignac and Coibion (2025), using a survey of French firms, report that the degree of pass-through to wage expectations declines when price inflation expectations exceed 6 percent.

Table 4. Estimation results of the degree of linkage by the level of price inflation expectations

Dependent variable: income expectations		
	(1)	(2)
	Japan	United States
Low level dummy (β_L)	0.0147***	0.0285***
	(0.0020)	(0.0025)
Middle level dummy (β_M)	0.0053***	0.0187***
	(0.0018)	(0.0028)
High level dummy (β_H)	-0.0007	-0.0038
	(0.0029)	(0.0031)
Constant (α)	0.1326***	0.5660***
	(0.0070)	(0.0124)
Observations	139,896	239,539
Adj. R-squared	0.1243	0.2052
Estimation period	Jun. 2006 - Dec. 2024	Jan. 1984 - Dec. 2024

Note: *** indicates significance at the 1 percent level. Figures in parentheses indicate robust standard errors.

Figure 9. Estimation results of the degree of linkage by the level of price inflation expectations



Note: Based on the results in Table 4. The bands in the figure represent 95 percent confidence intervals.

4.4 Impact of the degree of linkage between wage expectations and price expectations on households' spending attitudes

This section analyzes how the strengthening of the linkage between wage expectations and price expectations affects households' spending attitudes in order to explore the macroeconomic implications.

Standard economic theories imply that a rise in price expectations has two opposing effects: (1) an increase in real consumption due to a decline in real interest rates and relative price over time (substitution effect); and (2) a decrease in real consumption due to a decline in real wage expectations (income effect) (e.g., Coibion et al., 2023). There are a large number of studies

that examine which effect is greater. Some studies for Japan report that the stimulative impact on consumption through the substitution effect is greater than the downward impact through the income effect.[11] When wage expectations rise in line with price expectations, the downward pressure on households' consumption due to a decline in real wage expectations – the negative real income effect – may be mitigated to some extent. Under these circumstances, an increase in price expectations likely leads to an increase in consumption.

Based on these understandings, we examine how the degree of linkage between wage expectations and price expectations affects households' consumption, using the Opinion Survey – which asks about households' spending attitude in addition to their expectations for income and prices. Specifically, we estimate linear probability models in which households' spending attitudes are the dependent variable, while their price expectations, income expectations and their interaction terms are explanatory variables. The models are estimated by OLS. The dependent variable $C_{i,t}$ in Equation (7) represents respondent i's spending attitude at time t, and is a binary variable that takes a value of 1 if the respondent answered that everyday spending, such as living expenses and education costs, or selective spending, such as hobbies and leisure, "increased compared with one year ago."[12] Therefore, the coefficient β_1 can be interpreted as indicating that "under the condition that an income increase is not expected, a 1 percentage point increase in the respondent's price expectations increases the probability of choosing an increase in spending by $\beta_1 \times 100$ percentage points". Additionally, the sum of the coefficients $\beta_1 + \beta_3$ can be interpreted as indicating that "under the condition that an income increase is expected, a 1 percentage point increase in the respondent's price expectations increases the probability of choosing an increase in spending by $(\beta_1 + \beta_3) \times 100$ percentage points". It should be noted that $\pi^e_{i,t}$, $I^e_{i,t}$, and $\boldsymbol{X_{i,t}}$, represent the price expectation (quantitative response), income expectation (a dummy variable based on the qualitative response), and the vector of control variables, respectively.

$$C_{i,t} = \alpha + \beta_1 \pi^e_{i,t} + \beta_2 I^e_{i,t} + \beta_3 (\pi^e_{i,t} \cdot I^e_{i,t}) + \boldsymbol{X'_{i,t}} \gamma + \varepsilon_{i,t} \qquad (7)$$

Table 5 shows the estimation results for Equation (7). Figure 10 shows the degree to which an

[11] Ichiue and Nishiguchi (2015), using data from the Opinion Survey as does this paper, points out that a rise in price expectations pushes up households' spending attitudes. There are other studies that analyze this issue using Japanese data, such as Ito and Kaihatsu (2016), Jinnai et al. (2021), and Niizeki and Hori (2023). For analyses using data from countries and regions other than Japan, see Coibion et al. (2020) and D'Acunto, Malmendier and Weber (2023), etc.

[12] In the Opinion Survey, it is unclear whether the question about households' spending attitudes captures nominal or real consumption (Ichiue and Nishiguchi, 2015). In order to address the case where it captures nominal consumption, we include responses for current price perceptions (whether one perceives that prices have risen compared with one year ago) as dummy variables in the control variable vector $\boldsymbol{X_{i,t}}$.

increase in households' price expectations pushes their spending attitudes up by income expectations group, based on the estimation results (β_1, β_3) in Table 5. First, the estimation results show that, among households that do not expect an increase in income, an increase in price expectations leads to stronger attitudes toward everyday spending, while there is no statistically significant association with attitudes toward selective spending. These results are consistent with the findings in Coibion, Gorodnichenko and Weber (2022) and Coibion et al. (2023), who argue that the substitution effect associated with rising price expectations works more strongly for non-durable goods consumption, which includes many items of everyday spending, and Born et al. (2025), whose results indicate that the negative real income effect associated with rising price expectations is seen more strongly in households' selective spending on items such as electronic devices and travel.[13]

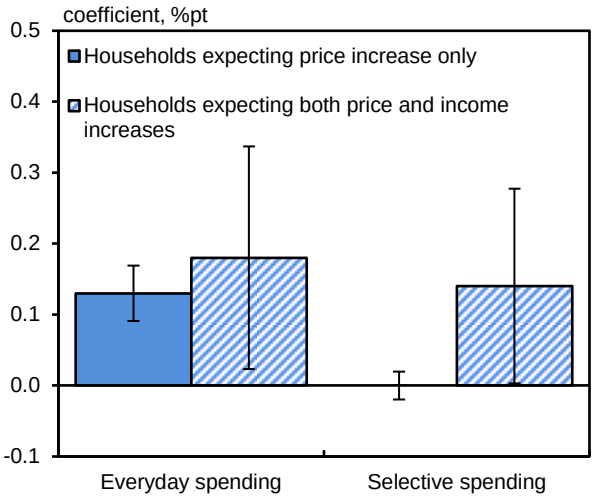
Table 5. Relationship between price expectations and spending attitude of households: Estimation results

Dependent variable: spending change		
	(1)	(2)
	Everyday spending	Selective spending
Inflation expectations (β_1)	0.0013***	-0.0000
	(0.0002)	(0.0001)
Income expectations (β_2)	0.0778***	0.0727***
	(0.0053)	(0.0046)
Inflation expectations	0.0006	0.0015**
× Income expectations (β_3)	(0.0008)	(0.0007)
Constant (α)	0.0500***	0.0979***
	(0.0083)	(0.0060)
Observations	137,793	137,793
Adj. R-squared	0.1060	0.0661
Estimation period	Jun. 2006 - Dec. 2024	

Note: *** and ** indicate significance at the 1 and 5 percent levels, respectively. Figures in parentheses indicate robust standard errors.

[13] Niizeki and Hori (2023), using Japanese data, report that the substitution effect associated with rising price expectations is strongly observed in durable goods consumption. These results contrast with those of Coibion, Gorodnichenko and Weber (2022) and Coibion et al. (2023), who use data from the U.S. and the Netherlands. On the other hand, Niizeki and Hori (2023) also find a slight increase in spending on some non-durable goods, such as storable items such as rice and detergent.

Figure 10. Relationship between price expectations and spending attitude of households: Estimation results



Note: Based on the results in Table 5. The bands in the figure represent 95 percent confidence intervals.

Furthermore, the estimation results reveal that, among households that expect an increase in income, an increase in price expectations leads to stronger attitudes toward selective spending. These results suggest that households incorporate price expectations into their income expectations, which mitigates the negative real income effect. Overall, the results in this section suggest that wage and income expectations being appropriately linked to price expectations is important for sustaining consumption and achieving sustainable economic growth.

5 Conclusion

This paper investigated the degree of linkage between wage expectations and price expectations among Japanese households, using microdata from household surveys. We also examined the heterogeneity in the degree of linkage across households' attributes and how the degree of linkage affects households' spending attitudes.

The main findings of this paper can be summarized in three points. First, the estimation results reveal that the degree of linkage between wage expectations and price expectations among Japanese households has strengthened in recent years. Second, we find that heterogeneity in the degree of linkage across households is statistically significantly associated with the labor market conditions of individual workers – such as labor market tightness and labor mobility – as well as their income levels and labor union membership status. These factors may influence the degree of linkage through workers' wage bargaining power. In Japan, labor market conditions have become prone to tightening partly due to population aging. Further intensification of competition for human resources among firms may continue to influence the degree of linkage. Third, we confirm that households with a stronger link between wage expectations and price expectations tend to maintain relatively stronger spending attitudes

during periods of rising prices, as their expected real income declines are more limited. These results suggest the importance of wage growth expectations being appropriately linked to price inflation expectations for sustaining consumption and achieving sustainable economic growth.

Finally, we discuss challenges that remain for further analysis. First, the Japanese household surveys used in this paper contain only qualitative responses on wage and income expectations. Therefore, while the data allows us to capture whether wages or income will increase (the extensive margin, EM), there is only limited information on the extent to which wages or income will increase (the intensive margin, IM). For this reason, all dependent variables in the estimation equations in this paper are binary variables – which take a value of only 0 or 1 – and we regard "the higher probability of households expecting price increases also expecting wage or income increases compared with households that do not" as the degree of linkage in this paper. However, surveys conducted in the United States and Europe often collect quantitative responses on wage expectations. In particular, Buchheim, Link and Möhrle (2024), using a survey in Germany, clearly distinguish between the EM and IM, and then report that the estimated degree of linkage along the IM is larger. A remaining challenge is to examine whether our finding – the recent strengthening of the linkage in Japan along the EM –also holds for the IM. Also, it is important to refine the analytical framework using various methods – such as the economic experiments in Hajdini et al. (2023) – in order to more accurately capture the causal relationship (pass-through) from price expectations to wage expectations within the linkage between the two.

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Appendix A: Estimation assumptions

This appendix summarizes the details of the microdata from the Workers Survey, the Opinion Survey, and the Michigan Survey used in this paper.

Overview of the "Questionnaire Survey on the Work and Life of Workers" (Workers Survey)

The analysis in this paper primarily uses microdata from the "Questionnaire Survey on the Work and Life of Workers" (Workers Survey), conducted by the Trade Union Confederation (RENGO) Research Institute for Advancement of Living Standards (RENGO-RIALS). This survey has been conducted semi-annually (in April and October) since the first round of the survey in April 2001. Initially, it was conducted as a postal-basis survey. Since the 20th survey in October 2010, it has been conducted as an internet-basis survey. Additionally, the survey area was limited to the Greater Tokyo area and Kansai area until 2017. Thereafter, the survey scope was expanded to include all 47 prefectures in Japan starting with the 35th survey in April 2018. Since the start of the internet monitor survey, approximately 2,000 individuals have responded in each survey round. Since the start of the nationwide survey, the number of respondents has increased to approximately 4,000. The dataset is in a repeated cross-sectional format. For our analysis, we use data from 47 survey rounds, spanning from October 2001 to October 2024.

The Workers Survey covers employees working in private firms. In contrast, the Opinion Survey and the Michigan Survey cover general households – including retirees and unemployed individuals – and hence differ from the Workers Survey. Furthermore, the Workers Survey explicitly asks about "wages" in the questionnaire. Generally, surveys for households tend to ask about "households' income" in their questionnaire, which may include non-wage income – such as pensions, asset income, and a spouse's income. This difference also characterizes the Workers Survey. Additionally, the Workers Survey covers various factors that may have a strong relationship with wage expectations – such as price expectations, economic outlook, and anxiety about unemployment. This feature allows us to analyze the relationship between wage expectations and price expectations.

The Workers Survey contains rich information on the attributes of respondents' working environment. This can be regarded as another advantage of using this survey. Specifically, the survey collects information on the employment-based size and the industry of the firm each respondent works for, employment status and labor union membership status, in addition to basic sociodemographic attributes such as prefecture, age, gender, and income level. This allows for control of respondents' attributes in our analysis.

The Workers Survey asks its main questions – such as respondents' expectations on wages and

prices – in terms of changes from the previous period (i.e., short-term expectations). For example, the question on the outlook for wages asks, "Do you think your own wage income one year from now will increase or decrease compared with now?" and requires respondents to choose from six options: "will increase significantly," "will increase slightly," "will remain almost unchanged," "will decrease slightly," "will decrease significantly," and "unknown". In our analysis, we treat "unknown" as a missing value and use the remaining five choices.

Overview of the "Opinion Survey on the General Public's Views and Behavior" (Opinion Survey)

Section 4.3 – using the level of price inflation expectations, and Section 4.4 – analyzing the impact on households' spending attitude, use microdata from the "Opinion Survey on the General Public's Views and Behavior" (Opinion Survey) conducted by the Bank of Japan (BOJ). This survey has been conducted since 1993. The aim of the survey is to capture households' perceptions of their living conditions and how changes in financial and economic conditions affect their attitudes and behavior, thereby providing reference for the BOJ's monetary policy conduct and business operations. The survey asks 4,000 individuals aged 20 and older nationwide. The response rate is approximately 50-60% for each survey round. The dataset is in a repeated cross-sectional format. The analysis in this paper uses 75 quarterly observations covering the period from June 2006 to December 2024. This approach follows the methodology of Fujii, Nakano and Takatomi (2025), which takes into account changes in survey methodology.

The Opinion Survey asks households about their views on future prices and income, as well as their spending attitudes, from both quantitative and qualitative perspectives. From the quantitative perspective, the survey asks about households' price expectations – expected changes in prices over the next year. From the quantitative perspective, it asks, for example, about households' income expectations – expected changes in income over the next year, and their spending attitudes – current spending compared with a year earlier. Specifically, the question about income expectations asks, "How do you think your household's income one year from now will change compared with now?" and requires respondents to choose from three options: "will increase," "will remain unchanged," and "will decrease." The question about spending attitudes asks, "How are you changing your everyday spending, such as living expenses and education costs, and your selective spending, such as hobbies and leisure, compared with one year ago?" and requires respondents to choose from three options: "increasing," "not changing," and "decreasing."

The survey also collects information on economic outlook and anxiety about unemployment, which can affect income expectations, as well as basic sociodemographic attributes (prefecture of residence, age, gender, and income level). This allows for controlling these factors in the

analysis, and thus this feature can be considered an advantage of this survey.

In our analysis, we exclude the following observations as outliers in each survey round: (1) observations above the top 0.5th percentile or below the bottom 0.5th percentile of the distribution of price inflation expectations; and (2) observations with expected inflation exceeding 20%. This approach follows the method used in the literature (Fujii, Nakano and Takatomi, 2025; Bachmann, Berg and Sims, 2015). The share of removed observations is approximately 10% of the total observations.

Overview of the "Survey of Consumers" (Michigan Survey)

Section 4.3 estimates how the level of inflation expectations affect the degree of linkage between wages expectations and price expectations in Japan and the United States, and compares the results. In the analysis for the United States, we use microdata from the "Survey of Consumers" (Michigan Survey). This survey is conducted monthly by the Survey Research Center at the University of Michigan, and it covers 500 households aged 18 and older in the United States. Some respondents in each survey round were also surveyed six months earlier, which allows us to construct panel data for two periods. However, we treat the data as a repeated cross-sectional format to maintain consistency with other data used in this paper. This paper uses data collected in 492 monthly survey rounds conducted from January 1984 to December 2024 – a period when inflation in the United States had subsided after the high inflation that began in the 1970s. This approach follows Bachmann, Berg and Sims (2015).

Similar to the Opinion Survey, the Michigan Survey asks households about their views on future prices and income from both quantitative and qualitative perspectives. We use quantitative price expectations – expected changes in prices over the next year, and qualitative income expectations – expected household income one year ahead, to maintain consistency with the Opinion Survey. Furthermore, as with the other surveys, the Michigan Survey collects various information – such as economic outlook, anxiety about unemployment, and sociodemographic attributes – which is considered to have a strong relationship with income expectations. Therefore, we can control these factors in our analysis.

Finally, similar to the analysis using the Opinion Survey, we exclude the following observations as outliers in each survey round: (1) observations above the top 0.5th percentile or below the bottom 0.5th percentile of the distribution of price inflation expectations; and (2) observations with price inflation expectations exceeding 20%. The share of removed observations is approximately 10% of the total observations.

Appendix B: Robustness checks for the main results

This appendix presents the robustness checks of the estimation results obtained in Section 4. In Section B.1, we estimate a probit model – a nonlinear model. In Section B.2, we conduct 2SLS estimation using instrumental variables, comparing each with the results of the OLS estimation of the linear probability model in Section 4.1. In Section B.3, we conduct an estimation using the employment conditions DI from the Survey on Labour Economy Trend as a proxy for the degree of labor market tightness.

B.1 Probit model estimation

Our analysis uses binary variables that take the value 0 or 1 as dependent variables. In such cases, it is necessary to use either a linear probability model or a nonlinear model such as a probit model. The linear probability model has the drawback that the predicted probability that the dependent variable is equal to one may fall outside 0-1. However, it is also well known that estimated marginal effects – which represent the impact of explanatory variables on the dependent variable – tend to be roughly similar to those from probit model estimations, and thus pose little problem in practice (Angrist and Pischke, 2009). Indeed, the literature has noted that it is difficult to interpret the results of probit models when interaction terms are included in the model (Ai and Norton, 2003). Based on these understandings, we use linear probability models in Section 4. However, there are also some studies based on probit models (Bachmann, Berg and Sims, 2015; and Dräger and Nghiem, 2021).

To check the robustness of our results, we estimate a probit model in this appendix and compare the results with those from the linear probability model in Section 4.1. Table B.1 compares the coefficients from Equation (1) in Section 4.1 estimated using the linear probability model with the marginal effects estimated using the probit model. As in the case of the linear probability model, the probit model also shows a statistically significant relationship between wage expectations and price expectations, and that this relationship has strengthened in recent years. These results show that the estimation results from the linear probability model are robust.

Table B.1. Comparison between the linear probability model and the probit model

Dependent variable: wage expectations				
	(1)	(2)	(3)	(4)
Linear probability model				
Inflation expectations (β)	0.0513***	0.0139**	0.0609***	0.1203***
	(0.0034)	(0.0055)	(0.0050)	(0.0089)
Probit model				
Inflation expectations (β)	0.0490***	0.0152***	0.0573***	0.1219***
	(0.0034)	(0.0054)	(0.0050)	(0.0102)
Observations	60,189	22,075	27,549	10,565
Pseudo R-squared	0.1105	0.1158	0.1127	0.1223
Estimation period	Oct. 2001 - Oct. 2024	Oct. 2001 - Oct. 2013	Apr. 2014 - Oct. 2021	Apr. 2022 - Oct. 2024

Note: *** and ** indicate significance at the 1 percent and 5 percent levels, respectively. Figures in parentheses indicate robust standard errors. The results from the linear probability model are the same as in Table 1. Results from the probit model represent the marginal effects and the pseudo R-squared.

B.2 Estimation using the instrumental variable method

In Section 4.1, we estimate a linear probability model in which wage expectations are the dependent variable and price expectations are the explanatory variables by OLS. However, this approach raises the concern that the estimation results may be biased due to endogeneity arising from omitted variables and simultaneity, which may lead to a failure to correctly identify the causal relationship between wage expectations and price expectations. To address this, we here estimate our model by a two-stage least squares (2SLS) approach using instrumental variables to confirm the robustness of the results by OLS, following Buchheim, Link and Möhrle (2024). Equation (B-1) defines the instrumental variable $Z_{j,t}$, following Buchheim, Link and Möhrle (2024) and Patzelt and Reis (2024).

$$Z_{j,t} = e_t \, s_j \tag{B-1}$$

Here, e_t represents the year-on-year change in the nationwide CPI for energy at time t, and s_j represents the share of energy expenditure in the total consumption expenditure of households with attribute j (by prefecture of residence, household size, and age group of the household head), based on the 2019 National Survey of Family Income, Consumption and Wealth. We estimate the model by 2SLS, assuming that $Z_{j,t}$ affects general price expectations but does not directly affect the income expectations of individual households. This methodology generates exogenous variation to attribute-level variables by combining nationwide-level shocks (shift) to a given series with the corresponding regional or attribute-specific shares of that series, as with $Z_{j,t}$ in this analysis. This type of instrumental variable is also known as a "shift-share

instrumental variable" and has been used in many recent studies.[14] Borusyak, Hull and Jaravel (2025) argue that at least one of the following two conditions must be satisfied in order to use a shift-share variable method as an identification strategy: (1) the shift must be exogenous, and (2) the share must be exogenous. $Z_{j,t}$ in this paper is considered to satisfy condition (1), since energy prices – which serve as the shift component – fluctuate significantly due to factors exogenous to Japan.[15]

The model specification is as shown in Equations (B-2) and (B-3). Equation (B-2) indicates the first-stage regression of the 2SLS estimation. Price expectations $\pi^{e}_{i,j,t}$ are regarded as an endogenous variable and regressed on the instrumental variable $Z_{j,t}$ and the vector of control variables $\boldsymbol{X_{i,j,t}}$. It should be noted, however, that the weak-instrument problem is more likely to arise when the endogenous variable is discrete, as pointed out by Xu (2021). To address this problem, we use quantitative price expectations data from the Opinion Survey in this section, instead of data from the Workers Survey. Specifically, $\pi^{e}_{i,j,t}$ in Equation (B-2) is the quantitative price expectations (one year ahead) of respondent i with attribute j at time t, and the coefficient β in Equation (B-3) can be interpreted as indicating that "a 1 percentage point increase in the respondent's price expectations increases the probability of expecting an income increase by $\beta \times 100$ percentage points." In Equation (B-3), we use a dummy variable for income expectations $I^{e}_{i,j,t}$ as the dependent variable, since the Opinion Survey asks households' qualitative income expectations instead of wages. Due to these data differences, the absolute values of the estimated coefficient β in Equation (B-3) cannot be directly compared with the estimates based on the Workers Survey (e.g., Table 1).

$$\pi^{e}_{i,j,t} = \mu + \rho\, Z_{j,t} + \boldsymbol{X'_{i,j,t}}\, \varphi + e_{i,j,t} \qquad \text{(B-2)}$$

$$I^{e}_{i,j,t} = \alpha + \beta\, \widehat{\pi^{e}_{i,J,t}} + \boldsymbol{X'_{i,j,t}}\, \gamma + \varepsilon_{i,j,t} \qquad \text{(B-3)}$$

Table B.2 shows the estimation results using 2SLS. In the first stage, the coefficient on the instrument ρ is statistically significantly positive in all specifications except for column (2). Also, the F-statistic exceeds the rule-of-thumb value of 10. These results support the validity of the instrument used in the model. In the second stage, the full-sample estimation results for β, as shown in column (1), suggest that there is a statistically significant positive link between the income expectations and price expectations of Japanese households in the long run. In

[14] General shift-share instrumental variables are often constructed as a weighted average of shocks and shares for N types of series ($Z_{j,t} = \sum_{n=1}^{N} e_{n,t}\, s_{j,n}$). As explained in Borusyak, Hull and Jaravel (2025), $Z_{j,t}$ in this paper can be regarded as a special case where $N = 1$.

[15] For example, in 2015, energy prices fell significantly due to the impact of the U.S. "shale revolution," whereas in 2022, they rose significantly due to the impact of Russia's invasion of Ukraine.

addition, the subsample estimation result, as shown in columns (2)-(4), suggest that the linkage has strengthened particularly since the COVID-19 pandemic. These results indicate that the OLS estimation results in Section 4.1 are generally robust.

Table B.2. Estimation results of the degree of linkage: 2SLS

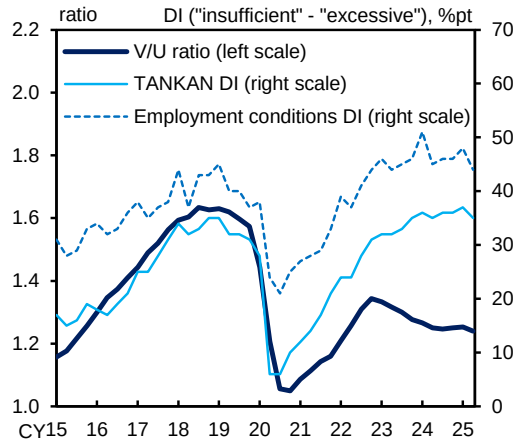
Dependent variable: income expectations				
	(1)	(2)	(3)	(4)
Second stage				
Inflation expectations (β)	0.0053***	0.0015**	-0.0019	0.0182***
	(0.0005)	(0.0007)	(0.0027)	(0.0046)
Constant (α)	0.1180***	0.0947***	0.1928***	0.0626*
	(0.0062)	(0.0081)	(0.0164)	(0.0370)
First stage				
Instrumental variable (ρ)	0.2373***	-0.0310	0.4559***	0.2509***
	(0.0284)	(0.0537)	(0.0426)	(0.0502)
F-statistic	607.55	483.44	58.85	45.63
Observations	139,896	59,076	60,383	20,437
Adj. R-squared	0.1115	0.1112	0.1287	0.0115
Estimation period	Jun. 2006 - Dec. 2024	Jun. 2006 - Dec. 2013	Mar. 2014 - Dec. 2021	Mar. 2022 - Dec. 2024

Note: *** and * indicate significance at the 1 percent and 10 percent levels, respectively. Robust standard errors are reported in parentheses. The *F*-statistic reports the Kleibergen-Paap rk Wald *F*-statistic constructed in the first stage of the 2SLS estimation.

B.3 Use of the Survey on Labour Economy Trend

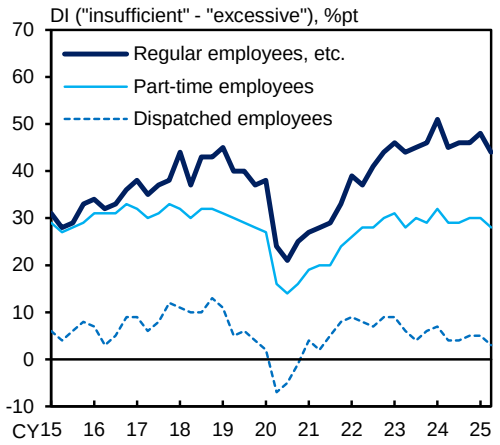
Section 4.2 uses the V/U ratio (active job openings-to-applicants ratios) by prefecture as a proxy for labor market tightness. This indicator has also been used in prior studies such as Kondo (2007), Kishaba and Okuda (2025), and Kido and Suita (2025). However, as shown in Figure B.1, the nationwide V/U ratio has shown more muted movements than other labor market indicators since the 2020s. The V/U ratio is calculated using data from the public employment security offices. However, the number of users of public services has been structurally declining in recent years partly due to an increase in the use of private services. Bank of Japan (2024a) points out that the deviation may partly reflect these structural shifts.

Figure B.1. Various measures of labor market conditions (national)



Note: The V/U ratio is seasonally adjusted. The Tankan DI is for all industries and enterprises. The employment conditions DI is from the Survey on Labour Economy Trend for regular employees, etc.
Sources: Ministry of Health, Labour and Welfare; Bank of Japan.

Figure B.2. Employment conditions DI (national)



Note: Based on the Survey on Labour Economy Trend.
Source: Ministry of Health, Labour and Welfare.

In this section, we check the robustness of our results using another indicator – the employment conditions DI. This indicator is calculated as the share of establishments reporting "insufficient" minus those reporting "excessive," based on data from the Survey on Labour Economy Trend. Since this survey asks firms directly about the degree of labor shortage, it is less likely to be affected by structural shifts in the use of job placement services. The data have been available since 2015. They are reported for six regions (Hokkaido/Tohoku, Kanto, Chubu, Kinki, Chugoku/Shikoku, and Kyushu/Okinawa) rather than for individual prefectures and separately for three types of employment (regular employees, etc., part-time employees, and dispatched employees). We merge these data with those from the Workers Survey and estimate a model as in Equation (4) of Section 4.2.[16] Column (1) of Table B.3 and Panel (a) of Figure B.3 show the estimation results. These results confirm that the linkage between wage expectations and price expectations tends to be stronger in regions and employment types where labor shortages are more severe (i.e., where there is more tightening in the labor market), consistent with the results obtained using the V/U ratio.

Figure B.2 indicates that perceived labor shortages have remained more severe for regular employees than for other types of employment. In this regard, we estimate the degree of linkage by employment type to examine how heterogeneity in labor shortages across employment types affect the linkage, using the same specification as the analysis using dummy variables for household attributes in Section 4.2. Column (2) of Table B.3 and Panel (b) of Figure B.3 show

[16] Samples that answered "regular employee" for employment type in the Workers Survey were matched with the value of the employment conditions DI for "regular employees, etc."; samples that answered "part-timer" or "so-called 'arbeit' workers" were matched with the value for "part-time employees"; and samples that answered "contract employee" or "dispatched employee" were matched with the value for "dispatched employees".

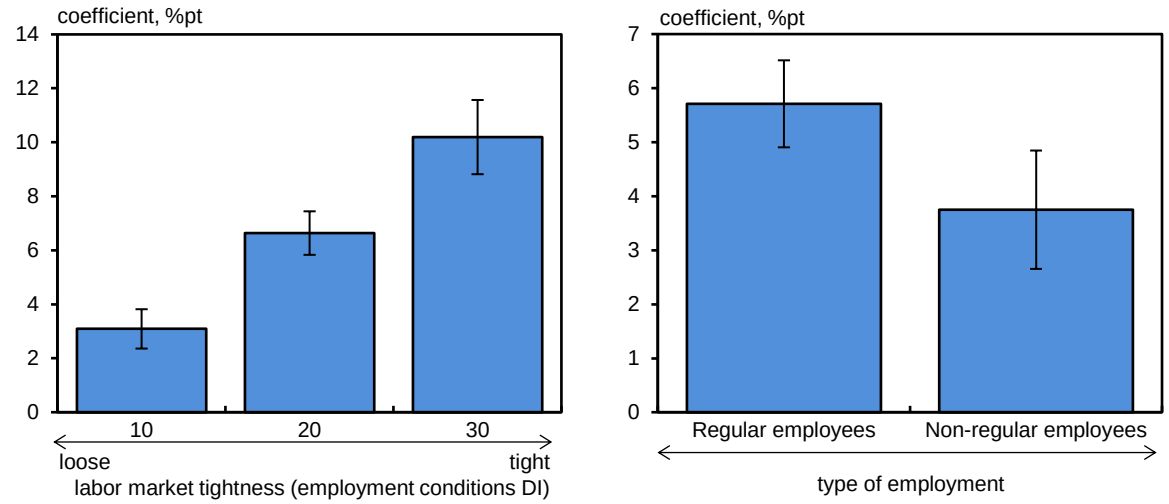
the results. These results suggest that strong perceptions of labor shortages for regular employees may enhance workers' wage bargaining power, leading to a stronger link between wage expectations and price expectations.

Table B.3. Estimation results of the degree of linkage by labor market tightness and type of employment

Dependent variable: wage expectations		
	(1)	(2)
	Labor market tightness	Type of employment
Inflation expectations	0.0132	0.0375***
	(0.0127)	(0.0056)
Employment conditions DI	-0.0008**	
	(0.0003)	
Inflation expectations	0.0018***	
× Employment conditions DI	(0.0004)	
Regular employees dummy		0.0153**
		(0.0061)
Inflation expectations		0.0195***
× Regular employees dummy		(0.0067)
Constant	0.2087***	0.1958***
	(0.0186)	(0.0177)
Observations	34,500	60,189
Adj. R-squared	0.1129	0.1068
Estimation period	Apr. 2015 - Oct. 2024	Oct. 2001 - Oct. 2024

Note: *** and ** indicate significance at the 1 and 5 percent levels, respectively. Robust standard errors are reported in parentheses.

Figure B.3. Estimation results of the degree of linkage by labor market tightness and type of employment



Note: Based on the results in Table B.3. The bands in the figure represent 95 percent confidence intervals. The employment conditions DI is calculated as "insufficient" minus "excessive" (percentage points).

Appendix C: Impact of worker and firm attributes on the degree of linkage

This appendix examines heterogeneity in the degree of linkage between wages expectations and price expectations across workers' attributes that we did not discuss explicitly in Section 4.2. These attributes include age, gender, and employment-based size and industry of firms that respondents belong to. The analysis uses microdata from the Workers Survey. The estimation equations are the same as those in the analysis using dummy variables for worker attributes in Section 4.2.

The estimation results are summarized in Table C. The results by age show that the linkage is weaker for older workers aged 50 and above. The results by gender show that the linkage is weaker for women. Although the underlying exact reasons behind these results remain unclear, the results for older workers may partly reflect customary practice in which many firms stop regular pay increases once employees reach their 50s.[17] Also, the results for women may partly reflect the tendency for the regular employment ratio for women to be relatively low. Meanwhile, no significant differences were observed in the estimation results by size and industry.

[17] For details on the Japan's seniority-based wage system, see Ito and Hoshi (2020).

Table C. Estimation results of the degree of linkage by worker attributes

Dependent variable: wage expectations				
	(1)	(2)	(3)	(4)
	Age	Sex	Firm Size	Industry
Inflation expectations	0.0625***	0.0586***	0.0443***	0.0378***
	(0.0054)	(0.0043)	(0.0053)	(0.0069)
Ages 40-49 dummy	-0.1021***			
	(0.0064)			
Ages 50+ dummy	-0.1613***			
	(0.0057)			
Inflation expectations	-0.0091			
× Ages 40-49 dummy	(0.0080)			
Inflation expectations	-0.0327***			
× Ages 50+ dummy	(0.0071)			
Female dummy		-0.0044		
		(0.0056)		
Inflation expectations		-0.0191***		
× Female dummy		(0.0066)		
Medium-sized dummy			0.0079	
			(0.0065)	
Large-sized dummy			0.0247***	
			(0.0066)	
Inflation expectations			0.0092	
× Medium-sized dummy			(0.0080)	
Inflation expectations			0.0027	
× Large-sized dummy			(0.0080)	
Manufacturing dummy				-0.0026
				(0.0075)
Wholesale & retail dummy				-0.0102
				(0.0094)
Inflation expectations				0.0135
× Manufacturing dummy				(0.0092)
Inflation expectations				0.0177
× Wholesale & retail dummy				(0.0115)
Constant	0.1911***	0.1930***	0.1952***	0.2101***
	(0.0176)	(0.0175)	(0.0184)	(0.0229)
Observations	60,189	60,189	55,729	35,417
Adj. R-squared	0.1064	0.1062	0.1104	0.1132
Estimation period	Oct. 2001 - Oct. 2024			

Note: *** indicates significance at the 1 percent level. Robust standard errors are reported in parentheses. The medium-sized dummy and large-sized dummy are dummy variables that take a value of 1 for firms with 100 – 999 employees and 1,000 or more employees, respectively.