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List of Abbreviations

AAPOR	American Association for Public Opinion Research
AD	Aggregate demand
AS	Aggregate supply
BCS	Joint Harmonised EU Programme of Business and Consumer Surveys
BOP-HH	Bundesbank‘s Online Panel Households
CB	Central bank(s)
CE	Consensus Economics (professional forecasting company)
CES	Consumer Expectation Survey
ECBS	European Commission Business Survey (part of BCS)
ECCS	European Commission Consumer Survey (part of BCS)
EC	European Commission
ECB	European Central Bank
EP	European Parliament
Fed	Federal Reserve System
HFCS	ECB‘s Household Finance and Consumption Survey
HICP	Harmonised index of consumer prices
HICPX	HICP excluding energy and unprocessed food (core inflation)
IE	Inflation expectation(s)
ILB	inflation-linked bond(s)
ILS	inflation-linked swap(s)
SIGE	Survey on Inflation and Growth Expectations
SCE	Fed‘s Survey of Consumer Expectations
SPF	ECB’s Survey of Professional Forecasters

List of Symbols

i_t	policy interest rate
π^*	inflation target
π^e	expected inflation
π_t	realized inflation (any period, usually one year)
π^e_{t+1}	expected inflation at time $t+1$ from the perspective of time t (one-period lookahead)
r_t	natural rate of interest (NRI)

1 Introduction

Expectations, for most economic agents a subjective-psychological quantity,[1] and inflation, the *change* of price levels, play a major role in Economics. Unsurprisingly, their combination, the *inflation expectations* (IEs), play a major role as well: a household which formed a high short-term—that is: soon— IE will expect higher wages in the wage negotiations to come to compensate for a anticipated loss of purchasing power, while a *realised* higher wage will lead to a cost push that eventually increases price levels— the *expectation* realizes itself in process of self-fulfilment. As such, measures of IEs are classically used by central banks (CB) to figure out where inflation is heading (Sousa et al., 2016, p. 42).

While it is impossible to measure the somewhat elusive IEs directly, economic agents can be *enquired* about their expectations (Schafer, 2022, p. 1). This may, for instance, take the form of targeted surveys or randomized controlled trials via online-panels. Inherently, the resulting data will carry *uncertainty*, as the knowledge of agents is limited and often the personal biases are implicitly represented.

Furthermore, IEs, measured by observing financial markets participants and *market data*, have been found useful by CBs to obtain data on asset prices, such as stock prices and interest rates— the second classic use-case for IEs from the perspective of the CBs (Weber et al., 2022, p. 158).

When it comes to *long*-term IEs the primary economic agents, households (and firms), will think about the goals of the central bank (CB) as the CB with its means of monetary policy will try to attain its—nowadays usually announced—inflation target. The economic decisions of the aforementioned economic agents depends on the IEs, namely in consumption and investment. The long-term IEs are said to be *anchored*[2], when the *long*-term IEs align to the announced inflation goal. As the IEs are taken as a summary statistic this is understood not only to be mean-centered around the inflationary goal, but also that the variance of the IEs among the households and firms is low, otherwise the most notable empirical features of IEs may not be accounted for (D'Acunto et al., 2023, p. 144). By taking this perspective it can be seen that this directly relates to the *trust* in the CBs: the CB is trusted to reach their stated inflationary goal, when the households and firms expect the goal to be reached; with the implication being a reduced inflation persistence (Bems et al., 2021, p. 1–2).

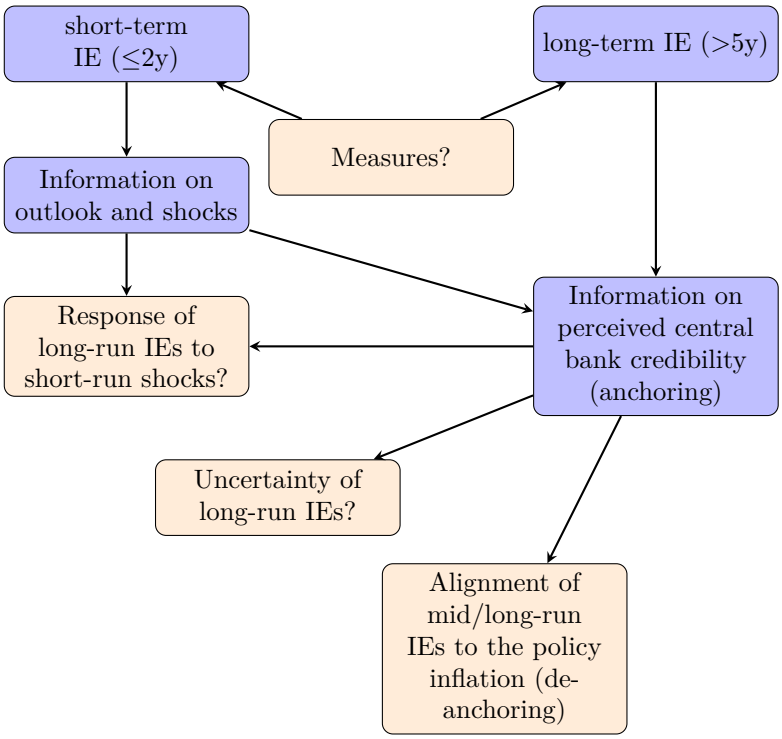
Figure 1 illustrates the research goal of this paper. Short-run IEs are taken to be up to two years, medium-run means two to five years, and long-run expectations are ranging from a horizon with five or more years. The Federal Reserve System (Fed) also considers the current and next term as a near-term horizon with bottom-up analysis of specific product prices (Bernanke, 2007), which is of no concern in this paper.

The first major question is how IEs of different time horizons can be measured and how the measures differ. There are survey-based measures surveying households and

1. This is when not following the rational-expectation framework (D'Acunto et al., 2023, p. 133 f.). Note that full information rational expectations (FIRE) models do not allow for any dispersion in subjective expectations in economic agents—contradictory to the data.

2. Note that there is some imprecision in this definition. There is no agreed precise definition of anchoring in the state of the art. Not every CB announces its inflationary goal and there are different interpretations of what *alignment* could contextually mean. Usually, long-term IEs are considered for anchoring (Beckmann et al., 2022, p. 11).

Figure 1: Relationship of short- and long-term IEs and the research goal.



Source: author's own illustration adapted from the Monetary Dialogue Preparatory Meeting (Feb 2 2022) presentation for Beckmann et al. (2022) which is adapted of ECB (2021c, p. 41).

firms, market-based, and professional forecasters, who survey experts in the field. The first group has been found lacking in particular, although there is no obvious and unambiguous way to measure IEs (Beckmann et al., 2022, p. 8). How *accurate* are they in their prediction of actual inflation, and how *uncertain* are the measures in relation to the IEs? To answer this question the properties of the measures and their interrelation to economic decision making and the agents in question must be analysed.

The second group of questions are related to the *meaning* of the measures of IE. Short-run measures provide information about inflation developments in the near-term, but the question remains on how the *long*-run IEs respond to price-level relevant short-run shocks—possibly even multiple ones like the EU is facing currently. As an implication of the subjective nature of the IE measures based on surveys and analytical forecasting errors, the follow-up question arises as to how *certain* forecasts of long-run IEs are. Certainty is understood as a subjective quantity with limited knowledge, as perfect predictability of events leading to short-run shocks are inherently impossible.

The inflationary goals of CBs are usually set to be medium-run, in particular for the ECB (Hoffmann et al., 2023, p. 1). In the case of the ECB, the inflationary goal was made symmetric around 2% to avoid IEs to anchor *below* the two percent target—a likely event in the economic scenery after the Great Financial Crisis (2007–2008)—rather than the more classic case of anchoring *above* the inflationary goal. Nevertheless, the long-term IE measures provide a key signal of CB policy credibility and as such are the focus of this paper (Adrian, 2023).

The effect of *de-anchoring* is a detachment of the long-term IEs from the ECB's (or

any other CB's) long-term inflationary target. Thus it describes a loss of confidentality of the CB. Persistent high inflation increases the risk of de-anchoring, as households' and firms' higher IEs cause inflationary pressure (Beckmann et al., 2022, p. 25). This gives rise of the last question: how are the economic agents' IEs aligned to the policy inflation (set by the CB) or can a de-anchoring be observed?

The first question can thus be summarized as,

> "What are the measures of inflation expectations (IEs)
> and how do they compare in accuracy and uncertainty?"

And the second question—restricted on the ECB to keep the scope managable—,

> "How do measured long-term IEs align with the ECB's inflation goal
> and how robust against shocks and certain are the results?"

It shall be noted, due to time and space constraints, that the main focus is to introduce the measures of IEs. A complete and exhaustive analysis of the aforementioned questions would require research-level resources. Therefore, it may be an advantageous to think of the answering as a form of sea trial for the concepts introduced.

The literature in Economics in regards to inflation expectation is plentiful, for the empirical side from the point-of-view of a CB the bibliography of (ECB, 2021c, p. 108–117) may point to a relevant subset. A critical—moderately interesting—voice may be found at (Rudd, 2021, p. 2 ff.).As in regards to empirical measures of IE, this paper mostly focuses on the EU situation. Common measures from the US can be found at (D'Acunto et al., 2023, p. 135–138).

2 Theory

Inflation expectations are first and foremost a theoretical construct—a quantity that *cannot* be observed directly. As such, all empirical measures of IE are forced to observe proxies (Beckmann et al., 2022, p. 8).

In the following section, some theory is introduced to form a fundamental problem sensitivity and understanding about inflation expectations. This knowledge is being picked up again, when the measured data is discussed and understood in how it relates to IEs.

As we are in a macroeconomic setting, we consider the expected inflation π^e to be an aggregate statistic of economic agents. More precisely, we denote:

$$\pi^e_{t+1} := E_t\left[\pi_{t+1}\right] := E\left[\pi^{t+1} \mid \text{economic agents with knowledge/beliefs at } t\right], \quad (1)$$

as the (aggregated) inflation expectation in the *one-period look-ahead*. Note that the definition in Equation 1 is *global* and not on an individual level, i.e. for each individual economic agent. When taking the inflationary target π^*, one way to define anchoring is to assume $\pi^e_{t+1} = \pi^*$ independently of any short-term shocks for a period long enough to correspond to mid-/long-run IEs (Bonatti et al., 2022, p 11). This

approach of defining anchoring does not capture the de-anchoring of IE for certain groups or makes precise the exact horizon, both of which is a goal of monetary policy to keep anchored (Adrian, 2023).

This definition is symmetric to the (past) oriented definition of *inflation*. Given the price levels P_t at time t, define

$$\pi_t = \frac{P_t - P_{t-1}}{P_{t-1}}, \tag{2}$$

as the inflation rate at time t (with a "one-period look-behind"). The inflation rate is the *relative* change of prices from the perspective at $t-1$ happening during the period. One fundamental—yet important—problem of macroeconomics is how to define the price levels. One way is to define P_t as the GDP deflator, a production based quantity, or by consumer price indexes which resemble the *cost of living* (Blanchard et al., 2021, p. 35–37). These kind of inflation indexes are introduced in Section 3.1.

Comparing equation 2 and equation1, both quantities, the IE and the inflation itself, suffer from the problem of measuring. Though in the case of the IEs, the knowledge and dependence on subjective beliefs of the economic agents add another layer of complexity. Furthermore, looking back is an empirical problem, looking ahead a predictive problem.

To study the elusive concept of IE, the influence of this factor in the economic process can be reflected[3]. From the CB's perspective, the IEs of the households and firms are of primary interest due to their role in the monetary transmissions mechanism. This is captured by the "expectations channel" (cf. Figure 2). Looking at Table 1 the influence of the inflation expectation is organized in a AD-AS-model.

Table 1: IE and households and firms in the AD-AS-model

economic agent	aggregate demand (AD)	aggregate supply (AS)
households	consumption/durable goods	wage indexation
firms	capital goods	wage indexation cost push price making

Source: adapted from (Bonatti et al., 2022, p. 8).

The AD-model captures the effect of the price level on output by deriving it from the equilibria conditions of the markets of the goods and financial markets. The households are influenced by the *intertemporal price effect* (or intertemporal substitution), that is, the expected price changes are taken into account in the planned spending—withholding or immediate purchase–of the household (Weber et al., 2022, p. 158).

For common goods, an expected increase of prices—ceteris paribus—will lead to an

3. Overthinking on the chicken or the egg type problem when asking whether IE even exists, is at best a philosophical—classifying it as philosophical already puts undeserved value into the question—nonsense problem leading to intellectual nihilism. This paper introduces surveys where the questions are mindfully prepared to reflect the concept of IE, and the responses to these questions empirically link with decision making of the economic agents. As this involves, among other fields, psychology, the empirical results may look messy and might raise the understandable desire for a theoretical framework or system. One may call it the normative power of "tangible results" that ought to make the scientific mind receptive of the concept of inflation expectations.

increased time preference, i.e. a higher likelihood of buying *now*. This increases short-term demand of goods, further pressuring prices (so-called demand-pull inflation). The aforementioned effects has been empirically confirmed (Beckmann et al., 2022, p. 10).

For durable goods, like houses, the household inspects the *real interest rate* along the length of the mortgage payments. The real interest rate r relates *approximatively* to the inflation π and the nominal interest rate i qua the Fisher effect,[4]

$$r = i - \pi. \tag{3}$$

The proof of the approximation can be found in (Blanchard et al., 2021, p. 564).

The households, or more general agents,—if acting rationally—will insert *their* expectation for π^e, more precisely for agent i we obtain:

$$r_t^i = i_t - E_t^i \left[\pi_{t+1}\right], \tag{4}$$

as the *perceived* real interest rate r_t^i by agent i at time t. The lower the perceived interest rate r_i^t is, the lower will be the perceived financial effort for i to fullfill the mortgage payments, thus the demand for durable goods increases for i.

In aggregation, higher individual IEs correspond to a higher π_{t+1}^e, as the latter is defined as the mean of individual perceived inflation rates (cf. equation 1). Implying that a higher IE π_{t+1}^e, leads to a lower real interest rate by the Fisher equation 3. A lower interest rate in turn leads c.p. to a higher demand for durable goods by households. Summed up in formulas: $\pi^e \uparrow \rightarrow r^e \downarrow \rightarrow$ demand for durable goods $\uparrow$. This is also why real interest rate is sometimes simply called inflation-adjusted interest rate.

The firms' demand for capital goods increases with a lower real interest rate as well. This is because more investment projects become viable with a lower real interest rate. Or, the future profits discount factor becomes smaller (p. 349–350). The "expectation channel" affects the "real interest rate channel" in the aforementioned two ways.

On the supply side the AS-model captures the effect of the production on the price levels, this is mostly qua wage setting on the labour markets.

As for the role of the labour market, assuming an absence of *money illusion*, i.e. the negotiation is about the *real* value of wages (Shafir et al., 1997), an expected increase in prices will lead to higher demands from the labourers' side. As contract negotiations inherently have nominal rigidities—as new salaries are not negotiated daily, sometimes even not by the economic agent himself rather than a collective bargaining entity (like trade unions)—there is a time delay included, which makes it impossible to take only realized inflation into account (if so, the labour would be provided for a subpar real wage before the next negotiation cycle), thus the expected inflation of the *next contractual period* is relevant.

The cost-push inflation is an inflationary effect that is caused by a general increase in prices on the input costs of firms. Like in the aforementioned case of wage negotia-

4. The interaction term between r and π^e is ignored for simplicity.

tions, the pushing of costs does suffer from rigidities as well, as it takes time to adapt the prices of goods and push them into the sales pipeline or renegotiate contracts (so-called menu costs). A higher IE will lead firms to expect their costs to increase even outside of wage negotiations, which happens to act on the supplier side as well. This process can potentially lead to the wage-price spiral as workers aim to maintain their real power purchasing parity in times of increasing prices. Eventually, this can result in a high persistent inflation and de-anchored IEs. Additionally, firms may anticipate further supply shocks, which are embedded into the firms' IEs. Regardless of whether the supply shock factually happens, the *fear* alone will suffice to affect the firm and the overall economic situation. The underlying problem is for the firms' decision makers to distinguish between temporary and persistent changes (Beckmann et al., 2022, p. 11).

There is also the factor of *price setting* to be considered. First, there is the assumption of *sticky prices*, i.e. that there is a rigidity of prices in the market in the sense that the prices are not adjusted quickly to the ideal prices. This is, among other reasons, because of the *menu costs*, i.e. the cost of change of prices, and contract negotiations. Despite the mere pushing of increasing costs (i.e. adjusting the price as a markup over the costs), firms will set prices depending on their IE. This is for instance captured by the concept of *greedflation*. This concept combines "greed" and "inflation," suggesting that some price increases during the pandemic were driven not just by supply chain disruptions or increased costs, but by opportunistic pricing strategies. There is some empirical evidence that a predatory price setting has had happened in U.S. retailing (Dekimpe et al., 2023, p. 332). If firms were to systematically abuse elevated households' IEs by higher pricing ("flying under the rader"), this would also incentivize firms to run influence campaigns on the price perception of the populace to grow their profit margin.[5]

Note that this is a simplification of the influence of IE to the economic decision process, which is, in fact, more complex (Beckmann et al., 2022, p. 9–10).

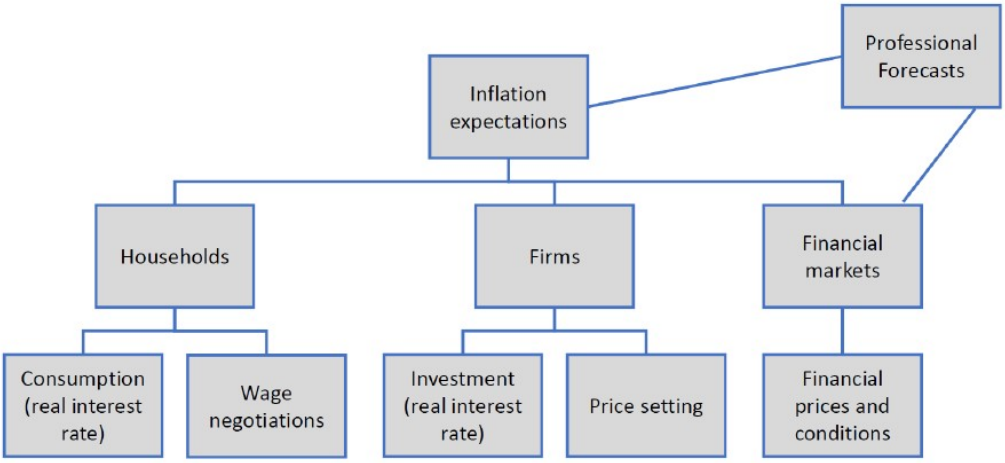
The monetary transmission process is displayed in figure 2. These are ordered by the relevant agents of the measures of IE: the private agents, households and firms, the financial market, serving as an object of analysis for the market-based IE measures, as well as the professional forecasters serving e a unique role in the transmission process.

The transmission of the IE to the private agents, the households and firms, were already explained. This leaves the financial markets and the professional forecasters and their relation to IEs to be explained.

Professional forecasters, such as specialized forecasting companies (e.g. Consensus Economics, Bloomberg Consensus, Reuters Consensus etc.) and economists working for financial institutions, research organizations, and CBs, provide informed predictions about future inflation rates based on surveys. These surveyed forecasts (the ones the professional forecasters are collecting) are based on a variety of models and data, including current economic conditions and monetary policy actions. Their forecast reports—which includes written analysis—are widely disseminated and can influence

5. One may assume that particularily conservative-leaning CEOs would run such campaigns to support their political ideology—as regularly happens in the Western democracies—, as this kind of "Angstpropaganda" is conservative in nature.

Figure 2: Transmission mechanism of inflation expectations (*expectation channel*).



Source: Beckmann et al. (2022, p. 9).

the expectations of rational-analytic economic agents, most importantly the financial markets, or the CBs itself. The latter establishes a feedback loop as the professional forecasters will influence the inflation expectations of market participants.

Inflation expectations also influence the financial markets. Directly, because they influence the prices of inflation-indexed financial assets and derivatives. Indirectly, because—as seen before—the IEs influence the economic conditions in many ways, the housing market, investments, wage development, which are important factors for determining the financial pricing and conditions.

As this paper is not primarily a paper on theory, the interested reader who is interested in "expectations-augemented Phillips curve" or the "three equation model of new-Keynesiasm" is referred to (Carlin et al., 2009, p. 13–35; Rudd, 2021, p. 13–35; Blanchard et al., 2021, p. 548–549). Interesting numerical simulations on the effects of short-term shocks on (anchored) IEs within a framework of the aforementioned equations can be found in (Bonatti et al., 2022, p. 11 ff.).

3 Measures of Inflation Expectations

Economic agents are forming beliefs about inflation in order to make economic decisions, partly due to how the theoretical reflections of the prior section indicates. In the following sections, economic agents and their factual relation with IEs is discussed, to then introduce—and understand—the available measures for IE.

Measures of IE are either survey-based or market-based. The survey-based methods differ in the time horizon they are trying to capture, mostly one, two, and/or five years ahead, their sample size, and the type of data that is obtained (price data vs qualitative/quantitative expectations).

A summary of the presented measures can be found in Table 2. Each type of IE measure is introduced with its specific characteristics. The information the IE measures give about the underlying economic agent is discussed from the perspective

of monetary policy. Then, specific surveys are discussed and some related research presented.

3.1 IE targets: inflation indexes and prices

While in the ideal world of mathematics, inflation can defined as the rate of change of price levels as in equation 2, in the real world—this includes measures of IE— inflation indexes are used to capture inflation. Inflation indexes are statistical measures used to track changes in the general price level of goods and services within an economy over time, for instance by keeping track of the prices of a basket of goods and services. They are divided into two groups: the core inflation indexes and the headline inflation indexes.

Indexes measuring *core inflation* exclude items that are highly volatile in price, such as food and energy, in their computation in order to provide a more stable measure of underlying inflation trends. Core inflation measures are designed to capture the underlying demand pressure in the economy, which is more relevant for monetary policy decisions.

Headline inflation indexes include all items in the consumer basket, providing a comprehensive measure of overall price changes. As consumers happen to consume all products, including food and energy, this better measure better captures the perspective of consumers.

Core inflation indexes are often considered a better predictor of future headline inflation due to their ability to filter out short-term price shocks, in particular of the indirect effect pass-through energy price shocks (Schafer, 2022, p. 9; ECB, 2021d, p. 83).

Consumer price inflation in Europe is measured by the Harmonised Index of Consumer Prices (HICP), which the ECB decided since its inception in 1998(p. 4). The country-wide HICP indexes are compiled in each member state seperately to then be aggregated for the Europe-wide level. The basket of goods represented by the HICP is updated annually to include new goods that have become an integral part of household consumption (such as wireless headphones) and to eliminate those that have become obsolete (such as DVDs). It is a 'Laspeyres-type price index', which means that the prices are compared to the base period (when the good is put into the basket). On average, the prices of about 700 products are collected every month at different points of sale in about 1,600 different cities in Europe(Blanchard et al., 2021, p. 37). The HICP is a headline inflation index, the index excluding energy and food—thus making it an core inflation index—is called HICPX.

The HICP is derived from the consumer price indices (CPIs) that is used, both share the concept of COGI, the cost of goods index (ECB, 2021d, p. 9). In the USA, the computation of the CPI is done by the U.S. Bureau of Labor Statistics (BLS), which also keeps track of the basket of goods, right now containing college tuitions (code: EB011) as well as encyclopedias (code: EA013), drawing a reasonably pleasant picture of the US demographics (Bureau of Labor Statistics, 2024).

3.2 Surveying private agents

The first family of measures are targeting households and firms for their IEs. They are mostly qualitative ("did inflation go up or down?") in nature. Quantitative measures are directed towards the actual change of inflation ("how *much* did inflation change in the last period?"), as such are inherently imprecise as private agents cannot be expected to analytically pinpoint specific inflation rates up to one or two decimal points. However, the rounding behaviour of respondents gives data about the uncertainty of IEs (Binder, 2017, p. 11).

General challenges for designing surveys for private agents can be found in (Weber et al., 2022, p. 161–164). Summarizing the challenges:

Question Wording: The way questions are phrased can significantly impact responses. For instance, asking about "inflation" versus "price changes" can yield different results, as not all respondents may understand the concept of inflation. As the average attention spans decrease, it might not be a wise idea to use the word "inflation" and explain what "inflation" means in a small-print footnote.[6]

Priming and Probing: Providing background information or follow-up questions can influence respondents' answers. For example, informing respondents about recent inflation rates before asking for their expectations can prime them to give higher or lower estimates. Repeated surveying of respondents may influence their responses, as respondents learn how to respond differently than the broader population (so-called panel conditioning effect).

Cognitive Load: Surveys that require respondents to assign probabilities to different inflation outcomes can be cognitively demanding, leading to higher dropout rates or inaccurate responses. Respondents may have an easier time to deliver point predictions, which do not carry information on the uncertainty.

The response rates for private surveys are generally low at 10%, while response rates of government-run surveys are 50% to 80% (p. 164)[7]. The aforementioned problems are less impactful if rather than the general population only a specific, more informed, group (e.g. firm managers) are being questioned.

3.2.1 Households

Households, forming the group of consumers, are the primary group of private agents that are being surveyed. Characteristically households have a high degree of subjectivity in their IE, and thus of imprecision. In summary, inflation expectations for private households are formed through a combination of personal experiences, media influences, cognitive/socioeconomic factors, and historical inflation experiences. They are primarily measured through survey-based methods, which face the design challenges elaborated in the prior subsection.

Households often form their inflation expectations based on *personal experiences* and observations of price changes in their daily lives. This includes the prices they see

6. As the Bundesbank is doing in their online-panels.

7. The American Association for Public Opinion Research (short: AAPOR) defines the response rate quota as the number of completed interviews divided by the number of *possible* interviews, the details of the computation depends on the way interviews are implemented (AAPOR, 2023).

while shopping for groceries, gasoline, and other frequently purchased items. For instance, if a household observes a significant increase in the price of milk, they might expect overall inflation to rise, even if this is not reflective of broader economic trends. Households tend to focus on certain features of the distribution of percentage price changes in grocery shopping in supermarkets when forming beliefs about inflation expectations, this is effect is stronger if the household happens to be low-income (Chua et al., 2024, p. 428). This shaping of experience can even be found among CBs' executive staff (Malmendier et al., 2021, p. 42).

More generally, *historic events* also form a household's IE and affect their reaction to short-term shocks significantly. The experience of the Weimar hyperinflation has shaped Germany's society considerably in the 1920–30s, even with an empirical intergenerational effect (Braggion et al., 2024, p. 14–15).

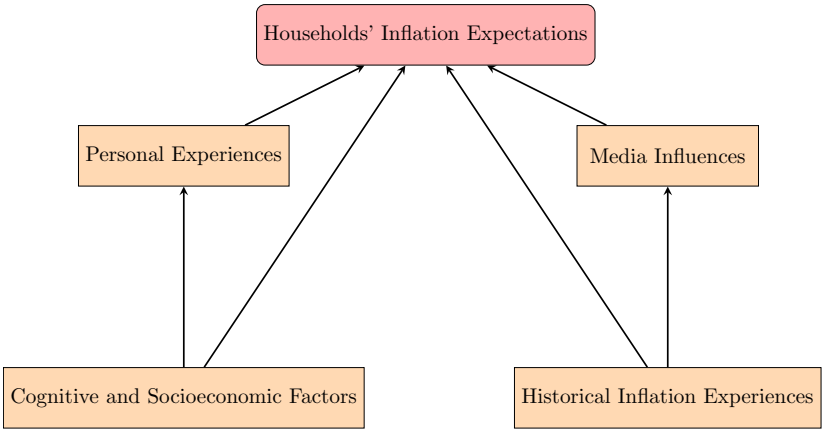
Media coverage and social interactions also play a crucial role in shaping households' IEs. Households may update their expectations based on news reports about inflation or discussions with family and friends. However, the complexity of economic news can sometimes lead to misunderstandings or incomplete updates of inflation expectations. Communication by the CBs, in particular *forward guidance*, could play a role here (Dräger et al., 2024, p. 16–17). However, for example it has been found—qua the Bundesbank Online Panel Households (BOP-HH)—that the ECB's updated inflationary goal on the symmetric 2% has made little difference for the IE of households, while the information that the ECB would allow for a overshooting of inflation after a period of running below target has had significant impact on the household IE's (Hoffmann et al., 2023, p. 16–17). Historical events tend to get replicated in the media as they typically form part of a cultural experience.

Note that foreign influence operations could also target economically expectations formed by the households. For instance, shortly after the start of the war of aggression by Russia against Ukraine, partisan operations ran a propaganda operation targeting the German populace with the content that in the winter of 2022–23 the German gas storages would be exhausted and the people consequently are forced to freeze. This media coverage would elevate the effect of of the 2022–23 Russia-EU gas dispute–already a macroeconomic shock relevant for the households' IEs (for the Czech situation Paličková et al. 2024, p. 6). In the language of Equation 1 the economic agents can expected to split into two groups—the ones susceptible to Russian propaganda and the ones who are not—which would not be detectable in the mean statistic.

Cognitive abilities and *socioeconomic* status significantly influence how households form their IEs. Households with higher cognitive abilities and better financial literacy tend to have more accurate IEs (ECB, 2024b, p. 4). Conversely, those with lower cognitive abilities or from lower socioeconomic backgrounds often have higher and more biased inflation expectations (Weber et al., 2022, p. 166). Depending on the IQ—a proxy for intelligence as a personality trait—the aforementioned intertemporal consumption effect and borrowing varies among men, who may require different communication techniques in terms of monetary policy (D'Acunto et al., 2019, p. 27–29). The socioeconomic status determines the living circumstances of individuals, and as such they have an indirect effect on the personal experiences of said individual.

Figure 3 sums up the discussion of the IEs formed by the households.

Figure 3: Factors for IE of households



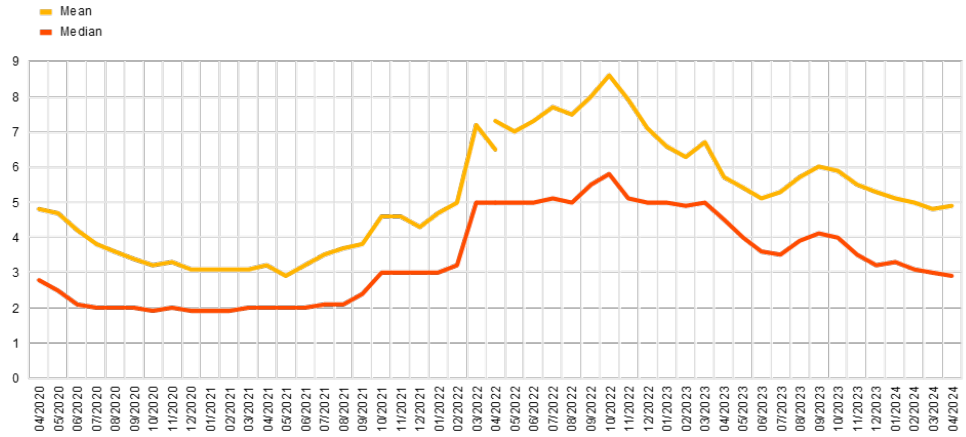
Source: author's own illustration.

There is evidence from South Africa that in economically stable times—the households are said to be *inattentive* in this case—the IE of the households converge to the IE of financial markets (Reid, 2015, p. 158). Short-time shocks immediately influence short-run IEs of households (Dietrich et al., 2022, p. 36). Household's behaviour is found to be inconsistent and maybe even erratic with respect to their (reported) IEs (Bonatti et al., 2022, p. 17). These factors altogether lead to a systematic upward bias of household IEs in the mean and median (Weber et al., 2022, p. 165–167), being unaware of recent inflation dynamics as presented in official statistics (Beckmann et al., 2022, p. 12). There is a delayed adjustment due to information frictions and rigidities (p. 10). Communication by CBs, such as forward guidance, should be comparatively clear as opposed to financial market participants, when communicating with households and firms (Coibion et al., 2022, p. 1581 f.).

As to concrete surveys on households, both the surveys on firms and households have been found lacking (Beckmann et al., 2022, p. 27). To close this gap the Consumer Expectations Survey (CES) has been established in 2020 (ECB, 2021a, p. 7). It was started to provide a high-frequency panel survey to the ECB for the data of euro-area households. The *Consumer Expectations Survey* (CES) collects – among other data – IE and inflation perception (i.e. backwards) in the euro area grouped by country, age group and income quintile. Households are asked about their expectations for future inflation rates over different time horizons, such as the next twelve months or the next five years which filling a data gap in long-term IEs. The survey is conducted online and aims for a representative sample of the adult population of the covered countries (aged 18 to 70) (p. 18). The CES questionnaire design benefits from best international practices and insights from cognitive interviewing. This ensures that questions are understood as intended and that the data collected is reliable and valid (examples—like the avoidance of the word "inflation"—of the questionaire can be found in the Appendix in p. 113–134).

Some European countries still hold their own surveys, like the German Bundesbank via their online-panel for household surveys BOP-HH.

Figure 4: CES – Inflation expectations over the next 12 months (quantitative)



Source: from the CES online presence (https://www.ecb.europa.eu/stats/ecb_surveys/consumer_exp_survey/results/html/ecb.ces_results_may_2024_inflation.en.html).

Figure 4 shows the time series of the 12-month forward-looking IE survey. Both the mean and the median statistics are shown, where the top and bottom 2% of the answers have been cut off (winsorized), which is standard procedure for the aggregated statistics provided by the CES (ECB, 2024a, p. 6). The break in the time series at April 2022 denotes the event that five new countries joined (IE, GR, AT, PT, FI)[8] the original six largest euro area countries (BE, DE, ES, FR, IT, NL) the CES started its evaluation on. The graph shows that—in the median—the households' *short*-run expectations were anchored at the 2% target in the period 05/2020–08/2021 and detached thereafter. The mean statistics show the attested upward bias.

Besides the CES, the European Commission (EC) conducts several economic surveys to gather information on various aspects of the economy. These surveys are part of the Joint Harmonised EU Programme of Business and Consumer Surveys (BCS). This includes the European Commission Consumer Survey (ECCS). Unlike the CES the data of consumer surveys of the ECCS reaches back to 1972. The sample size is considerably larger, and there is additional quarterly data on consumption of certain types of durable goods. While the CES is done by an online-panel, the ECCS's data gathering is done by partners in each member country of the EU, such as the GfK in Germany.

3.2.2 Firms

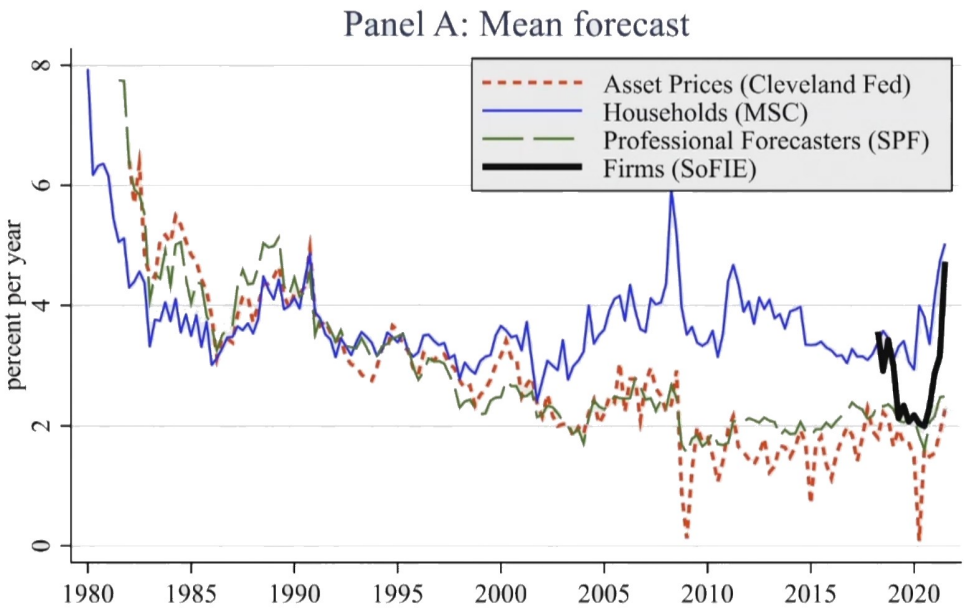
Besides households, also firms are being surveyed to obtain their IEs. Obviously, representatives of the company—mostly C-level, managers or experts—and not the firms are being questioned pars pro toto. As such, these representatives also hold subjective IEs like the households do, however, one may expect a higher degree of (economic) literacy and cognitive aptness in this group compared to the general populace. Furthermore, companies are not closed entities in the sense that they necessarily have to set prices of goods and services, thus they are informed—though biased—about prices better than the average. This is why companies can also be asked about their

8. ISO 3166-1 alpha-2 codes: IE = Ireland, GR = Greece, AT = Austria, PT = Portugal, FI = Finland

expectation of *their* prices—from the factor market and from their goods. From the CB's perspective this makes them interesting to take a look at (Bernanke, 2007).

Firms' expectations get mostly influenced by their local industry setting, a sectoral-aggregate confusion (Andrade et al., 2022, p. 55). This implies that firm-based measures should ideally target respondents in multiple sectors of the economy. There is an empirical claim that firms' IEs—despite their heterogeinty—align with forecasts by professional forecasters (Bryan et al., 2014, p. 23), though there contradicting data seen in Figure 5, which suggests that the alignment of the IEs are situation dependant: the unaligment in the graph starts from the inception of the COVID-19 crisis. It shows firm data from the Survey of Firm's Inflation Expectations (SoFIE) and household data from the Michigan Survey of Consumers (MSC).

Figure 5: Inflation expectation data from US forecasts/surveys



Source: slightly graphically edited from the presentation by Yuriy Gorodnichenko at Session 2: Inflation expectations at the ECB's Drivers and Dynamics Conference 2021 (https://www.youtube.com/watch?v=FHlAuGsO9u0&t=567s; compare Weber et al. (2022, p. 166)).

As part of the BCS, the EC also conducts a survey on the firms, the European Commission Business Survey (ECBS). The ECBS distinguishes respondents by the sectors: industry, service, retail trade, construction. There used to be a survey of financial companies, which has been discontinued in April 2023 (EC, 2024, p. 48).

The Banca d'Italia, the CB of Italy being a part of the the Eurosystem, has since 1999 hold the Survey of Inflation and Growth Expectation (SIGE). About 1.5k firms (50 or more employees) are asked about their short-term IE and expected development of prices. Additionally, the Banca d'Italia inquiries about current events, such as "In the first quarter of 2024, was your firm's business affected by Red Sea shipping routes being closed since the end of last year?[9]

9. Survey question for Q1/24 in march 2024, see https://www.bancaditalia.it/statistiche/basi-dati/bird/inflazione-e-crescita/questionario-inflazione/documenti/en_quest_I_trim_2024.pdf?language_id=1.

Unfortunately, the data of firms is still lacking, somewhat akin to the situation regarding data from households (Beckmann et al., 2022, p. 27). Even though firm data may be interesting due to their nature as a price setter and expertise in their sector of the economy. Unlike the situation with the households the situation of the incomplete does not seem to have been tackled (Sousa et al., 2016, p. 44).

3.3 Market-based

Market-based measures of IE extract the expectations from the prices of different financial assets, namely inflation-linked swaps (ILS) and inflation-linked bonds (ILB). The idea is that the agents on the financial markets "price in" their expectations of inflation and, being in a competitive setting, they do well in that regard. However, as premia are priced in, the prices of inflation linked financial assets do not carry perfect information on the real interest rate, that is a risk-free quantity.

The first ILB was issued in 1780 during the American Revolutionary War to secure the payments of the serving—surprisingly economically apt and aware—soldiers (Shiller, 2003). This was still in the era where states try to inflate their debt burden "away". ILBs are a type of bond whose principal and interest payments are adjusted to reflect changes in inflation rates. This adjustment is typically made by linking the bond's cash flows to a specific inflation index, such as the Consumer Price Index (CPI) or the HICP. As for the first ILBs issued in 1780: they had the good basket written on the contract(ECB, 2007, p. 7). The primary purpose of ILBs is to protect investors from the erosion of purchasing power caused by inflation, ensuring that the real value of their investments is maintained over time (so-called inflation risk).

Since 1780 the nature of central banks have changed, however, as CB independence and the more-or-less strict mandates of price stability ought to neutralize inflation risk factually. As the issuer of ILBs is not protected against the upside risk of inflation, the issuer must have trust in the CB's ability to keep inflation in check during the instrument's time to maturity, while the buyer is protected against the tail event of a high inflation.

On top of the linked inflation index, both risk and—depending on the market—liquidity *premia* are put on the nominal price of ILBs (Beckmann et al., 2022, p. 21). This implies that the market participants' inflation expectations, that is "priced" into the market, cannot be directly measured. The *break-even inflation rate* is defined as the spread between the yield of a conventional nominal bond i and an ILB r of the *same* maturity M[10]. As formula,

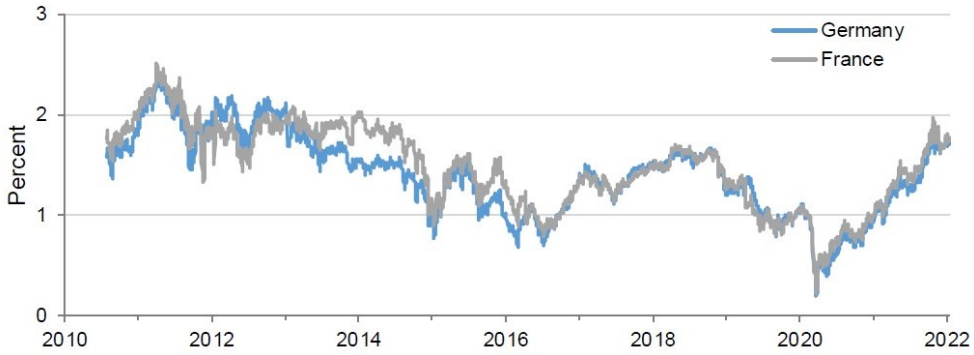
$$BEIR_{t,M} = i_{t,M} - r_{t,M}, \tag{5}$$

which looks like the (approximation of the) Fisher equation (Equation 3) solved by π^e (ECB, 2007, p. 25). The yield of a ILB is the break-even inflation rate summed with the real interest rate. If the realised inflation rate π^{t+M} surpasses the break-even inflation rate $BEIR_{t,M}$, then the ILB outperforms the fixed bond. Likewise, if it happens to be lower, then the fixed bond outperforms the ILB. The break-even

10. Note that it is nontrivial to find a similar bond with the properties, even from the same issuer. The cash-flows are almost always different.

inflation rate is where the ILB and the fixed bond perform the same. The BEIR can be taken as a proxy for the IE of the financial market's participants.

Figure 6: Break-even inflation rates derived from 10y-maturity-ILBs



Source: Beckmann et al. (2022).

The time series of BEIRs for a ten year maturity from Germany and France is displayed in Figure 6 shows that for the most part the time series are *under* the symmetric inflationary goal of $\pi^* = 2\%$. The difference is, however, due to difference in premia in risk and liquidity. Calculating this inflation risk premia from ILBs is a bit more involved, see (Kupfer, 2018).

Note that the share of ILB to the total bond market in the euro area is only around 10% (Beckmann et al., 2022, p. 21). In Germany in particular it is below 3% and since 2024 no new ILBs are being issued, in France around 10%. For the risk premia the average estimate for Germany is 50 basis points and for France 5 basis points (Camba-Méndez, 2020, p. 15).

Other relevant market-based instruments are inflation-linked swaps (ILS) and other inflation options.

ILS differ from ILB, that the latter is issued by the state and the former is a free-market derivative traded over the counter (OTC). The ILS contract simple exchanges a inflation (rate) against a fixed or floating component. For example, the inflation payer (seller of the ILS) could be paying HICP against a floating rate of EURIBOR+2%. Often these agreements are zero-coupon inflation swaps.

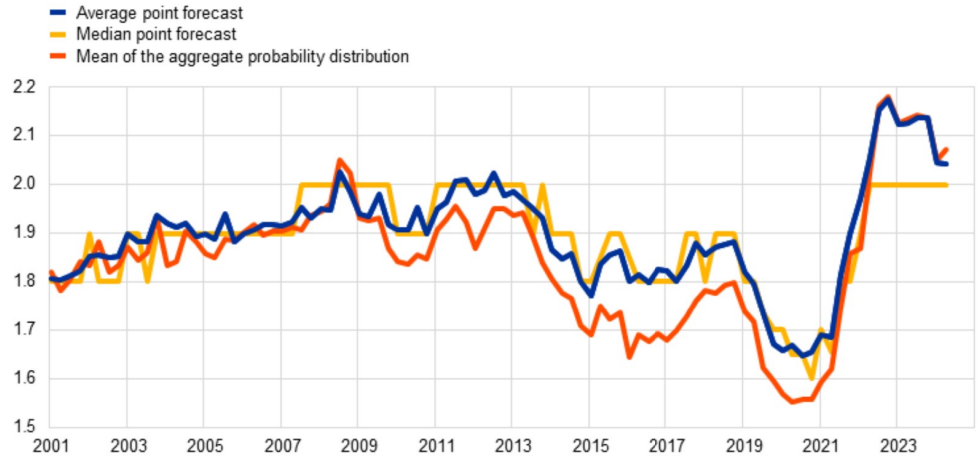
3.4 Professional forecasting

As the last survey-based group professional forecasters are being asked, which is to say that specialised groups of professionalized people (and/or institutions) in the space of financer or monetary theory/policy are being interviewed on their perspective about the IE. The surveys, while having a low sample size, show the opinion of the best informed people over longer time-horizons.

Consensus Economics (CE) is the market leader in this space, with a long-standing tradition of delivering valuable data. Trust in this market is important, as professional forecasters could be deliberately wrong—the contrarian gambit—and announce extreme predictions for a marketing effect—as giving just the correct predictions like the others will fail to gather attention (Sousa et al., 2016, p. 44).

The ECB has an own Survey of Professional Forecasters (SPF). The respondents, of which only 86 are public, are experts employed by financial or non-financial institutions, such as economic research institutions.The survey asks for point forecasts and probability distributions for the rates of annual HICP inflation, annual core HICP inflation, real GDP growth and unemployment expected in the euro area at several horizons. Additionally, the SPF holds special surveys where the respondents are asked about their methods of prediction. In 2021 they were also asked about the ECB's new monetary policy. The low number of respondents and static behaviour of the long-term IEs are criticised, but it is unclear on why other surveys do not suffer from a similar problem (Oinonen et al., 2020, p. 684).

Figure 7: Longer-term IEs by SPF



Source: the ECB's SPF for Q2 2024, https://www.ecb.europa.eu/stats/ecb_surveys/survey_of_professional_forecasters/html/ecb.spf2024q2~804a80b66b.en.html.

Figure 7 shows long-term IEs obtained by the SPF. From 2010–2022 the graph shows similarities to the graph of the 10y-BEIRS in figure 6, indicating an alignment. Professional surveys do have the advantage of giving reliable data on the long-term IEs.

Internally, the Eurosystem/ECB has a macroeconomic staff projection—independently on the Governing Council—that also takes into account the national experts' forecasting (ECB, 2021b, p. 24 f.). Additionally, the ECB has a Survey of Monetary Analysts, in which several dozen analysts are being asked, among other questions, what they think the HICP(x) inflation is going to be and the probability of going above/below the ECB's inflationary goal.

Professional forecasters have been found to be in line with standard models, in particular the Taylor rule, and affected by U.S. macroeconomic data (Beckmann et al., 2020, p. 1023).

Table 2: Summary of IE surveys and measures

Name	Type	Institution	Geography	Frequency	horizon	target	since	size	comments
CES	HH	ECB	country/EA	monthly	12m/3y	consumer prices	2020	19k	probabilities (ECB, 2024a, p. 3), 11 countries
ECCS	HH	EC	country/EU	monthly/quarterly	12m	prices (sectorial)	1972	32k	part of BCS; quarterly for durable goods
SCE	HH	Fed	state/US	monthly	1y/3y/5y	consumer prices	2013	1.3k	rotating online-panel
BOP-HH	HH	DBB	DE	monthly	12m	VPI	2019	2.5k–5k	BOP-F for firms; sociodemographic data
HFCS	HH	ECB	country/EU	waves			2010		surveying done in waves
ECBS	Firm	EC	country/EU	monthly/quarterly	3m	Prices	1962	21k–47k	part of BCS; investment integrated
SoFIE	Firm	SF	US	quarterly	12m/5y	CPI	2018	∼300	add-on module to online-panel
SIGE	Firm	Banca d'Italia	Italy	quarterly	12m	HICP	1999	1.5k	industry/services
CE	Pro.	Company	World	monthly	multiple	HICP/CPI	1989	700–1k	sample = total asked p.m.
SPF	Pro.	ECB	EU	quarterly	several	HICP(X)	1999	86	probabilities, sample = contributors
ILB	Mar.	financial market	worldwide	daily	multiple	HICP/CPI w/o tobacco	1780	N/A	target depends on location, 1981 modern start

HH = Household; Pro. = Professional; Mar. = Market
DBB = Deutsche Bundebank; EC = European Commission
VPI = Verbraucherpreisindex (= German CPI)
m = monthly; y = yearly; EA = Euro Area; SF = Survey Firm
CES = Consumer Expectation Survey (https://www.ecb.europa.eu/stats/ecb_surveys/consumer_exp_survey/html/index.en.html)
SCE = Survey of Consumer Expectations
ECCS = European Commission Consumer Survey (part of BCS)
ECBS = European Commission Business Survey (part of BCS)
SoFIE = Survey of Firm's Inflation Expectations; SIGE = Survey on Inflation and Growth Expectation

Source: adapted and extended from (ECB, 2021c, p. 15).

4 Analysis

4.1 Accuracy and uncertainty of IE measures

This section is intended to wrap-up the results so far and answer the first posed question. The measures of IE were introduced in Section 3 onwards. This leaves the accuracy and uncertainty of the measures to discuss.

Figure 5 in section 3.2.2 is illustrative of the upward inflation bias of households, and how the upward bias is comparatively lower for firms and even more for professional forecasters. The CES data, as illustrated in figure 4, of the 12m-lookahead IEs indicate a sharp upward inflationary bias.

Practically, the influence of professional forecasters and those of financial market participants has been found to be more important (ECB, 2021c, p. 118). This is partly due to lack of data for households and their uncertainty (Beckmann et al., 2022, p. 27). Since then, the situation has improved with the CES.

During the long period of low-inflation before the outbreak of the COVID-19 pandemic, evidence strongly suggests that in the Euro area long-term IEs (survey-based) were de-anchoring and going below the inflationary target of 2% (Neri, 2023, p. 16). This effect, however, has been negated since the inflationary surge shortly after the outbreak of the COVID-19 pandemic.

As a result it can be summarized that in both accuracy and uncertainty there is a hierarchy starting from the least educated parts of the households, over the firms to the professional forecasters. The market-based metrics are doing reasonably well, though estimating the risk premia is a challenge and the markets are not always large—or transparent—enough. The major challenge is the sparse data combined with the heterogeneity, especially for households and firms. Professional data may suffer from the low amount of respondents as well as groupthink, but is otherwise accurate and certain.

4.2 Alignment of long-term IEs and inflationary goals

The second question how the long-term IEs are aligning and how robust they are against schocks.

First, many measures of IE fall short in terms of horizon to test for the match of long-term IEs and inflationary goal(Sousa et al., 2016, p. 53). Secondly, the long period of *low* inflation, poses the problem of *mid*-term de-anchoring (Gobbi et al., 2019).

When IEs are anchored, then short-term shocks should have a less persistent effect on Inflation (Beckmann et al., 2022, p. 3); in fact, there is empirical evidence that this is the case (Beckmann et al., 2024, p. 24). In this case, the economic actors will trust the CB to bring back the inflation rates to its set goal, and if they do not, the CB has to establish trust (Bonatti et al., 2022, p. 29). The inverse statement—short-term shocks have a less persistent effect on inflation, then long-term IEs are anchored—also has empirical backing (Gobbi et al., 2019, p. 14).

Recent data on German consumers have shown a short-term de-anchoring of expectations during the inflationary surge in 2021–2022 (Coleman et al., 2023, p. 2), but

the quick recovery of the inflation to towards the inflationary goals has re-anchored expectations. Consumers are, after all, fickle in their opinions.

5 Conclusion

Inflation has been felt by many people in their daily lives, and it is a trait humans developed to predict the future ahead of them. The concept of inflation expectation captures this prediction and as the thought itself translates itself into economic action, subjectivity enters the field of Economics.

The problem of heterogeneity in the household and firm data sets has given rise has been tackled and has given rise to empirical studies, covering local areas or specific topics. Research has to work on finding and summarizing for patterns and extract universal propositions independent of time and place.

For the CBs the danger of de-anchoring is omnipresent, but the fears of a de-anchoring after a long period of inflation *over* the target don't seem to materialize (Beckmann et al., 2022, p. 28). The recent CPI for Germany in May 2024 is at 2.4% compared to last year (source: DESTATIS data), the same recovery to "normality" can be seen in the recent Europe-wide data. The price shocks of the COVID-19 crisis and the energy price shock at the start of the Russian invasion of the Ukraine in 2022 have caused a sharp increase in inflation, and thus ended the period of inflation rates near the zero lower bound, where a de-anchoring seemed definitely possible.

To avoid the de-anchoring of IEs, the recommended monetary policy is to nurture the net of surveys—households and firms—and optimize the CB's communication techniques—for non-experts. Simple messages are sometimes better (Coibion et al., 2020, p. 21).

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