

Detailed Methodology for the Survey of Firms' Inflation Expectations (SoFIE)

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1 About SoFIE

The Survey of Firms' Inflation Expectations (SoFIE) is a nationally representative, quarterly survey of chief executive officers (CEOs) and other top executives started by Olivier Coibion and Yuriy Gorodnichenko in the second quarter of 2018. Survey data are collected during the first month of each quarter (January, April, July, and October). The dataset contains a limited number of characteristics about each respondent's firm, including sector, industry, and size. The surveyed firms represent various industries within either the manufacturing sector or the services sector. Within the manufacturing sector, companies are classified into food and drink, textiles and clothing, electrical, chemicals and plastics, transport, timber and paper, basic metals, mechanical engineering, and other manufacturing. Within the services sector, the companies are classified into hotels and restaurants, transport and storage, post and telecommunication, financial intermediation, renting and business activities, and other services. Additionally, firms are classified as small, with 1 to 19 employees; medium, 20 to 249 employees; or large, 250 or more employees. Firms are repeatedly sampled in the survey, providing a panel dimension at the individual-firm level.

SoFIE is a set of five questions asked as part of a longer privately-run survey that is administered by an external company. In each quarter, respondents are asked the following question:

Question 1: “What do you think will be the inflation rate (for the Consumer Price Index) over the next 12 months? Please provide an answer in an annual percentage rate.”

There is also a second question that rotates among a set of four questions. The rotation is as follows:

Question 2A, asked each April (second quarter) survey wave: “What annual inflation rate do you think the U.S. Federal Reserve is trying to achieve on average?”

Question 2B, asked each July (third quarter) survey wave: “What do you think has been the annual inflation rate (for the Consumer Price Index) over the last twelve months? Please provide an answer in annual percentage rate.”

Question 2C, asked each October (fourth quarter) survey wave: “What do you think will be the average inflation rate (for the Consumer Price Index) over the next 5 years? Please provide an average annual percentage rate.”

Question 2D, asked each January (first quarter) survey wave: “What do you think is the probability that the annual inflation rate (for the Consumer Price Index) over the next 12 months will exceed 5%?”

Each quarter, we report the mean and standard deviation for Question 1 and the second question asked.

2 Summary of Methodology

Free-text responses to each question are allowed. While most respondents surveyed provide point estimates as requested by the question, others provide a range, a lower bound only, or an upper bound only. Respondents can also decline to answer the question by, for example, stating that they are unsure or do not know the answer, or by writing another response from which a usable answer to the question cannot be extracted. Because of the free-text nature of the responses, answers are cleaned and sorted into usable and unusable responses prior to calculating means and standard deviations for each survey question.

For each survey, we derive the mean response and the standard deviation across responses separately for both questions asked in that quarter. Aside from question 2D, usable responses are those for which the respondent provides a point estimate or a range estimate. In the latter case, we take the midpoint of the range. For question 2D, we also use responses that provide a lower bound or upper bound probability; in these cases, we either take the midpoint between the lower bound and 100 or the midpoint between 0 and the upper bound. We also interpret responses that imply that inflation will certainly be above (below) 5 percent as implying a probability of 100 percent (0 percent).

For all further calculations, we drop unusable responses. This leaves us with N usable responses for a given question. For each question other than question 2D, we remove outliers by sorting the responses from least to greatest and dropping the bottom 5 percent of the N responses and the top 5 percent of the N responses.

We then apply survey weights to the remaining responses. These are post-stratification weights calculated to make the sample representative relative to the distribution of annual pay-

rolls by industry and firm size. Beginning with 2023:Q2, payroll data are obtained from the most recently available Statistics of US Businesses (SUSB) from the United States Census Bureau. Prior to this date, sample weights are calculated with the 2019 release of the SUSB. Each usable survey response is assigned a weight based on the industry and size of the respondent firm, and we renormalize the weights by dividing each response weight by the sum of the weights across all usable responses. Thus, our results are weighted trimmed means and standard deviations, with the exception of question 2D responses, which are not trimmed.

3 Detailed Data-Cleaning Methodology

The SoFIE data cleaning methodology takes Candia et al. (2021) as its starting point.¹ However, there are three key differences. First, we use trimmed means and trimmed standard deviations that remove extreme values based on the potentially changing distribution of responses in each quarter, departing from the prior practice in Candia et al. (2021) to trim responses greater than 15 percent or less than -2 percent regardless of the shape of the distribution. Second, we revised the methodology for calculating survey weights to better adjust for instances in which there are zero usable responses to a question from firms from a given combination of economic sector and firm size and to be able to more frequently and efficiently update the economic data underlying the weights. Third, for question 2D, our interpretation of usable responses differs, and we include answers in which the respondent gives an upper bound or a lower bound probability only along with answers that do not contain a numerical probability but do imply certainty about the outcome.

3.1 Categorize responses into subgroups, and label them with a "flag"

For all questions excluding question 2D, the following flags are assigned to each response:

1. Point: If the interviewee gives a specific number.
2. Range: If the interviewee gives both an upper bound and a lower bound.
3. NA: Unusable responses. These include responses in which the interviewee is unsure, does not know the answer, does not respond to the question, says the value will increase/decrease/not change from its current or preceding value, or provides only a lower bound or only an upper bound.

For question 2D only, the following flags are assigned to each response:

1. Point: If the interviewee gives a specific probability. Additionally, answers indicating that the interviewee believes inflation will remain below 5 percent are coded as 0 percent probability, whereas answers indicating the belief that inflation will be above 5 percent are coded as 100 percent probability.
2. Range: If the interviewee gives both an upper bound and a lower bound.
3. Upper bound: If the interviewee gives only an upper bound on the probability.
4. Lower bound: If the interviewee gives only a lower bound on the probability.
5. Likely: If the interviewee gives some variation of the response "it is likely to occur."
6. Unlikely: If the interviewee gives some variation of the response "it is unlikely to occur."

¹Candia, Bernardo, Olivier Coibion, and Yuriy Gorodnichenko. 2021 "The Inflation Expectations of US Firms: Evidence from a new survey." NBER WP No. w28836. National Bureau of Economic Research. <http://www.nber.org/papers/w28836>

7. NA: All other unusable responses. Includes responses such as "possible," "maybe," or "it might."

3.2 After flags are assigned, assign "clean" responses

For all questions excluding question 2D:

1. If Flag = Point, assign the point estimate to "clean". Any value given which is in the interval $[-0.2, 0.2]$ and is not specified to be a percent in the raw answer is taken to be a percentage; for example, 0.1 will be replaced by 10 percent but "0.1%" will be coded as 0.1.

2. If Flag = Range, assign the lower bound to "lower" and the upper bound to "upper". If at least one of "lower" or "upper" is in the interval $[-0.2, 0.2]$ and if the range was not specified to be a percent in the raw answer, both "lower" and "upper" are taken to be a percentage; for example "0.1 to 0.25" is taken to be 10 percent to 25 percent but "0.1-0.25%" is taken to be 0.1 percent to 0.25 percent. Assign the "clean" value to be the midpoint between values "lower" and "upper".

For question 2D only:

1. If Flag = Point, assign the point estimate to "clean".
2. If Flag = Range, assign the lower bound to "lower" and the upper bound to "upper".
3. If Flag = Upper bound, assign 0 to "lower" and assign the given upper bound to "upper".
4. If Flag = Lower bound, assign the given lower bound to "lower" and assign 100 to "upper".
5. Any value in "clean", "upper", or "lower" which is in the interval $(0, 1]$ and is not specified to be a percent in the raw answer is taken to be a percentage; for example, 0.8 will be replaced by 80 percent but "0.5%" will be coded as 0.5. Additionally, any value above 100 is replaced with 100, and any value below 0 is replaced with 0.
6. For responses flagged as range, upper bound, or lower bound, assign the "clean" value to be the midpoint between values "lower" and "upper".

For all questions, usable responses are those for which a "clean" value can be assigned; all other responses are dropped for the purpose of computing weighted means and standard deviations.

3.3 Trim outlier responses

For each survey and each question except question 2D, we trim outlier "clean" values as follows. Suppose there are then N responses with "clean" values. Let $n = \text{floor}(0.05 \cdot N)$. We then sort the N responses, first by "clean" value from lowest to highest, and then by firm ID. We then remove the bottom n responses and the top n responses. That is, if i is the row number of each observation after sorting, we keep any observation with $i \in (n, N - n]$. This leaves $N - 2n$ responses.

3.4 Calculate the weights

To conduct the survey, the survey company built a panel of firms from the manufacturing and services sectors in which the share of firms in a given industry in the panel is representative of that industry's contribution to the gross value added. The industry classification of companies is based on ISIC divisions. Sample weights used by the survey company to construct the panel

were not provided, so it was necessary to perform a reverse-engineering process to build weights that make the survey representative at the gross-value-added level. Economic data by company size and industry was obtained from the Census Bureau’s Statistics of US Businesses (SUSB) Annual Datasets by Establishment Industry for the U.S. & states, which offers size- and industry-specific data on the number of firms, number of establishments, employment, and annual payroll. Industry classification in the SUSB is based on the North American Industry Classification System (NAICS). As SoFIE uses the ISIC classification and the SUSB uses NAICS, it was necessary to make a concordance between both industrial classification systems. Appendix 1 provides a detailed description of this concordance.

We construct weights to make the survey representative of the observed payroll distribution, understanding payroll as a proxy of gross value added. Beginning with 2023:Q2, payroll data are obtained from the most recently available SUSB; in 2023:Q2, this was the 2020 SUSB. Prior to this date, sample weights are calculated with the 2019 release of the SUSB. We use the headline SUSB Annual Datasets by Establishment Industry for the U.S. & states table rather than the "detailed employment sizes" table because of the reduced incidence of noise being applied to payroll cells. For small firms, we take payrolls for firms with Enterprise Employment size of <20 employees. For medium firms, we take the sum of payrolls for firms with Enterprise Employment size of 20-99 employees and 37.5 percent of payrolls for firms with Enterprise Employment size of 100-499 employees, for which the latter is an estimate of payrolls for companies with between 100 and 249 employees.² For large firms, we take the total reported payrolls minus the payrolls obtained for small and medium firms.

Weights are calculated on a survey-question-by-survey-question basis. Prior to calculating weights, we drop all unusable responses (those for which a "clean" value cannot be assigned) and trim. If we then have a response from at least one firm for each ISIC division and company size (hereafter, ISIC-size), the weight calculation is straightforward. For each survey question and ISIC-size, we conduct the following steps:

1. Calculate the fraction of total annual payroll belonging to that ISIC-size, relative to the total annual payroll across all ISIC sectors in the survey.
2. Calculate the fraction of firms belonging to that ISIC-size who responded to the survey question, relative to the total number of unique firms who responded to the survey question.
3. The final weight for the ISIC-size is then the ratio between (1) and (2).

In practice, after dropping unusable responses and trimming, it has always been the case that there are no sampled firms within some ISIC-sizes. It is therefore necessary to adjust the process of constructing final weights to ensure they are still representative. Full technical details on how this is achieved may be found in Appendix 2.

3.5 Calculate the mean and standard deviation

After dropping unusable survey responses and trimming, each remaining survey response is assigned a weight based on the ISIC-size of the respondent firm. To calculate the weighted mean and standard deviation (SD), we renormalize the weights by dividing each response weight by the sum of the weights across all usable responses. Since a firm could provide a usable response for one question while not providing a usable response for the other question, the process of calculating the weighted mean and SD is done independently for each question.

²We use 37.5 percent because $(249 - 100)/(499 - 100) \approx 150/400 = .375$.

4 Appendix 1: ISIC-NAICS Concordances

4.1 Manufacturing Concordance

Table 1: SoFIE Manufacturing ISIC-NAICS Concordance

ISIC 3.1 Description	ISIC 3.1 Code	SICDescription	ISIC4 Code	ISIC4 Description	NAICS 2017 Code	NAICS Description
Food & Drink	1500	MANUFACTURE OF FOOD PRODUCTS AND BEVERAGES	10	Manufacture of food products	311	Food Manufacturing
			11	Manufacture of beverages	312	Beverage and Tobacco Product Manufacturing
	1600	MANUFACTURE OF TOBACCO PRODUCTS	12	Manufacture of tobacco products		
Textiles & Clothing	1700	MANUFACTURE OF TEXTILES	13	Manufacture of textiles	313	Textile Mills
	1800	MANUFACTURE OF WEARING APPAREL; DRESSING AND DYEING OF FUR	14	Manufacture of wearing apparel	314	Textile Product Mills
	1900	TANNING AND DRESSING OF LEATHER; MANUFACTURE OF LUGGAGE, HANDBAGS, SADDLERY,	15	Manufacture of leather and related products	315	Apparel Manufacturing
Timber & Paper	2000	MANUFACTURE OF WOOD AND PRODUCTS OF WOOD AND CORK, EXCEPT FURNITURE;	16	Manufacture of wood and of products of wood	321	Wood Product Manufacturing
	2100	MANUFACTURE OF PULP, PAPER AND PAPER PRODUCTS	17	Manufacture of paper and paper products	322	Paper Manufacturing
	2200	PUBLISHING, PRINTING AND REPRODUCTION OF RECORDED MEDIA	18	Printing and reproduction of recorded media	323	Printing and Related Support Activities
Chemicals & Plastics	2300	MANUFACTURE OF COKE, REFINED PETROLEUM PRODUCTS AND NUCLEAR FUEL	19	Manufacture of coke and refined petroleum	324	Petroleum and Coal Products Manufacturing
	2400	MANUFACTURE OF CHEMICALS AND CHEMICAL PRODUCTS	20	Manufacture of chemicals and chemical products	325	Chemical Manufacturing
	2500	MANUFACTURE OF RUBBER AND PLASTIC PRODUCTS	21	Manufacture of pharmaceuticals, medicinal	326	Plastics and Rubber Products Manufacturing
Basic Metals	2700	MANUFACTURE OF BASIC METALS	24	Manufacture of basic metal	331	Primary Metal Manufacturing
	2800	MANUFACTURE OF FABRICATED METAL PRODUCTS, EXCEPT MACHINERY AND EQUIPMENT	25	Manufacture of fabricated metal products, except	332	Fabricated Metal Product Manufacturing
Mechanical Engineering	2900	MANUFACTURE OF MACHINERY AND EQUIPMENT NOT ELSEWHERE CLASSIFIED	28	Manufacture of machinery and equipment	333	Machinery Manufacturing
	3000	MANUFACTURE OF OFFICE MACHINERY AND COMPUTERS	26	Manufacture of computer, electronic and optical	334	Computer and Electronic Product Manufacturing
Electrical	3100	MANUFACTURE OF ELECTRICAL MACHINERY AND APPARATUS NOT ELSEWHERE CLASSIFIED	27	Manufacture of electrical equipment	335	Electrical Equipment, Appliance, and Component Manufacturing
	3200	MANUFACTURE OF RADIO, TELEVISION AND COMMUNICATION EQUIPMENT AND APPARATUS				
Transport	3300	MANUFACTURE OF MEDICAL, PRECISION AND OPTICAL INSTRUMENTS, WATCHES AND CLOCKS				
	3400	MANUFACTURE OF MOTOR VEHICLES, TRAILERS AND SEMI-TRAILERS	29	Manufacture of motor vehicles, trailers and semi-	336	Transportation Equipment Manufacturing
Other	3500	MANUFACTURE OF OTHER TRANSPORT EQUIPMENT	30	Manufacture of other transport equipment	337	Nonmetallic Mineral Product Manufacturing
	3600	MANUFACTURE OF OTHER NON-METALLIC MINERAL PRODUCTS	23	Manufacture of other non-metallic mineral	327	Furniture and Related Product Manufacturing
	3700	RECYCLING	31	Manufacture of furniture	337	Furniture and Related Product Manufacturing
			32	Other Manufacturing	339	Miscellaneous Manufacturing
			N/A (Included in 38)	not a manufacturing	N/A (Included in 56)	N/A

Source: Federal Reserve Bank of Cleveland

4.2 Services Concordance

Table 2: SoFIE Services ISIC-NAICS Concordance

ISIC 3.1 Description	ISIC 3.1 Code	SICDescription	ISIC4 Code	ISIC4 Description	NAICS 2017 Code	NAICS Description
Hotels & Restaurants	5500	HOTELS AND RESTAURANTS	55-56	Accommodation and food service activities	72	Accommodation and Food Services
Transport & Storage	6000	LAND TRANSPORT; TRANSPORT VIA PIPELINES	49	Land transport and transport via pipelines	48-49 ex. 491 and	Transportation and Warehousing
	6100	WATER TRANSPORT	50	Water transport	492	
	6200	SUPPORTING AND AUXILIARY TRANSPORT ACTIVITIES; ACTIVITIES OF TRAVEL AGENCIES	52	Warehousing and support activities for	493	
Post & Telecommunication	6400	POST AND TELECOMMUNICATIONS	51	Mail transport	491	Postal Service
	6500	FINANCIAL INTERMEDIATION, EXCEPT INSURANCE AND PENSION FUNDING	60	Postal and courier activities	492	Couriers and Messengers
Financial Intermediation	6600	INSURANCE AND PENSION FUNDING, EXCEPT COMPULSORY SOCIAL SECURITY ACTIVITIES AUXILIARY TO FINANCIAL INTERMEDIATION	61	Telecommunications	517	Telecommunications
	6700	REAL ESTATE ACTIVITIES	64-66	Financial and insurance activities	52	Finance and Insurance
	7100	RENTING OF MACHINERY AND EQUIPMENT WITHOUT OPERATOR AND OF PERSONAL AND	68	Real estate activities	53	Real Estate and Rental and Leasing
Renting & Business Activities	7200	COMPUTER AND RELATED ACTIVITIES	58	Publishing activities	511	Publishing Industries (except Internet)
	7300	RESEARCH AND DEVELOPMENT	60	Programming and broadcasting activities	515	Broadcasting (except internet)
	7400	OTHER BUSINESS ACTIVITIES	62	Computer programming, consultancy and related	519	Other Information Services
			63	Information service activities	518	Data Processing, Hosting, and Related Services
			69-75	Professional, scientific and technical activities	54	Professional, Scientific, and Technical Services
			77-82	Administrative and support service activities	561	Administrative and Support Services
Other Services	8000	EDUCATION	85	Education	61	Educational Services
	8500	HEALTH AND SOCIAL WORK	86-88	Human health and social work activities	62	Health Care and Social Assistance
	9000	SEWAGE AND REFUSE DISPOSAL, SANITATION AND SIMILAR ACTIVITIES	36-39	Water supply; sewerage, waste management and	562	Waste Management and Remediation Services
	9100	ACTIVITIES OF MEMBERSHIP ORGANISATIONS NOT ELSEWHERE CLASSIFIED	94	Activities of membership organizations	N/A	N/A
	9200	RECREATIONAL, CULTURAL AND SPORTING ACTIVITIES	90-93	Arts, entertainment and recreation	71	Arts, Entertainment, and Recreation
	9300	OTHER SERVICE ACTIVITIES	59	Motion picture, video and television programme	512	Motion Picture and Sound Recording Industries
			95-96	Other service activities	81	Other Services (except Public Administration)

Source: Federal Reserve Bank of Cleveland

5 Appendix 2: Weights-Building Computational Details

If we have at least one surveyed firm for each ISIC division and company size (ISIC-size) with a response for a particular survey question, post-stratification weights are computed as follows. We have strata j_k , where each j corresponds to a different ISIC code and $k \in \{1, 2, 3\}$ denotes either small, medium, or large firms, respectively. For each survey question, we collect n_{j_k} responses for each stratum for a total of $n = \sum_{j,k} n_{j_k}$ responses across strata. Let $y_{j_k,i}$ denote response i within stratum j_k , and let $\bar{y}_{j_k} = \frac{1}{n_{j_k}} \sum_{i \in j_k} y_{j_k,i}$ denote the mean response for stratum j_k .

In the population, stratum j_k represents proportion P_{j_k} of the population, where P_{j_k} is the fraction of total annual payroll belonging to stratum j_k , relative to the total annual payroll across all strata. The weight for stratum j_k is then

$$w_{j_k} = \frac{P_{j_k}}{n_{j_k}/n}$$

where n_{j_k}/n represents the number of sampled firms in stratum j_k as a fraction of the total

number of sampled firms. The weighted mean for each question is then

$$\bar{y} = \sum_{j_k} P_{j_k} \bar{y}_{j_k} = \frac{\sum_{j_k} w_{j_k} n_{j_k} \bar{y}_{j_k}}{\sum_{j_k} w_{j_k} n_{j_k}} = \frac{\sum_{j_k} w_{j_k} \sum_{i \in j_k} y_{j_k, i}}{\sum_{j_k} w_{j_k} \sum_{i \in j_k} 1} = \frac{\sum_{j_k} \sum_{i \in j_k} w_{j_k} y_{j_k, i}}{\sum_{j_k} \sum_{i \in j_k} w_{j_k}}$$

This is simply a weighted average in which the weight assigned to observation j_k, i varies according to j_k .

In reality, calculating \bar{y} for any one survey question is complicated by two factors. First, as of 2023Q1, prior to any data cleaning, it has always been the case that $n_{j_k} = 0$ for at least one j_k ; that is, there are no sampled firms within stratum j_k . Second, after data cleaning, it is normally the case that the set of j_k for which $n_{j_k} = 0$ increases.

If, for a particular j , $n_{j_k} = 0$ but $n_{j_{k'}} \neq 0$ for some $k \neq k'$, collapse the strata j_1, j_2 , and j_3 into a single stratum j by defining

$$n_j = \sum_k n_{j_k}$$

and

$$P_j = \sum_k P_{j_k}$$

Assign weight $w_j = \frac{P_j}{n_j/n}$ to any observation $y_{j_k, i}$, and then proceed as before. In other words, if J' is the set of all j such that $n_{j_k} = 0$ for some k , our strata becomes

$$(j_k | j \notin J') \cup (j | j \in J')$$

If, on the other hand, for a particular j , $n_{j_1} = n_{j_2} = n_{j_3} = 0$, we recalculate all P_{j_k} after excluding the payroll of ISIC code j from the total annual payroll across all ISIC sectors in the survey and drop stratum j from any further calculations. In other words, if J'' is the set of all j such that $n_{j_k} = 0$ for **all** k , our strata becomes

$$(j_k | j \notin J'')$$

In the case where we have elements in both J' and J'' , our strata becomes

$$(j_k | j \notin J' \cup J'') \cup (j | j \in J')$$