Inflation expectations as macroeconomic shocks

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Abstract

Inflation expectations of households and firms are highly dispersed because many of them are inattentive to actual inflation. An increase in attention leads to a revision of expectations towards actual inflation, which could affect many important economic decisions. We track the macroeconomic impact of (in)attention shocks using a functional VAR, taking into account the heterogeneity of inflation expectations within and between households and firms. We find that a fairly small attention shock can significantly boost economic activities regardless of their effect on inflation expectations and actual inflation. This suggests that attention shocks inform better economic decisions and improve resource allocation, rather than working through a real interest rate channel. Inflation expectations of households and firms play a similar role. But firm inflation expectations add valuable information about the economy and have a more meaningful impact on inflation.

Keywords: Inflation expectations, Attention, Functional VAR, Central bank communication
JEL: C32, D83, E31, E58

1 Introduction

Inflation expectations lie at the heart of many important economic decisions, including consumer spending and saving, as well as firm investment plans, wage negotiations, and pricing strategies. Assuming full-information rational expectations (FIRE), standard economic theory suggests that higher inflation expectations lower the real interest rate, which should encourage spending and investment. Labour unions and firms may raise prices to catch up with higher anticipated inflation in the future. Therefore, inflation expectations could be a powerful policy tool for central banks, especially when their hands are tied with other tools. In reality, however, households and firms are neither perfectly informed nor rational. Recent studies have documented that the general public pays little attention to, and knows little about, central banks. It is therefore difficult for central banks to engineer inflation expectation with precision. (see e.g. Coibion et al., 2020a) In addition, higher inflation may be associated with a weaker economy and lower income (i.e. a supply-side view of inflation), offsetting the stimulative effect through the real interest rate channel. Partly in recognition of these risks, central banks often prioritise communicating with professional forecasters and financial market participants,[1] focusing on monetary policy transmission through the financial market.

That said, inflation expectations of households and firms remain an important policy topic for at least two reasons. First, attention is time-varying, and people pay attention to inflation when they think it matters, such as during the recovery from the COVID-19 pandemic. When central banks have the attention, they need to better understand how their communication influences the economy. On the contrary, when inflation expectations are severely biased due to inattention, standard monetary policy tools could be less effective. (Carrier and Mavromatis, 2025) Second, inflation expectations could be subject to exogenous variation and drive the business cycle. Since people primarily pay attention to information in their local environment

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[1]For a recent policy discussion on inflation expectations of different agents, see Fed Governor Christopher Waller's speech at the 2025 Bank of Korea International Conference on "Structural Shifts and Monetary Policy".

rather than economy-wide data. Expectation shocks can arise from a shift in attention, a change in the local environment and the way information is processed (e.g. sentiment), even when the broader economic situation remains unchanged. In the past two decades, a burgeoning literature based on household and firm surveys has greatly advanced our understanding of how inflation expectations affect individuals' economic decisions from a microeconomic perspective. But it remains unclear how these microeconomic effects translate into macroeconomic outcomes, which is of more interest to central banks.

In this paper, we study inflation expectations as macroeconomic shocks. A major challenge of this study is the large cross-sectional dispersion in inflation expectations, which could obfuscate the relationship between inflation expectations and macroeconomic variables. (D'Acunto et al., 2023) We address this challenge by modelling the joint dynamics of macroeconomic variables and the entire distribution of inflation expectations using a functional VAR (FVAR). When considering shocks to the distribution of inflation expectations, we draw on the insights from previous work that inattention to inflation is the primary source of disagreement over inflation expectations. An (in)attention shock should cause people to revise their expectations (away from) towards actual inflation, regardless if their initial beliefs are upward or downward biased. We find that (in)attention shocks have a significantly (negative) positive impact on the economy, even when they affect only a small proportion of the population. Since (in)attention shocks can cause a revision of inflation expectations in either direction, their economic impact is unlikely to work through the real interest rate channel, but possibly reflects better-informed economic decisions and less misallocation of resources. People with upward-biased beliefs manifest a supply-side view of inflation because attention shocks cause a downward revision of inflation expectations while boosting economic activity. Conversely, people with downward-biased beliefs manifest a demand-side view of inflation. The overall view of the population as a whole depends on whether attention shocks hit the left or right side of the inflation expectation distribution more. Thus, we provide a new explanation of the supply/demand-side view of inflation, in addition to the explanation based on historical experience (Candia et al., 2023a).

In addition to heterogeneity within households and firms, we also examine the heterogeneity between these two types of agents. Since households and firms form inflation expectations in a similar way and firm managers may use their expectations for personal rather than business decisions (Kumar et al., 2015), it is unclear whether firm expectations play a role independent of households expectations. We find that firm inflation expectations contain valuable additional information about the economy, suggesting that firms are more sophisticated than households when forming inflation expectations. This is particularly true in economies with high and volatile inflation such as the Philippines, where firms pay closer attention to inflation. We also find firm expectations drive inflation more meaningfully than household expectations, reflecting firms' role as the price setter.

Our results come with several policy implications. First, central banks should monitor inflation expectations not only as a transmission channel but also as an important source of uncertainty. To correctly interpret the data, it is important to look into heterogeneity among households and firms. However, firm surveys have not been established in many economies. Closing this data gap could be particularly valuable if the central bank is mainly concerned about inflation dynamics. In economies where the distributional data is not readily available to inform policy, it may be worthwhile to construct new statistics, such as the percentage of inflation expectations falling within a neighbourhood of historical inflation. In terms of communication, central banks should focus on aligning inflation expectations within a more reasonable range. They can use straightforward and direct communication to educate the public about inflation and central banking, thereby increasing the chances of breaking through the veil of inattention.

This study bridges the macroeconomic role of households' and firms' inflation expectations to an extensive literature that study these expectations from a microeconomic perspective.[2] In particular, our (in)attention shocks relate to experiments that treats people with information about actual inflation and central banks. In the macroeconomic literature, our work is most closely related to Ascari et al. (2024), who use functional VAR to study mean and dispersion shocks to household inflation expectations. We take a step forward by jointly modelling inflation expectations of both households and firms and consider micro-founded (in)attention

[2]For comprehensive surveys of this literature, see D'Acunto et al. (2023) and D'Acunto and Weber (2024) for households, Candia et al. (2023a) for firms, and Coibion et al. (2020a), Weber et al. (2022), and Coibion and Gorodnichenko (2025) for both types of agents. They cover a wide range of topics, including but not limited to survey design, stylised facts and determinants of inflation expectations, the relationship between inflation expectations and economic decision-making, and central bank communication.

shocks. (In)attention shocks affect the distribution of inflation expectations locally whereas Ascari et al. (2024) consider global shocks that reshape the entire distribution. We argue that local shocks are more realistic and easier to interpret. For instance, inattention shocks could account for much negative effects of Ascari et al. (2024)'s dispersion shocks. We also consider a different sample focusing on Asia. Inflation expectations in emerging Asia are under-examined. To our best knowledge, this is the first attempt to model inflation expectations in the Philippines, which differ from those in well-studied Asian economies such as Japan and New Zealand. Our evidence on the Philippines is consistent with studies of other emerging economies with high and volatile inflation (e.g., Iran, Ukraine, Uruguay, Argentina, Israel, see Coibion et al. 2020a; Weber et al. 2025), where people pay more attention to inflation. This paper is also related to Meeks and Monti (2023), who argue that the mean or median is not necessarily more informative than other characteristics of the distribution of inflation expectations, such as mode and tails. They find that the dispersion of inflation expectations is important to understanding inflation dynamics through the lens of the Phillips curve. But they use household instead of firm expectations. Most macroeconomic papers only consider the aggregate inflation expectation of households, possibly due to data limitation. For example, Bonciani et al. (2024) and Vatsa et al. (2025) examine respectively how food and energy prices shape the aggregate inflation expectation. Ascari et al. (2023) use theory-based sign restrictions to identify shocks to the aggregate inflation expectation, which are stagflationary. Bracha and Tang (2025) identify a shock that drives deviations of inflation expectations from FIRE and find it contractionary and deflationary.

The rest of the paper is organised as follows. The next section discusses data, focusing on survey of inflation expectations. Functional VAR and the identification strategy are introduced briefly in section 3. We consider aggregate inflation expectations using a standard VAR in section 4, focusing on households versus firms and motivating the need to consider the distribution of inflation expectations. The main results on functional VAR and (in)attention shocks are presented in section 5. The last section concludes.

2 Data

2.1 Survey of inflation expectations

Table 1 summarises household and firm surveys in six Asia-Pacific economies, namely Japan, the Philippines, New Zealand, Australia, South Korea, and Thailand. There are two major household surveys in Japan. We use the Cabinet Office survey, which has a longer history and is conducted more frequently than the Bank of Japan's opinion survey. Whenever information about the sampling method is available, these surveys are conducted on a representative sample, at least in their latest versions. One exception is that ANZ Business Outlook survey is based on a smaller sample (380 responses in 2019) of ANZ clients, although ANZ is the largest bank in New Zealand. The Reserve Bank of New Zealand's Business Expectations Survey is more representative but started only since 2025. For emerging economies, information about the sampling method is either not available or lacking details. In terms of availability, we obtain cross-sectional data for both households and firms in Japan and the Philippines. Japan's surveys use multiple-choice question with pre-coded ranges to elicit inflation expectations. The Philippines's surveys use open questions, but our data has been compiled into fairly thin bins . Korea's consumer survey and Thailand's firm survey also compile raw answers into 8 bins. On the time dimension, household data are usually available for a longer period than firm data. As many firm surveys are fairly new (except the ANZ survey), previous studies in this literature have focused on households. Even in the US, the Cleveland Fed's SoFIE started to collected firm inflation expectations since 2018Q2.

As reported in the 5th row, we consider 1-year-ahead inflation expectations in most cases, with different wording across surveys (e.g. prices in general, prices of typical purchase, or CPI).[3] The Philippines' data is special and requires further discussion. For Philippine firms, we use 1-quarter-ahead expectations, which goes back further in time than the 1-year version. When both are available, the 1-quarter- and 1-year-ahead expectations are very close. This is consistent with the literature, which finds that firms' short- and long-term inflation expectations are highly correlated. (Kumar et al., 2015; Candia et al., 2024; Savignac et al., 2024) For Philippine households, inflation expectations are calculated as a weighted average of expectations

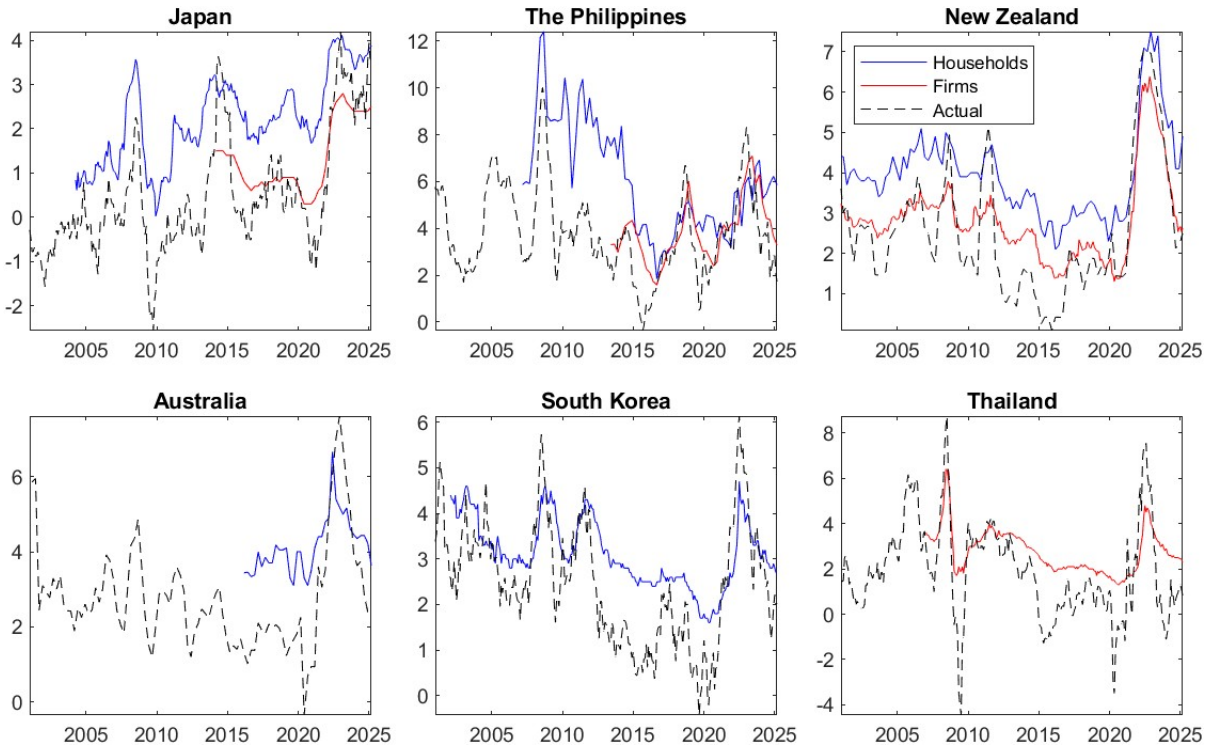
[3]De Bruin et al. (2012) find that wording can affect how much households extrapolate personal price experiences in inflation expectations. Studies of firm expectations (Kumar et al., 2015; Coibion et al., 2018; Savignac et al., 2024) typically find limited sensitivity of survey results to wording.

Table 1: Data on household and firm inflation expectations

	Japan		The Philippines		New Zealand		Australia	South Korea	Thailand
Survey	BOJ TANKAN	Cabinet Office Consumer Confidence Survey	BSP Business Expectations Survey	BSP Consumer Expectations Survey	ANZ Business Outlook survey	RBNZ Household Expectations Survey	University of Melbourne CASiE Survey	BOK Consumer Survey	BOT Reports on Business Sentiment Index
Sampling	Representative sample fixed for 2-3 years	Representative sample with 1/15 replaced every month	Unknown	Unknown	Past and current ANZ clients	Representative sample from the Dynata panel	Representative, repeated cross-sectional	Unknown	Business across sectors and of different sizes
Cross-section	10 bins by design	7 bins by design	Open[a]	Open[a]	Not available to the author	Not available to the author	Not available to the author	Since 2013: 8 compiled bins [e]	Since September 2012: 8 compiled bins [e]
Time series	2014Q1	2004M4	2013Q2[b]	2007Q1[b]	1991M2[c]	1995Q1	2016Q1[d]	2002M2	2007M1
Definition	1Y ahead CPI	1Y ahead prices of typical purchases	1Q ahead CPI	The weighted average of 1Y ahead prices of various goods and services	1Y ahead CPI	1Y ahead CPI	1Y ahead prices of typical purchases	1Y ahead inflation	1Y ahead inflation
Responding period	About one month before the end of quarter	The 15th of every month	Variable but often in the first two months of each quarter	Variable but often in the first month of each quarter	Unknown. The results are published within the last two business days of each month	After the release of previous quarter's CPI, typically during the second half of the first month of each quarter	Unknown	The middle week of each month	Since 2016: till the end of the month

[a] Cross-sectional data confidential and is available from BSP upon request.
[b] Missing in 2020Q2.
[c] Missing in every January.
[d] The CASiE survey is conducted monthly since the 90s. But only Quarterly data since 2016Q1 is freely available on the RBA's website.
[e] Bins are variable overtime.

Figure 1: Aggregate inflation expectations and actual inflation



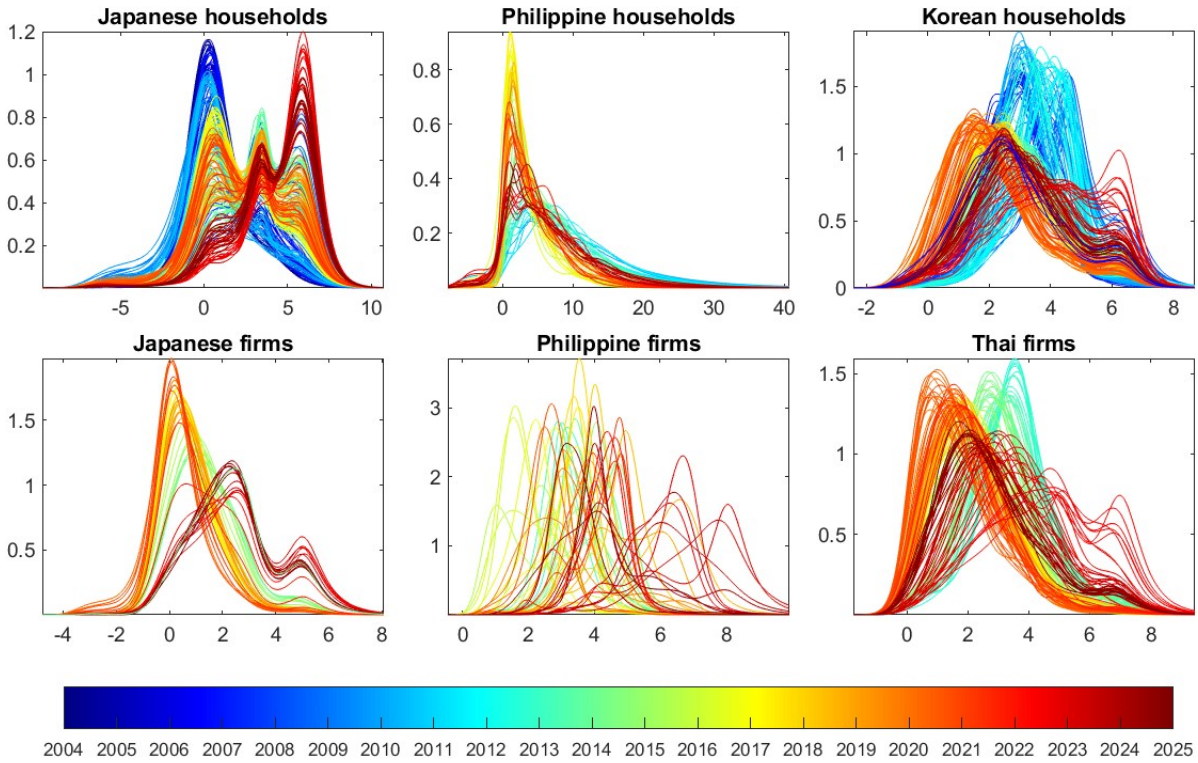
Note: The aggregate inflation expectation is either the cross-sectional mean or median, depending on the data source.

regarding price changes for individual goods and services. This is referred to in Dietrich et al. (2023) as the "aggregated measure", whereas the inflation expectation elicited from the question about aggregate prices is referred to as the "aggregate measure". The aggregated measure could be more prone to reporting errors and has different properties compared to the aggregate measure. For example, grocery (especially food) and energy prices have been found to have a disproportionately large effect on the aggregate measure, relative to their consumption shares. The extrapolation from personal shopping experience is less likely to affect the aggregated measure. We employ the aggregated measure for several reasons. Firstly, the aggregate measure is only available since 2014Q2 and briefly changed from an open-ended format to pre-coded ranges between 2022Q2 and 2023Q1. The format change appears to cause a structural break in the data, as survey results can be sensitive to the question design (Coibion et al., 2020a). Furthermore, respondents are treated with information about recent inflation before answering the question about aggregate prices, but after answering questions about the prices of individual goods and services. The treatment effect can bring the aggregate measure of inflation expectations significantly closer to actual inflation (see Savignac et al., 2024; Weber et al., 2025, among many others), which makes the sample less representative.[4] At last, Dietrich et al. (2023) find the aggregated measure a better predictor of consumers' spending plans. Further details on Philippine surveys can be found in appendix A.

Our data show stylised facts that are consistent with what is documented in the literature. Figure 1 illustrates the overall upward bias in household (and, to a less extent, firm) inflation expectations in all six economies. The bias is large especially when inflation is relatively low but reduces when inflation spikes. This is consistent with rational attention models where agents pay closer attention to inflation when inflation is deemed important. (Weber et al., 2025; Bracha and Tang, 2025) Furthermore, aggregate inflation expectations of households and firms are highly correlated. This is because firm managers are also consumers, who rely on similar sources of information and form inflation expectations in a similar

[4]Inflation expectations of Philippine firms are also affected by this treatment effect. But the effect might be small if Philippine firms pay close attention to inflation anyway, as will be shown shortly.

Figure 2: Estimated density of inflation expectations

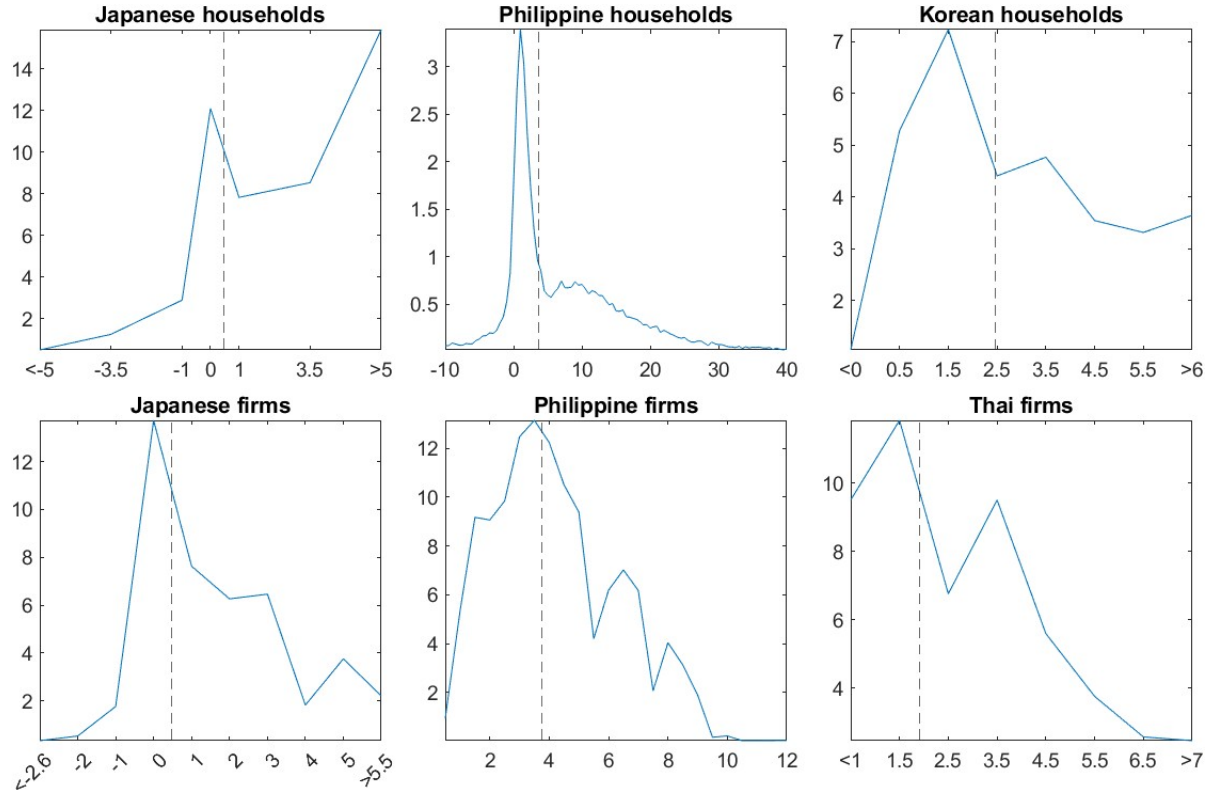


Note: Details of the estimation can be found in section 3.

way as other households.(Kumar et al., 2015; Candia et al., 2024; McClure et al., 2025) In particular, the literature suggests that firms pay little attention to inflation just like households, while having much better knowledge about prices in their own industries (Coibion et al., 2018) or individual individual goods and services (Kumar et al., 2015). However, the distributions of household and firm inflation expectations can be very different. Figure 2 plots the estimated of inflation expectation distributions wherever cross-sectional data is available. It is evident that the distributions are highly dispersed to the extent that a considerable proportion of the expectations never materialised in history. While disagreement over inflation expectations can be systemically related to characteristics such as the firm's industry and size, and the consumer's age, gender, and financial situation, it is primarily explained by inattention (Coibion et al., 2018). Many papers find that firms are relatively better informed than households and form expectations in a more sophisticated way. (Link et al., 2023b; Savignac et al., 2024; Wehrhöfer, 2025) Indeed, the distribution is less dispersed for firms than households in Japan and the Philippines. Note that the dispersion is particularly large for Philippine households because we employ the aggregated measure. Another consequence of inattention is sticky beliefs and slow learning as agents collect and process information infrequently. (Link et al., 2023a) Figure 2 shows that the distributions often remain fairly stable until shifted by major shocks such as the COVID-19 pandemic. Before the pandemic, the distributions are right-skewed, consistent with Uno et al. (2018)'s finding that inflation expectations are downwardly rigid. Interestingly, the distribution for Philippine firms is extremely volatile, probably because Philippine firms pay closer attention in an environment of high and volatile inflation (the average inflation is around 3.75% after BSP adopting inflation targeting since 2002, the highest in our sample). We also find that the distributions can be multimodal, which highlights richer information in the distribution than summary statistics. For instance, when Japan's inflation peaked at 4.2% year-on-year in January 2023, firms' inflation expectations were divided between two "mainstream" views, one at around 5% and the other one at around 2.5%.

To examine if changes in the distributions concentrate in specific intervals, we calculate the standard deviations for each bin of inflation expectations. As reported in figure 3, the bin in the neighbourhood of the average inflation (vertical lines) is highly volatile. This is as expected because expectations within

Figure 3: StD of inflation expectations by bins



Note: The vertical lines represent the sample average of actual inflation. The ticks on the X-axis represent the midpoints of the bins, except for the bins on the far left and right.

these ranges are held by those who pay attention to actual inflation and driven by macroeconomic shocks. For Philippine households, the standard deviation peaks at around 1%, which is much lower than the average inflation of 3.75%. This should be interpreted with caution, as their inflation expectations are based on the aggregated measure. More interestingly, bins further away from the average inflation can also be volatile. Notably, the volatility concentrates in very high expectations for Japanese households and very low expectations for Thai firms. Volatility in these bins may reflect inattention, should bring expectations away from actual inflation.

2.2 Macroeconomic variables

The literature suggests that people primarily rely on food and energy prices, as well as media reports, to form their inflation expectations.[5] The relative importance of the information sets vary. Agents with better knowledge of past inflation, i.e. some firms, do not extrapolate much from personal shopping experience, and hence their expectations are less affected by food and energy prices (Wehrhöfer, 2025). Kumar et al. (2015) document that personal shopping experience is considered by more New Zealand firms as important than gasoline prices. Kikuchi and Nakazono (2023) find explicitly that it is food prices rather than energy prices that drive consumer inflation expectations in Japan. Bonciani et al. (2024) show that food price shocks explain inflation expectations more than a 'representative' inflation shock. (D'Acunto et al., 2021) suggest that the extent of extrapolation depends on the frequency of purchase rather than expenditure share, which again suggests food prices more important in expectation formation. To model inflation expectations in VAR, we separately include the prices of food (including non-Alcoholic beverages), energy (Electricity, gas and other fuels; and Fuels and lubricants for personal transport equipment), and the rest (i.e. core) components of the CPI.[6][7] We use consumer prices because they are directly observable to consumers and more relevant to the formation of inflation expectations. Other papers in the literature often employ international commodity prices, which can deviate significantly from consumer prices in our sample.

Other macroeconomic variables included in the VAR are as follows. Real activity is measured by industrial production, which is collected from OECD's Main Economic Indicators for New Zealand and Australia and from World Bank's Global Economic Monitor for the rest economies.. Since this variable covers different industries across economies (manufacturing only in emerging economies but a wider range of industries in advanced economies), we also use total employment and the unemployment rate that are more comparable across economies. Labour market data is also interesting because the literature reports strong correlation between expectations about inflation and labour market conditions (e.g. Bhandari et al., 2025). The last variable is the end-of-period policy interest rate. We use the shadow rate estimated by Leo Krippner for economies that have hit the effective lower bound, i.e. Japan, Australia, and New Zealand, and the interbank rate for other economies.

Data are collected monthly if possible, otherwise quarterly.[8] Prices and real activity are seasonally adjusted by the sources or the author using X-13ARIMA-SEATS. Variables not already in percentage (i.e. prices, industrial production, and total employment) are expressed in natural logarithm.

3 Methodology

The literature has proposed several ways to model functional variables in VAR. We work with the probability density function (PDF), following Chang et al. (2024). Below is a brief introduction to their framework. Interesting readers are referred to the original paper for details.

For simplicity, consider a functional VAR (FVAR) with one lag and no deterministic component. The

[5] Candia et al. (2023b) find that firms inattentive to past inflation form inflation expectations based on their recent experience of production cost.

[6] Ideally, one should use individual-level food and energy prices to explain individual-level inflation expectations, such as in (Diamond et al., 2020). But such data is not available to us.

[7] In a more parsimonious specification, we drop energy prices since more recent studies find a small role of energy prices in explaining inflation expectations (Binder, 2018; Patzelt and Reis, 2024). The main results remain robust.

[8] Australia started to publish monthly CPI since September 2017. But the monthly version covers a smaller basket of goods and services, and Australia still use the quarterly version as the main measure of inflation.

FVAR consists of a vector of aggregate variable Y_t and a distributional variable x_{it} with log kernel $\ell_t(x)$:

$$Y_t = B_{yy}Y_{t-1} + \int B_{yl}(\tilde{x})\,\ell_{t-1}(\tilde{x})\,d\tilde{x} + u_{y,t}$$

$$\ell_t(x) = B_{ly}(x)\,Y_{t-1} + \int B_{ll}(x,\tilde{x})\,\ell_{t-1}(\tilde{x})\,d\tilde{x} + u_{l,t}(x).$$

The time t PDF of x_{it} is given by $p_t(x) = \frac{\exp[\ell_t(x)]}{\int \exp[\ell_t(\tilde{x})]d\tilde{x}}$. To reduce the dimension of the FVAR, Chang et al. (2024) assume that the log kernel has a K-dimensional representation

$$\ell_t(x) = \sum_{k=1}^{K} \alpha_{k,t}\zeta_k(x) = \zeta'(x)\,\alpha_t, \tag{1}$$

where $\zeta(x) = [\zeta_1(x), ..., \zeta_K(x)]'$ is a vector of basis functions[9], and $\alpha_t = [\alpha_{1,t}, ..., \alpha_{K,t}]'$ are time-varying sieve parameters. Let $\xi(x)$ be another K-dimensional vector of basis functions and define

$$B_{yl}(\tilde{x}) = B_{yl}\xi(\tilde{x}), B_{ly}(x) = \zeta'(x)\,B_{ly}, B_{ll}(x,\tilde{x}) = \zeta'(x)\,B_{ll}\xi(\tilde{x}), u_{l,t}(x) = \zeta'(x)\,u_{\alpha,t}(x).$$

Substituting the log kernel with its K-dimensional representation in the FVAR and using terms defined above, we have

$$\begin{array}{l} Y_t = \Phi_{yy}Y_{t-1} + \Phi_{y\alpha}\alpha_{t-1} + u_{y,t} \\ \alpha_t = \Phi_{\alpha y}Y_{t-1} + \Phi_{\alpha\alpha}\alpha_{t-1} + u_{\alpha,t} \end{array}, \tag{2}$$

where $\Phi_{yy} = B_{yy}$, $\Phi_{y\alpha} = B_{yl}\int \xi(\tilde{x})\,\zeta'(\tilde{x})\,d\tilde{x}$, $\Phi_{\alpha y} = B_{ly}$, $\Phi_{\alpha\alpha} = B_{ll}\int \xi(\tilde{x})\,\zeta'(\tilde{x})\,d\tilde{x}$. In the state-transition equations (2), α_t are unobservable but can be estimated from a sample $X_t = [x_{1t}, ..., x_{Nt}]'$ drawn from the distribution. Assuming an independent and identically sample across i and t[10], the measurement equation of X_t is given by

$$p(X_t|\alpha_t) = \exp\left\{\sum_{i=1}^{N}\zeta'(x_{it})\,\alpha_t - N\ln\int \exp\left[\zeta'(x)\,\alpha_t\right]dx\right\}. \tag{3}$$

Chang et al. (2024) then show how to approximate the measurement equation (3) such that the model can be estimated by the Kalman filter in two-steps. The first step involves computing the maximum likelihood estimator $\hat{\alpha}$ from the cross-sectional observations X_t, separately for each period t. The second step is to estimate a linear state-space model where $\hat{\alpha}$are interpreted as noisy measure of the latent α. This framework also allows us to deal with mixed frequency and missing observations easily.[11]

A further complication of our application is that we only observe the frequency of sample X_t within each bin. Survey institutions often take the midpoint of each bin when calculating summary statistics. This practice is also often adopted in the literature (e.g. Hori and Kawagoe, 2013; Diamond et al., 2020), which we follow. For example, if 30.2% of the responses fall within the range of -2% to 0%, we consider this as 302 responses of -1%. To introduce back uncertainty around the midpoint, we apply Gaussian kernel smoothing with bandwidth set to half of the bin width. The sieve parameters are then estimated using a large number of draws from the smoothed distribution. This means we can no longer determine K by Bayesian marginal data density as in Chang et al. (2024). Instead, we visually examine the fitness of estimated PDF to ensure

[9]Following Chang et al. (2024), we employ the following basis functions

$$\zeta_K(k) = \max(\bar{x} - x, 0),$$

$$\zeta_k(k) = [\max(x_{k-1} - x, 0)]^3, k = K-1, ..., 1,$$

where x_k are K-1 knots, $\bar{x}$ is the upper bound of data.

[10]The assumption of iid sample requires repeated cross-sectional data but most surveys of inflation expectation employ a rotating panel. Ignoring the correlation makes the estimation less efficient.

[11]The time series of household inflation expectations are much longer than those of firm inflation expectations. In practice, it is difficult to use the Kalman filter and recover many missing observations of firm expectations at the beginning of the sample. To make the most of the data, the sample is split into two parts, with firm expectations observed in the second half. We first estimate the model using the first half of the sample. Since Minnesota priors are conjugate, we can combine the resulting posterior with a Minnesota prior for firm expectations to create a prior for the first half of the sample.

that it captures the main features of the raw data without overfitting the smoothed distribution.[12] Smoothed distributions and estimated PDFs are reported in appendix B.

The state-transition equations are estimated at the monthly frequency with 12 lags. Given the non-trivial dimension of the model and the relatively short sample period, we apply Bayesian shrinkage using the Minnesota prior of Sims and Zha (1998). The priors centres around white noise for (the sieve parameters of) inflation expectations and oil prices and around the random walk for other variables. To make the most of available data, our sample includes the period of the COVID-19 pandemic. However, estimation is likely to be distorted by the pandemic due to e.g. structural breaks and measurement errors. As noted by Heffetz and Reeves (2021), disruptions to data collection cause significant bias in the unemployment rate. In economies like Thailand, these disruptions are so severe that data collection is suspended. In addition, the relation between employment and production might be affected by furlough policy and reduced working hours. After the pandemic, inflation expectations is likely more sensitive to actual inflation as agents pay more attention in the high-inflation environment. We absorb unusual variations during the pandemic with shifts in shock volatility (following Lenza and Primiceri, 2022) or intercepts (following Cascaldi-Garcia, 2022). Both methods generate similar results. By default, we follow the literature and refer the pandemic period as from March to August 2020. But our results remain robust when we extend the pandemic period further, up to the end of the Public Health Emergency of International Concern declared by the WHO in May 2023.

3.1 Identification

Inflation expectation shocks are identified by the recursive scheme of Ascari et al. (2024), which consists of two restrictions. First, food and energy prices are not affected contemporaneously by other variables in the model. Second, inflation expectations are not affected contemporaneously by variables other than food and energy prices. In the FVAR, the second restriction must hold for the entire population, including those who pay close attention to macroeconomic data. We can achieve identification if surveys of inflation expectations are conducted within a calendar period while macroeconomic data are either released with a lag or measured at the end of each period.[13] This is the case for the FVAR economies, Japan and the Philippines (see the bottom row of table 1). The timing of the information set is less important for other economies[14], which are modelled by a standard VAR with only aggregate variables. This is because the second restriction holds at least approximately when the majority (instead of the entirety) of the population are inattentive to contemporaneous macroeconomic data.

The recursive scheme implies ordering food and energy prices first, followed by (the sieve coefficients of) inflation expectations, and other variables. When the model contains both household and firm inflation expectations, households are placed after firms to identify household expectation shocks, and vice versa. In doing so, we assume that changes in people's beliefs do not affect each other contemporaneously, unless the changes are driven by the intersection of their information sets (e.g. food and energy prices). Over time, beliefs may spread across the population either directly or through their impact on the economy. In FVAR, the recursive scheme allows us to identify a block of shocks corresponding to the sieve coefficients of inflation coefficients. We search for a linear combination of these shocks such that they perturbate the distribution in a desired way.[15]

4 Standard VAR (SVAR)

We first consider aggregate inflation expectations using standard VAR, which allow us to study more economies. Here, the focus is on the differences between household and firm expectations. To this aim, we compare the VAR with expectations of one type of agents (the small model) to the VAR with expectations of both households and firms (the large model).

[12] Since K and the specification of basis functions differ across economies, we estimate FVAR on an economy-by-economy basis.

[13] If surveys are conducted quarterly but macroeconomic data are available monthly, agents may observe data of the earlier months within the survey quarter but not data of the later months.

[14] We cannot find the responding period for New Zealand's firm survey and Australia's household survey. For Thailand's firm survey before 2016, the responding period is from the last week of a month until the third week of the following month.

[15] The identification in FVAR is unique if 1) the decomposition of the log kernel in eq (1) is unique; and 2) the linear combination is unique. The second condition holds because a principal submatrices of a Cholesky factor is invertible

4.1 Impulse responses

Figure 4 reports impulse responses for Japan, the Philippines, and New Zealand where data on inflation expectations are available for both households and firms. Results for other economies are left in appendix C. Figure 4 show that it is important to control for firm expectations when estimating the impact of household expectation shocks (see the left panels). On the contrary, adding household expectations to the model barely affect the estimates of impulse responses to firm expectation shocks (see the right panels). The value-added of firm expectations (i.e. the differences between black solid lines and red dashed lines) is particularly larger in the Philippines and New Zealand but much smaller in Japan. This suggests that inflation expectations of Japanese firms affect the managers' personal decisions more than business decisions (as consistent with the finding of Kumar et al., 2015), probably because of decades of low and stable inflation around zero. In all three economies, we find household expectations respond strongly to firm expectation shocks but not vice versa. Thus, firm expectations may depend more on private information contained in their shocks than macroeconomic variation induced by household expectation shocks. This adds to the evidence that firms are more sophisticated than households when forming expectations. Furthermore, firm expectations are more persistent than household expectations in response to their own shocks, suggesting that private information contained in firm expectation shocks is valuable to firms and costly to collect.

Turning to the impact on the economy, both household and firm expectation shocks lead to higher inflation. But firm expectations drive inflation considerably higher, reflecting firms' role as the price setter, in line with micro evidence (e.g. Wehrhöfer, 2025). However, the impact on real activity shows no systematic pattern. On the one hand, higher inflation expectations is expansionary through the real interest rate channel. On the other hand, households and firms may associate higher inflation with a more pessimistic economic outlook and hence reduce employment and spending on consumption and investment. The latter is referred to in the literature as the supply-side view of inflation and its strength varies across countries. Coibion et al. (2018) and Candia et al. (2023a) document that firms in New Zealand have a more demand-side view of inflation, as historical correlation between inflation and growth has been positive. Consistently, we find that both household and firm expectation shocks are expansionary in New Zealand, at least in the near term. In Japan, the prolonged period of the effective lower bound should make the demand-side view of inflation more popular (Coibion et al., 2020b; Binder and Brunet, 2022). We find this is the case for firm expectation shocks but not for household expectation shocks. At last, our results for the Philippines are mixed and difficult to interpret. The shock to household (firm) expectations has a negative (positive) impact on industrial production but the opposite impact on employment.

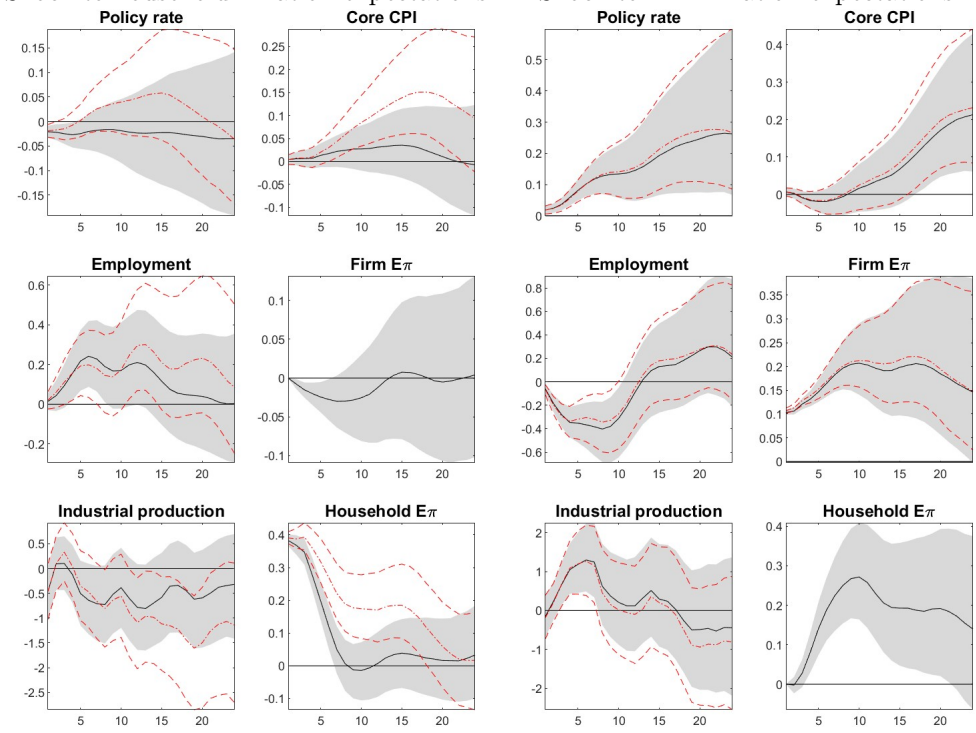
4.2 Variance decomposition

The impulse response analysis has shown meaningful impact of inflation expectation shocks on the real economy. We now examine more formally the importance of inflation expectation shocks relative to other shocks using forecast error variance decomposition (FEVD), which is reported in figure 5. Similar to Ascari et al. (2024), we find variation in inflation expectations is primarily explained by shocks to their own and food and energy prices. The latter (mainly energy prices in the short term but more equally between food and energy prices in the longer term) are particularly important to Japanese households, explaining around 50% of variance in their inflation expectations across the horizon. One notable exception is Philippine firms, as more than 50% of variance in their inflation expectations is explained by macro shocks. This suggests that Philippine firms pay closer attention to inflation in an environment of high and volatile inflation.

Inflation expectation shocks are economically significant. In Japan and New Zealand, about 20% of the two-year ahead variance in core CPI is explained by inflation expectation shocks. The number is comparable in the US (24% according to Ascari et al. 2024), but considerably lower in the Philippines (10%). This is again consistent with Philippine firms having better knowledge of inflation. Interestingly, inflation expectation shocks explain even more variation in the policy rate than in inflation and real activity. In Japan, shocks to firm inflation expectations can have an immediate effect on monetary policy, although their effect on inflation and real activity takes much longer to materialise. This suggests that inflation expectations may enter the central bank's reaction function independently of other macro variables.

Figure 4: SVAR impulse responses

(a) The Philippines



(b) Japan

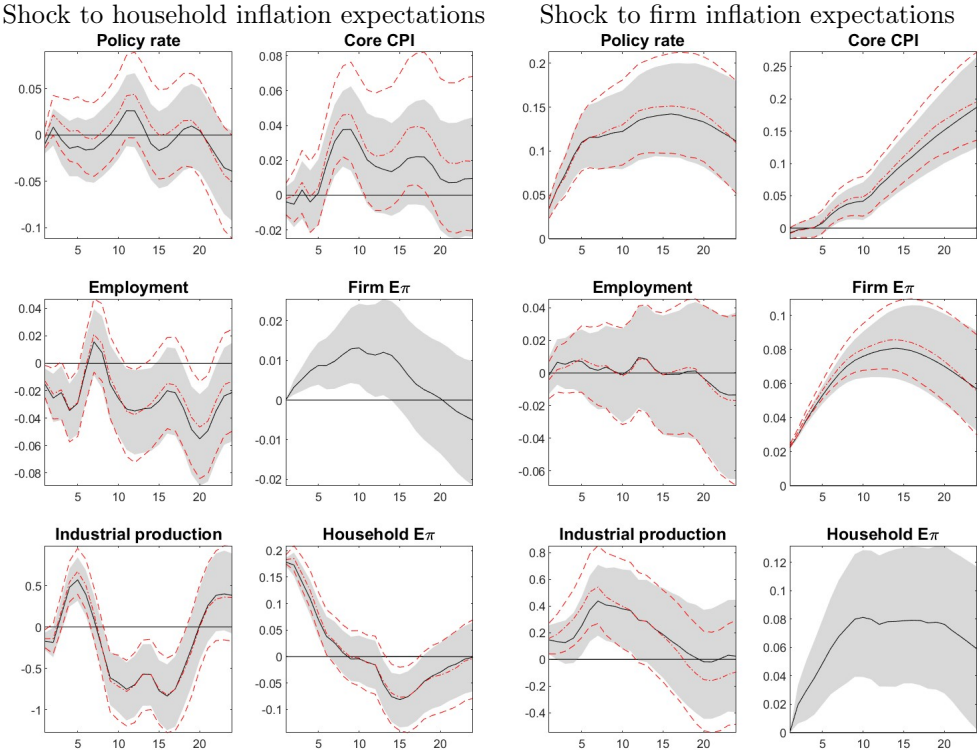
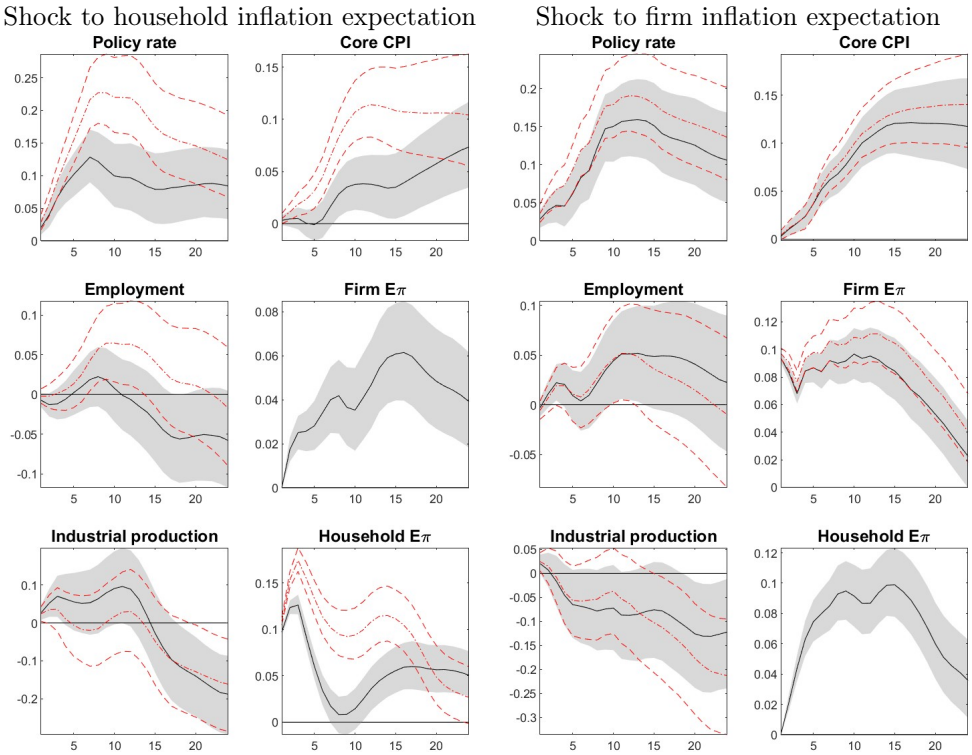


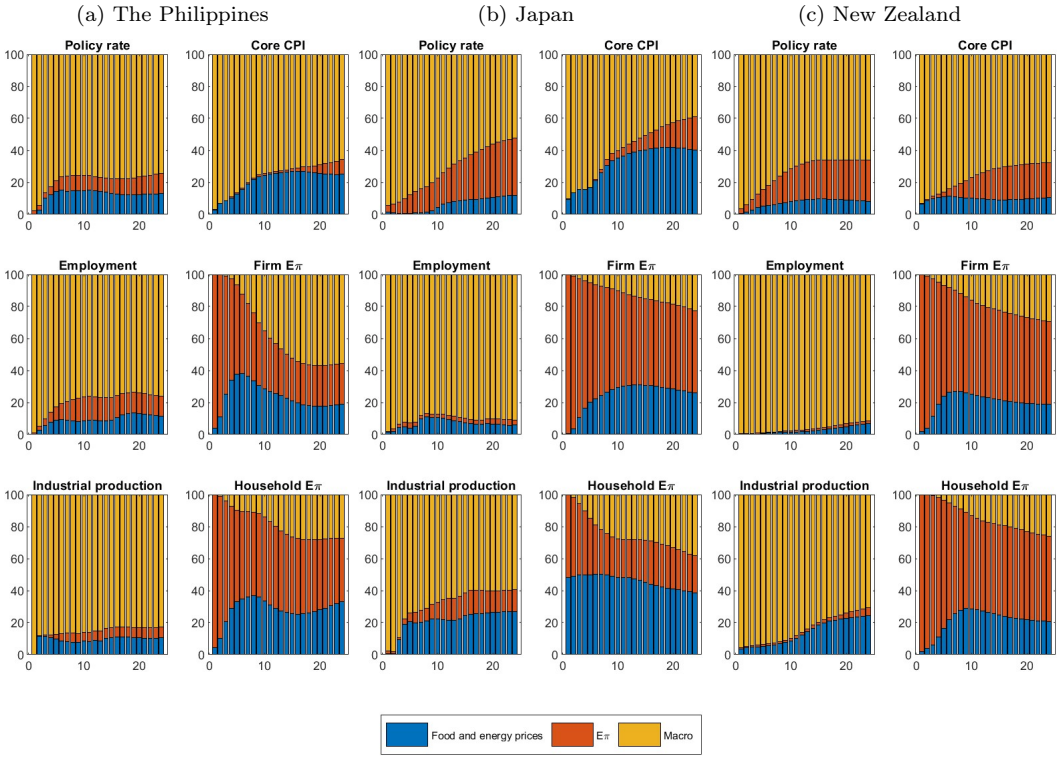
Figure 4: SVAR impulse responses

(c) New Zealand



Note: The size of the shock is one standard deviation. All variables are expressed in percentage. The interest rate and inflation expectations ($E\pi$) are annualised. The black solid lines represent the median impulse responses generated using a model with both household and firm inflation expectations, with the grey area representing the 68% confidence interval. The red dashed lines represent the 16%, 50%, and 84% quantiles of the impulse responses generated using a model with only household or firm inflation expectations.

Figure 5: SVAR forecast error variance decomposition



Note: FEVD is calculated using the posterior mean.

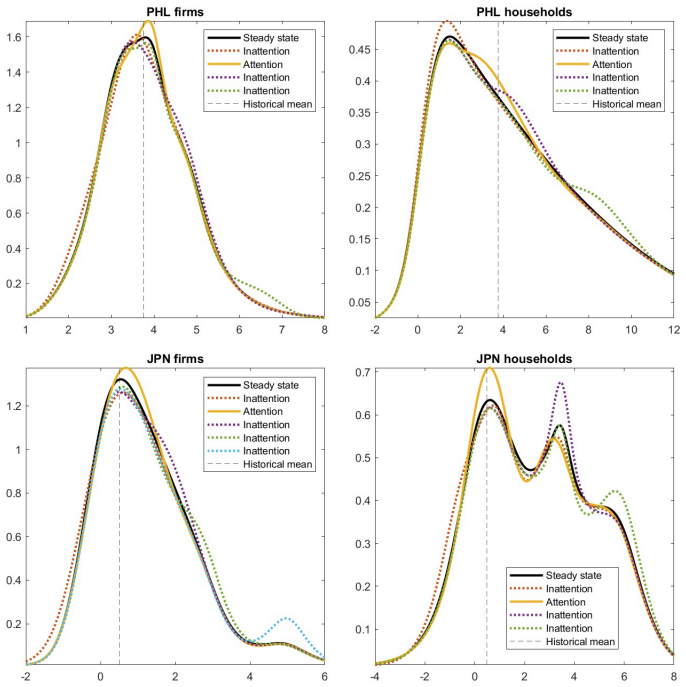
5 Functional VAR (FVAR)

The SVAR's impulse responses could be difficult to interpret because the model ignores heterogeneity in inflation expectations. Specifically, inflation expectations shocks are likely to affect only a portion of the population at any given time, with the impact depending on which portion are affected. For example, agents who are more knowledgeable and better informed about the economy tend to have expectations that are more in line with actual inflation rates[16], and may act more rationally based on these expectations. Conversely, agents with severely biased expectations may be more inclined to associate higher inflation with a weaker economy. The heterogeneity also enables us to better distinguish between household and firm expectations, given the significant differences in their distributions. In contrast, SVAR relies on a few episodes in which aggregate inflation expectations diverge between the two types of agents.

To capture the cross-sectional heterogeneity, we incorporate the distribution of inflation expectations into a FVAR and examine shocks hitting different intervals on the distribution. Each materialised shock is represented by a normal distribution. The PDF of the shock is multiplied by a scale factor and added to the PDF of the ex ante distribution. The sum, after being normalised to have an integral of 1, is the PDF of the ex post distribution. The location of the shock is determined by its mean. We consider shocks centred at e.g. 0%, 0.5%, 1% and so on. The scale factor determines the shock size. A scale factor of 0.02 implies that $0.02/(0.02+1)\times 100 \approx 1.96\%$ of the population change beliefs. The standard deviation determines the shock width, which is set proportionally to the standard deviation of actual inflation. The ex post distribution needs to be smooth enough to ensure goodness of fit by eq (1). This means that the scale factor (standard deviation) of the shock needs to be small (large) enough. In practice, we set the standard deviation in the range of 0.05 - 0.2, and the scale factor in the range of 0.02 - 0.04. Furthermore, the standard deviation and the scale factor are kept the same for shocks to the same ex ante distribution. This makes these shocks more

[16]Indeed, Ascari et al. (2024) find in a FEVD exercise that more central quantiles of the distribution of inflation expectations are better explained by macroeconomic shocks.

Figure 6: Perturbations to the steady-state distributions of inflation expectations



Note: Black solid lines are steady-state PDFs. Each coloured area is a perturbation to the steady state with red indicating a expansionary perturbation and green a contractionary perturbation. The steady-state PDFs plus a perturbation is a distribution kernel, i.e. not normalised to integration one.

comparable, given the nonlinearity in eq (1). We examine sensitivity to shock specifications in appendix D.

A key insight from the literature is that inattention to recent inflation is the primary source of disagreement over inflation expectations. Several studies (e.g. Coibion et al., 2018; Candia et al., 2023b; Weber et al., 2025) have found that perception of recent inflation is a strong and the best predictor of inflation expectations. Those whose perception is closer to actual inflation rates also make better forecasts. Furthermore, factors such as food and energy prices do not help explain expectations above their contribution in shaping perception. Following this insight, shocks that reallocate mass in the neighbourhood of recent inflation rates (attentive region) are interpreted as attention shocks. And shocks that reallocate mass outside that region are interpreted as inattention shocks.[17] Note that (in)attention shocks are loosely defined because the attentive region is unknown and can be arbitrary. Figure 3 illustrate selected shocks to the steady-state distribution of inflation expectations (black solid lines). In the steady state, the long-term average inflation (black dashed vertical lines) can be considered as a reasonable perception and is taken as the centre of the attention shocks. The ex post distribution upon an attention shock is represented by coloured solid lines, and the ex post distribution upon an inattention shock is represented by coloured dotted lines. A main finding of this paper is that attention shocks tend to increase output and employment at least in the short term, whereas inattention shocks that focus on the further tails tend to have a more negative impact, regardless if the shock hit households or firms. For demonstration, we report impulse responses to the attention shock centred at the long-term average inflation and the inattention shock focusing on the far right tail in figure 7 and 8 respectively. Although both shocks only affect 2%-4% of the population, their impact on real activity is sizeable, larger than the those estimated in SVAR. Importantly, the impact on real activity has the same sign regardless of how (in)attention shocks affect expected and actual inflation. These shocks may cause people to revise their expectations upwards or downwards, depending on whether their initial beliefs are to the left or right of the attentive region. Specifically, the attention shocks shown in figure 7 reallocate mass

[17] Using inflation perception instead of inflation expectations may allow tighter identification of attention shocks. But data on inflation perception is even more scarce. It is also possible to identify shocks to inflation expectations independently of inflation perception. Such shocks are unlikely small and play a niche role.

from both sides into the attentive region for households and firms in the Philippines and Japanese firms. The shock generally lower the expectations of affected for Japanese households. This means that the impact of in(attention) shocks on economic activity does not reflect the real interest rate channel. Instead, our results are consistent with micro evidence that knowledge of inflation help make better economic decisions (Coibion et al., 2020b). The attention shock also reduces the dispersion in inflation expectations and thus the misallocation of resources (Ropele et al., 2024). In this sense, our (in)attention shocks are similar to dispersion shocks studied in Ascari et al. (2024). The main difference is that our shocks are local while Ascari et al. (2024)'s shocks are global. Our local shocks are consistent with microeconomic evidence on attention and arguably more realistic as a reshape of the entire distribution is unusual except in times like the COVID-19 pandemic. Local shocks are also help interpretation. For example, Ascari et al. (2024) find that the median-preserving dispersion shock affecting only the left (right) side of the distribution is expansionary (mildly contractionary) on real activity. This is consistent with our result since their left skewed shock reallocate mass outside the attentive region.

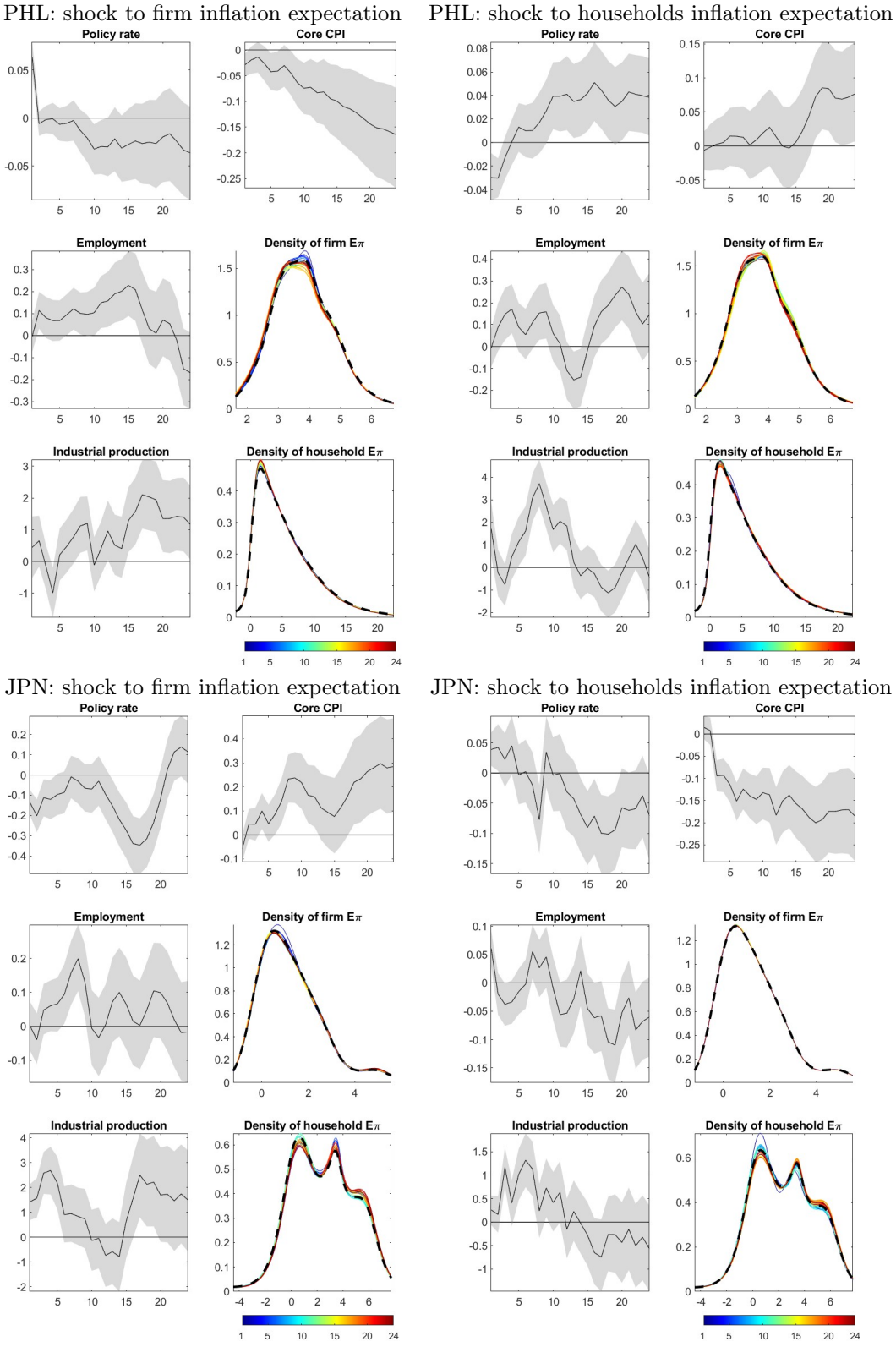
Our (in)attention shocks can also be used to explain the supply/demand-side view of inflation. To see this, suppose that variance in the aggregate inflation expectation is primarily driven by people with downward biased expectations. Attention shocks cause them to revise expectation upwards, which generate a positive correlation between the aggregate inflation expectation and real activities. The aggregate data manifests a demand-side view of inflation. Figure 3 suggests that this could be the case for Philippine households and firms. On the contrary, if variance in the aggregate inflation expectation is primarily driven by people with upward biased expectations. Attention shocks cause them to revise expectation downwards, and the aggregate data manifests a supply-side view of inflation. Figure 3 suggests that this could be the case for Japanese households.

6 Conclusion

We study the macroeconomic impact of shocks to households' and firms' inflation expectations using (functional) VAR models, focusing on two distinct Asian economies: the Philippines and Japan. In the Philippines, where inflation has been high and volatile, economic agents pay closer attention to inflation. In particular, firm expectations are less biased, less dispersed, more volatile, and more persistent after shocks. These expectations also hold valuable information for the economy, as they significantly affect model estimation. In contrast, economic agents seem less attentive to inflation in Japan. In both economies, inflation expectation shocks meaningfully impact the economy. Firm expectations are especially important to inflation compared to household expectations, reflecting firms' role as price setters. Inflation expectations may affect the economy through a real interest rate channel and an attention channel. The latter allows agents to make better decisions and reduce misallocation. We examine this attention channel by identifying (in)attention shocks in FVAR. These shocks cause people to revise their expectations away from or towards actual inflation. We find that (in)attention shocks have a significantly (negative) positive impact on the economy, even when they affect only a small proportion of the population. We then use (in)attention shocks to interpret the supply or demand-side view of inflation.

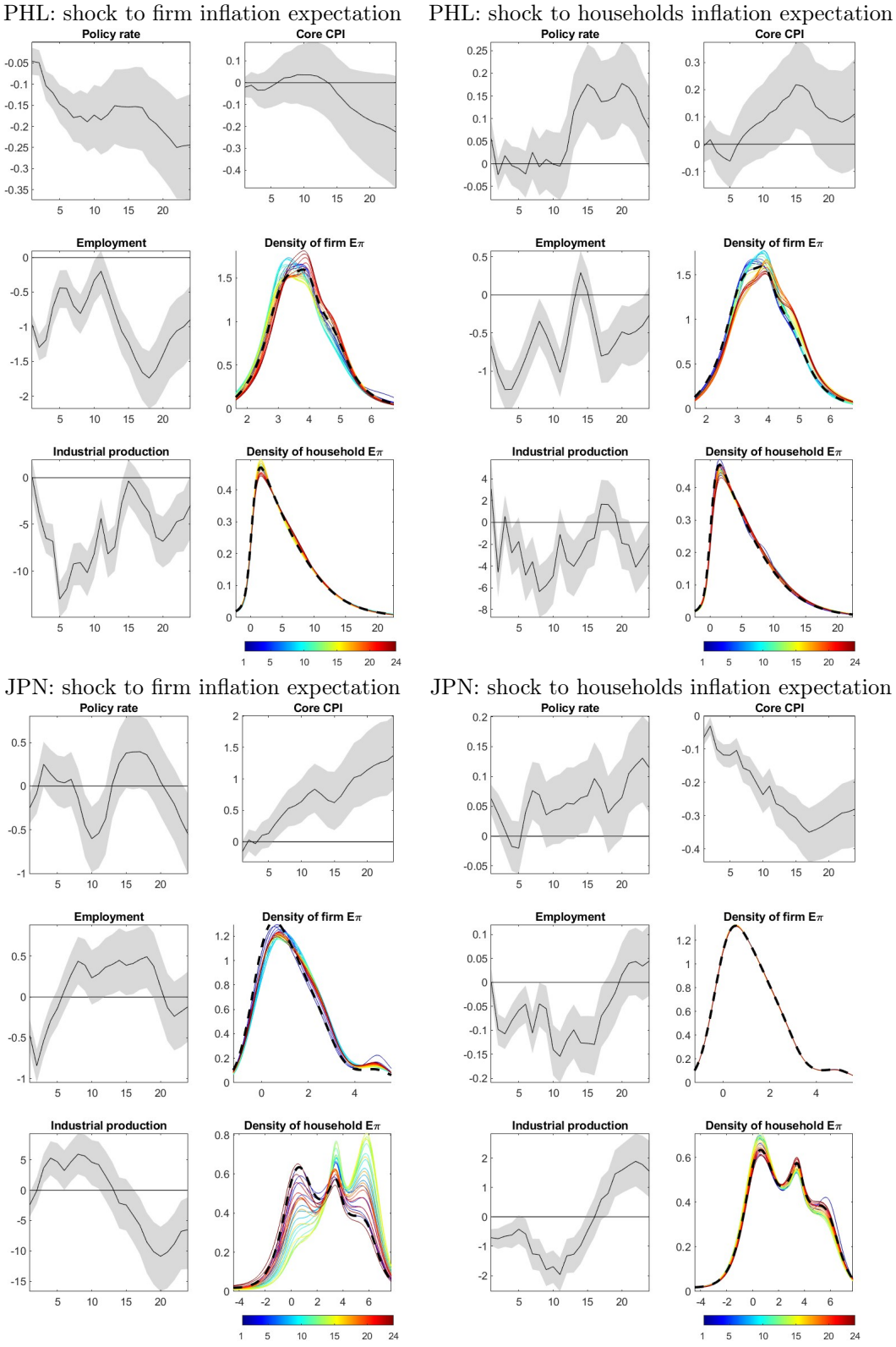
A limitation of this paper is that (in)attention shocks are identified loosely. Better data may allow for direct measurement of attention, following Link et al. (2023a) and Bracha and Tang (2025).

Figure 7: FVAR impulse responses: attention shock



Note: All variables are expressed in percentage. The interest rate and inflation expectations are annualised. For aggregate macroeconomic variables, the X-axes indicate time, and the black solid lines represent the median impulse responses with the grey area representing the 68% confidence interval. For the PDFs of inflation expectations, the X-axes is the support of the density function, each line represents the posterior median of a PDF at a given time, with colour indicating time.

Figure 8: FVAR impulse responses: inattention shock



Note: All variables are expressed in percentage. The interest rate and inflation expectations are annualised. For aggregate macroeconomic variables, the X-axes indicate time, and the black solid lines represent the median impulse responses with the grey area representing the 68% confidence interval. For the PDFs of inflation expectations, the X-axes is the support of the density function, each line represents the posterior median of a PDF at a given time, with colour indicating time.

Figure A.1: Inflation expectations of PHL firms: 1Q vs 1Y

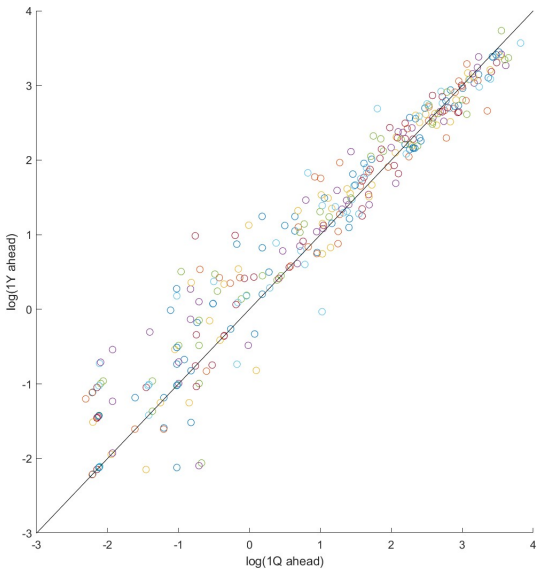
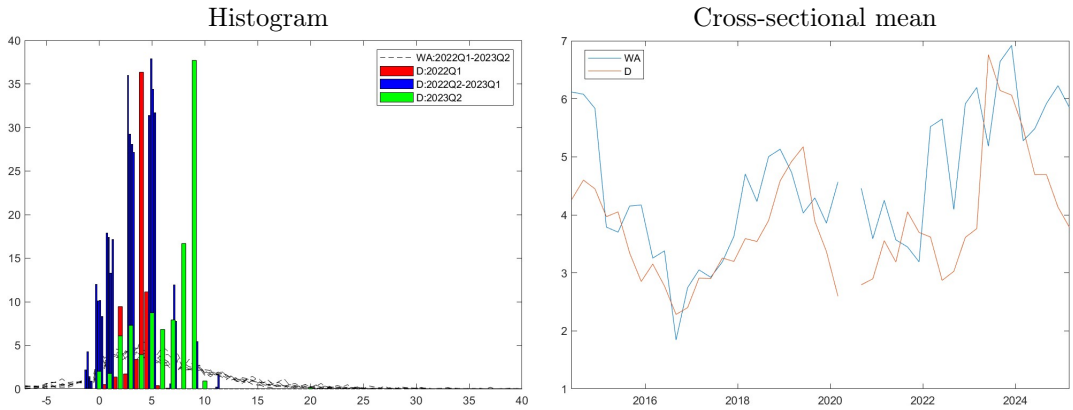


Figure A.2: Inflation expectations of PHL households: aggregated vs. aggregate measure



Note: WA stands for weighted average and the aggregated measure of inflation expectations. D stands for direct and the aggregate measure of inflation expectations.

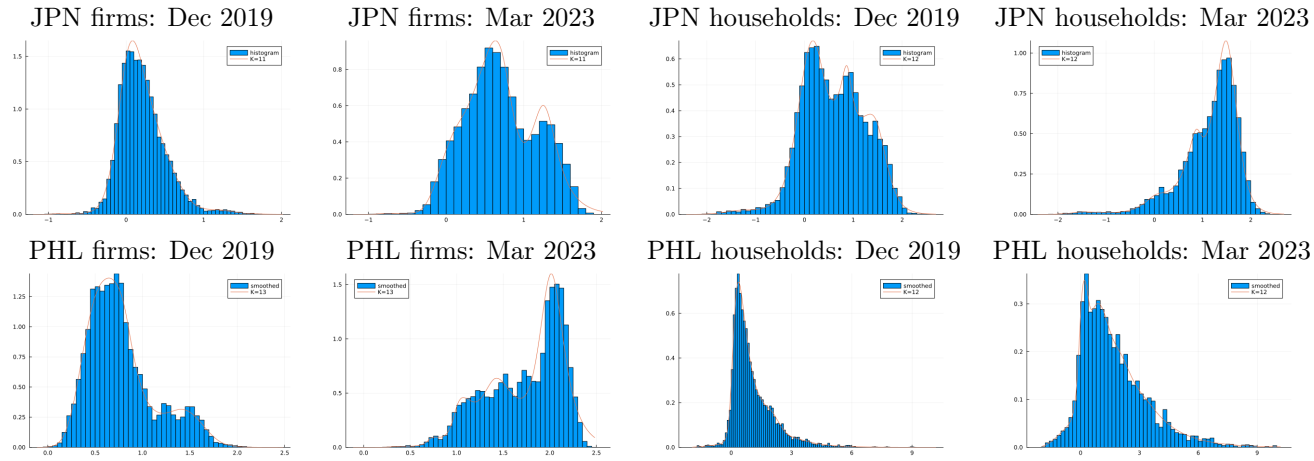
A Nuance issues in the Philippines surveys

In this section, we provide further details on several issued regarding Philippine surveys discussed in section 2.1.

First, we show that 1-year- and 1-quarter-ahead inflation expectations of Philippine firms are similar both cross-sectionally and overtime. Figure A.1 is a scatter plot of 1-year-ahead against 1-quarter-ahead inflation expectations, where each dot is the frequency of data points falling into a 0.5-width bin, and dots of the same colour come from the same time. We find all dots fall near the 45-degree line.

Next we examine the difference in the aggregated and aggregate measure of household inflation expectations. We focus on the period from 2022Q1 to 2023Q2, during which the aggregate measure switched from an open-ended format to pre-coded ranges (on 2022Q2) and switched back (on 2023Q1). The left panel of figure A.2 shows histograms of the aggregated measure in black dashed lines and the aggregate measure in bars respectively. Both measures paint very different pictures of the cross-sectional distributions in terms of kurtosis and skewness. This is consistent with the literature, which documents that disagreement about aggregate inflation reflects primarily disagreement about the weights of different categories in constructing

Figure A.3: Fitness of cross-sectional distributions



Note: The X-axis is scaled by 1/4 so 1% in the figure means 4% in the data.

price indices (Kumar et al., 2015) and the weights are related to the frequency of purchases (D'Acunto et al., 2021). That said, the distributions under both measures have similar centres. Consequently, the mean expectations of both measures co-move fairly closely overtime (see the right panel). A notable gap in the mean is when actual inflation surge in 2022, which is reflected in the aggregated measure quickly but not in the aggregate measure until mid 2023. Furthermore, while the distribution under the aggregated measured remains largely the same during the reported period, the distribution under the aggregate measure changes dramatically especially when the survey question changes format. This is consistent with Dietrich et al. (2023)'s finding that the aggregated measure display less volatility.

B Smoothing and fitting of cross-sectional distributions

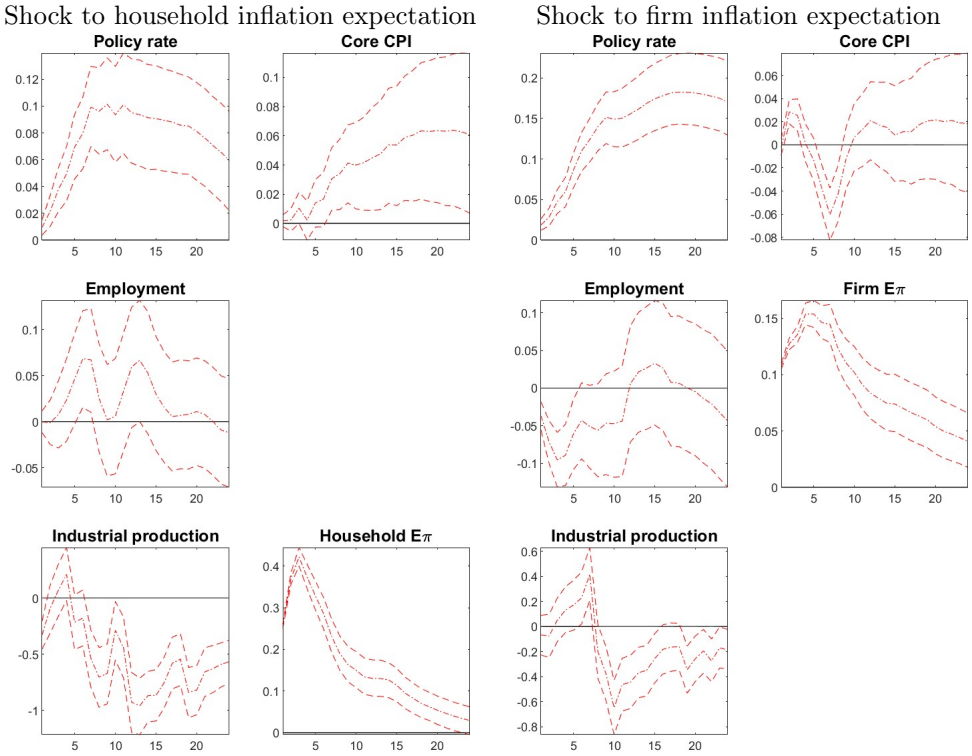
Japan's Cabinet Office Consumer Confidence Survey has 7 bins (-∞, -5%], (-5%, -2%], (-2%, 0%), 0%, (0%, 2%), [2%, 5%), [5%, ∞). We replace them by discrete values -6%, -3.5%, -1%, 0%, 1%, 3.5%, 6%. The Bank of Japan's TANKAN has 10 bins: (-∞, -2.6%], [-2.5%, -1.6%], [-1.5%, -0.6%], [-0.5%, 0.4%], [0.5%, 1.4%], [1.5%, 2.4%], [2.5%, 3.4%], [3.5%, 4.4%], [4.5%, 5.4%], [5.5%, ∞). We replace them by discrete values from -3% to 6% with a step of 1%. Surveys in the Philippines have 0.5%-wide bins that cover the range of data from minimum to maximum. As a standard practice, we drop extreme responses that are unlikely to underpin any economic decisions. For the Philippines household survey, these are values greater than 40% and smaller than -7% and yield losses of at most 4% of data. For the Philippines firm survey, these are values greater than 9% and yield losses of at most 1.6% of data. The bandwidth in Gaussian kernel smoothing is set to 1 for Japan household survey, 0.5 for Japan firm survey, and 0.25 for the Philippines surveys. We draw 100k observations from the smoothed distributions.

The smoothed distributions, the estimated PDFs, and the selected Ks are reported for December 2019 (before the the pandemic) and March 2023 (the peak of inflation surge post-pandemic) in figure A.3.

C Additional SVAR results

In figure A.4, the pooled model for household inflation expectations is based on data from Japan, the Philippines, New Zealand, Australia, and South Korea; the pooled model for firm inflation expectations is based on data from Japan, the Philippines, New Zealand, and Thailand. The pooled model is estimated recursively by using the posterior of the previous economy as the prior for the next economy. All data are in deviations from the country-level mean. The first economy is Japan with Minnesota priors.

Figure A.4: SVAR impulse responses: pool



Note: The size of the shock is one standard deviation. All variables are expressed in percentage. The interest rate and inflation expectations ($E\pi$) are annualised. The black solid lines represent the median impulse responses generated using a model with both household and firm inflation expectations, with the grey area representing the 68% confidence interval. The red dashed lines represent the 16%, 50%, and 84% quantiles of the impulse responses generated using a model with only household or firm inflation expectations.

D Additional FVAR results

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