Responses of Households’ Expected Inflation to Oil Prices and the Exchange Rate: Evidence from Daily Data

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and Toshiaki Shoji (Seikei University)
Acknowledgement

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  – C-23K01342
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1. Research Questions
Question (1) = Central theme

Can daily data help predict changes in monthly data on household inflation expectations ($\pi^e$)?
Background

Inflation ($\pi$) has finally come, 

**EVEN TO JAPAN!**
Excludes fresh food; starting from 2020, I excluded mobile phone fees and lodging.
Background (continued)

• Policy-makers worry: will $\pi$ become pervasive?

• Macro theory: $\pi^e$ holds the key.

• Recent experiences: $\pi^e$ can change abruptly.

• Implication: we need **timely** monitoring.
Methodology

• **MIDAS** regressions
  – “Mixed Data Sampling”
  – Ghysels et.al. (2004)
Question (2)

Market $\pi^e$ vs Households $\pi^e$: Are they different?

- Literature: Consumer perceptions are influenced by prices of goods that they purchase frequently.

- If so, daily data on those prices might help.
Utilize Barcode price data at supermarkets (called “CPINOW”)
Question (3)

- CPINOW includes items that are rarely sold.
- Can we do even better by focusing only on frequently purchased products?

Construct new indices = “Daily CPI of frequently purchased products”
Literature: determinants of HH $\pi^e$

- Jonung (1981)
  - HH $\pi^e$ is heavily influenced by perceived $\pi$.
- D’Acunto et. al. (2021, 2022)
  - Importance of frequently purchased items.
- Coibion et. al. (2015)
  - Importance of oil prices
- Kilian et. al. (2022)
  - Criticism
Structure of talk

1. Research question
2. Data on daily indicators
3. Do the daily indicators help predict *actual* inflation?
4. Data on inflation expectation
5. Do the daily indicators help predict *expected* inflation?
6. Summary
2. Daily data
[2-1] Existing series

We consider two types of daily series:

• **Market** indices
  – Oil futures
  – Exchange rate

• **Retail** prices
  – Gasoline prices *(weekly)*

and...

Known to affect BEI.
**Nikkei CPINOW**

(purchased from Nowcast, Inc.)

- POS data, from 1,200 supermarkets.

- Composition
  - Dominated by processed food (80%).
  - Few fresh food items: eggs & mushrooms.
  - Others: toilet papers, detergents, etc.
CPINOW: Ingredients

• Products: 217 “Categories”

• Example of a category:
  “Instant Cup Chinese Noodles”
  • It consists of 13,766 “items” = barcodes (as of 2022).
    e.g. “Nissin Cup Noodle: Brazilian Chicken Noodle Cup 74G”.
CPINOW: How it’s made

• **Unit = (shop) X (item)**
  – E.g., “Nissin Cup Noodle: Italian Curry: Cup 83G” sold at “Supermarket #843”

• For each of (shop)x(item), they record daily sales values and quantities.
  → Compute YoY rate of change of (value/quantity).

• Take their weighted averages across (shop)x(item).
Y-o-Y rate of change
[2-2] CPINOW: possible drawbacks

• CPINOW includes items that are rarely sold.

• They go in and out of the sample.

• Problems?
  – Buyers do not observe their prices frequently.
  – They may make the series noisier.
[2-3] Our new indices

= Daily CPI of Frequently Purchased Products

• Choose categories frequently purchased.
  – Like "Instant Cup Chinese Noodles".

• Within category, pick (shop)x(item) that appear frequently in the data.
Data for our new indices

• Obtained underlying data for CPINOW
  – from Prof. Tsutomu Watanabe = Founding Father of CPINOW.
  – Drawback: consists of only around 300 shops.
    = Those that have agreed to academic usage.

• Frequently purchased categories are chosen based on Household Survey.
Our index (1) **P_ALL**

- Computed in the same way as CPINOW, from our narrower data set, for the sake of comparison.
Our index (2) **P_FREQ**

- Includes only categories of goods that are purchased at least once a month.

- Categories are weighted according to their purchase frequencies in Household Survey.

- Within each category, (shop)x(item) are weighted according to the number of their appearances in the data per month (computed for each year).
Our index (3) P_VERYFREQ

• Same as P_FREQ but only those categories that are purchased at least twice a month.

• Examples of VERYFREQ
  – Tofu, Onigiri, Yogurt, Cup Noodles, Bread, Soda, Ice Cream, Egg, Milk, Plastic Bags, ...

• Examples, FREQ but not VERYFREQ:
  – Chinese Noodle, Ham, Cheese, Chocolates, Sanitary Item...
Our index (4) P_FREQ\textsuperscript{N}, P_VERYFREQ\textsuperscript{N}

• N = number

• Within each category, include only (shop)x(item) that appeared at least N times per month (in a given year).
[2-4] Comparison of daily indices
Same graph, different axes
3. Do they help explain *actual* inflation?
MIDAS estimation

\[ \Delta CPI_m = a_1 \Delta CPI_{m-1} + a_2 \Delta CPI_{m-2} + \text{other controls} \]

Daily Data Part

\[ f(0) \cdot DAILY_{md} + f(1) \cdot DAILY_{md-1} + f(2) \cdot DAILY_{md-2} + \cdots \]
For \( f \), use “polynomial distributed lag (PDL)” (or Almon) weighting.

\[
f(i) = \theta_0 + \theta_1 \cdot i + \theta_2 \cdot i^2
\]
Estimation

• Sample period: Apr 2005 – Feb 2023

• Other controls:
  – Two dummies for consumption tax hikes.
### Monthly CPI = Headline

### Daily P = CPINOW

<table>
<thead>
<tr>
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<tbody>
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<tr>
<td>Adjusted R-squared</td>
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<td>0.955</td>
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</table>
PDL coefs
monthly CPI = Headline, daily P = CPINOW

![Graph showing the relationship between monthly CPI and different factors like Gasoline, Exchange rate, and Oil. The x-axis represents time in months, and the y-axis represents the change in CPI. The graph indicates how each factor affects the monthly CPI over time.](image-url)
### Monthly CPI = Various
### Daily P = CPINOW

<table>
<thead>
<tr>
<th></th>
<th>Total, less Fresh Food</th>
<th>Total, less Food &amp; Energy</th>
<th>Goods</th>
<th>Frequently Purchased Items</th>
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<td>Coef</td>
<td>t-Stat</td>
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<table>
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<th>Fresh Food</th>
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</table>

(Note) Frequently purchased items exclude fresh food.
Monthly CPI = **Food** less fresh food

Daily P = **Various**

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<thead>
<tr>
<th></th>
<th>CPINOW</th>
<th>P_ALL</th>
<th>P_FREQ</th>
<th>P_VERYFREQ</th>
<th>P_FREQ30</th>
<th>P_VERYFREQ30</th>
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<td>5.E-02</td>
<td>5.E-02</td>
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<thead>
<tr>
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<th>P_VERYFREQ30</th>
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<tr>
<td>Adj. R sq.</td>
<td>0.977</td>
<td>0.976</td>
</tr>
</tbody>
</table>
4. Data
on expected inflation
Consumer Confidence Survey
by the Cabinet Office of Japan

• Monthly, 15th day of the month.

• Q: “What do you think about prices of goods that your household regularly purchases frequently one year from now?”

• Since April 2004
• Two important survey design changes.
  – Use dummy variables to control for their effects.
Shares of survey responses

-10>X
-10<X<-5
-5<X<-2
-2<X<0
X=0
0<X<2
2<X<5
5<X<10
10<X

0-2%
0%
2-5%
5-10%
Over 10%
Household inflation expectations
5. Do the daily indicators help predict expected inflation?
Estimation

• Sample period: Apr 2005 – Feb 2023

• Other controls:
  – Two dummies for consumption tax hikes.
  – Two dummies for survey design changes.
  – CPI for Energy, lagged 2 months.
    • I tried including various lagged CPI’s, and this one turned out to be significant.
## Estimation result with CPINOW

<table>
<thead>
<tr>
<th>LHS(-1)</th>
<th>Coef</th>
<th>t-Stat</th>
<th>Coef</th>
<th>t-Stat</th>
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<td>0.015</td>
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<td>CPI energy (-2)</td>
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<td>Slope</td>
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<td>CPINOW</td>
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<td>2.E-02</td>
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<td>Slope</td>
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<tr>
<td>Adjusted R-squared</td>
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PDL coefs

Gasoline

CPINOW
Monthly LHS var. = **Expected Inflation**
Daily P = **Various**

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<thead>
<tr>
<th></th>
<th>CPINOW</th>
<th>P_ALL</th>
<th>P_FREQ</th>
<th>P_VERYFREQ</th>
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<td>2.E-02</td>
<td>2.E-02</td>
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<td>3.E-05</td>
<td>2.E-05</td>
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<td><strong>t-Stat</strong></td>
<td>2.16</td>
<td>2.61</td>
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<td><strong>Adj. R sq.</strong></td>
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<tr>
<td><strong>Adj. R sq.</strong></td>
<td>0.975</td>
<td>0.975</td>
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7. Summary
Conclusions

• CPINOW helps explain HH inflation expectations.
• Gasoline prices also, to some extent.
• But **not** oil prices or the exchange rate.
  – **BIG CONTRAST** with expectations of the **market**.

⇒ Consumers seem to base their expectations on what they directly observe.

**Seeing is believing**
Future work

• Our new indices did not make much difference (after so much time and efforts): we must find out why.

• Add more daily indicators
  – Text data such as newspaper articles (Shintani & Yamamoto 2023).

• Automatic selection of regressors.
  – MIDAS + LASSO.

• Forecast performance evaluation.
Thank you!
Appendix (A): Literature Review on the determinants of inflation expectation in Japan
• Ueda (2010)
  – VAR with output gap, r, π & π^e (US & JPN)

• Nishiguchi, Nakajima & Imakubo (2014)
  – VAR with π of frequently purchased items, π of less frequently purchased items, HH’s perceived π, & π^e.

• Kamada, Nakajima & Nishiguchi (2015)
  – how means and higher moments of π^e react to monetary policy announcements and actual π.

• Shintani & Yamamoto (2023)
  – How HH π^e responds to newspaper articles.
Appendix (B)
More on daily data other than CPINOW
Data handling issues

• Exclude weekends (5 days per week).

• Missing data due to a holiday: the value for that day is set equal to that of the previous day.

• For variables other than CPINOW, I take log differences from 261 weekdays (≈ 1 year) ago.
Market indicator 1: Oil Price (Brent)

log difference from 261 weekdays ago
Market indicator 2: Exchange Rate (USD-JPY)
Retail indicator 2: Gasoline price
weekly data converted into daily

log difference from 261 weekdays ago
Additional indicators that did not help

- Wheat prices
- Geopolitical risk
Daily Business Cycle Indicator

Nikkei-UTEcon Daily Economic Indicator

Source: UTokyo Economic Consulting Inc. (UTEcon)

Unfortunately, it was insignificant...
Appendix (C)
Adjustment to
daily barcode price data
It matters how you define “YoY”.

• CPINOW is defined as “rate of change from 365 days ago” (even for leap years).
• We follow them.
• Note 365 is not a multiple of 7 (364 is).
• “Seasonality” pattern is likely to be different for leap years.
We detect 3 notable patterns in the un-adjusted data.

• (1) Day-of-week effect: amplified by taking the 365-day-difference as opposed to 364.
• (2) Zero effect: things tend to be cheaper on the 10\textsuperscript{th}, the 20\textsuperscript{th}, and the 30\textsuperscript{th} days of the month.
• (3) New year effect: things tend to be cheaper on January 1. (why??)
We adjust for the three effects, year-by-year.

• Here, “year” is defined as “from the day after Feb 28 of this year” “until Feb 28 of the next year”.

• Regress “P” on its own lags (up to the 7th) and dummies for the three effects. Take out the effects of those dummies.
  – For leap years, add dummies for the “9 effects” and “New year’s eve effects”.
Appendix (D)
Within-month frequency distributions of (shop)x(item), typical examples
Number of (shop)x(item) that fall into a group

Number of days on which a particular (shop)x(item) appeared in the data set (i.e., sold at least 1 unit)
Feb 2022

Eggs

Feb 2023

Both
Feb 2022

Cup Noodles

Feb 2023

Both
Appendix (E)
Daily indices, visual inspection
Appendix (F) More on data on inflation expectations
(1) April 2013
Change of survey method

• Before: direct-visit and self-completion questionnaires

• After: Mail Survey Method.
(2) April 2009: Range change

Before

I assign conventional numerical values to each range to compute expected inflation as a weighted average.
After
Data shows that expectations can change abruptly.

Note: CPI is core, adjusted for mobile phone fees
Appendix (G) Heterogeneity of expectations across age groups
3 groups: below 30, 30-59, above 60

• Older people are most responsive to gasoline prices (puzzling).

• Younger people are most sensitive to CPINOW.
Inflation expectations by age group
<table>
<thead>
<tr>
<th></th>
<th>Below 30</th>
<th></th>
<th></th>
<th></th>
<th></th>
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</thead>
<tbody>
<tr>
<td></td>
<td>Coef</td>
<td>t-Stat</td>
<td>Coef</td>
<td>t-Stat</td>
<td>Coef</td>
<td>t-Stat</td>
<td></td>
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<tr>
<td>LHS(-1)</td>
<td>0.718</td>
<td>10.49</td>
<td>1.154</td>
<td>16.61</td>
<td>1.099</td>
<td>15.68</td>
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<tr>
<td>LHS(-2)</td>
<td>0.164</td>
<td>2.29</td>
<td>-0.184</td>
<td>-2.54</td>
<td>-0.124</td>
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<tr>
<td>CPINOW Intercept</td>
<td>0.019</td>
<td>2.10</td>
<td>0.015</td>
<td>2.25</td>
<td>0.014</td>
<td>2.06</td>
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<tr>
<td>CPINOW Slope</td>
<td>-0.001</td>
<td>-1.29</td>
<td>-0.001</td>
<td>-2.13</td>
<td>-0.001</td>
<td>-2.06</td>
<td></td>
</tr>
<tr>
<td>CPINOW Quadratic</td>
<td>0.000</td>
<td>0.80</td>
<td>0.000</td>
<td>1.99</td>
<td>0.000</td>
<td>1.98</td>
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<tr>
<td>Gasoline Intercept</td>
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<td>0.28</td>
<td>0.001</td>
<td>1.28</td>
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<td>0.000</td>
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<td>-1.75</td>
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<td>0.000</td>
<td>1.19</td>
<td>0.000</td>
<td>1.71</td>
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<tr>
<td>Adjusted R-squared</td>
<td>0.920</td>
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<td>0.973</td>
<td></td>
<td>0.974</td>
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</tbody>
</table>
Appendix (H): Determinants of Market Expectations (BEI)
VAR with 4 variables

• Oil Price, Exchange Rate, CPINOW, BEI

• Oil Price and Exchange Rate are in first differences.

• Lag length = 20

• Sample period: November 2013 – March 2022
Oil and exchange rate are much more important.