# Japan Is Not an Island? *

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**Abstract**

Using a novel dataset of Japanese firms, this study examines how firms form inflation expectations. Based on the Lucas island model, we investigate which information, aggregate inflation rate or industry inflation rate, affects inflation expectations. There are three findings. First, we find that only the aggregate inflation rate influences firms' inflation expectations. Second, large firms are more attentive to the aggregate inflation rate than small firms. Third, the formation process of firms' inflation expectations changes depending on how the industry inflation rate changes.

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*Keywords:* firms expectations; island model; inflation expectations;

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# 1 Introduction

There is growing interest in how firms form expectations. Modern economics is based on full-information rational expectations (FIRE hereafter). However, many studies show that agents do not follow FIRE. If agents do not form FIRE, how do they form expectations? Many paper studies how households and professionals form expectations. Because of the lack of data, there are few papers that study how firms form their expectations.

This study aims to answer how firms form their inflation expectations. We combine unique survey data on Japanese firms with accounting data. Using these data, we analyze which information, aggregate inflation rate or industry inflation rate, affects inflation expectations. Using a survey data of French manufacturing firms, Andrade et al. (2020) investigate how firms' expectations are affected by both aggregate and industry-specific conditions based on the island model. Andrade et al. (2020) show that firms' expectations are affected by industry-specific shocks, which is consistent with the island model. We use the Japanese firm data to test if their results are consistent with Japan.

We obtain three findings. First, we find that only the aggregate inflation rate influences firms' inflation expectations. That is, when firms predict the future inflation rate, they do so based on macroeconomic information, not on their own industry. Second, large firms are more attentive to the aggregate inflation rate than small firms. This result suggests that there is heterogeneity in the expectation formation process depending on the characteristics of the firm. Third, the formation process of firms' inflation expectations changes depending on how the industry inflation rate changes. In other words, the expectation formation process of firms changes not only depending on the characteristics of the firm but also on the macroeconomic condition.

Our paper is related to the literature that studies how firms form their expectations. Using firm data in Germany, Bachmann and Elstner (2015) explore whether firms have systematic expectation bias. They find that one-third of firms systematically over- or underpredict their production growth. Coibion et al. (2018a) study how firms form expectations and show several facts of firms' expectations. They show that there is a large dispersion in beliefs about past and future macroeconomic conditions. Using firm data in New Zealand, Kumar et al. (2015) investigate whether inflation expectations are anchored or not. They find that firms' inflation expectations are little anchored in the inflation targets. Massenot and Pettinicchi (2018) examine the expectation formation process of firms. They find that firms form too optimistic expectations after their business has improved. They also find that older and larger firms have a smaller extrapolation bias.

# 2 Data

The data we use is the "Annual Survey of Corporate Behavior" (ASCB hereafter) conducted by the Economic and Social Research Institute, Cabinet Office of Japan. Several studies use this data to analyze firms' expectations and their actions (Kaihatsu and Shiraki, 2016; Koga and Kato, 2017; Nakazono et al., 2020; Tanaka et al., 2020). We use data over the period 2003-2018. Survey targets are all listed firms on the Tokyo and Nagoya Stock Exchanges. Half of the firms on average respond to the survey each year, about 1,100 firms. ASCB is conducted annually. The institute sends the questionnaire to firms every December, and firms respond to the survey by mid-January. Firms are asked to answer their business outlook for GDP, industry demand, their business plan, and others.

# 3 Estimation strategy

Lucas (1973) shows a model of agents' expectation formation under imperfect information, called the "Lucas island model". The economy consists of many separate competitive sectors, each of which

is called an island. $p_t$ and $p_t^z$ are the logarithms of nominal price in the aggregate economy and in island $z$ in period $t$. $I_t^z$ is the information available in island $z$ about the economy. Agents have a prior distribution for $p_t$ that is normal with mean $E_t[p_t|I_t]$ and variance $\sigma_p^2$. $I_t$ is the information set consisting of full information about the economy without $p_t^z$. Agents observe $p_t^z$:

$$p_t^z = p_t + z_t^z, \tag{1}$$

where $z_t^z$ is an island-specific shock. $z_t^z$ is white noise, normally distributed, and has variance $\sigma_z^2$. Based on Lucas (1973), we assume that $p_t$, $E[p_t|I_t^z]$, and $p_t^z$ are jointly normally distributed with the same expected values, and there exists $\theta$[1] $> 0$. such that:

$$E_t[p_t|I_t^z, p_t^z] = (1-\theta)E_t[p_t|I_t] + \theta p_t^z. \tag{2}$$

Based on the Lucas island model, we estimate the following equation:

$$E_t^i \pi_{t+1}^{agg} = \alpha_i + \beta \times \pi_t^{agg} + \gamma \times \pi_t^z + \Delta\pi_{t\to t+1}^{agg} + \Delta\pi_{t\to t+1}^z + \mathbf{X}\eta + \varepsilon_{i,t}, \tag{3}$$

where $E_t^i \pi_{t+1}^{agg}$ is the inflation expectations of firm $i$ in year $t$. $\pi_t^{agg}$ and $\pi_t^j$ are an aggregate inflation rate and an inflation rate in sector $z$ in period $t$. $\mathbf{X}$ includes time dummy. $\Delta\pi_{t\to t+1}^{agg}$ and $\Delta\pi_{t\to t+1}^j$ are control variables. In Equation (2), the left-hand side is the inflation expectations in period $t$ of the inflation rate in period $t$, and the right-hand side is the aggregate inflation rate and the inflation rate in sector $z$ in period $t$. In Equation (3), however, the left-hand side is the inflation expectations in period $t$ of the inflation rate in period $t+1$. Since there is a time gap between Equation (2) and Equation (3), Equation (3) includes control variables to adjust for it.

# 4 Results

We investigate which information, aggregate inflation rate or industry inflation rate, affects inflation expectations. Table 1 shows results of Equation (3). As a result, the coefficients of aggregate inflation are significantly positive, while the coefficients of the industry inflation rate are insignificant. That is, we find that only the aggregate inflation rate influences firms' inflation expectations.

Next, we separate the data based on firm characteristics and estimate Equation (3). We separate the data with firm size. We define that firms with employment greater than the median are defined as large firms, and firms with employment less than the median are defined as small firms. Panel (A) in Table 2 shows the results. As a result, we find that the coefficient of aggregate inflation rate for large firms is larger than that for small firms. That is, the result suggests that large firms are more attentive to the aggregate inflation rate than small firms.

Finally, we separate the data based on the condition of the aggregate economy. We separate the data by whether the industry inflation rate rises or falls compared to the previous period. Panel (B) in Table 2 shows the results. As a result, we find that when the industry inflation rate rises, only the aggregate inflation rate influences firms' inflation expectations, while when the industry inflation rate falls, both the aggregate inflation rate and the industry inflation rate influence firms' inflation expectations. The results suggest that the formation process of firms' inflation expectations change depending on how the industry inflation rate changes.

[1] $\theta = \frac{\sigma_p^2}{\sigma_p^2 + \sigma_z^2}$

# 5 Conclusions

This study examines how firms form inflation expectations by a novel dataset of firms' inflation expectations. Based on the Lucas island model, we investigate which information, aggregate inflation rate or industry inflation rate, affects inflation expectations.

First, we find that only the aggregate inflation rate influences firms' inflation expectations. That is, when firms predict the future inflation rate, they do so based on macroeconomic information, not on their own industry. Second, large firms are more attentive to the aggregate inflation rate than small firms. This result suggests that there is heterogeneity in the expectation formation process depending on the characteristics of the firm. Third, the formation process of firms' inflation expectations changes depending on how the industry inflation rate changes. In other words, the expectation formation process of firms changes not only depending on the characteristics of the firm but also on the macroeconomic condition.

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Table 1: Which information, aggregate inflation rate or industry inflation rate, affects inflation expectations more?

| | (1) | (2) | (3) | (4) |
|---|---|---|---|---|
| $\pi_t^{agg}$ | 0.333*** | 0.361*** | 0.396*** | 0.600*** |
| | (0.021) | (0.012) | (0.028) | (0.033) |
| $\pi_t^z$ | −0.011 | −0.002 | −0.011 | 0.001 |
| | (0.007) | (0.004) | (0.010) | (0.007) |
| $\Delta\pi_{t\to t+1}^{agg}$ | | | 0.212*** | 0.372*** |
| | | | (0.020) | (0.030) |
| $\Delta\pi_{t\to t+1}^{z}$ | | | −0.007 | 0.001 |
| | | | (0.011) | (0.006) |
| Constant | 0.036*** | −0.245*** | 0.038*** | −0.072*** |
| | (0.005) | (0.021) | (0.006) | (0.013) |
| Fixed effect | YES | YES | YES | YES |
| Time fixed effect | NO | YES | NO | YES |
| Observations | 11,861 | 11,861 | 8,111 | 8,111 |

Note: Standard errors in parentheses are clustered at sector levels, and ***, **, and * indicate $1\%$, $5\%$, and $10\%$ significance, respectively.

Table 2: Is there heterogeneity in the effect of the aggregate inflation rate or industry inflation rate on inflation expectations?

| Panel (A) | Small | | Large | |
|---|---|---|---|---|
| | (1) | (2) | (3) | (4) |
| $\pi_t^{agg}$ | 0.263*** | 0.284*** | 0.384*** | 0.473*** |
| | (0.032) | (0.027) | (0.030) | (0.029) |
| $\pi_t^z$ | 0.003 | −0.007 | −0.010 | 0.003 |
| | (0.011) | (0.011) | (0.012) | (0.008) |
| $\Delta\pi_{t\to t+1}^{agg}$ | 0.187*** | 0.143*** | 0.360*** | 0.094** |
| | (0.025) | (0.018) | (0.028) | (0.033) |
| $\Delta\pi_{t\to t+1}^{z}$ | 0.004 | −0.003 | −0.005 | 0.002 |
| | (0.009) | (0.008) | (0.008) | (0.005) |
| Constant | −0.138*** | −0.139*** | −0.102*** | −0.357*** |
| | (0.012) | (0.014) | (0.010) | (0.017) |
| Fixed effect | YES | YES | YES | YES |
| Time fixed effect | NO | YES | NO | YES |
| Observations | 2,897 | 2,897 | 3,525 | 3,525 |
| Panel (B) | Inflation | | Deflation | |
| | (1) | (2) | (3) | (4) |
| $\pi_t^{agg}$ | 0.369*** | 0.587*** | 0.521*** | 0.566*** |
| | (0.023) | (0.033) | (0.049) | (0.068) |
| $\pi_t^z$ | −0.012 | −0.010 | 0.050*** | 0.046** |
| | (0.010) | (0.007) | (0.015) | (0.017) |
| $\Delta\pi_{t\to t+1}^{agg}$ | 0.208*** | 0.358*** | 0.285*** | 0.358*** |
| | (0.039) | (0.021) | (0.080) | (0.093) |
| $\Delta\pi_{t\to t+1}^{z}$ | −0.010 | −0.002 | 0.011 | 0.004 |
| | (0.008) | (0.003) | (0.010) | (0.008) |
| Constant | 0.007* | −0.036 | 0.286*** | −0.029 |
| | (0.003) | (0.025) | (0.033) | (0.048) |
| Fixed effect | YES | YES | YES | YES |
| Time fixed effect | NO | YES | NO | YES |
| Observations | 5,077 | 5,077 | 2,939 | 2,939 |

Note: Standard errors in parentheses are clustered at sector levels, and ***, **, and * indicate $1\%$, $5\%$, and $10\%$ significance, respectively.