

# Inflation at the Household Level: Online Appendix<sup>☆</sup>

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## Abstract

This appendix contains additional results on using scanner data to estimate inflation rates at the household level. There are four sections. Section 1 provides details on the distribution of spending across types of goods in the KNCP. Section 2 shows cross-sectional distributions of Fisher and Paasche inflation rates. Section 3 shows the evolution over time of measures of dispersion of Fisher and Paasche inflation rates. Section 4 exhibits differences in mean inflation rates by income. Section 5 examines the relationship between household demographics and substitution patterns. Section 6 shows cross-sectional distributions of two-year inflation rates.

*Keywords:* inflation, heterogeneity

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## 1. Distribution of expenditure across categories in the KNCP

Table 1 compares the distribution of spending across types of goods in the KNCP with the weights used to construct the published CPI. All of the data in the table are for 2012. The first column of the table shows the weights for the CPI for urban consumers, while  
5 the second column shows the distribution of spending in the Bureau of Labor Statistics' Consumer Expenditure Survey (CEX) for that year; the CEX distribution differs from the

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CPI weights because not all CEX households are urban. The third column of the table shows the distribution of spending across all purchases in the KNCP data, and the fourth column considers only the purchases that we use to construct our household inflation rates — barcodes that a household purchases in both quarter  $t$  and quarter  $t + 4$ , from households with at least five matched barcodes. About 61 percent of spending in the KNCP is on food and beverages, a share that rises to 74 percent in the matched purchases that we use to measure household inflation. By contrast, food and beverages have only a 15 percent weight in the CPI. But despite the heavy weight of food in the KNCP, many other types of purchases are represented, including housekeeping supplies, pet products, and personal care items. Housing, on the other hand, gets much less weight in our data than in the CPI, primarily because shelter, which has a 32 percent expenditure share in the CPI, is not measured in the KNCP. Similarly, the KNCP measures very little transportation spending. Apparel is measured in the KNCP, but we observe no purchases of matched apparel barcodes in consecutive periods, so apparel gets zero weight in our household inflation rates.

Table 1: Percentage distribution of spending across categories in different datasets, 2012.

	CPI-U	CEX	KNCP	
			all spending	5+ matched UPCs
Food and beverages	15.26	16.03	61.22	74.38
Food	14.31	15.00	58.08	67.61
Food at home	8.60	8.91	53.87	64.77
Cereals and bakery products	1.23	1.22	7.71	9.10
Cereals and cereal products	0.47	0.41	2.91	3.25
Bakery products	0.76	0.81	4.80	5.86
Meats, poultry, fish, and eggs	1.96	1.94	7.53	6.35
Meats, poultry, and fish	1.84	1.82	6.98	4.93
Eggs	0.11	0.12	0.55	1.42
Dairy and related products	0.91	0.95	7.92	13.15
Fruits and vegetables	1.29	1.66	7.36	6.90
Nonalcoholic beverages, beverage materials	0.94	0.84	6.85	13.52
Other food at home	2.28	2.30	14.84	15.75
Sugar and sweets	0.31	0.33	2.95	3.05
Fats and oils	0.26	0.26	1.58	2.40
Other foods	1.71	1.70	10.31	10.30
Food away from home	5.71	6.09	4.22	2.83
Alcoholic beverages	0.95	1.03	3.13	6.78
Housing	41.02	35.63	9.03	5.11
Shelter	31.68	22.52	-	-
Fuels and utilities	5.30	5.49	0.08	0.08
Household furnishings and operations	4.04	7.62	8.95	5.04
Window and floor coverings and other linens	0.27	0.32	-	-
Furniture and bedding	0.71	0.89	-	-
Appliances	0.29	0.67	1.17	0.09
Other household equipment and furnishings	0.48	-	1.07	0.14
Tools, hardware, outdoor equipment, supplies	0.68	-	1.09	0.21
Housekeeping supplies	0.89	1.39	5.62	4.59
Household operations	0.73	2.64	-	-
Apparel	3.56	3.95	8.40	-
Transportation	16.85	20.48	0.22	0.14
Private transportation	15.66	19.25	0.22	0.14
Public transportation	1.19	1.23	-	-
Medical care	7.16	8.10	6.92	4.85
Recreation	5.99	6.18	6.57	5.85
Video and audio	1.90	2.23	2.11	0.47
Pets, pet products and services	1.10	-	4.27	5.37
Sporting goods	0.46	-	-	-
Photography	0.11	-	0.16	0.01
Other recreational goods	0.45	-	0.02	-
Other recreation services	1.75	-	-	-
Recreational reading materials	0.23	-	-	-
Education and communication	6.78	5.57	-	-
Other goods and services	3.38	4.07	7.64	9.67
Tobacco and smoking products	0.81	0.76	1.87	6.46
Personal care	2.57	1.43	4.47	2.66

Subcategories are not exhaustive and do not necessarily add up to higher-level categories.

## 2. Cross-sectional distributions of Fisher and Paasche inflation rates

This section presents cross-sectional distributions of Fisher and Paasche inflation rates, similar to the distributions shown for Laspeyres indexes in Figure 3 of the main paper.

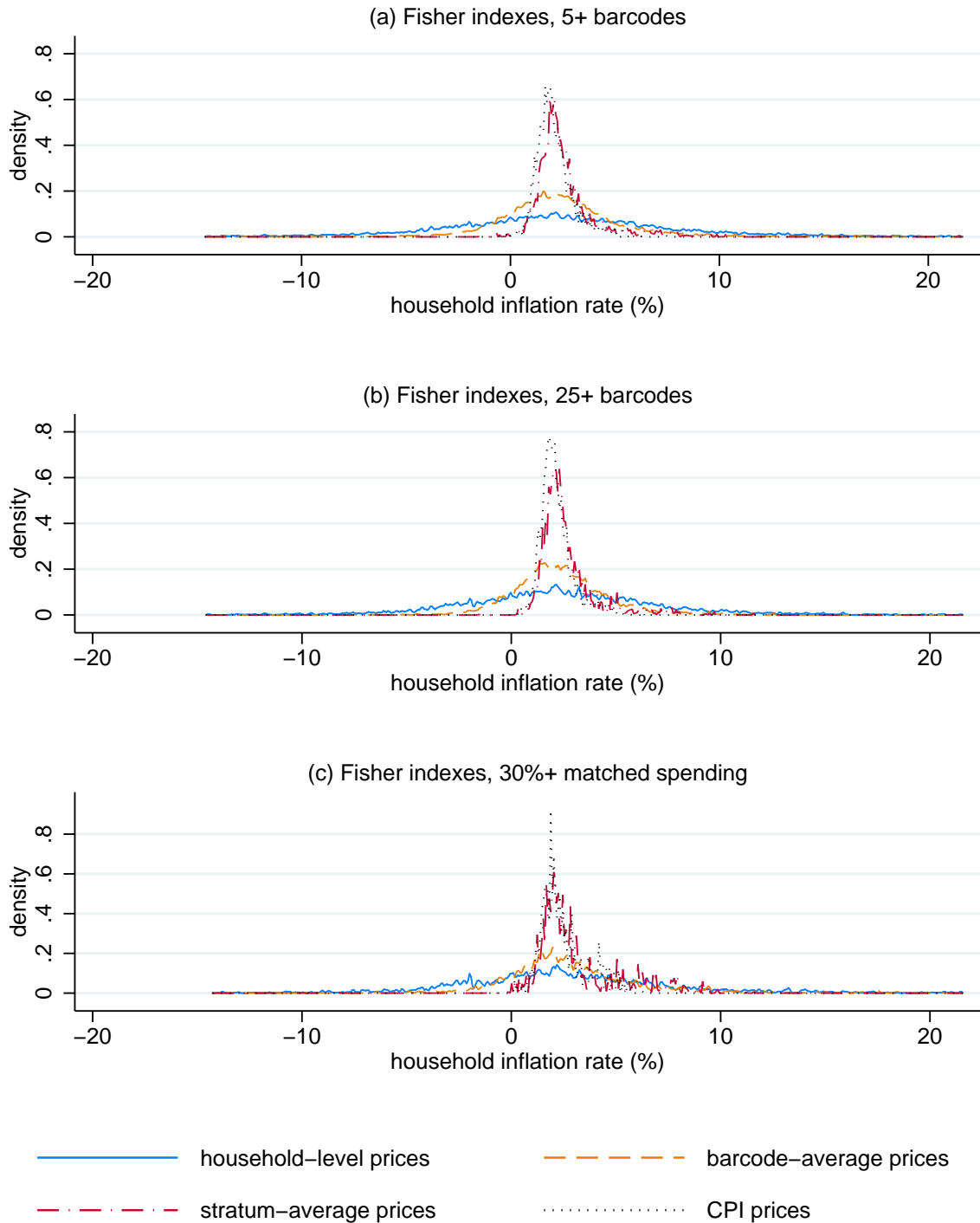


Figure 1: Distributions of household-level inflation rates (Fisher indexes) from fourth quarter of 2004 to fourth quarter of 2005.

Kernel density estimates using Epanechnikov kernel. Bandwidth is 0.05 percentage point for inflation rates with household-level and barcode-average prices and 0.005 percentage point for inflation rates with CPI prices. Data on 23,635 households with matched consumption in 2004q4 and 2005q4. Plots truncated at 1st and 99th percentiles of distribution of inflation rates with household-level prices.

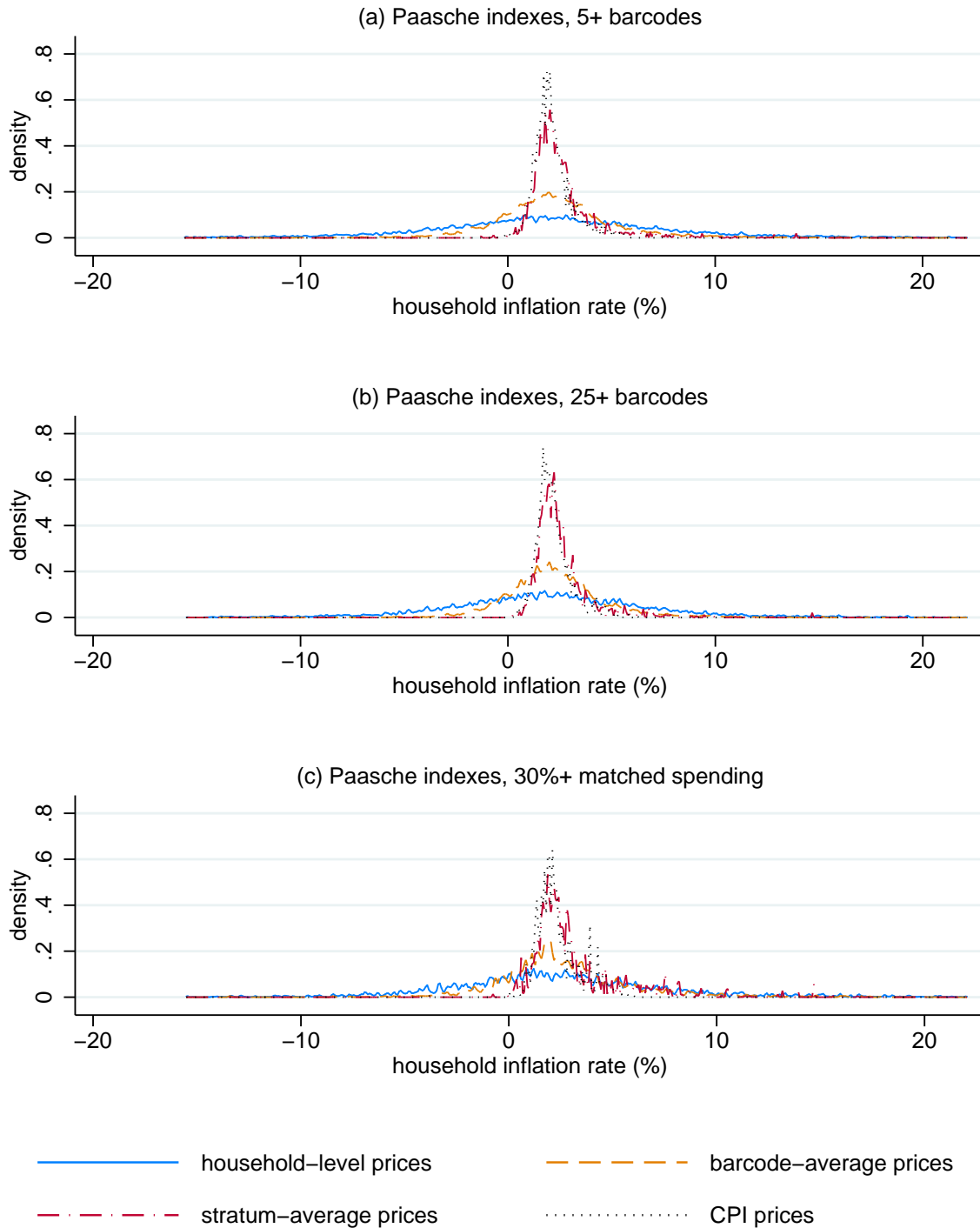


Figure 2: Distributions of household-level inflation rates (Paasche indexes) from fourth quarter of 2004 to fourth quarter of 2005.

Kernel density estimates using Epanechnikov kernel. Bandwidth is 0.05 percentage point for inflation rates with household-level and barcode-average prices and 0.005 percentage point for inflation rates with CPI prices. Data on 23,635 households with matched consumption in 2004q4 and 2005q4. Plots truncated at 1st and 99th percentiles of distribution of inflation rates with household-level prices.

### 3. Evolution over time of dispersion in inflation rates

<sup>25</sup> This section presents time series of dispersion measures for Fisher and Paasche inflation rates, similar to the time series shown for Laspeyres indexes in Figure 4 of the main paper.

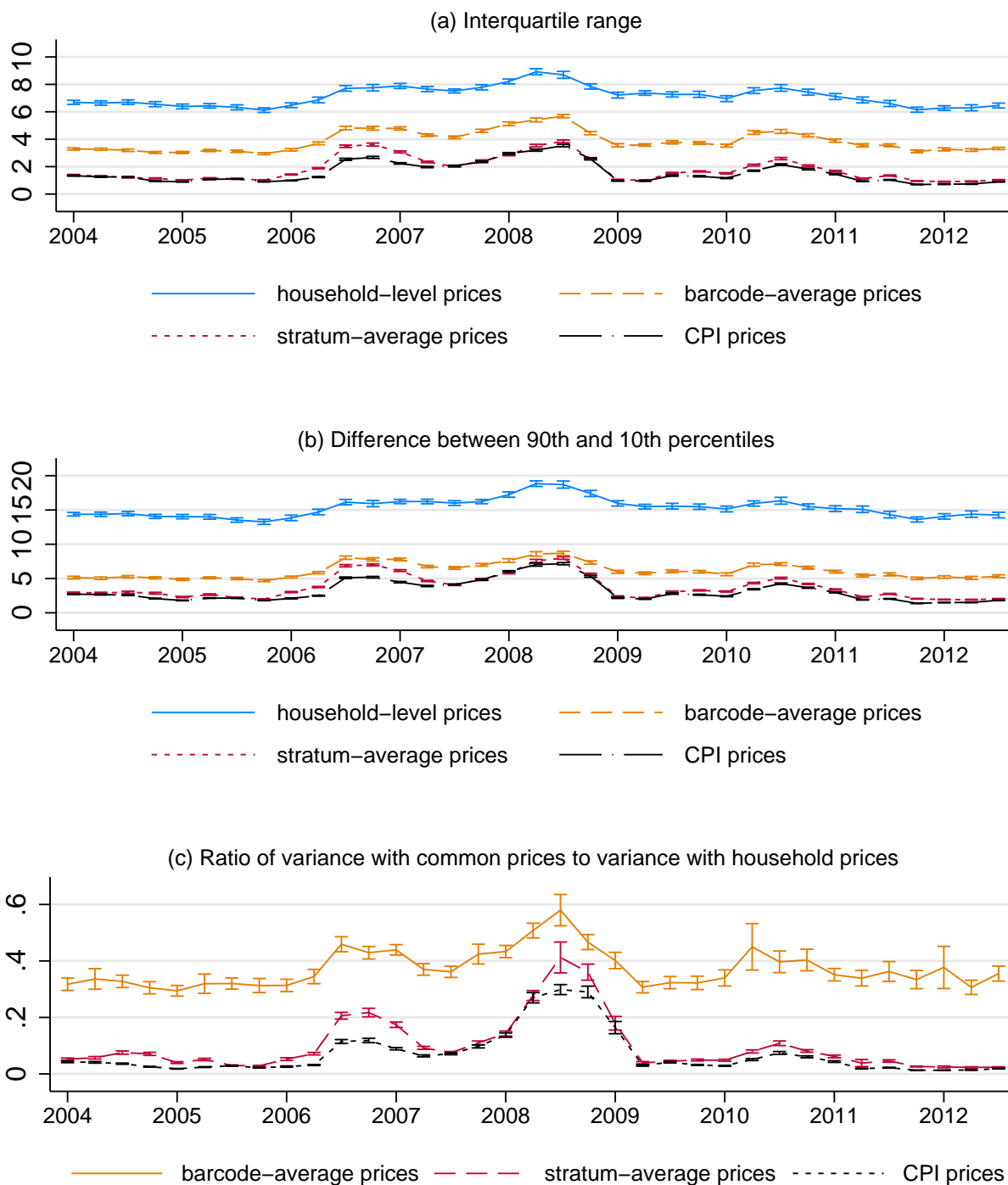


Figure 3: Measures of the dispersion of household-level inflation rates (Fisher indexes). Vertical bars show an interval of  $\pm 2$  bootstrap standard errors around each point estimate. In panel (c), variances are calculated on data from 1st to 99th percentiles of distribution of inflation rates with household-level prices at each date.



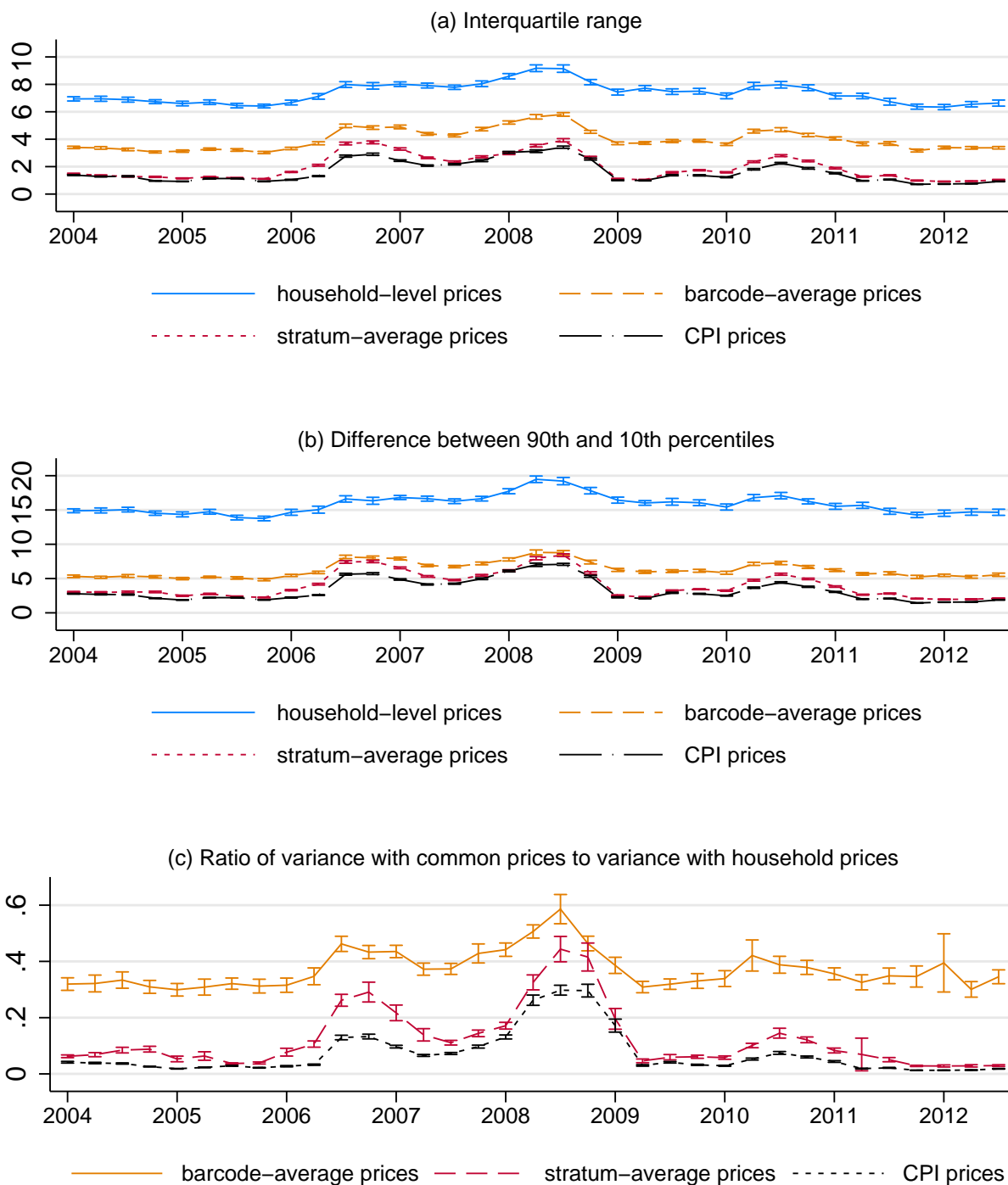


Figure 4: Measures of the dispersion of household-level inflation rates (Paasche indexes). Vertical bars show an interval of  $\pm 2$  bootstrap standard errors around each point estimate. In panel (c), variances are calculated on data from 1st to 99th percentiles of distribution of inflation rates with household-level prices at each date.

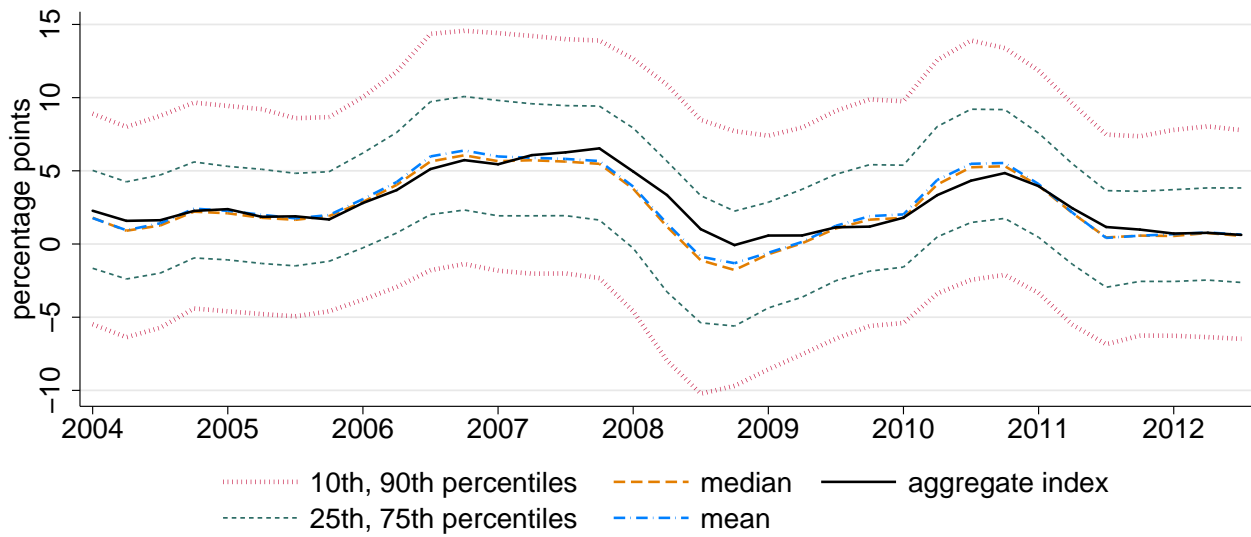


Figure 5: Evolution of the distribution of household inflation rates (Fisher indexes) with household-level prices. Mean is calculated on data from 1st to 99th percentiles of distribution of inflation rates at each date.

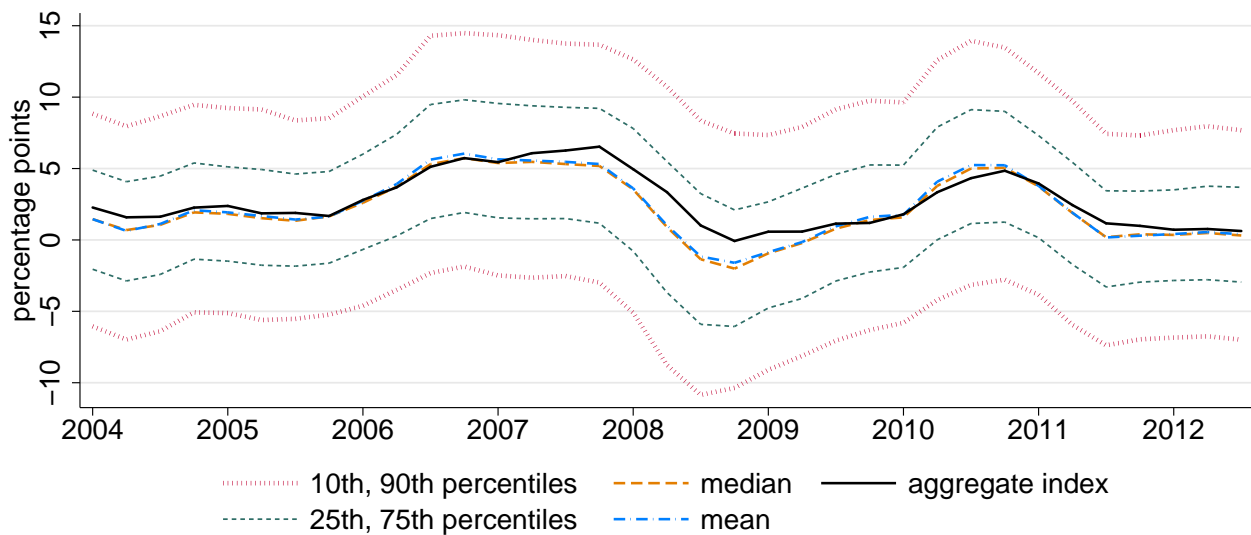


Figure 6: Evolution of the distribution of household inflation rates (Paasche indexes) with household-level prices. Mean is calculated on data from 1st to 99th percentiles of distribution of inflation rates at each date.

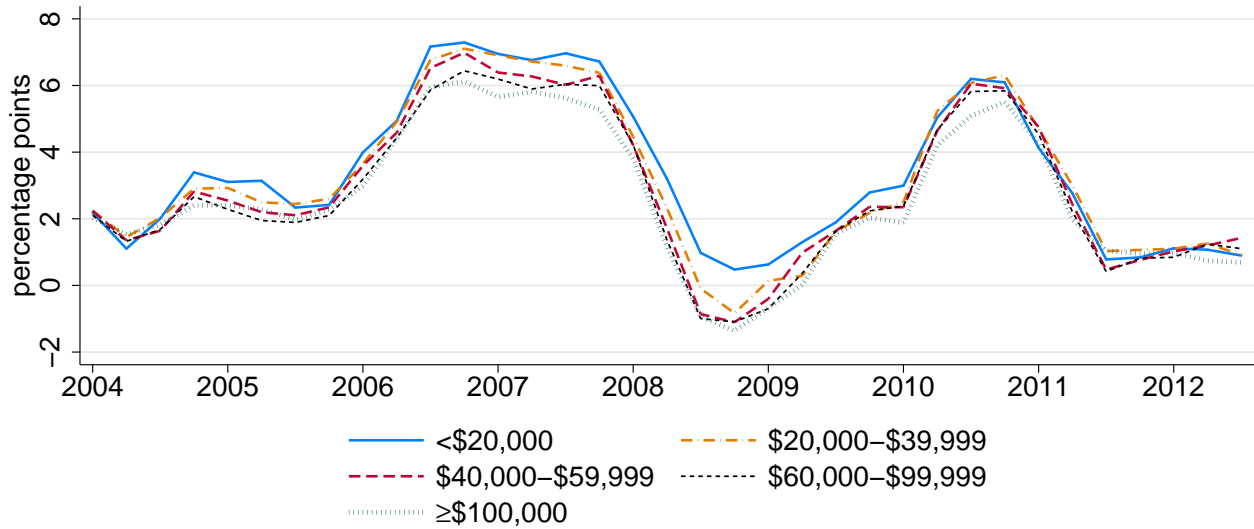


Figure 7: Mean inflation rates at different levels of household income. Calculated with Laspeyres indexes and household-level prices.

#### 4. Inflation rates and household income

Figure 7 shows the mean inflation rates among households at different income levels. Inflation is consistently higher for lower-income households — so much so that, even as the  
 30 depth of the Great Recession produced widespread deflation, households with incomes below \$20,000 still had a positive inflation rate.

## 5. Household demographics and substitution patterns

Table 2 measures the relationship between household demographics and substitution patterns. We use ordinary least squares and median regressions to examine the association of the Laspeyres-Paasche difference with household demographics, and a linear probability model to examine how demographics relate to the probability that a household's Laspeyres inflation rate is greater than its Paasche inflation rate. These regressions use the data for all quarters and control for time effects. The largest effects are found for age, income, and household size. Households with heads between ages 40 and 70 have an average Laspeyres-Paasche difference about 0.2 percentage point larger than households with heads between ages 20 and 29; this is substantial relative to the mean difference of 0.6 percentage point. Households with children also show stronger substitution, as do those with relatively low, but not the lowest, incomes. Nonetheless, as with household-level inflation rates themselves, the low  $R$ -squared in the regressions shows that demographics have almost no power to explain differences between households' Laspeyres and Paasche inflation rates.

Table 2: Regressions of household-level difference between Laspeyres and Paasche inflation rates on household demographics.

	$\pi_{it,t+4}^L - \pi_{it,t+4}^P$				$\pi_{it,t+4}^L > \pi_{it,t+4}^P$	
	(1) OLS		(2) Median		(3) OLS	
	coeff.	std. err.	coeff.	std. err.	coeff.	std. err.
household income						
\$20,000–\$39,999	0.095	(0.029)	0.074	(0.022)	0.013	(0.003)
\$40,000–\$59,999	0.031	(0.031)	0.036	(0.022)	0.008	(0.004)
\$60,000–\$99,999	0.001	(0.035)	0.013	(0.024)	0.006	(0.004)
$\geq$ \$100,000	-0.004	(0.040)	0.007	(0.031)	0.007	(0.004)
average age of household head(s)						
30–39	0.119	(0.097)	0.103	(0.055)	0.017	(0.009)
40–49	0.196	(0.096)	0.166	(0.051)	0.030	(0.008)
50–59	0.228	(0.097)	0.184	(0.053)	0.030	(0.008)
60–69	0.195	(0.098)	0.175	(0.054)	0.030	(0.009)
$\geq$ 70	0.100	(0.098)	0.116	(0.054)	0.020	(0.009)
highest education of household head(s)						
high school diploma	0.056	(0.062)	0.048	(0.048)	0.008	(0.007)
some college	0.051	(0.062)	0.036	(0.047)	0.003	(0.007)
bachelor’s degree	0.008	(0.065)	0.025	(0.051)	0.001	(0.008)
graduate degree	0.042	(0.066)	0.023	(0.054)	0.001	(0.008)
Census region						
Midwest	0.054	(0.029)	0.049	(0.020)	0.010	(0.003)
South	-0.104	(0.025)	-0.086	(0.017)	-0.003	(0.003)
West	0.026	(0.032)	-0.001	(0.024)	0.004	(0.004)
# household members	0.047	(0.013)	0.047	(0.009)	0.007	(0.001)
has children	0.132	(0.068)	0.177	(0.053)	0.018	(0.007)
has children $\times$ # household members	-0.036	(0.021)	-0.038	(0.015)	-0.004	(0.002)
black	0.046	(0.039)	0.017	(0.025)	-0.005	(0.004)
Asian	-0.137	(0.064)	-0.069	(0.053)	-0.022	(0.007)
other nonwhite	0.050	(0.055)	0.013	(0.032)	0.001	(0.005)
Hispanic	-0.046	(0.036)	-0.019	(0.023)	-0.002	(0.004)
$R^2$	0.0010				0.0011	
$R^2$ (time dummies only)	0.0004				0.0003	
$N$	835,386		835,386		835,386	

The dependent variable is the difference between the household inflation rate, computed with household prices and the Laspeyres index, and the aggregate inflation rate for the equivalent universe of goods. Bootstrap standard errors are in parentheses. Column (1) shows results from ordinary least squares regression, and column (2) from median regression. Regressions include time dummy variables. Omitted categories of categorical variables are: income less than \$20,000; white; non-Hispanic; heads’ average age less than 30; heads’ highest education less than high school diploma; Northeast region.

## 6. Cross-sectional distributions of two-year inflation rates

This section presents cross-sectional distributions of two-year inflation rates for an illustrative time period, the fourth quarter of 2004 through the fourth quarter of 2006. The distributions are presented with Laspeyres, Fisher, and Paasche indexes. Each figure shows  
50 the distributions of household inflation rates in 2004–2005 and in 2005–2006, as well as the distribution of the annualized inflation rate that each household experienced over the two-year period from 2004 to 2006. The distributions of inflation rates for the two one-year periods are similar, whereas the annualized two-year inflation rates are somewhat less dispersed but still very heterogeneous.

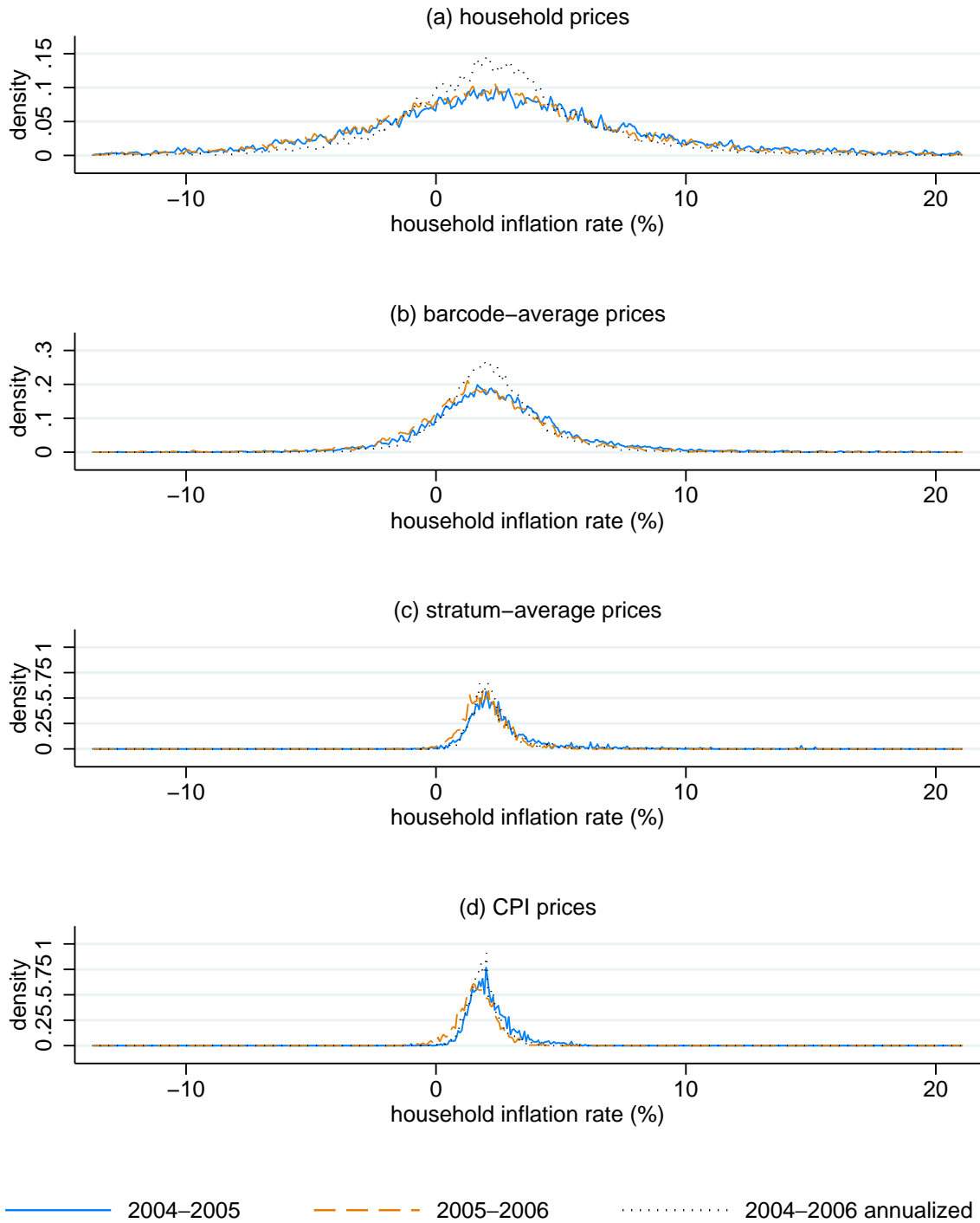


Figure 8: Distributions of one-year and two-year household-level inflation rates, 2004q4–2005q4 and 2005q4–2006q4.

Calculated with Laspeyres indexes. Kernel density estimates using Epanechnikov kernel. Bandwidth is 0.05 percentage point for inflation rates with household-level and barcode-average prices and 0.005 percentage point for inflation rates with CPI prices. Sample limited to 19,252 households with inflation rates calculated for both 2004q4–2005q4 and 2005q4–2006q4.

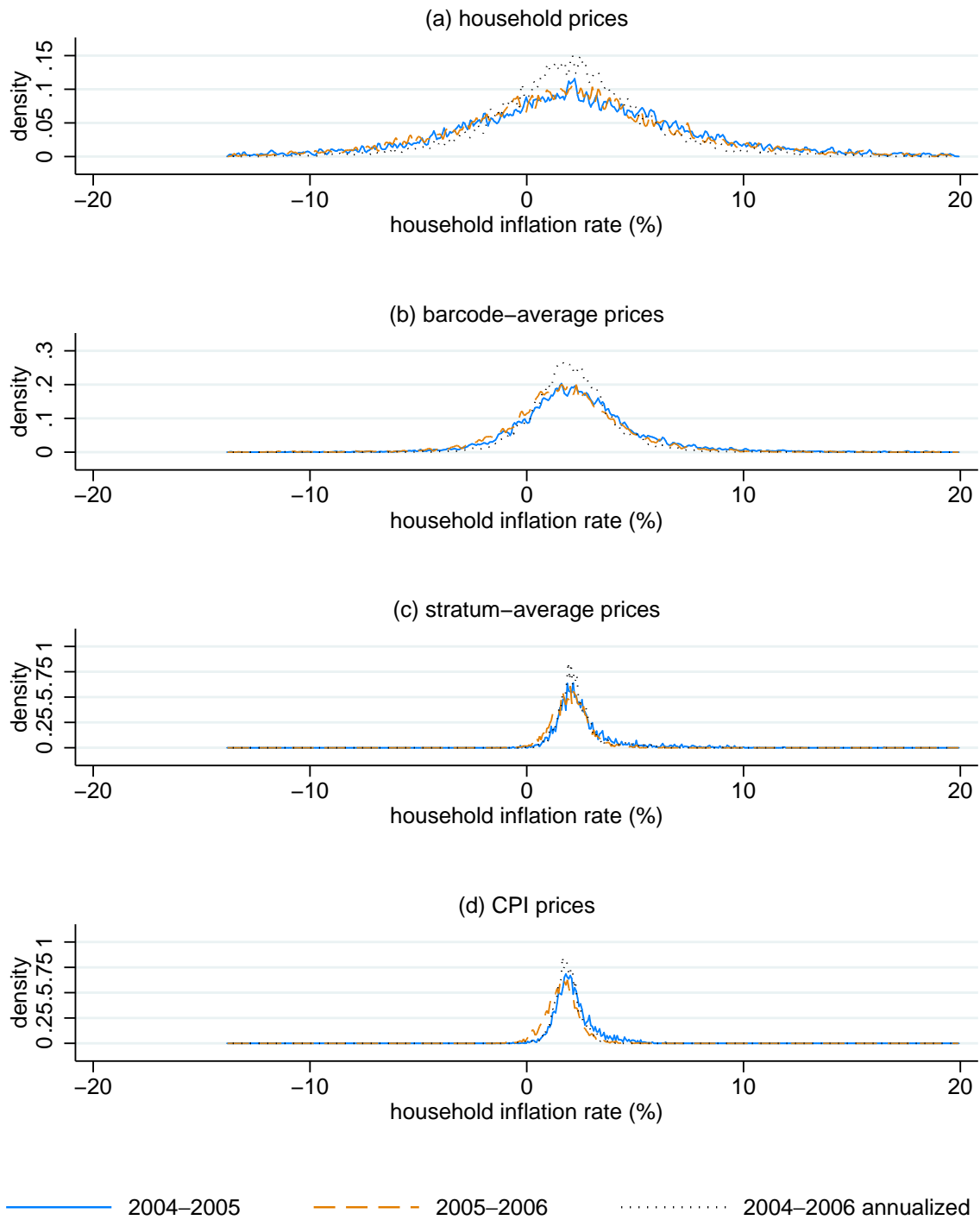


Figure 9: Distributions of one-year and two-year household-level inflation rates, 2004q4–2005q4 and 2005q4–2006q4.

Calculated with Fisher indexes. Kernel density estimates using Epanechnikov kernel. Bandwidth is 0.05 percentage point for inflation rates with household-level and barcode-average prices and 0.005 percentage point for inflation rates with CPI prices. Sample limited to 19,252 households with inflation rates calculated for both 2004q4–2005q4 and 2005q4–2006q4.



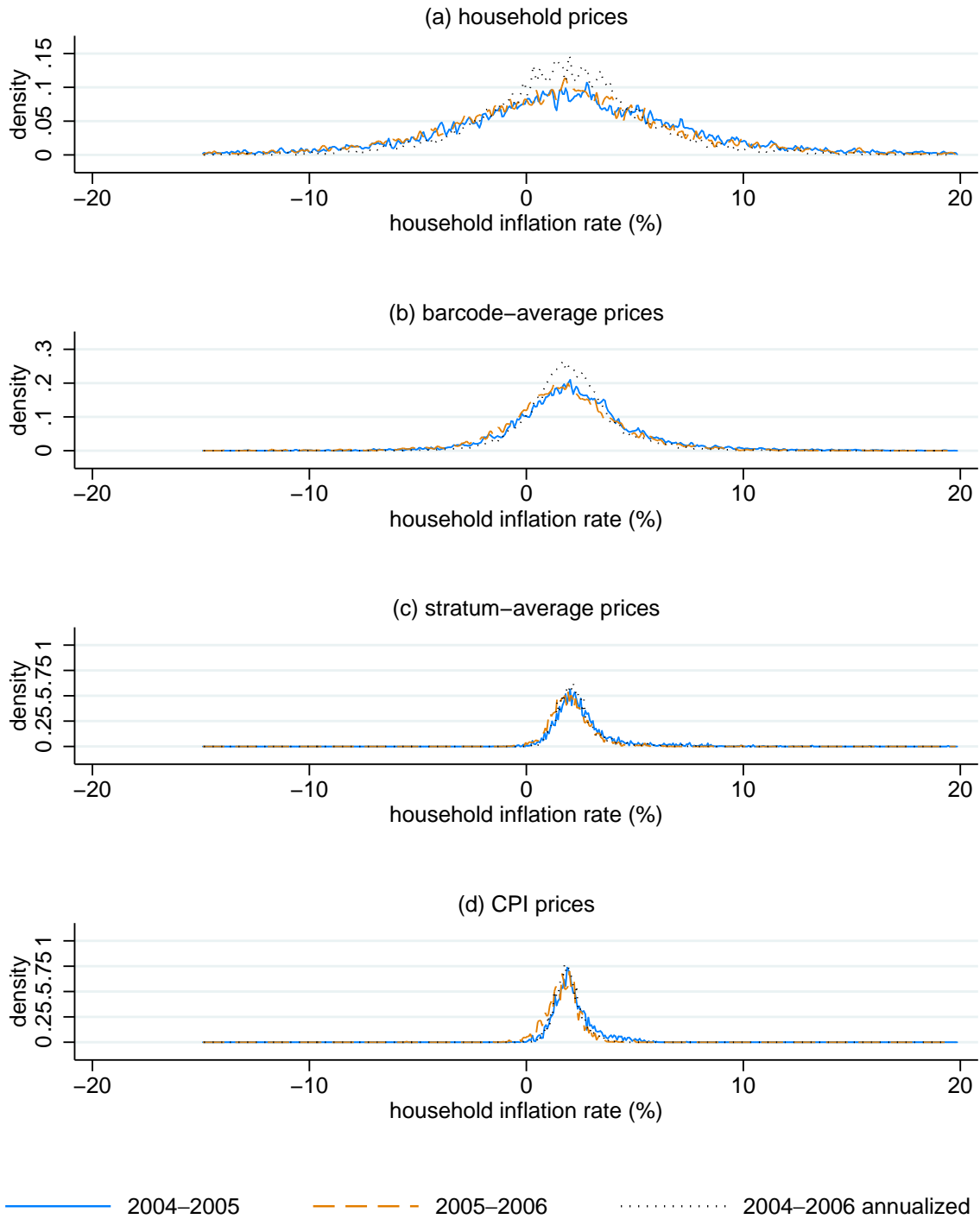


Figure 10: Distributions of one-year and two-year household-level inflation rates, 2004q4–2005q4 and 2005q4–2006q4.

Calculated with Paasche indexes. Kernel density estimates using Epanechnikov kernel. Bandwidth is 0.05 percentage point for inflation rates with household-level and barcode-average prices and 0.005 percentage point for inflation rates with CPI prices. Sample limited to 19,252 households with inflation rates calculated for both 2004q4–2005q4 and 2005q4–2006q4.