



Consumer Inflation Expectations and Household Weights

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Weights?*

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Abstract

There are substantial differences between general inflation expectations as reported in consumer surveys and CPI inflation. This paper proposes that some of this difference can be explained by the fact that households are not weighted the same in the two measures. In the CPI, households are weighted according to their expenditure, while they have equal weights in the consumer survey. To estimate the impact of the weighting difference, it is assumed that households predict the inflation of their own consumption basket. New empirical evidence is provided that supports this assumption as consumers do not predict CPI inflation and they predict a basket of goods. The estimated difference in mean expectations explained by the difference in weights is 0.7 percentage points or 20-25% of the difference for the US.

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1 Introduction

Consumer inflation expectations have at times diverged substantially from CPI inflation. For example, the median participant in the New York Fed Survey of Consumer Expectations predicted one year ahead inflation at 3% year over year on averaged across the years since 2013 for the US. Over the same period, participants of the survey of professional forecasters from the Philadelphia Fed predicted CPI inflation at around 2% year over year and actual CPI inflation was less than 2% year over year.¹

This large difference has lead to a wealth of models trying to explain how consumers form their expectations to allow for this apparent upward bias.² A key component in many of these models is that consumers want to accurately predict the CPI inflation, but fail to do so due to strong priors, lack of financial literacy, tracking only certain categories of goods in the CPI, etc. This paper offers a new explanation that requires that consumers predict their own basket's rate of inflation. If this assumption is satisfied, there is an automatic difference between the average of the consumer surveys and the CPI inflation due to the different weighting of consumers.³ The CPI

¹The focus here is on the NY Fed survey for the US instead of the longer running U Michigan survey, as it has more income brackets that allow a better mapping between income and consumption.

²See for example Gramlich (1983), Souleles (2001), Carroll (2003), Souleles (2004), Brachinger (2008), Pfajfar and Santoro (2008), Bruine de Bruin et al. (2010), Meyer and Venkatu (2011), Coibion and Gorodnichenko (2015), Trehan (2015), Malmendier and Nagel (2015) or Binder (2017).

³The different weighting of households should also be taken into account when estimating the impact of alternative explanations for this gap. For example, if a model is found to explain 50% of the gap when not taking into account the weighting, this number

tracks the inflation rate of aggregate consumption, which means that large spenders have a higher weight than small spenders. This contrasts with the simple average in consumer surveys, which is the average of individual inflation rates.

These two ways of constructing an aggregate inflation measure have been well documented since at least Prais (1959), but to the author's knowledge they have never used in this context. However, the estimates presented here contribute to this literature as well, as an independent way is offered to estimate what the potential difference could be, if the CPI was weighted differently.⁴ As the CPI is used in wage negotiations, to determine eligibility for social programs and the size of the payments as well as many other important economic variables, it is critical to know if there is any difference in the two weightings. As the vulnerable population that depends on the social programs is typically not part of the large spenders in the economy, the CPI might not accurately reflect their rate of inflation. If they experience higher inflation than the one implied by the CPI, social programs will not adequately help them.

In a first step, new evidence is presented supporting that consumer predict their own basket's rate of inflation. Specifically, it is shown that the vast majority of consumers in the UK do not equate general inflation with the

might shift substantially once the weighting is taken into account. If the large spenders are barely affected by the model, the true impact is likely much smaller, while the opposite is true if large spenders are heavily affected.

⁴Muellbauer (1974), Deaton (1998), Kokoski (2000), Izquierdo et al. (2003) or Ley (2005) calculated the difference between the two weighing methods of the CPI with mixed results.

CPI and that consumers in the US predict a basket of goods. Subsequently, it is assumed that consumers predict their own basket's rate of inflation. The NY Fed consumer survey is then reweighted to match the CPI weighting to estimate how much of the difference is due not having the same weights.⁵ To this end, the relationship between demographic variables and consumer expenditure from consumer expenditure surveys are used to impute the consumer expenditure in the consumer expectation surveys. While it is only possible to obtain an approximation, this estimate suggests that there is a 0.7 percentage point difference or it explains 20-25% of the difference.

The remainder of the paper is structured as follows: the next section presents the weighting difference in more detail. The following two sections present the evidence that consumers do not predict the CPI, but have a basket in mind. The fifth section constructs consumer expenditure for the NY Fed expectation survey and reweights it accordingly to estimate the impact of the weighting. The last section concludes.

2 Model

The general idea is that consumers predict their own basket's rate of inflation, rather than the CPI inflation. Every consumer thus looks at the basket of goods he or she consumes and calculates an approximate rate of inflation. This rate of inflation can be the same as CPI inflation, but can also differ substantially. These individual rates of inflation are then averaged across

⁵The UK survey only collects categorical variables and has much fewer details regarding the demographics. Due to this, the comparison is not presented for the UK, where the difference is negligible.

consumers to produce the average consumer inflation expectations.⁶ The consumer expectation survey thus gives every consumer the same weight, independent of their spending e . This is equivalent to first calculating the expenditure share s_{ic} of every good (or service) c in the basket of a consumer i and then averaging these expenditure shares across consumers to obtain overall shares for the survey $s_{c,survey}$.

$$s_{c,survey} = \frac{\sum_i s_{ic}}{\sum_{ic} s_{ic}} = \frac{\sum_i \frac{e_{ic}}{\sum_c e_{ic}}}{\sum_{ic} \frac{e_{ic}}{\sum_c e_{ic}}} \quad (1)$$

In a second step, these average expenditure shares are used together with the current price p_{ct} and the expected price in 12 months p_{ct+12}^e using the Laspeyres formula to calculate the overall rate of inflation INF_{survey} .

$$INF_{survey} = \frac{\sum_c p_{ct+12}^e * s_{c,survey}}{\sum_c p_{ct} * s_{c,survey}} \quad (2)$$

This approach is different from the way the CPI is constructed. In the CPI, consumers are weighted according to their spending and large spenders have a higher weight. This is equivalent to first adding up all the expenditures e_{ic} across consumers i in category c and then calculating the expenditure shares of the aggregate for the CPI $s_{c,CPI}$.

$$s_{c,CPI} = \frac{\sum_i e_{ic}}{\sum_{ic} e_{ic}} \quad (3)$$

The second step is the same as for consumer expectations above, except that the shares are changed to the CPI shares instead of the survey shares.

$$INF_{CPI} = \frac{\sum_c p_{ct+12}^e * s_{c,CPI}}{\sum_c p_{ct} * s_{c,CPI}} \quad (4)$$

⁶One can also use the median instead.

Table 1 illustrates this difference further: Assume there are only two consumers and the two goods food and transportation with the expenditures shown in Table 1. Based on the CPI weighting, food has a weight of $s_{food,CPI} = 41.5\%$ in the aggregate CPI and transportation $s_{transport,CPI} = 58.5\%$. In contrast, in the consumer survey, food has a weight of $s_{food,survey} = 45\%$ and transportation $s_{transport,survey} = 55\%$; the average expenditure share of the two consumers.

Table 1: USD expenditure in food and transportation for two consumers

Consumer	1	2	sum
Food	3,000 (50%)	14,000 (40%)	17,000 (41.5%)
Transportation	3,000 (50%)	21,000 (60%)	24,000 (58.5%)

Expenditure shares in brackets.

If the rates of inflation of the two items are different, then the survey based inflation is different from the CPI. Specifically, if it is assumed that food inflation is higher (e.g. 10% than transportation inflation (e.g. 0%). Then the consumer survey will report a higher rate of inflation than the CPI (e.g. 4.5% and 4.15% for the survey and the CPI, respectively). As a result, the average of consumers predicting their own basket's rate of inflation will be higher than the CPI inflation.

With many consumers in an economy and very skewed consumption patterns, it could be the case that a very large percentage of the population has a higher (or lower) rate of inflation than the CPI inflation implies. Indeed, based on the 2018 US consumer expenditure survey, the top third of spenders had a weight of around $2/3$ in the CPI. In contrast, the top third

of spenders only has a 1/3 weight in consumer surveys.

3 Is General Inflation the CPI?

Most consumer surveys ask respondents about their general inflation perceptions and expectations rather than CPI inflation perceptions specifically. One exception is the UK Inflation Attitudes Survey from the Bank of England. Every first quarter since 2016, it collects CPI perception (Nowcasts) in addition to general inflation perceptions. This can be used to test, whether consumers interpret general inflation as CPI inflation or not. If respondents interpret the two as being different, they do not predict CPI inflation when asked about general inflation. In contrast to the US, the survey asks consumers in categorical ranges instead of point forecasts. The midpoint of the range is used to obtain point perceptions. This allows to test, whether there are differences between the two and thus whether consumers report CPI perceptions when asked about general perceptions. Three statistics are used to compare the two measures: the mean perception error (MPE), which is the difference between the CPI inflation A_t and the perceptions P_t both averaged across individuals and time;

$$MPE = \frac{1}{T} \sum_t \left(A_t - \frac{1}{n_t} \sum_i P_{it} \right) \quad (5)$$

the mean absolute error (MAE), which is the absolute difference averaged across the two dimensions

$$MAE = \frac{1}{T} \sum_t \left| A_t - \frac{1}{n_t} \sum_i P_{it} \right| \quad (6)$$

and lastly the mean squared error (MSE), which is the squared difference averaged across the two dimensions

$$MAE = \frac{1}{T} \sum_t \left(A_t - \frac{1}{n_t} \sum_i P_{it} \right)^2. \quad (7)$$

Table 2 reports these three measures for the different variables.

The first three rows clearly show that general inflation perceptions are generally higher than actual CPI inflation (the second row uses the same sample as CPI perceptions), while CPI perceptions are a touch below actual CPI inflation. This higher perception of general inflation also lead to higher absolute and squared errors relative to CPI perceptions. Given the clear difference in all three statistics, consumers' general inflation perceptions are not the same as CPI perceptions or inflation.

One would expect that respondents that get the CPI perceptions right might be better informed than people who do not. One would thus expect that these respondents make more accurate predictions about general inflation as well. To test whether this is the case, one can take the 20% of respondents who report CPI inflation perceptions closest to the actual CPI inflation and check, what they report as general inflation perceptions. The exact threshold chosen is consumers that report within 0.5 percentage points of the actual CPI inflation. Due to this, their MAE is less than 0.5 and MSE less than 0.25 and one would expect similar numbers for the other variable. If they are very different, then these informed consumers clearly do not think that general inflation is the same as CPI inflation. As row CPI2 reports, they predict much higher general inflation than the CPI inflation and while the respondents are somewhat closer to the CPI than the average

Table 2: Inflation Perceptions UK

	MPE	MAE	MSE
General inflation*	-0.87	1.23	0.92
General2 inflation*	-0.87	1.01	0.87
CPI inflation	0.13	0.73	0.61
General3 inflation [#]	0.32	0.75	0.61
CPI2 inflation [#]	-0.82	0.82	0.79
Same ⁺	-0.22	0.47	0.46

*General uses the full sample for perceptions, while General2 uses the same sample as the CPI perceptions (four observations Q1 2016-Q1 2019). [#]General3 takes the individuals that reported general inflation closest to the CPI and reports their CPI prediction, while CPI2 takes the individuals that reported CPI inflation closest to the CPI and reports their general inflation prediction. ⁺Reports the errors for the respondents who reported the same number for both CPI and general inflation.

for general inflation perceptions, they are still not closer than the average of CPI perceptions. This suggests that these informed consumers do not think the two are the same.

Conversely, one could ask whether the consumers that report general inflation closest to actual CPI inflation think that the two are the same. To test this, one can take the 20% of respondents who report general inflation perceptions closest to actual CPI inflation and check their CPI inflation perceptions. Again, the exact threshold chosen is consumers that report within 0.5 percentage points of the actual CPI inflation. Due to this, their MAE is less than 0.5 and MSE less than 0.25 and one would expect similar numbers for the other variable. As the row General3 in the table reports, this is not the case and consumers with general perceptions close to actual CPI inflation do not report CPI perceptions any different from all consumers included in the survey.

In general, around 20% of consumers reports the same CPI perception and general inflation perception. These respondents have the lowest MAE and MSE as reported in the last row (Same) of Table 2. As consumers report ranges, it is likely that the actual percentage is even lower if consumers were able to give exact numbers. Together, this suggests that for the vast majority of consumers, there is a difference between CPI inflation and general inflation. This is consistent with consumers predicting their own basket's rate of inflation, rather than the CPI.

4 Is a Basket of Goods Predicted?

As consumers are not predicting CPI inflation when asked about general inflation, the question is what do consumers predict. Several researchers suggested that consumers' predictions are closely attached to items consumers buy frequently or to the rate of inflation of a specific category of goods like food prices or the oil price.⁷ The NY Fed consumer survey allows to test this. If consumers predict a the rate of inflation of a basket of items that is not the CPI, then it can be interpreted that they might predict their own basket's rate of inflation. In addition to asking consumers about their general inflation expectations, the survey also asks about the expected rate of inflation in the six categories: food, a gallon of gas, college education, medical care, gold and rent. All these variables are part of the typical consumption basket and can provide evidence as to how consumers form their expectations. Specifically, if consumers only care about food inflation when they are asked about general inflation, there should be a very high correlation between the two inflation rates. If instead consumers find multiple categories important, they should put high weights on more than one category.

An OLS regression of the form

$$INF_{it} = \alpha + \beta x_{it} + \varepsilon_{it} \tag{8}$$

is run, where INF_{it} is the one year ahead expectation of general inflation and x_{it} are the inflation rates for each of the six categories. Given point estimates might have strong outliers that could drive the results, respondents

⁷For example, Brachinger (2008), or Coibion and Gorodnichenko (2015).

who report inflation numbers outside of the range $\pm 100\%$ are excluded from the analysis. The regression uses the survey weights. The results for the six categories including and excluding a constant are shown in the first two columns Table 3.

All categories appear to be statistical significant, however only the coefficients for food and rent are sizable. Indeed, the food (incl beverages) weight in the US CPI is 14.6% for 2016 and rent 7.9%-33.7%, depending if the owners' equivalent rent is included based on data from the Bureau of Labor Statistics. Based on the numbers in the table, it appears that food has a higher weight than in the CPI. Education, medical care and gas are all below 10%, as is their weight in the CPI. It appears that both education and medical care has a somewhat smaller weight than in the CPI, while gas is around the 3% it should be (including only motor fuel). The close to 0% weight of gold is very reassuring, as this indicates that the numbers are broadly representative. If people are asked to provide many numbers, it could be the case that they provide very similar numbers for all of them, because they were asked together. The stark differences in importance suggests otherwise.

Based on the variance explained of 11%-26%, one can also conclude that consumers are not only taking into account at food and rent for their inflation expectations. The well documented outliers in the consumer surveys might also contribute to some of the unexplained variance. Overall, it can be concluded that consumers do not in general just follow one specific category for their inflation expectations but rather use some basket of goods. With around 80% of the variance unexplained, it is also likely that other goods

Table 3: Relative Importance of Categories

	<i>Dependent variable:</i>			
	1-yr ahead inflation expectations			
	(1)	(2)	(3)	(4)
Gas	0.024*** (0.004)	0.039*** (0.004)	0.022*** (0.004)	0.034*** (0.004)
Food	0.235*** (0.007)	0.259*** (0.007)	0.217*** (0.007)	0.233*** (0.007)
Medical	0.028*** (0.004)	0.046*** (0.004)	0.030*** (0.004)	0.045*** (0.004)
Educ	0.036*** (0.005)	0.053*** (0.005)	0.028*** (0.005)	0.041*** (0.005)
Rent	0.179*** (0.006)	0.200*** (0.006)	0.150*** (0.006)	0.163*** (0.006)
Gold	0.013*** (0.004)	0.016*** (0.004)	0.005 (0.003)	0.006* (0.004)
Housing			0.127*** (0.005)	0.147*** (0.005)
Constant	1.777*** (0.061)		1.482*** (0.061)	
Observations	78,143	78,143	78,090	78,090
R ²	0.114	0.256	0.122	0.265
Adjusted R ²	0.114	0.256	0.122	0.265

Note: *p<0.1; **p<0.05; ***p<0.01

and services not included in these specific categories drive the expectations. There still could be periods, where one specific good or service is very important for inflation, like the oil price rise and fall in 2008, but this is not the case over longer periods. Since rent is not one of the every day purchases, but has a relatively high weight, the table is also evidence against the idea that purchase frequency matters a lot.

The general shelter category of the CPI includes both rent and owners' equivalent rent (OER). The survey also asks about housing prices, which are closely related to OER. The last two columns of Table 3 present the regression results including this variable. The inclusion of this variable increases the overall housing weight to 27%-30%, very close to 33% of the shelter category. Two caveats to this analysis are the same weighting issue raised in the model section above and that the importance is assumed constant across individuals and years. Particularly, the CPI weights are based on aggregate consumption shares, while the weights in the table are closer to the average of individual weights. Also people are known to have variations in their relative importance of goods and these also change over time. Together, this is consistent with people predicting a basket of goods, which can be different for different people and is in line with consumers predicting their own basket's rate of inflation.

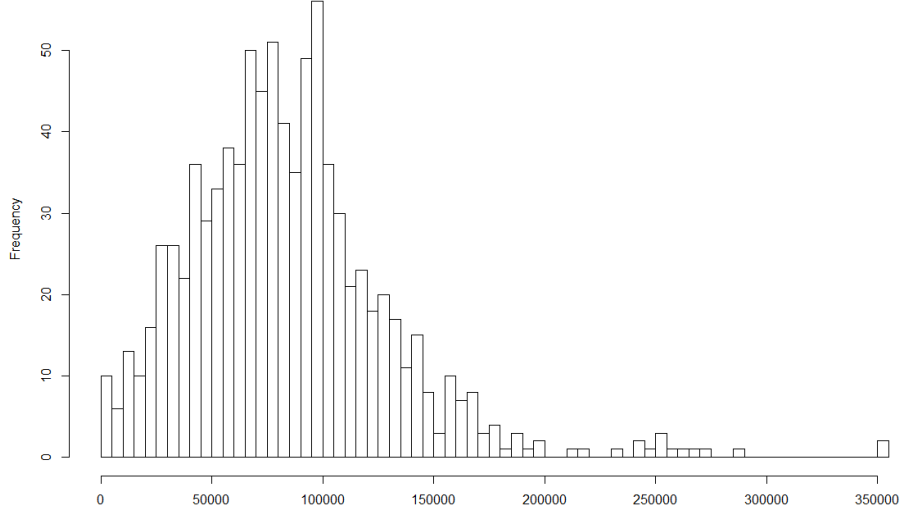
5 Impact of Weighting Differences

There are essentially two options to estimate the impact of the different weightings on the difference between expectations and CPI inflation. The

first option is to reweight CPI inflation to match the weighting of the consumer survey as closely as possible and then compare the two. The second option is to reweight the consumer survey to match the CPI weights as closely as possible and then compare the two. There is already some literature that estimates to what extent CPI inflation would change if it was weighted differently. This corresponds to the former approach and researchers found mixed results for the US. Specifically, Kokoski (2000) found very little difference for the US. Most analyses have the limitation that they assume that the elementary indices are the same. This means that while the weight on chicken might be different for different people, the price index of chicken is the same. As the price changes at different stores or geographic locations are different, this likely underestimates the difference. In addition, the US data has the limitation that not all weights can be produced because it uses two separate surveys that cannot be merged.

As the latter approach has not been undertaken previously, the former is presented here. In order to reweight the survey, the 2018 micro data of consumer expenditure surveys collected by the Bureau of Labor Statistics are used. While the issues of reweighting the CPI are not present when reweighting the consumer survey, there is a new strong limitation. This limitation is the lack of consumer expenditure data in the consumer expectation surveys. Because of this limitation, it is necessary to impute the consumer expenditure for each consumer based on demographic variables. As Figure 1 shows, there is a large variation of income in every consumption bracket. As a result, knowing the income of the consumer is not enough to obtain a good estimate for consumer expenditure.

Figure 1: Histogram of the Income for Consumers Near the Average Consumption Level



The figure shows the histogram of pre tax income in the US for consumers with an expenditure between \$56k-60k per year based on the 2018 Consumer Expenditure Survey.

In order to estimate the consumption of the contributors of consumer expectation surveys, the consumer expenditure surveys are used, which are collected by the statistical agencies to produce the expenditure weights for the CPI. In a first step, the variable definitions in the consumer expenditure survey are matched to the ones available in the expectations survey. For example, the pre tax income is split into 11 brackets in the NY Fed survey. Then the regression are run between the consumer expenditure and the demographic variables based on the following equation

$$EXP_i = \alpha + \beta_1 INC_i + \beta_2 INC_i^2 + \beta_3 SIZE_i + \beta_4 EDU_i + \delta ETH_i + \varepsilon_i \quad (9)$$

Where EXP_i is the natural log of consumer expenditure, INC_i is the in-

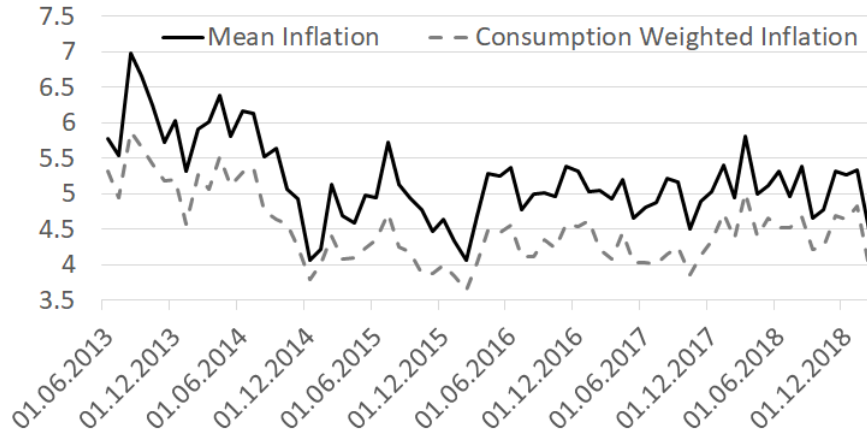
come, $SIZE_i$ is the number of people in the household, EDU_i is the education level of the person responding to the survey and ETH_i is a set of dummy variables for the ethnicity of the person responding.⁸ Table 4 reports the regression results.

Table 4: Consumption Regression	
	<i>Dependent variable:</i>
	EXP (US)
SIZE	-0.172*** (0.013)
EDU	0.061*** (0.002)
INC	0.142*** (0.005)
INC2	0.001*** (0.000)
Constant	9.774*** (0.020)
Observations	23,149
ETH Dummies	Yes
R ²	0.537
Adjusted R ²	0.536
<i>Note:</i>	*p<0.1; **p<0.05; ***p<0.01

⁸Initially, the regression also included the age and gender of the person responding, but neither was found to be statistically significant.

Based on the r-squared, the regression explains around 50% of the variance in consumer expenditure. The next step is to use data to estimate the consumer expenditure for the consumer expectation survey. Once this has been estimated, the consumption weighted mean inflation expectations of the survey can be calculated and compared to the unweighted mean. Figure 2 shows the cross-sectional average inflation expectation with matching samples for the US. It is immediately clear that the consumption weighted expectations are much lower. Indeed, the consumption weighted expectations are 4.5% on average and the unweighted ones 5.2%, a 0.7 percentage point decrease in the inflation expectations or 20-25% of the gap between the average of 5.2% and the 2% of professional forecasters. The two lines in the chart almost move in sync, but small variations are also noticeable like in December 2014, when the difference between the two lines becomes very small.

Figure 2: Comparison of US One Year Ahead Mean Inflation Expectations



This figure shows the average inflation rate forecast from the NY Fed Survey as well as the imputed consumption weighted average.

Consumer expectation surveys typically have outliers. A way to avoid these is to use the median. In the context of consumption weighted expectations, there is no clearly defined median. For example, the inflation expectation of the median spender might be an outlier itself. Moreover, consumers are prone to report rounded numbers. For example, over 17% of consumers reported an expected inflation of 3% over the course of the NY Fed survey. As a result, it is quite likely that the median of a range of consumption expenditure will also give a median of 3%.⁹ Indeed, the median expectations of consumers that have an expenditure of the median plus and minus \$500 is also 3%. This result is relatively robust for different

⁹This is also the reason, why the NY Fed survey makes some adjustments to avoid having a median of 3% in most periods. Essentially, it adds small random errors to all numbers reported before calculating the median.

thresholds as well.

Another sensitivity test is to exclude outliers from the analysis. Restricting the possible inflation expectations within an absolute value of 20 percent maintains a 0.2 percentage point gap between the mean measures. Reducing the cutoff further reduced the variability and increases the share of 3% responses and thus the gap as well. An alternative sensitivity test is to take into account the tenure of survey participants. It is likely that someone who contributed several times to the survey will more accurately predict their own basket's rate of inflation. If the sample is reduced to only include individuals that already contributed at least 6 times to the survey maintains a difference of 0.6 percentage points.

Overall, it appears that the different weighting contributes an estimated 0.7 percentage points or 20-25% of the difference between the CPI and the mean of consumer expectations for the US.

6 Conclusion

This paper aimed to estimate how much of the difference between consumer expectations for general inflation and the CPI is due to different weighting. First, new evidence that consumers report their own basket's rate of inflation is presented showing that they predict a basket of goods and do not interpret general inflation as CPI inflation. Second, the paper estimated the weighting impact for the US and finds that it is around 0.7 percentage points or 20-25% of the gap between consumer expectations and professional expectations. Given the strong data limitations due to the consumer expectation surveys

lacking consumer expenditure data, there is further research needed to more clearly pin down the exact weighting impact.

This also has some clear policy implications. Many social programs are linked to CPI inflation, but this analysis suggests that a large part of the population experiences higher rates of inflation. Beyond social programs, inflation is also important for wage negotiations. The small spenders that have a negligible weight in the CPI are more likely to be parts of the vulnerable population that benefit from the social programs or wage increases. As a result, their standard of living is declining, because too low an inflation rate is used to adjust the payments.

One interesting avenue of future research related to consumers predicting their own basket's rate of inflation could be what role the movement of people has and how this relates to the apparent outliers in the survey. A person planning to move from a rural town to a big city might expect to pay much higher prices once the move happens. This could lead to substantially larger differences in price expectations than if people expect to remain in the same place.

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