



JSPS Grants-in-Aid for Creative Scientific Research

Understanding Inflation Dynamics of the Japanese Economy

Measuring Inflation By Company Using Scanner Data

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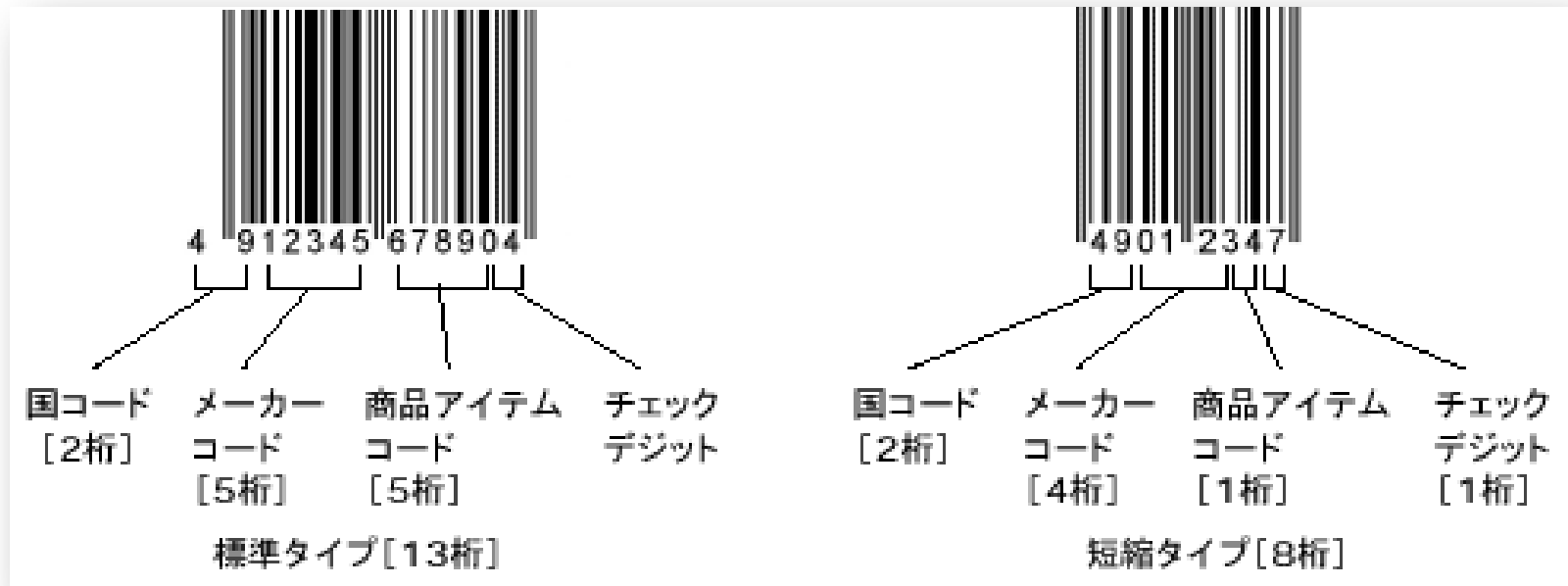
Nowcast Inc

May 2, 2016

Four dimensions of scanner data

- Inflation **by Item** (i.e. product group)
- Inflation **by Outlet**
- Inflation **by Household**
- Inflation **by Manufacturer**

JAN: Japanese Article Number



Product ID:
MEIJI Milk Chocolate
4902777193946

Nikkei POS (Point-of-Sale) Data

Data frequency: Daily

Sample period: 1988-2016

No. of Outlets: 300

No. of Products: 300K

No. of Product Groups: 213

No. of Manufactures: 16008 in 2013

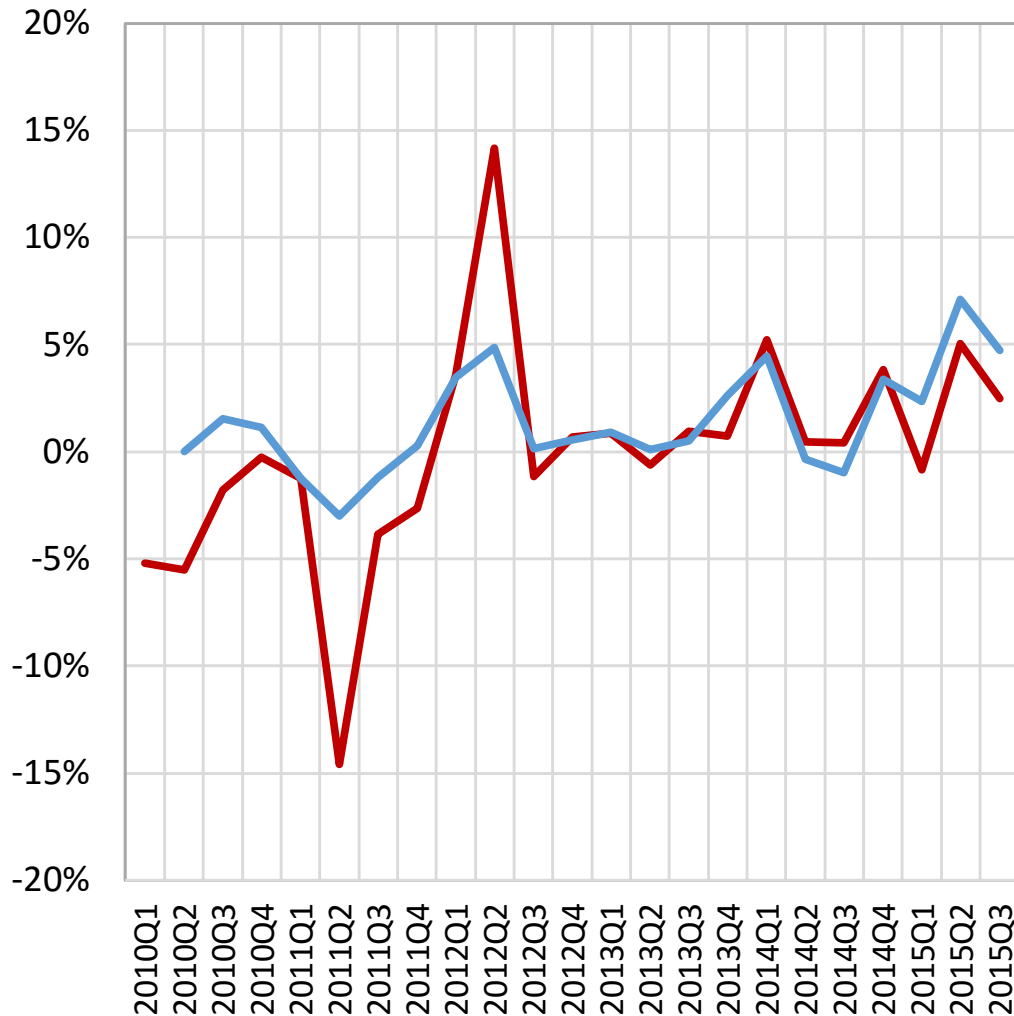
Total Sales: 0.42 trillion yen in 2013

Descriptive statistics on firm sales and the number of products per firm

	Mean	Median	Std. Dev.	10th Percentile	90th Percentile	Max
No. Firms per Category	177	109	241	28	359	2412
Firm Sales	272	6	3339	0	170	259424
Log Firm Sales	13	13	3	10	17	24
No. of JAN codes per Firm	25	5	120	1	44	6703
JAN code Sales	11	1	70	0	17	9555

Note: Firm and JAN code sales are in hundred thousand yen. The figure in the column “Mean” is weighted by annual category sales.

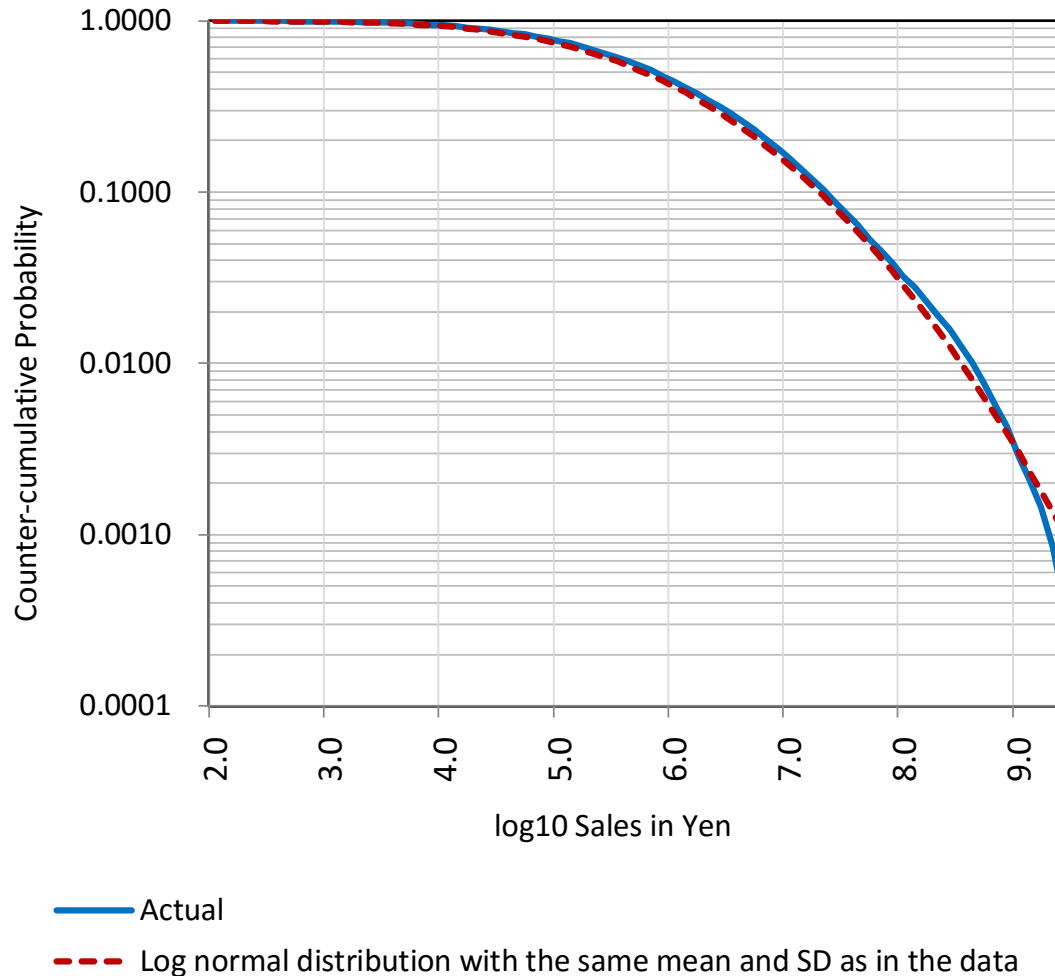
Meiji Holdings Co., Ltd.



- Y/Y sales growth constructed from scanner data
- Y/Y sales growth released by the company

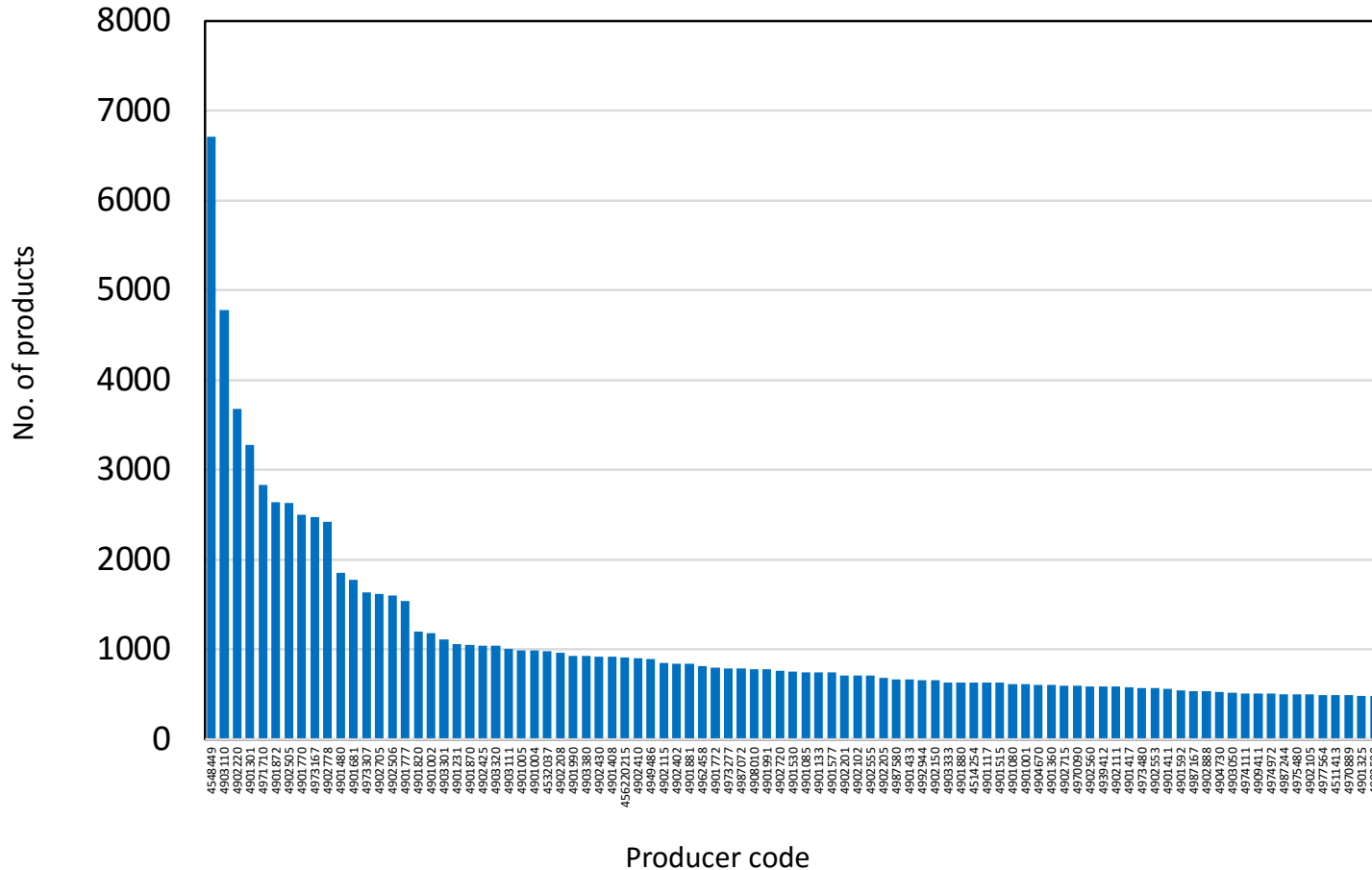


Firm Sales Distribution in 2013



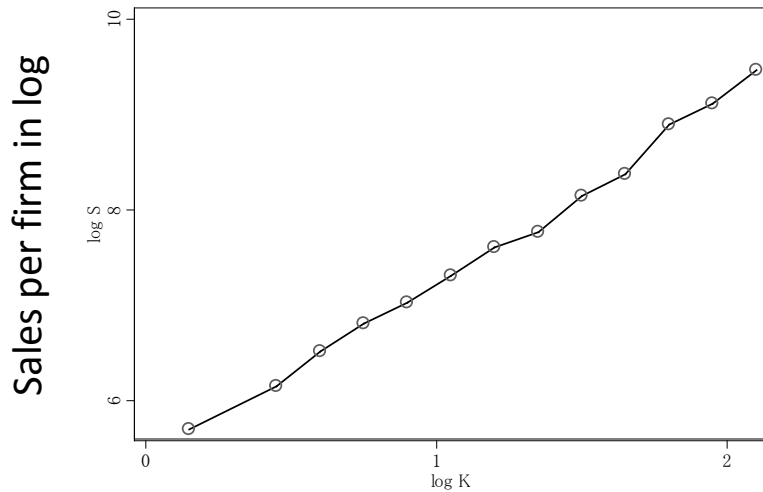
Fact #1: Firm sales calculated from scanner data follow a log normal distribution, which is consistent with the findings reported in previous studies based on the financial statement data.

The number of products for individual firms

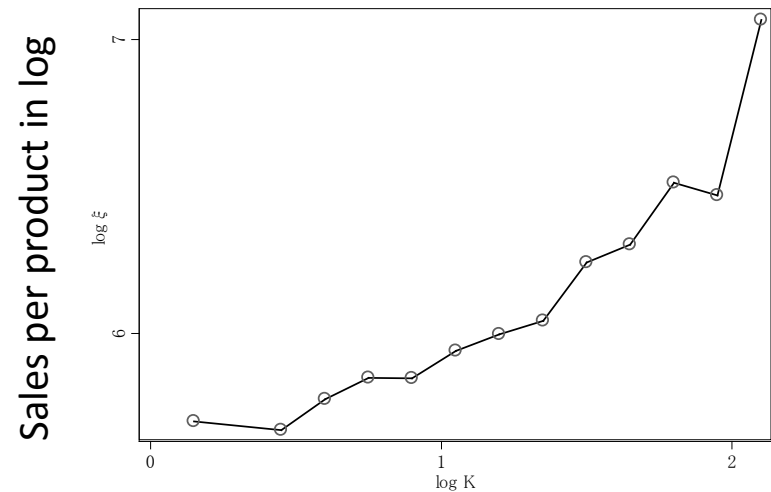


Fact #2: Firms are typically with multi products (i.e., JAN codes), but the number of products significantly differs across firms.

Firm sales, the number of products, and the sales per product



The number of products for a firm in log



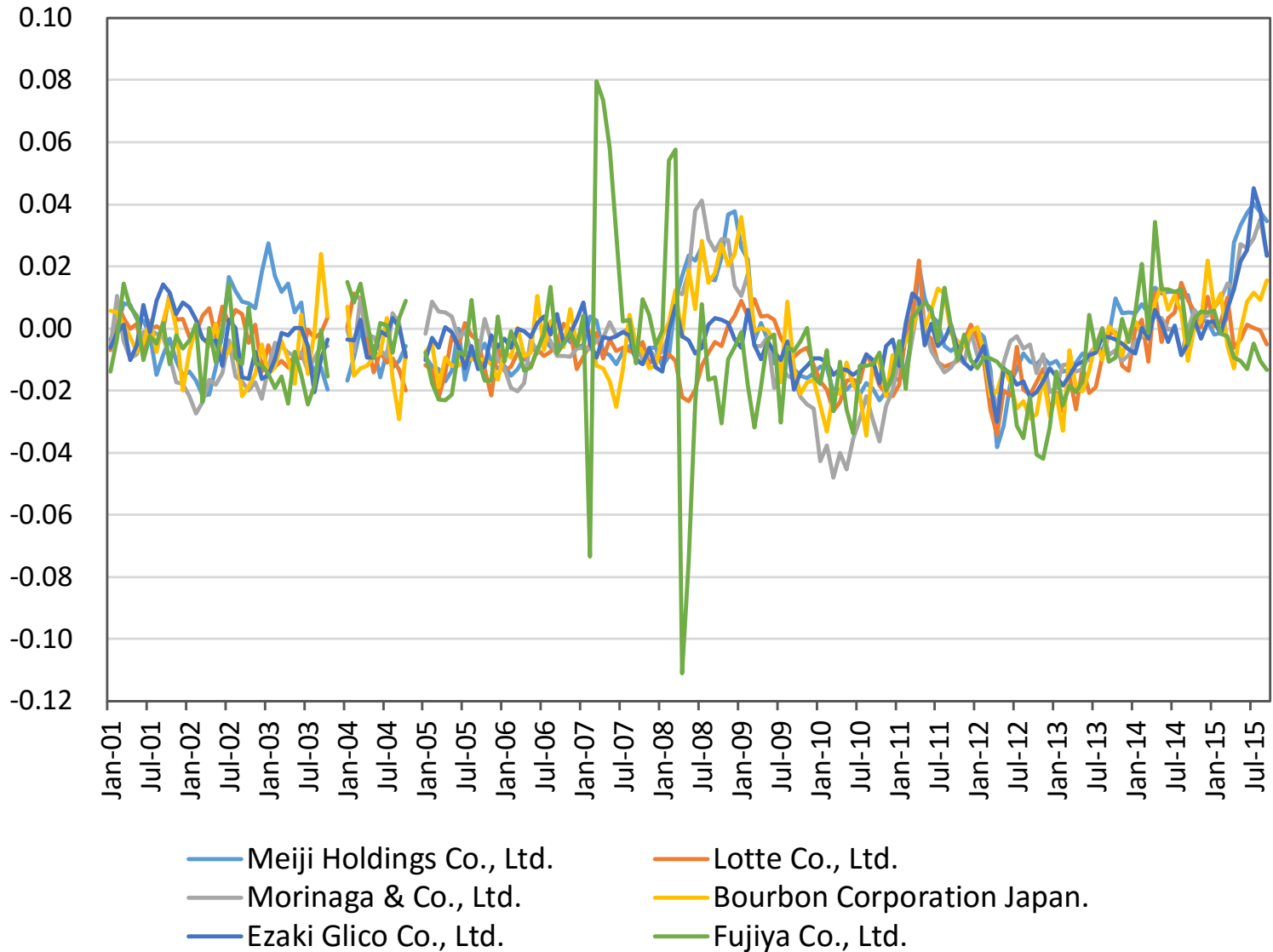
The number of products for a firm in log

Fact #3: Firms with larger sales tend to have a larger number of products. Also, firms with a larger number of products tend to have products with a larger sales per product.

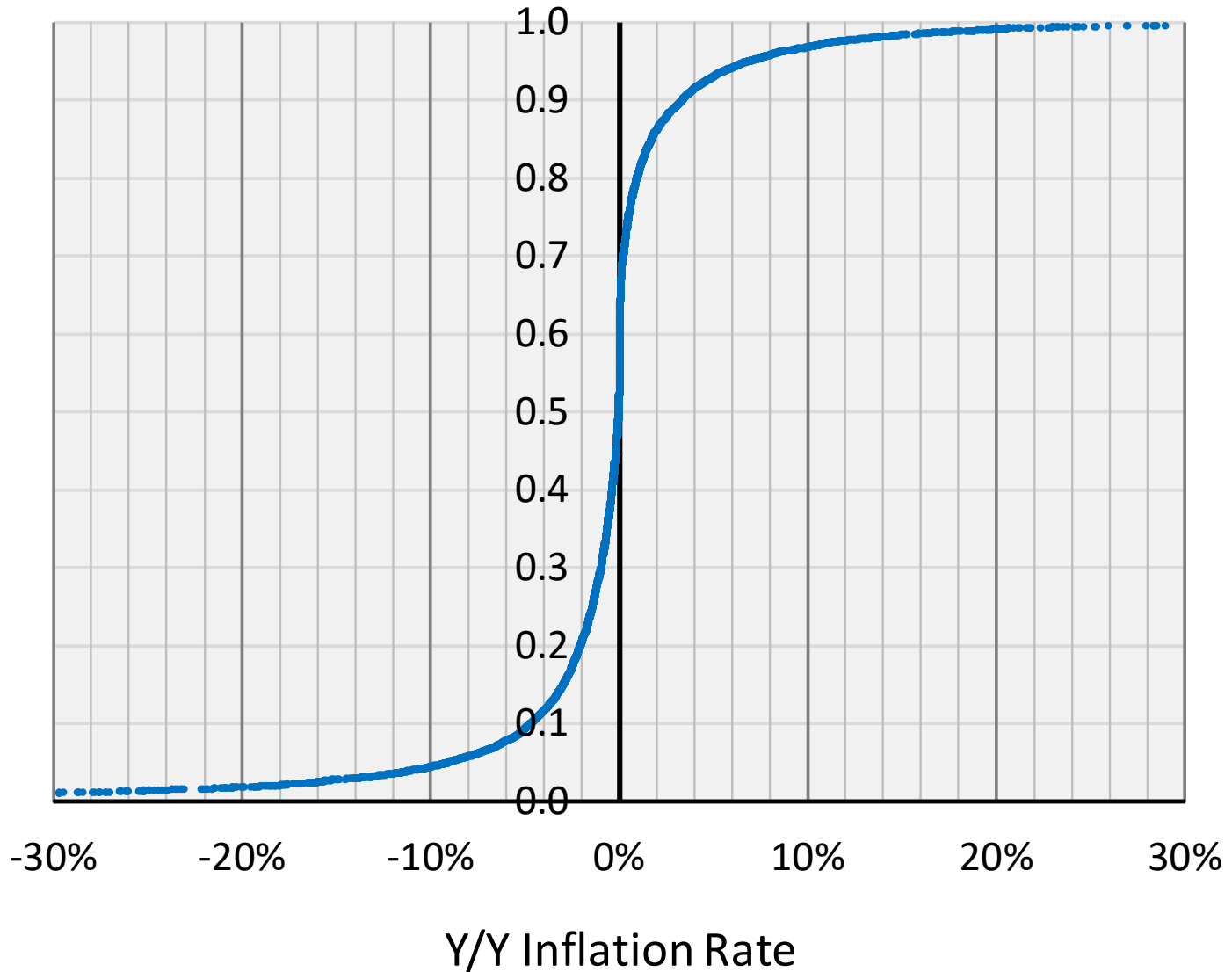
What we do in this paper

- We calculate Tornqvist inflation by company.
 - Tornqvist weighting at the product level with weights calculated from scanner data
 - Monthly frequency
 - Year on year inflation rates
- We ask whether inflation is driven by manufacturers or by outlets.
 - Specifically, we ask who makes a decision on whether a product is on sale or not: is it decided by manufactures or by outlets.
 - To address this question, we decompose inflation fluctuations into various factors, including the factor associated with manufacturers and the factor associated with outlets.

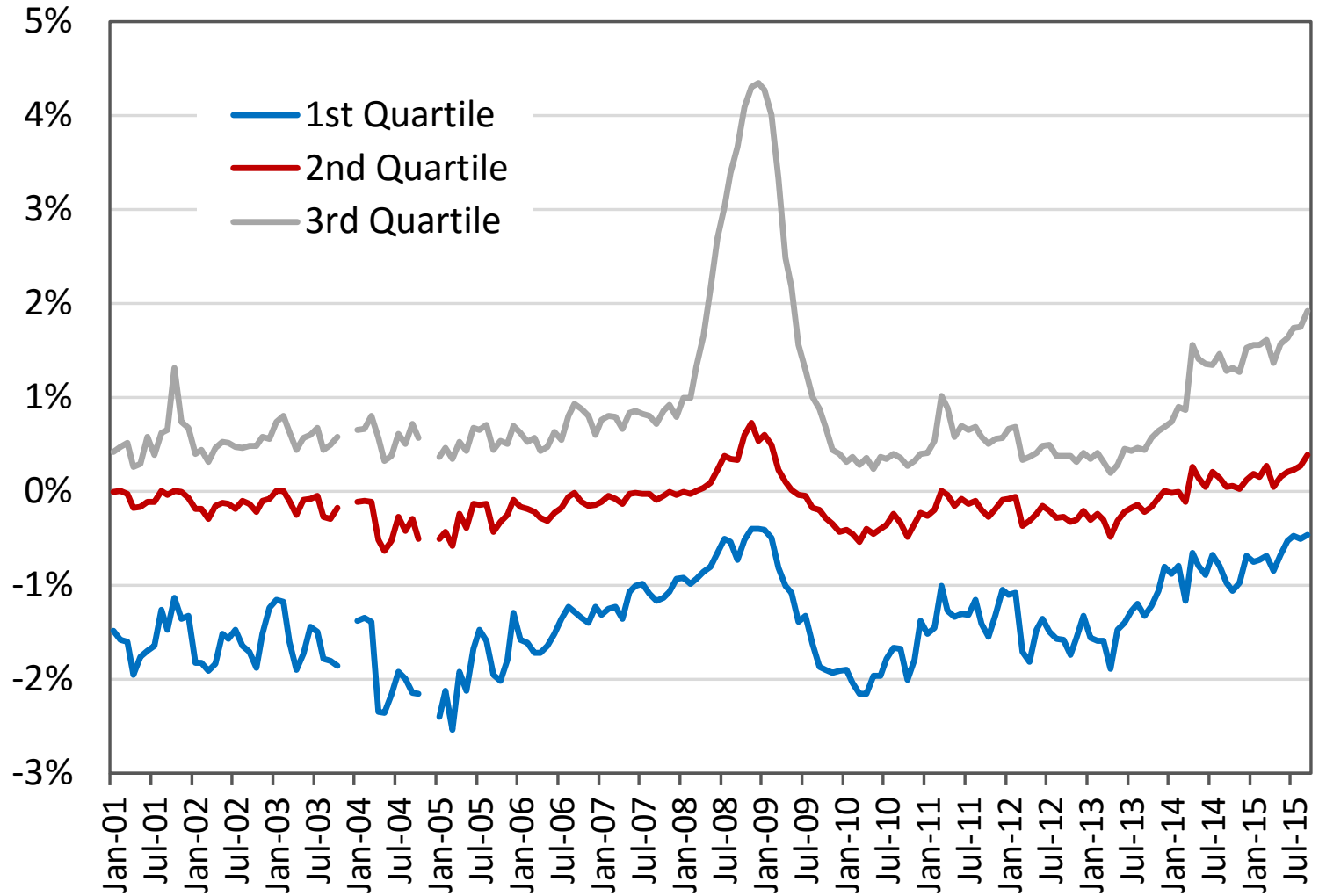
Y/Y Inflation Rates for Chocolate Producers



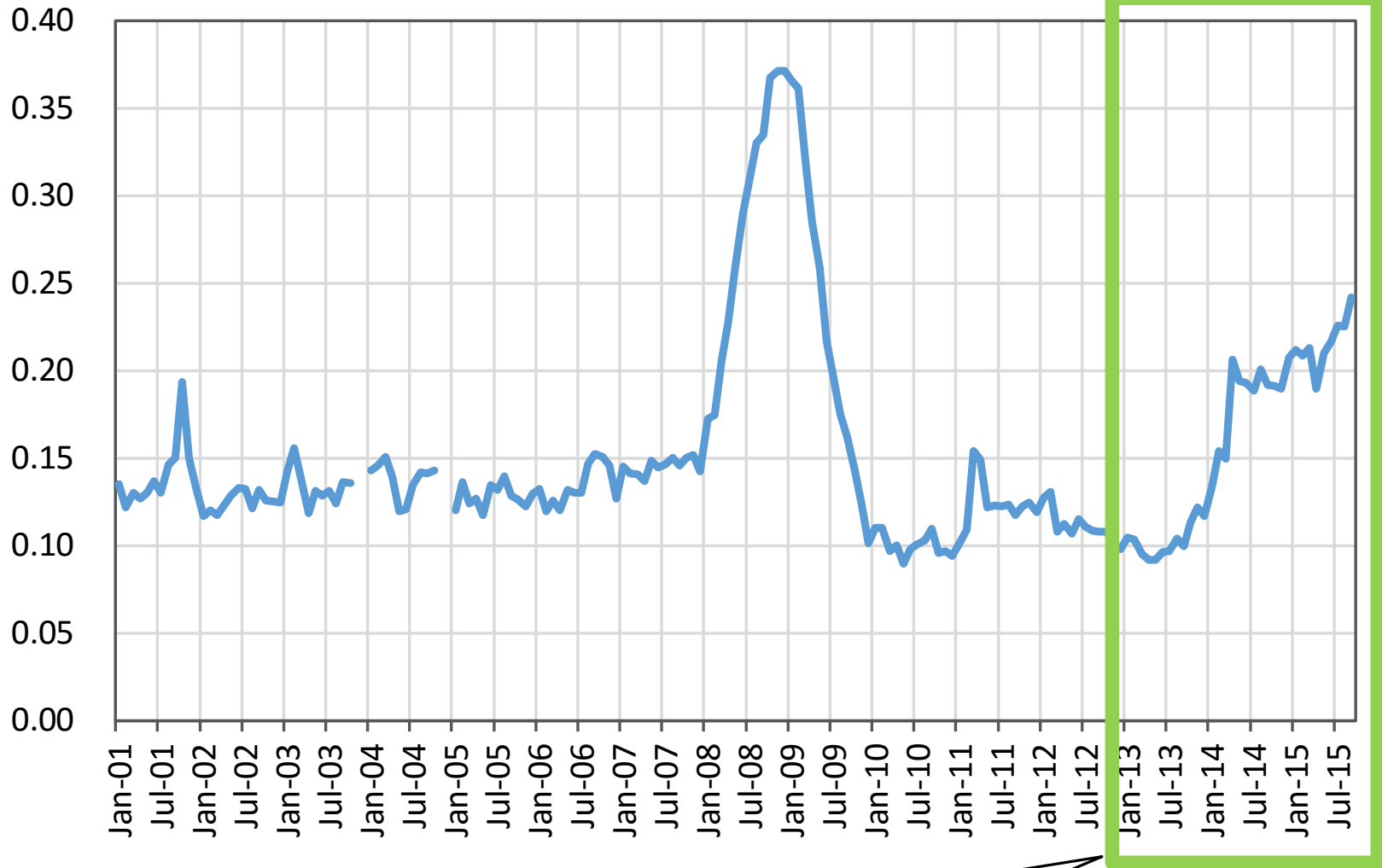
Cumulative Distribution of Y/Y Inflation Rates in Jan 2013



Quartiles of Inflation Distributions

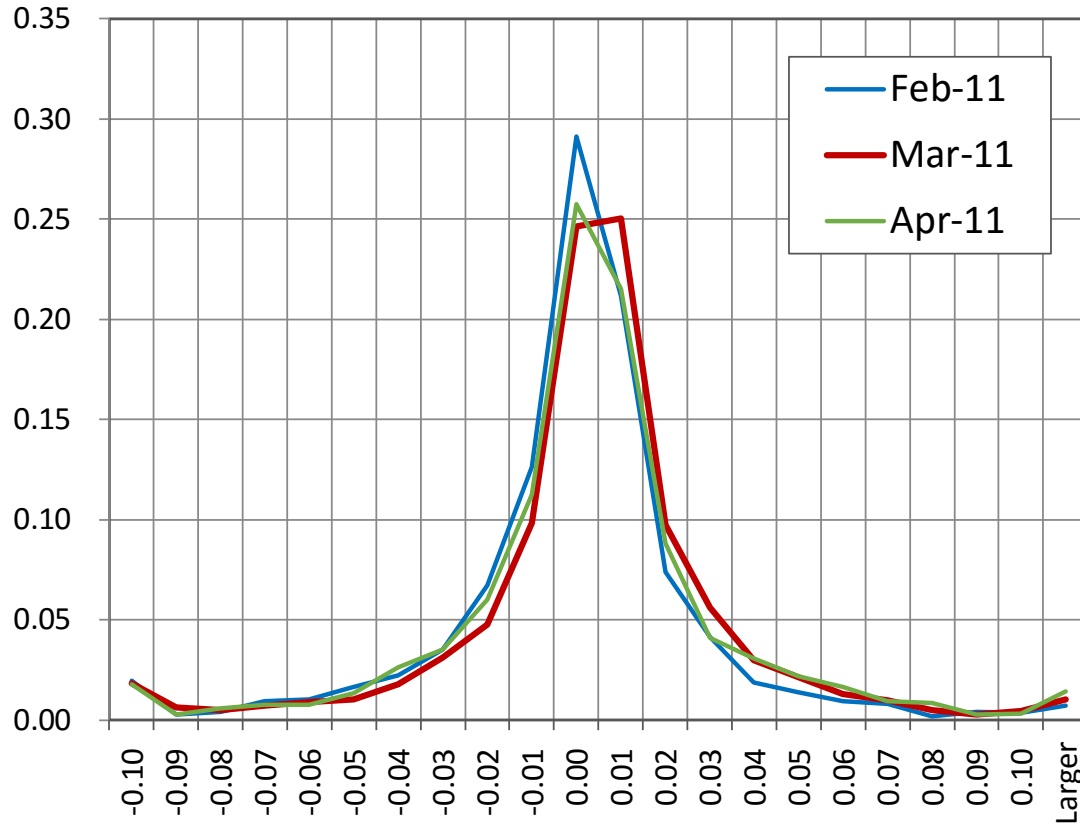


Fraction of firms with above 2 percent inflation



Abenomics and Bank of Japan's Quantitative and Qualitative Easing (QQE) have started in early 2013

Inflation distributions before and after the East Japan Earthquake in March 2011



Contributions of individual manufacturers to the inflation rate in March 2011:

All-Japan Egg Retailers Union	+0.032%
Toyo Suisan Kaisha Ltd.	+0.026%
NH Foods Ltd.	+0.026%
Nissin Foods Holdings Co., Ltd.	+0.021%
Ajinomoto Co., Inc.	+0.019%
Yamazaki Baking Co., Ltd.	+0.016%
Suntory Holdings Limited	+0.013%
Fuji Baking Co., Ltd.	+0.012%

Is Inflation driven by producers or outlets?

		Producers		
		Producer A	Producer B	Producer C
Outlets	Outlet #1	P_{A1}	P_{B1}	P_{C1}
	Outlet #2	P_{A2}	P_{B2}	P_{C2}
	Outlet #3	P_{A3}	P_{B3}	P_{C3}

If prices are determined by outlets, we should observe comovement of prices across producers

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Estimating equation

Frequency of temporary sales at an outlet for a product produced by a manufacturer

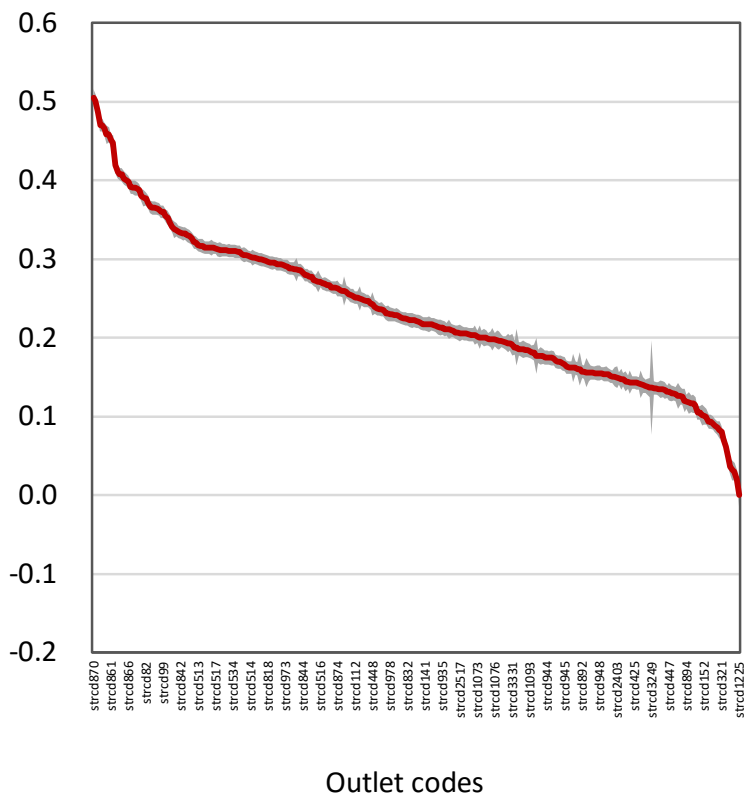
$$\begin{aligned} &= \alpha \times \text{Outlet Dummies} \\ &+ \beta \times \text{Manufacturer Dummies} \\ &+ \gamma \times \text{Product Category Dummies} \\ &+ \delta \times \text{Time Dummies} \\ &+ \text{disturbance term} \end{aligned}$$

Note: Temporary sales are identified by applying the sales filter proposed by Eichenbaum et al (2011) to our daily price data.

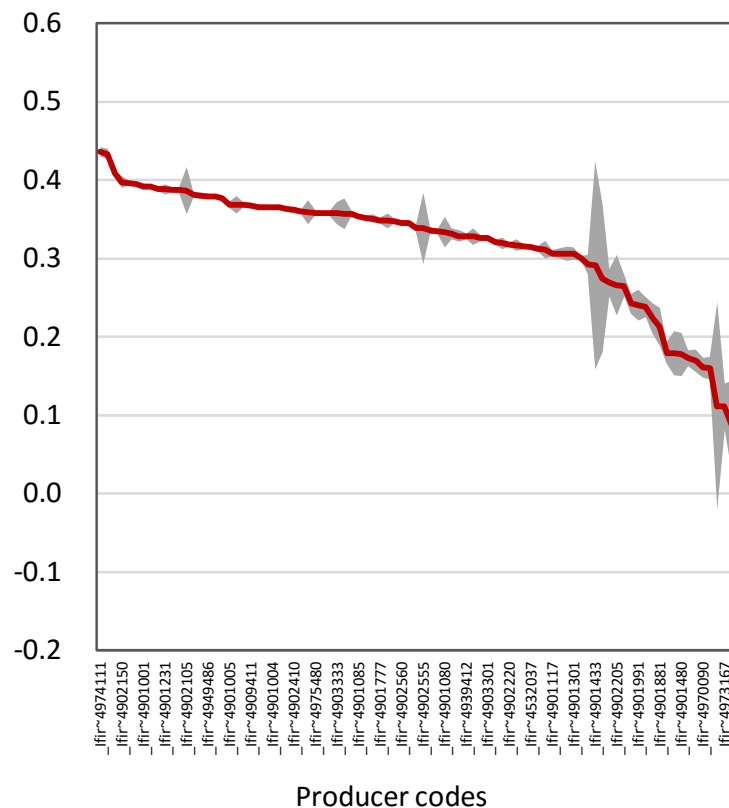
Are temporary sales driven by producers or retailers?

Annual frequency regression

Coefficients on outlet dummies



Coefficients on producer dummies

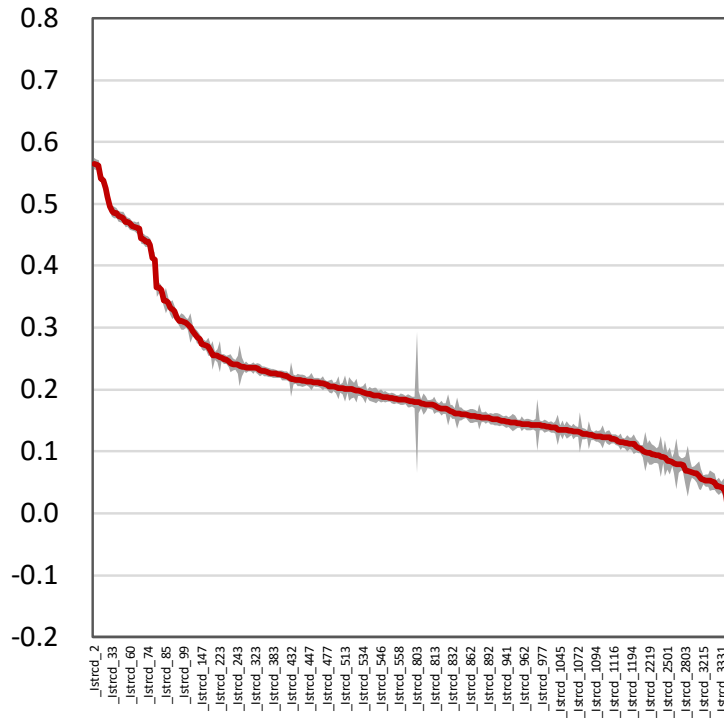


The estimated coefficients on outlet dummies are statistically different from each other, implying that the frequency of temporary sales significantly differs across outlets. Similarly, the estimates associated with producer dummies are significantly different from each other. In this sense, the decision on whether a product is on sale or not is made not only by outlets but also by producers.

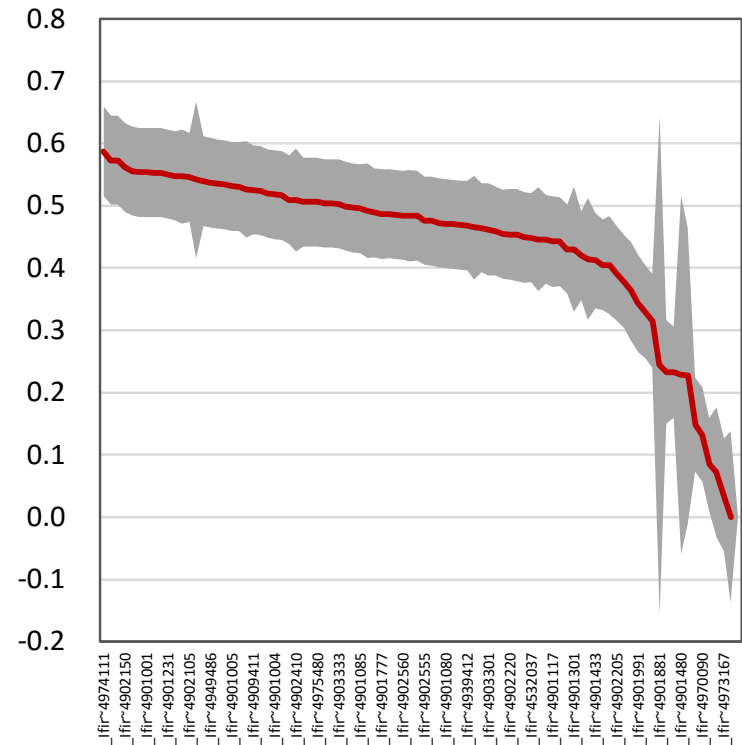
Are temporary sales driven by producers or retailers?

Daily frequency regression

Coefficients on outlet dummies



Coefficients on producer dummies



The estimated coefficients on outlet dummies are statistically different from each other, as in the case of annual frequency regression. However, the estimates associated with producer dummies are not significantly different from each other, implying that the frequency of temporary sales does not differ across producers. Therefore, the decision on whether a product is on sale or not is made mainly by outlets (not by producers) at the daily frequency.

Summary

- Scanner data has four dimensions. We can calculate inflation using scanner data in four different ways: (1) inflation by item; (2) inflation by outlet; (3) inflation by household; (4) inflation by manufacturer.
- We find that firms are typically with multi products (i.e., with multiple JAN codes), but the number of products significantly differs across firms: the average number of products per firm is 25 while its std. dev. is 120. **Firms are highly heterogeneous in terms of the number of products they produce.**
- **We find heterogeneity in the rate of inflation across firms**, although the heterogeneity is not as large as observed in the number of products across firms.
 - For example, the Y/Y inflation rate in Sep 2015 is +0.4 percent for a median manufacturer, but it is below -0.5 percent for the lowest 25 percent of manufactures while it is above +1.9 percent for the highest 25 percent of manufactures.
- **We find that decision on whether a product is on sale or not is made mainly by outlets (not by manufacturers) at the daily frequency. However, the decision regarding temporary sales is made jointly by outlets and manufacturers at a longer frequency (e.g., at an annual frequency).**

Paying attention to inflation by producer may be a good thing even from a practical viewpoint because ...

- We may have deeper understanding on inflation fluctuations.
 - We have rich information about a number aspects of individual firms, such as sales, production, and inventory. We may be able to use this to learn about their pricing behavior. For example, when the price of a firm declines, we may be able to say that this is due to temporarily high inventory, therefore the price will soon return to its original level.
- We may identify a set of firms that are responsible for economy-wide inflation/deflation.
 - The presence of large heterogeneity across firms in terms of sales and the number of products suggests that economy-wide inflation/deflation could be driven by a handful of firms.