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SURVEY EXPECTATIONS: ANALYSIS OF

SURVEY OF PROFESSIONAL FORECASTERS

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ABSTRACT

Questo testo si propone di fornire una descrizione chiara e lineare dei principali aspetti teorici sulle aspettative circa le macro-variabili economiche e di indagare empiricamente le caratteristiche che mostrano le aspettative formulate degli agenti professionisti che operano in risposta ai sondaggi gestiti principalmente dalle maggiori Banche Centrali.

La tesi, in questo modo, si va ad affiancare ad un'ampissima letteratura antecedente che ha studiato le varie sfaccettature dei survey expectations negli ultimi decenni.

INTRODUCTION

Expectations on economic macro variables are fundamental tools for government institutions, businesses, and households in order to formulate decisions for the future. This text aims to provide a clear and linear description of the main theoretical aspects of survey expectations but also to empirically investigate the characteristics that the surveys of professional agents show. In doing so, we take as reference the data provided by the Federal reserve of Philadelphia, which is the agency on which the entire analysis of the survey of professional forecasters is based.

In chapter 1 the discussion starts by telling the various typologies of collection and formation of expectations: that is market based, model extrapolation and survey-based expectations. In addition to this, it is reported the role that these have in the economy and which are the main agencies that deal with the collection of such information.

In chapter 2 the purpose is to provide a brief look at the massive literature and studies that have entertained scholars over the past decade. In particular, we dwell on how the perspectives regarding the formation of beliefs have changed over time:

passing from the assumption of rational expectations to adaptive compartments and anchored opinions.

The third chapter is devoted to the description of the variables used, in addition to the explanation of the worksheets and their structures.

Finally, chapter 4 presents the entire experimental part, where the characteristics of the point predictions of the forecasters in the long term are analysed and we look for evidence in the behaviours especially in periods of shock where future expectations can be considered more important for the implementation of effective policies.

The ultimate goal is to have clear how the forecasters act and to establish in a more or less absolute way the reliability of their judgments in particular historical moments. Depending on their truthfulness and the influence of central bank support, it is also possible to obtain the perception of how the respondents operate and form their expectations on future values.

CHAPTER 1

The expectations and forecasts of many Macroeconomics variables are important tools that many institutions use in order to implement their strategies. There are many ways to achieve these forecasts, for example deriving market sentiments, or by the formulation of econometric models or the grouping and analysis of survey-based information.

In this introductory chapter of the survey expectations, I'm going also to explain the various themes that regard the argument. I am going to focus my attention on many topics such as the role of decision makers, recent history, the main agencies which use the survey method for collecting prediction data; but also the different subgroups of possible survey recipients and some interesting previous studies and analysis that take part in recent literature. In doing so I will try to underline the main reasons why the following chapters will deal specifically with SPF surveys.

1.1 EXPECTATION'S FORMATION SOURCES

It is complex to find a point to start with; to fully understand the importance of the topic I am dealing with; I could start from the crucial role that the predictions of some variables have on the implementation of strategies of governance or policy makers and monetary institutes. But actually, I would prefer to describe beforehand the main ways in which information and predictions are found and recorded.

One of the first documentations of how relevant the expectations are can be detected in Keynes (1936); he emphasised their role in the amount of final product, employment, and savings. Its first classification divided expectations in two types: the first one is the short-term expectations, concerning the price the producer expects to get for its product at the time he starts the production process, the long-term expectations, are the second type and consist in the entrepreneur hopes to earn in the future. After that period a long and intensive literature evolved and experimented about this topic, discussing several scenarios for the collection of informative data.

There are three different ways in which one can find information about future scenarios for the main macroeconomic variables, such as, for instance, the future inflation rate or GDP level.

1.1.1 Market-based

Let's take into account the inflation for a moment. If an agent is interested in future values of inflation for the next few years, he can find information from different sources. A possible provider is the financial market that can give intrinsic expectations; These are tied to the market for Treasury Inflation-Protected Securities (TIPS) and are based on CPI inflation. As said in a message of James Bullard[1], through an article of "The Regional Economist": "*The basic idea is that a nominal security, such as a Treasury note, and a real (or inflation-adjusted) security with the same maturity both trade in the market. The price difference between the two could be interpreted as the market participants' expectation of inflation over the horizon of the security; this difference is also called the breakeven inflation rate.*"

One warning in using this is that TIPS spreads also reflect differences in the liquidity and risk characteristics of nominal and real securities, so that premia may be associated with liquidity and risk, as opposed to inflation expectations themselves.

Another example is the derivatives contracts like Swap; In these contracts, a fixed inflation swap rate is exchanged against the realised inflation rate over an agreed

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[1] President since 2008 and CEO Federal Reserve Bank of St. Louis. He also participates on the Federal Open Market Committee, which sets the direction of U.S. monetary policy.

period of time. Hence, we can interpret the fixed leg of the swap as a measure of investors 'inflation expectations over a given contract time span.

The same valence can also be valid for expectations on the appreciation or depreciation of currencies; in the foreign exchange market (FOREX market), forward contracts make it possible to incorporate the expectations of operators, and in general financial intermediaries regarding future movements of local or foreign currencies thanks to covered interest parity.

A very positive feature is that market-based measures have high frequency and constant updates besides that are based on the financial transactions among numerous market participants, and thus on the aggregation of their investment decisions.

1.1.2 Models

The other path is that of Models, which are usually based on statistical time series properties of inflation and on information regarding economic variables. In poor words a model can be depicted as a mathematical description of something, a simplification of what happens in the real world, even not perfect[2].

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[2] "All Models are wrong, but some are useful" -George Edward Pelham Box

One of the most familiar traditional models of expectation formation is extrapolative models, which try to identify in functional form any regularities highlighted by a time series of observations referring to the same variable. An important and prominent form of this kind is adaptive expectations, which states that people form their expectations about what will happen in the future based on what has happened in the past. Most econometric models developed in the 1960s and 1970s employed this premise.

Another assumption, that recurs in the construction of models, is that of Rational expectations (RE), which states that agents' predictions of the future value of economically relevant variables are not systematically wrong. In modern econometrics, a silent consensus has been established that at the theoretical level the rational expectations hypothesis proposed by Muth[3] (1961) has gained general acceptance as the dominant model of expectations formation, even though recent theoretical and empirical work has questioned the premise.

In the meanwhile, I am separating the model formation from the surveys collection data, it is important to emphasize that such distinction is more apparent than real, since some surveys such as those of SPF may be generated by formal forecasting models, even if with the more personal model formalization. Alternative models of

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[3] John Fraser Muth was an American economist: his best-known contribution is "Rational expectations and the theory of price movements" (1961)

expectations formation provide different accounts of the way subjective ideas and the objective fact are linked.

1.1.3 Surveys

The last kind of forecast formation, which is the one I will centre to deal with the most relevant aspects throughout this text, is the survey-based expectation.

A survey is a research method used for collecting data from a predefined group of respondents to gain information and insights into various topics of interest. It is usually issued through the use of standardized procedures to avoid biased opinions that could influence the outcome of the research or study. The structure must be very well designed in terms of questions chronology, consistent logic and openness for effective results and conclusions.

Survey research is often used to assess thoughts, opinions, and feelings: for this reason, it focuses on a more subjective and personal perspective with respect to models, all this can be important to obtain adding details and knowledge in future expectations. As mentioned, they can play an interesting role both singularly and interacting with statistical or econometric models, and for this reason several papers have gathered evidence about the significance of adding a survey variable to a structural model equation, or vice versa, how models are used by professionists to

answer surveys questions. Good forecasts are likely to involve adding survey data to time series models or using forecasting techniques to combine forecasts resulting from surveys with those generated by time series techniques.

Considering again experts' surveys, they can be based on methods or models known by nobody but the forecasters themselves. Thanks to occasional surveys which ask how respondents formulate their forecast in the actual expectation surveys and quoting Batchelor and Dua[4] (1991) study, we notice that practically a half, 51%, of the Blue Chip Panel[5], deemed their most important technique the sole judgement; while 28% and 21% reported econometric modelling and time-series analysis respectively.

Obviously, there are many purposes for which surveys are implemented and according to the main goal there could be different facets in the type of questions; for instance, the investigation could be carried on in a qualitative way, which merely requests a tendency, or conversely, could be stressed a quantitative results path. The two different types are not in contrast, but, as opposite, can be seen as complementary and so, they are very useful if associated and compared.

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[4] R. Batchelor & P. Dua. Blue Chip rationality tests. *Journal of Money, Credit and Banking* (1991)
[5] Blue Chip Economic Indicators Survey, a privately operated professional forecast with a similar scale and scope to the SPF

Another aspect that depends on the mean of the investigation is the composition and kind of sample. Over the years many survey experiments are conducted evaluating the perception of future values of inflation or GDP or others by different points of view; in this case the responsible of the research built the sample in specific categories. I repeat that surveys contain information about agents' expectations which is not contained in standard macroeconomic data bases and depending on the agents who are consulted there can be found interesting feedback from different economic parts, so that different surveys can be made up for different target groups.

In general, The Survey of Consumer Expectations collects information on consumers' expectations and decisions on a broad variety of topics, including but not limited to inflation, household finance, the labour market, and the housing market. Usually the composition is heterogeneous, picking randomly individuals from different demographic and social conditions to better represent the whole society. Household Surveys are national surveys focusing mainly on consumption expenditure. Specifically, Household Budget Surveys are conducted in all EU Member States and their primary aim (especially at the national level) is to calculate weights for the Consumer Price Index.

Another category that over time assumes a huge importance is the firms' expectations, in fact, macroeconomists have long recognized that a firm's previsions about the future state of the economy has a significant effect on its decisions about

investment, employment, wages, and selling prices. As a consequence, it is possible to study and better understand how this affects and reflects business cycles. It is useful in particular in driving movements of economic output or, even better, during recession periods, as a guide for agents' uncertainty about future conditions.

Also in this case it is conducted by many National Institutions generally involving both industrial and services firms and companies trying to comprehend businesses of different sectors, sizes and revenues.

Lastly, the other agents entrusted with the task of answering the surveys are survey professional forecasters (hereinafter SPF). By many authors this should be the preferred one in order to test the rationality and obtain optimal responses for point prediction; in fact, common people and businesses can have a reasonable interest in hiding their own actual expectation. It is logical to assume a more inclusive and good information process by economists or experts which compose this category and thus, superior results are likely to be achieved.

More details about the features and role will be provided when I talk about the public agencies which operate in this field.

From an historical perspective, data collection on expectations of individuals has its roots through survey methodology in the years prior to World War II, when economists commenced to recognize the pressure of future events on current

decisions. The first effort to design an expectation survey in a systematic way was carried out in 1944 by an American Institution of the agriculture department.

In Europe the first study was conducted by the "Insitute für Wirtscaftsforschung"[6] in Munich in 1948, which matched the household component with the business one (questioning firms' expectations of the evolution of the business environment) and which structure was copied and spread over other countries.

In 1946 was proposed the so-called Livingston Survey[7], where economists were convened as experts to give point estimates for macroeconomics variables. This is what is now managed by the Federal Reserve Bank of Philadelphia (USA).

Albeit at first, about in the years '50s and '60s, the data coming from the sums did not seem to find a shared consensus, for some decades its use has been having a substantial increase and despite some scepticisms remain it represents one of the most used sources for measuring expectations.

Why should we prefer surveys, or what kind of different information are we able to obtain using this instrument instead of the other ones?

In this contest there are many factors that lead us to prefer surveys instead of methods and models. Many of them are listed by Michael P. Clements in one of the

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[6] The German Institute for Economic Research, based in Berlin, was founded in 1925, and is the largest German economic research institute. He carries out applied research in the field of economics and economic policy consultancy.

[7] The Federal Reserve Bank of Philadelphia took responsibility for the survey in 1990.

main textbooks I am consulting for references. "Survey expectations draw on a wide variety of information and assimilate them from various sources (which are not easily codified in a model). Then, they can be thought to be more accurate than models' forecasts in the short horizons to the extent they are based on up-to-date reading of the current state of the economy."

Secondly, they offer a clear and direct form of uncertainty when respondents are asked about their probability distribution function. And finally, can provide interesting features and clues about the behavioural introspective on how agents form their beliefs.

In addition, within surveys we would prefer professional panelist respect to common citizens.

Households may have a distorted perception (give the same weight to "informed" and "uninformed" consumers) having as a reference only certain goods and some categories such as food and bills for energy or water and may therefore be not fully grasping the movements in prices of the economy as a whole, as well as not realizing the size employment in the national territory but only in the neighbouring localities. Lastly, households' and firms' expectations are subject to the so-called "sticky information" and are updated more slowly than those of professional forecasts. No doubt, SPF are more practical than with the consumer expectations survey because the respondents were practising economists and therefore might be assumed to be more capable of and more comfortable with providing quantitative

answers to the questions. it can be reasonable assuming better performances by professionals which should be better informed and can manage more properly the data and signals from the environment.

1.2 THE ROLE OF EXPECTATIONS

So far, I have briefly explained different ways that allow us to reach expectations, but now it is good to try to explain their importance and function. The role that expectations play in the decisions and planning of strategies of other government agencies is large, and in some ways crucial. The revelation of future values of variables such as inflation, unemployment or the GDP is very useful for both state governments and central banks, but even for scholars. The interconnections of these macroeconomics measures induce particular attention on their evolution so that competent bodies can manipulate with the necessary tools and strategies and master them.

In many Nations, inflation expectation is the one which plays the leader role. Inflation expectations have become the most important indicator for monetary policy.

While in the first moment monetary policy frameworks were characterized by a monetary supply targeting, since the 1990's authorities started to appreciate and support the inflation targeting. In fact, in the 1980's there was a shift from the belief of a fixed and stable relationship between a money demand function and the influences affecting that demand, to a preference for flexible exchange rate and setting short-term interest rate to achieve a more controlled inflation.

The idea is that thanks to the control of the short-term policy rates and the respective effect of the expectations, the Central banks can easily hold the whole structure of linked variables. If the credibility of the Central bank subsists, as well as its mandate target, it helps out by setting anchor expectations of price and wage and feeding these value developments to actual inflation in future periods.

To see the strong linkage of these variables, let's notice that: Output depends on the expectation of next period's output, and negatively on the real rate of interest, defined as the difference between the nominal interest rate and the expected rate of inflation. In turn, this suggests that output is a function of the expected path of all future real rates. The real rate depends on the federal funds rate, set by the central bank according to a policy rule depicted approximately by John Taylor[8] (1993), and on the rate of inflation. If the path of expected product matters for defining inflation, so does the path of expected funds rates, which, again, depends on the path of future inflation, as well as on the imposed inflation target.

As mentioned, they may be used to assess the credibility of the central bank's inflation objective, and if it is effective, expectations take on a noteworthy role in price modelling. If the central bank turns out to be strong, and especially in recent years it has shown itself capable of respecting the objectives set, it is very likely

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[8] The Taylor rule is a formula that can be used to predict or guide how central banks should alter interest rates due to changes in the economy. it is useful in dual mandate monetary targets such as in the case of the FED.

$$i_{t=} \pi_t + r_t^* + \alpha(\pi_t - \pi_t^*) + \beta(Y_{rt} - Y_{rt}^*)$$

that the respondents will establish their own thoughts about inflation or, again, the unemployment rate, close to the target itself. If this happens, we can, on the one hand, use the polls as a good proxy for the validity of the work done by the Central bank and its monetary policy. On the other hand, some evidence lingers on the fact that anchored expectations act as a powerful downward force on inflation. Conversely, higher expectations of inflation may lead employees to demand higher wage settlements, but also a general upward pressure on the price structures, giving rise to cost-push effects on inflation.

Also in periods of shock and destabilization such as after the financial crisis, or the most recent pandemic due to Covid-19, the feedbacks deriving from the surveys are crucial for adopting effective interventions and at the same time addressing the same expectations with communication and actions.

Another important aspect concerns the use of forecasts to draw up the fiscal balance structure by the government. The projections of the GDP and inflation as well as for the unemployment rate have effects on the operations of the State.

The trend of the GDP and the level of employment influence fiscal revenues through taxes, for the budget different levels of output can lead to higher or lower revenues. The same can be said for the level of inflation that can influence the projection of the deficit or primary deficit, but also government savings and investments on the economy. For instance, if inflation is not well anticipated by

interest rates, its increase reduces the public debtor liabilities, hence, in this case, the deficit ratio falls down.

The preeminent aspect for governments is to analyse expectations to see deviations on economic trends and phases of business cycle to operate with stimuli and discretionary policy actions.

Planning for the future is a central part of economic life, and thus, it involves not only political institutions but in general all citizens and economic agents. For individuals, the need to make decisions about the type of house or car to buy, the amount of education to pursue, and the portion of income to save constrains households to think about which choices make the most sense not just for today but for the following years. In a similar way, business firms, in deciding where to locate factories and offices, what equipment to install, and what products to develop and produce, make decisions with consequences that might last many years. Individuals must make informed guesses about circumstances in the years ahead and then base decisions on these expectations.

1.3 AGENCIES

The first institution who decided to conduct systematic SPF surveys was the central bank of the United states of America. The survey began in 1968 and was conducted by the American Statistical Association and the National Bureau of Economic Research, but later on, in 1990 the survey was taken over by the Federal Reserve Bank of Philadelphia[9]. As the most long-term and the easily available database provided by the web site of the FED, the set of forecasts have been used continuously by scholars and researchers to conduct analysis and tests to try to improve the knowledge about their utility and effectiveness. They substantially consist of quarterly surveys of US macro-variables regarding National Income and Product Accounts, but forecasters also carry out different period information (for example Monthly Observations of Unemployment Rate, Nonfarm Payroll Employment, Industrial Production Index, Housing Starts).

In general, the FED classification of the variable of interest is in three groups: Real GDP and Its Components, CPI Inflation and PCE Inflation and U.S. Business Indicators.

The bank also lays out documentation about instructions for the survey's panelists on the variables currently included in the Survey of Professional Forecasters, the

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[9]https://www.philadelphiafed.org/surveys-and-data/real-time-data-research/survey-of-professional-forecasters

current definitions of the variables, and any current transformations of variables. Furthermore, the Census Bureau has promoted, since 1980, the Consumer Expenditure Surveys (CE) program for data on expenditures, income, and demographic characteristics of consumers in the United States.

The ECB Survey of Professional Forecasters (SPF)[10] began in January 1999 and it is a quarterly survey (January, April, July and October) of expectations for point forecasts and probability distributions for the rates of annual HICP inflation, annual core HICP inflation, real GDP growth and unemployment, deepened with a quantitative assessment of the uncertainty surrounding them.

The horizons of interest include the current and the next calendar year, a rolling horizon of one and two years ahead of the last available data and finally a long-term horizon.

The participants are experts affiliated with financial (about 60%) or non-financial institutions based mainly within the European Union (80%), and thus, it represents a very good synthesis of the whole EU conditions. Although habitually there is a preference for anonymity, the ECB provides a list with a good number of the institutes that collaborate in order to bring forward the SPF expectations. On average, the survey has had an active panel of about 75 professional forecasters but

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[10]https://www.ecb.europa.eu/stats/ecb_surveys/survey_of_professional_forecasters/html/index.en. html

with an actual participation in each round of approximately 60 respondents on average.

Since 2008 the ECB has also run a special survey every five years, exploring the forecast methodologies and processes underlying the contributions made to the regular quarterly survey. As well as for the American institute, here too, the data and information, albeit anonymous, are available every three months in order to allow the study and analysis of them.

The European Commission has recently developed indicators of economic sentiment through the Institute of Economic Studies and Analysis (ISAE), which is one of the funding institutes of the EU Harmonised Project on Business and Consumers surveys.

Even longer are the forecasts made up by the Bank of England: every quarter since 1996, the Central Bank has asked a group of external forecasters for their views on some key macroeconomic indicators. Also here are provided a collection of expectations of future inflation and GDP growth not only as point forecasts but also in the form of subjective probability distributions.

Central banks in several other economies (for example, Argentina, Brazil, Iceland, Indonesia, Israel, Mexico, South Africa, and Turkey) provide a summary of forecasts of key economic indicators by economists and analysts.

More recently also other public authorities implement its own survey, among these: the MAS Survey of Professional Forecasters of Singapore, conducted by the Ministry of Trade and Industry, or the Reverse bank of India.

Finally, an independent institution appeared in 1989. Consensus Economics is the world's leading international economic survey organization and polls more than 700 economists each month to obtain their latest forecasts and views. Our surveys cover Individual and Consensus (Mean, High and Low) Scenario Estimates for the principal macroeconomic indicators including GDP growth, inflation, production, interest rates and exchange rates in over 100 countries in the G7 and Western Europe, Eastern Europe, Asia Pacific and Latin America, as well as more than 40 Key Energy and Metal prices.

CHAPTER 2

So far, I have explained the guidelines to understand the basis of the topic, telling the main concepts of a topic that is actually much more complex. In this second chapter I will try to go deeper, taking up a very wide and discussed literature about what scholars have tried to find the most answers over the years and about what I will face in the experimental part of this thesis. In this regard, I will deal with the theoretical aspects of rational expectations, and more, the formation of expectations in general on the basis of adaptive learning and anchored expectation.

Hence, the meaning is to explain the basis of the main features of the previous theoretical studies and introduce the ideas of empirical analysis I will conduct later on.

The majority of the papers dealing with this topic refer to studies on household surveys and therefore the theoretical basis is based mainly on consumer expectation, for this reason I will avoid creating excessive confusion and mention only those in which a comparison or connection is evident also with SPF.

2.1 EXPECTATION FORMATION

The studies concerning the expectations and in particular the survey expectations are innumerable, the topic immediately aroused great interest trying to observe all aspects of the phenomenon. Hence, the analysis on how agents, from households to professionals, form their prospects or to what extent the results obtained are reliable and functional to observe the future trend of the economy.

An important concept to keep in mind for the rest of the thesis is that of Heterogeneous forecasts; for many scholars, it is a necessary assumption for individual forecasts which necessarily have to differ from each other. It might be the consequence of agents employing different models, relying on different information sets, or entailing different capacities to process information.

Since its formulation by Muth in 1961, the rational expectations hypothesis was certainly the most used and accredited. It is a bedrock of modern macroeconomics. REs were considered by most researchers to be the most appropriate hypothesis for economic analysis, since a necessary condition for optimization is that individuals eliminate any systematically erroneous component of their behaviour, even in the formation of expectations. Economic agents are then assumed to form expectations mechanically based on simple linear functions of economic outcomes that are presumed to be perfectly known.

Rational or model-consistent expectations are only a hypothesis to explain how expectations are formed, but this hypothesis is evaluated against alternatives that allow more flexibility and provide more information on how agents formulate their beliefs and how they adapt them in the face of new data and changes in their environments.

There is not enough incentive to go from incomplete to complete information, as the costs can be prohibitive, while the benefits tend to be small. Several macroeconomic theorists have gradually moved away from the rigorous RE framework[11].

Assuming that individuals know the true model of the economy is no more credible than asserting that economic forecasts made using econometric models will be free of systematic bias and information inefficiencies. This has led many researchers to explore the development of a weaker form of the rational expectations hypothesis that allows for uncertainty and model learning. A possible solution can be that of bounded rationality; in fact, it implies limiting agents' knowledge about the true structure of the whole economy.

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[11] Froot (1989), Lamont (1995), Zarnowitz (1995), Ehrbeck and Waldmann (1996) and Romer and Romer (2000) report evidence against the efficiency of survey forecasts, but Keane and Runkle (1998), Thomas (1999), Mehra (2002) and Ang, Bekaert and Wei (2005) report more favourable evidence. These are only a few of the author that tested for rationality and the conclusion for the majority still presents doubts.

As a slight departure from rational expectations, adaptive learning, offers a reasonable framework for modelling the behaviour of economic agents who are coping with rushing economic change.

In the adaptive learning approach, economic agents behave as statisticians or econometricians when they predict the economic variables necessary for their decision making.

AL substantially implies that inflation dynamics will be affected by the history of shocks driving the economy, and other variables such as GDP is the result of the trend of the previous periods.

There is a strong connection between RE and AL. For example, in the cobweb[12] model, if agents estimate an unknown constant expected value by computing the sample mean from past prices one can show that expectations will converge over time to the RE value. In other general models, convergence to RE can occur if agents use and run the appropriate regressions in the same way that an econometrician may do.

It is postulated by some theories the existence of informational resistances producing sticky expectations, while others suggest that agents may act as econometricians when forecasting.

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[12] The Cobweb model describe the temporary equilibrium market prices in a single market, and it is considered a benchmark model in economics dynamics.

In a model assumption with sticky information, agents update their information sets infrequently as a result of fixed costs; while in a context of noisy information agents continuously update their information sets but, for the reason that they can never fully detect the true state, they form and bring up-to-date beliefs about the data and variables through a problem of distortion.

In the first case there is the assumption that each agent updates its information set with a given probability $(1-\lambda)$[13] and doing so he behaves rationally (FIRE assumption is still accepted in this context). It is this differentiation that makes disagreement occur and rise in individual point prediction instead of the lack of rationality. The main implication that the literature underlines sticky information are the persistent and systematic error of the aggregate point prediction following a shock and accompanied by an increase of the cross-sectional dispersion.

In the second model case, when noisy information is taken into account, it is assumed that agents always use the latest information available but don't interrupt noisy signals and bad or not useful news. One of the main implications is that the reaction to a given shock differs among economic agents; that is because of the different degree of sensitivity to the shock itself and the differences of the information sets. The dispersion depends majorly on the ability of the agents of

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[13] Mankiw and Reis propose a model of inattentive agents who update their information sets each period with probability $(1 - \lambda)$ but acquire no new information with probability λ, so that λ can be interpreted as the degree of information rigidity and $1/(1 - \lambda)$ is the average duration between information updates.

understanding and capturing of the signal and how quickly they learn about the true state of economy and policy responses.

Another hypothesis that assumes relevance over time in place of the hypothesis of full rationality is that of anchored expectations. Many studies confirm that inflation expectations have become more anchored, and perhaps more so in countries with inflation targets, where central banks set a more or less precise level of optimal inflation and give input to all economic agents of the medium to long term.

It is linked to Fellner's[14] hypothesis of credibility. The standard adaptive view of his idea is lacking in that it omits the unmeasurable influence of the government's political stance towards inflation. If the government was perceived as lax in fighting inflation, inflation expectations would be shifted, if instead the government was perceived as willing to bear any social cost to eradicate inflation, expectations would be shifted down.

Professional forecasters' expectations come closest to interest rates. This suggests that the stance of monetary policy is an important determinant of expectations. Indeed, central banks argue that managing inflation expectations is one of the most important prerequisites for achieving price stability and promoting sustainable growth.

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[14] William John Fellner was a Hungarian-American economist and Sterling Professor of Economics at Yale University

Policy makers stress that it is imperative that inflation expectations remain anchored to the long-term inflation target.

2.1.1 Deflationary shocks and de-anchoring of inflation expectations

An occasional paper from the Bank of Italy proposes a study of the possible effects of a prolonged period of low inflation, particularly in a situation of monetary policy rates near the zero-lower bound, to find out if it can heighten the risk of inflation expectations de- anchoring from the central bank objective.

Bank of Italy's Governor Visco[15], at the World Savings Day conference in Rome stressed the relationship between actual and expected inflation and hinted that the de-anchoring of inflation expectations may easily turn into a forerunner of deflation. President Draghi emphasised several times the risk that a protracted period of low inflation may become embedded in inflation expectations; he specified that the ECB is prepared to do whatever it takes in order to raise inflation and inflation expectations as fast as possible, since it is mandatory by the price stability directive.

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[15] Ignazio Visco is an Italian economist, current Governor of the Bank of Italy, since 1 November 2011

There has been used a New Keynesian model, where for agents drops the hypothesis of rationality (used just as benchmark) but use regression equations (adaptive learning) to predict the future value of the variables. Clearly, being a research project with reference to the Euro system, the studies were applied to the ECB SPF. "The principal findings are:

-Under learning, price dynamics in 2015-16 are on average 0.6 percentage points lower than in the case of fully rational agents, as inflation expectations are strongly affected by repeated deflationary shocks.

-The learning process implies a de-anchoring of inflation expectations

from the central bank target,

-Output expectations would also be lower in the case of learning, resulting in a slower recovery of economic activity

-Long-run simulations, where all the model structural shocks are set to zero, indicate that under learning inflation tends to remain persistently low whereas it returns rapidly towards the central bank target if expectations are assumed to be rational."[16]

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[16] Banca d'Italia: "*Deflationary shocks and de-anchoring of inflation expectations*" by Fabio Busetti, Giuseppe Ferrero, Andrea Gerali and Alberto Locarno

2.2 RESULTS OF A FED 2009 SPECIAL SURVEY

A very interesting facet was given by the Real-Time Data Research Center which conducted in November 2009 a very special survey to investigate some opinions and methods the SPF adopted.

Even if only twenty-six respondents participated in this specific survey it resulted informative.

The main intention was to find out the opinions on recent and possible future changes that the body that manages the surveys has made. Besides to this main section, however, the survey also focuses on the methodologies adopted to construct the forecasts and how often the information needed to provide answers about the point prediction and the probability distribution are updated.

There was the curiosity in understanding the extent to which the panelists' reported forecasts reflect the outcome of a pure mathematical model simulation, pure expert judgment stemming from intuition developed from long years of studying the data, or even a combination of the two methods.

Surprisingly, SPF panelists change their forecasting approach with the length of the forecast horizon. They usually apply standard methods for the shortest horizons but as the length goes on, they declared that they prefer personal judgement over models.

Please select the method that best describes how you forecast.

Pure Mathematical / Computer Model:	**1**
Model With Subjective Adjustments:	**20**
No Model – Experience and Intuition:	**4**

If you use a mathematical model, can you describe its general nature from among the following?

Structural – IS/LM AD/AS:	**4**
Structural – Other:	**2**
Time Series – Univariate:	**1**
Time Series – VAR / VEC:	**2**
Combination of methods listed:	**11**
Other:	**0**

Figure 1 -Results of model's questions, Real-Time Data Research Center Research Department
Source: Federal Reserve Bank of Philadelphia, Survey of professional forecasters

This definitely suggests SPF panelists are quite flexible in their approach to forecasting, using a combination of models in forming their expectations, rather than just one model and varying their methods with the forecast horizon.

The last point reflects the request on the frequency update of data. The Fed wants to know whether the participants' forecasts made at the beginning of the middle month of each quarter reflect the latest available historical information on the macroeconomy.

How often do you update your forecast?

Quarterly – following the advance release of NIPA:	**6**
Quarterly – other:	**3**
Monthly – following each release of NIPA:	**6**
Monthly – other:	**4**
More frequently than monthly:	**5**
Other:	**1**

Figure 2 -Results of data update frequency, Real-Time Data Research Center Research Department
Source: Federal Reserve Bank of Philadelphia, Survey of professional forecasters

The results say that the information are updated pretty frequently, hence, their projections incorporate practically the most recent information available on the economy around the survey's deadline.

2.3 THE EMPIRICAL ANALYSIS

What I want to look for is the compatibility of the forecasts with the current values and their relevance over time ... then try to understand when the forecasts are useful and more truthful than in other periods such as those of shock in which the errors are higher ... for the business forecasts are very important always and in any case but when the errors are more gross the support that forecasters offer is moreover to central banks that need feedback and forecasts to implement their respective strategies rather than for companies and businessmen who could therefore have the wrong clues about the short-term future of the economy.

In doing this I look for clues in the data that can provide evidence on the formation of expectations. Their usefulness also depends on how their thoughts are created and conceived. From here, after the fall of the almost fifty-year rational expectation hypothesis, it is possible to observe when the forecasts are anchored to the targets of the central banks themselves or to what extent and with which lag they depend more on adaptive learning and the study of past inflation levels.

In my analysis, I'll try to use different kind of methods respect previous studies to comprehend the effectiveness and the main features of the forecasts.

CHAPTER 3

In chapter one, I have described the agencies that systematically conduct surveys to obtain expectations of macro-variables. The analysis I am going to do is based not on all these different sources of data, but I decided to pick the one who presented the most convenient form and availability of information: the SPF of the Federal Reserve of Philadelphia presents many advantages as the longevity of the surveys, the explanations of the data and methodologies that the Bank provides directly, and the multitude of previous studies of many researches to make more coherent comparisons with.

Hence, in this chapter I am describing the main features of the data: how to find them, how to read the files and comprehend the structures and disposition of the variables. Thereafter, I will briefly explain how I manipulated and used the data to carry out my analysis.

3.1 SPF REPORT

Starting from the homepage of the Survey of Professional Forecasters, it is very simple to find the main information and documentation. At first look there are the last reports of the surveys which are the crucial summaries of the economic perspective for the future quarters and years.

It is usually released in the mid of the quarter (in mid-February, May, August, and November) and consists of less than twenty pages explaining the trend of the forecasters' conception of the economy.

In the first section there are the overviews of the main variables, starting with the output and the general condition of the labour market and unemployment, up to the inflation scenario. The description is always in comparison with the previous quarter forecast, both in the text and in the tables and bar charts which depict the median level and the mean probability of the variable growth. After thanks to the agents who took part in recent surveys, and after a summary table of the median of all the main variables, there is the second part of the report which includes exclusively the tables.

3.2 SURVEY VARIABLES

Obviously, the official Fed report is an important starting point for understanding the topic and the current scenario, but for the analysis, as mentioned, the central bank provides several excel sheets where the variables are explicit and collected in historical series.

We can choose if we are interested in the file with the single variable or aggregated variable grouped by contents, or, again, if we want to analyse individual forecasters or 'consensus' data.

Before examining the files, I would like to list and to describe some of the variables[17] which will be found in there and that may be used in the analysis.

The first round of measures regards the U.S. Business Indicators, here are:

- 'NGDP', forecasts for the quarterly and annual level of nominal GDP. Seasonally adjusted, annual rate, in billions $. Annual forecasts are for the annual average of the quarterly levels.

-'PGDP', forecasts for the quarterly and annual level of the chain-weighted GDP price index. Seasonally adjusted, index, base year varies. Annual forecasts are for the annual average of the quarterly levels.

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[17] Many of the variables can be found in the Bureau of Economic Analysis's Survey of Current Business (abbreviated SCB): http://www.bea.gov.

-'UNEMP', forecasts for the quarterly average and annual-average unemployment rate. Seasonally adjusted, percentage points. Quarterly forecasts are for the quarterly average of the underlying monthly levels. Annual forecasts are for the annual average of the underlying monthly levels.

GDP is the fundamental measure of a country's economic health, adding up the monetary value of all goods and services produced over a given period of time, minus the value of the goods and services used in production. It is important because businesses rely on GDP for major planning decisions, as well as for investors: GDP is a guide for estimating profit margins and making financial decisions.

Nominal Gross Domestic Product is not adjusted to account for the price changes from inflation and deflation. The rise and fall of prices are captured by nominal GDP, which tracks the gradual increase of the value of an economy over time.

The Unemployment rate indicator is measured in numbers of unemployed people as a percentage of the labour force. The unemployed are people of working age who are without work, are available for work. It is a lagging indicator, meaning that it generally rises or falls in the wake of changing economic conditions, rather than anticipating them.

The second kind of variables are Real GDP and Its Components; the variables in this section were added to the survey in 1981:Q3:

-'RGDP', forecasts for the quarterly and annual level of chain-weighted real GDP. Seasonally adjusted, annual rate, base year varies. Prior to 1981:Q3, RGDP is computed by using the formula NGDP / PGDP * 100.

-'RCONSUM', forecasts for the quarterly and annual level of chain-weighted real personal consumption expenditures. Seasonally adjusted, annual rate, base year varies.

Real gross domestic product is an inflation-adjusted measure that reflects the value of all goods and services produced by an economy in a given year and is often referred to as "constant-price," "inflation-corrected" GDP.

Finally, in the third round there are variables regarding CPI Inflation and PCE Inflation[18], panelists are asked to submit their projections in growth-rate form (not levels):

-'CPI', forecasts for the headline CPI inflation rate. Seasonally adjusted, annual rate, percentage points. Quarterly forecasts are annualized quarter-over-quarter percent changes of the quarterly average price index level. Annual forecasts are fourth-quarter over fourth-quarter percent changes.

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[18] The CPI guesses were added to the survey in 1981:Q3; instead, the other measures (PCE, CORE CPI and CORE PCE) were introduced to the survey in 2007:Q1.

-'CORECPI', forecasts for the core CPI inflation rate. Seasonally adjusted, annual rate, percentage points. Quarterly forecasts are annualized quarter-over-quarter percent changes of the quarterly average price index level. Annual forecasts are fourth-quarter over fourth-quarter percent changes.

-'PCE' and 'COREPCE', forecasts for the headline and core chain-weighted PCE inflation rate. Seasonally adjusted, annual rate, percentage points. Quarterly forecasts are annualized quarter-over-quarter percent changes of the quarterly average price index level.

-'CPI10' and 'CPI5YR', Forecasts for the annual-average rate of headline CPI inflation over the next 10 years and the next five years and thus, represents the forecast for the long-run term. The calculation of inflation is one that runs from the fourth quarter of the year before the survey year to the fourth quarter of the year that is ten years beyond the survey year, representing a total of 40 quarters or 10 years in the first case, and 20 quarters or 5 years in the second one. The first measure was introduced in 1991:Q4; while the 5 years inflation was asked starting from 2005:Q3.

The Consumer Price Index (CPI)[19] is a measure that examines the weighted average of prices of a basket of consumer goods and services, such as food, clothing, shelter, and fuels; transportation fares; service fees (e.g., water and sewer service); and sales

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[19] The U.S. Bureau of Labor Statistics (BLS) reports the CPI on a monthly basis and has calculated it as far back as 1913.

taxes. It is calculated by taking price changes for each item in the predetermined basket of goods and averaging them. It is the most widely used economic indicator for measuring inflation and, by proxy, of the effectiveness of the government's economic policy.

As well as the headline CPI, Core inflation (Core CPI) is the change in the costs of goods and services but does not include those from the food and energy sectors because of the higher volatility and widely fluctuation of their prices. it is a very important measure, in fact, the decisions about rates by the Federal Reserve are usually taken according to the trend of the Core values.

Although very representative, the coverage of the CPI is limited as it does not include the prices of investments in stocks and bonds, the expenditure of American consumers abroad and that of foreign consumers in America. Furthermore, some social categories such as exceptionally rich groups or those far below the poverty line are not considered in the index. A large part of the rural population can also be excluded as the index is more representative of the consumption habits of urban families.

Personal Consumption Expenditures (PCEs) refers to a measure of imputed household expenditures defined for a period of time. It measures the prices that people living in the United States, or those buying on their behalf, pay for goods and services. The PCE price index is known for capturing inflation (or deflation)

across a wide range of consumer expenses and reflecting changes in consumer behaviour, and respect to the CPI, tends to provide inflation trends that are less affected by short-term price changes.

For this reason, since 2012, the PCE Price Index became the primary inflation index used by the U.S. Federal Reserve when making monetary policy decisions.

3.3 DEALING WITH DATA SURVEY

The report is always accompanied by the charts that contain all the reference data. Fed makes Excel files available in the section of its website dedicated to SPF.

In this section there are the descriptions of these documents in order to better understand their structure and meaning.

For example, we can download the files called "MedianLevel.xlsx" and "MeanLevel.xlsx"; these are Excel workbooks with multiple worksheets. Each worksheet holds the time series of median forecasts and mean forecasts for the level of a different variable (50). The same thing is for the files "MedianGrowth.xlsx" and "MeanGrowth.xlsx": These are the growth rates of the levels provided in the median and mean level files respectively (annualized percentage points).

Now let's see how the single worksheet is structured, taking as reference the figure below.

YEAR	QUARTER	CPI1	CPI2	CPI3	CPI4	CPI5	CPI6		CPIA	CPIB	CPIC
2018	1	3,70	2,61	1,90	2,26	2,29	2,24		2,26	2,26	2,35
2018	2	3,50	2,01	2,37	2,35	2,38	2,23		2,55	2,34	2,40
2018	3	1,70	2,34	2,34	2,38	2,13	2,38		2,47	2,33	2,32
2018	4	2,00	2,40	2,43	2,22	2,36	2,40		2,39	2,35	2,24
2019	1	1,50	1,23	2,31	2,30	2,23	2,24		2,02	2,19	2,24
2019	2	0,90	2,67	2,17	2,16	2,07	1,95		1,97	2,09	2,18
2019	3	2,90	1,83	2,13	2,08	1,94	2,10		1,93	2,09	2,17
2019	4	1,80	1,84	2,18	2,08	2,11	2,10		1,85	2,11	2,19
2020	1	2,60	1,92	1,98	2,14	2,18	2,17		2,06	2,22	2,23
2020	2	1,20	-2,39	1,62	1,89	1,95	1,89		0,56	1,82	2,14
2020	3	-3,50	1,91	1,55	1,55	1,51	1,83		0,26	1,76	2,05
2020	4	5,20	2,16	2,11	1,81	2,15	2,18		1,21	2,06	2,10
2021	1	2,20	2,48	2,03	2,16	2,22	2,22		2,22	2,18	2,27
2021	2	3,70	3,38	2,70	2,41	2,46	2,30		3,05	2,39	2,41

Table 1- CPI Mean Level chart

The first two columns describe the year and the quarter of the survey, and so, each row gives the projections from a different survey, while the remaining columns give the projections with respect to different horizon targets. Here we distinguish the quarter projections with respect to the annual ones: the columns from 'CPI1' to 'CPI6'

The first index "1" represents the "forecast" for the quarter prior to the quarter in when the survey is conducted, it is simply the BEA's advance estimate for the prior quarter, since forecasters are permitted to forecast a revision to the BEA's advance estimate, but most do not.

The column "2" represents the forecast for the current quarter (nowcast or 0-step-ahead), defined as the same quarter in which the survey is conducted.

Finally, the numbers "3", "4", "5" and "6" are the forecast for the following quarters after the date of the survey itself, they simply represent a horizon, moving down a given column you get a given step-ahead forecast.

In the image I have marked with the same colour the lines that represent the same final target. e.g. the first cell coloured blue in 2020:Q1 is the BEA's estimate of the inflation of the previous quarter, or 2019:Q4 whose nowcast is in the "CPI2" column. The oldest forecast made was in the column "CPI6" in 2018:Q4 (four quarter before or a year before). the same is true for the orange cells: in 2021:Q1 in correspondence of "CPI2" there is the nowcast and in the diagonal on the right each cell corresponds to the forecast of this quarter from an increased lag quarter.

The letters "A" and "B", instead, represent annual-average forecasts for the current year and the next year, so denote the annual fourth quarter over fourth-quarter inflation forecasts. Since the 2005:Q3 survey was introduced the letter "C" was introduced for the CPI, which is the projection with horizon two years from the current one. Here it is important to underline that in a precise year, say 2020, the survey refers to the current calendar year; this means that from 2020:Q1 to 2020:Q4 the annual inflation is for the same 2020. In the first quarter the forecast has a four-quarter horizon, and it will be reduced as the next survey are carry out.

Another very important file is that which contains the mean probability forecasts. To measure expectations uncertainty, one needs further survey measurements where respondents are explicitly asked about the degree of confidence they attach to their point expectations. In Prob.xlsx there are the mean responses for the survey's six probability variables in the worksheet: PRGDP, PRPGDP, PRCCPI, PRCPCE, PRUNEMP and RECESS (the probability of a decline in real GDP in the current quarter and the following four quarters). The worksheets give the mean responses for the probabilities[20] that the change or the level of the variable falls into a number of alternative ranges[21].

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[20] The probabilities sum to 100 (up to a rounding error).
[21] It is important to specify that each variable has many caveats and differences with respect to the others. At the same time both the ranges and the number of annual forecast horizons change over time.

In table 2 I reported an example of the structure, using again the worksheet of the CPI. As usual, the first two columns are used to name the year and the quarter in which the survey is made, from 'PRCCPI1' to 'PRCCPI10' there are the bins in which the probabilities are for the first year; whereas, from PRCCPI11' to 'PRCCPI20' for the following year. Thus, the Survey asks the respondents for the probability of the annual rate of the inflation in the current year with respect to the previous one, and of the next year with respect to the current one.

YEAR	QUARTER	PRCCPI1	PRCCPI2	PRCCPI3	PRCCPI4	PRCCPI5	PRCCPI6	PRCCPI7	PRCCPI8	PRCCPI9	PRCCPI10
2019	1	0,38	0,93	4,38	19,57	45,89	22,77	4,79	0,87	0,29	0,14
2019	2	0,21	0,58	3,66	16,81	48,69	22,90	5,57	1,16	0,34	0,07
2019	3	0,04	0,07	2,03	10,47	48,31	34,14	4,41	0,38	0,12	0,04
2019	4	0,00	0,07	2,14	12,79	59,09	23,46	2,05	0,30	0,10	0,00
2020	1	0,08	0,59	4,83	20,38	41,04	25,42	5,85	1,60	0,19	0,02
2020	2	0,63	0,30	0,86	4,89	16,56	25,50	24,68	13,53	5,88	7,16
2020	3	0,07	0,13	0,65	2,67	6,56	13,81	21,82	30,22	17,31	6,76
2020	4	0,04	0,08	0,27	6,16	15,14	44,12	22,10	8,94	2,51	0,65
2021	1	0,13	0,66	3,78	16,58	33,94	27,65	12,04	3,98	1,15	0,08
2021	2	0,69	2,66	11,23	24,03	28,73	19,88	9,94	2,31	0,50	0,04

YEAR	QUARTER	PRCCPI11	PRCCPI12	PRCCPI13	PRCCPI14	PRCCPI15	PRCCPI16	PRCCPI17	PRCCPI18	PRCCPI19	PRCCPI20
2019	1	1,13	2,09	7,69	21,78	38,34	19,98	6,39	1,77	0,51	0,33
2019	2	0,87	1,76	8,00	18,29	39,50	21,74	7,03	1,90	0,59	0,32
2019	3	0,75	1,69	5,34	17,98	38,75	25,94	6,49	2,24	0,55	0,26
2019	4	0,59	1,57	5,46	20,68	37,42	26,90	5,67	1,31	0,31	0,08
2020	1	0,93	2,16	5,89	18,39	32,88	27,61	8,95	2,54	0,44	0,23
2020	2	0,66	0,42	2,37	7,66	20,39	31,44	20,57	9,24	4,37	2,88
2020	3	0,13	0,68	2,17	8,98	19,23	26,88	21,15	11,37	7,60	1,80
2020	4	0,13	0,71	2,50	11,18	28,81	30,27	18,21	6,07	1,77	0,35
2021	1	0,67	1,16	4,55	17,50	32,96	27,18	10,63	3,82	0,92	0,60
2021	2	0,44	2,07	10,11	25,25	32,16	18,92	7,19	2,46	0,79	0,62

Table 2 -CPI Mean probability file

As said, the ranges and the horizon target differ among the variables. Here I report two tables that the Fed gives as support and illustrate the range values for key variables such as the CPI and the RGDP.

Variable Number ↓	Survey Dates	
	2007:Q1 to Present	
	Ranges **(Fourth-Quarter over Fourth-Quarter Percent Changes)**	
	PRCCPI	**PRCPCE**
1	4.0 or more	4.0 or more
2	3.5 to 3.9	3.5 to 3.9
3	3.0 to 3.4	3.0 to 3.4
4	2.5 to 2.9	2.5 to 2.9
5	2.0 to 2.4	2.0 to 2.4
6	1.5 to 1.9	1.5 to 1.9
7	1.0 to 1.4	1.0 to 1.4
8	0.5 to 0.9	0.5 to 0.9
9	0.0 to 0.4	0.0 to 0.4
10	Will decline	Will decline
11		
12		
13		
14	Same as 1 – 10 for next year	Same as 1 – 10 for next year
15		
16		
17		
18		
19		
20		

Variable Number ↓	Survey Dates	
	2020:Q2 to Present (Real GDP)	2009:Q2 to 2020:Q1 (Real GDP)
	Ranges **(Annual-Average over Annual-Average Percent Changes, Percentage Points)**	
1	16+	6+
2	10.0 to 15.9	5.0 to 5.9
3	7.0 to 9.9	4.0 to 4.9
4	4.0 to 6.9	3.0 to 3.9
5	2.5 to 3.9	2.0 to 2.9
6	1.5 to 2.4	1.0 to 1.9
7	0.0 to 1.4	0.0 to 0.9
8	-3.0 to -0.1	-1.0 to -0.1
9	-6.0 to -3.1	-2.0 to -1.1
10	-12.0 to -6.1	-3.0 to -2.1
11	<-12.0	<-3.0
12 to 22	Same as 1 – 11 for next year	Same as 1 – 11 for next year
23 to 33	Same as 1 – 11 for year 3	Same as 1 – 11 for year 3
34 to 44	Same as 1 – 11 for year 4	Same as 1 – 11 for year 4

Table 3 -Probability description for CPI and Real GDP
Source: Federal Reserve Bank of Philadelphia

Quoting the work and the explanations of M.P. Clements about the topic in "Macroeconomic Survey Expectations" we can underline the importance of this table, also called Histograms. in some kind of research, we can be interested in

personal probabilistic beliefs about uncertain events, and personal point prediction forecasts or even the mean and median measures can tell us nothing about these beliefs. With a simple point prediction about a given variable we cannot know how it is formed or with which criterion the agent chose it among its probability distribution.

Observing the histograms one can get many information and assess the respondent's uncertainties about their point predictions. Clements itself proposed instruments to analyse probability distributions showing estimations of the first and second moments and explaining some of the basic assumptions in order to manipulate the histograms.

Other measures are the mean and the variance of aggregate histograms, obtained by fitting a normal distribution or a generalized Beta.[22]

If we have looked at data in an aggregate perspective, it can be better, in some cases, to observe individual forecasts. Fed makes individual responses one variable at time, but also comprehends all of them in a single excel file named SPF history.

In this case I will not dwell much, as the structure and the nomenclature are practically the same as the files of the aggregate measures.

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[22] To approximate the histograms to continuous distributions like the normal or generalized beta it is required three or more bins with non-zero probability. When there are less than three bins with non-zero probability one can fit the triangular distribution.

For convenience I report again the example of the CPI.

YEAR	QUARTER	ID	INDUSTRY	CPI1	CPI2	CPI3	CPI4	CPI5	CPI6	CPIA	CPIB	CPIC
2021	2	421	2	3,70	5,60	4,20	3,30	2,70	2,50	4,20	2,50	2,30
2021	2	422	2	3,70	3,35	3,05	2,65	2,15	2,15	3,19	2,15	#N/A
2021	2	423	2	3,70	3,75	3,25	3,30	3,02	2,64	3,50	2,72	2,52
2021	2	424	1	3,70	3,46	2,56	2,43	#N/A	#N/A	3,04	#N/A	#N/A
2021	2	426	2	3,70	2,43	2,78	2,51	2,52	2,52	2,86	2,55	2,53
2021	2	429	2	3,70	4,18	2,00	2,33	2,55	2,58	3,06	2,54	2,46
2021	2	433	2	3,70	4,05	2,43	2,19	2,15	2,62	3,10	2,33	2,29
2021	2	456	1	3,70	4,02	2,40	1,55	1,96	2,00	2,92	1,94	2,21
2021	2	484	2	3,70	3,00	3,30	2,80	2,60	2,30	3,20	2,35	2,40
2021	2	504	1	3,70	1,80	1,25	2,03	5,85	3,24	2,20	3,40	3,64
2021	2	508	2	3,70	0,36	4,84	2,05	3,20	0,36	2,72	2,60	2,03
2021	2	510	2	3,70	5,00	3,00	2,80	2,70	2,80	3,62	3,10	3,20
2021	2	518	2	3,70	2,87	2,61	2,30	2,18	2,29	2,88	2,29	2,13
2021	2	528	1	3,70	1,97	1,69	1,63	2,41	2,54	2,26	2,50	#N/A
2021	2	535	1	3,70	3,70	2,70	2,80	2,90	2,80	3,22	2,80	2,70
2021	2	546	1	3,70	4,50	3,50	3,00	2,70	2,60	3,69	2,63	2,50

Table 4 -Individual CPI forecasts

The only things to specify concern the third and fourth columns which respectively indicate the identification code of the agent and the sector to which they belong.

In the first case, the ID number is consistent over time, but it is confidential to maintain anonymous the agent identity; this solution lets you track all the previous forecasts made by the same individual. An exception subsists when the respondent leaves definitely the survey; in this scenario the new entrances have new numbers, apart when the number is used to identify the institution in which the respondent works and not the respondent itself.[23]

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[23] It may occur that an individual participant suddenly drops out of the panel for a large number of periods, and suddenly re-enters, suggesting that the same identifier might have been assigned to different forecasters.

The column described as Industry specifies the industry in which each respondent is collected: "1" is for financial service provider, while "2" is for nonfinancial service provider.[24] Rarely, it can happen to refer to the code INDUSTRY as "3" if there is no information about the firm.

The last remark is for the cells which contain the formula "#N/A" which refers to forecasts not available in that survey for that horizon target.

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[24] Financial firms: Insurance, Investment Banking, Commercial Banking, Payment Services, Hedge, Funds, Mutual Funds, Association of Financial Service Providers, Asset Management.
Nonfinancial firms: Manufacturers, Universities, Forecasting Firms, Investment Advisors, Pure Research Firms, Consulting Firms.

3.4 INDIVIDUAL AND CONSENSUS FORECASTS

I have shown several charts set up mainly in two different ways. Fed provides individual and aggregate values to allow readers to choose the most appropriate ones since both can have advantages and disadvantages. Clements proposed his view debating the utility or issues for both. For many purposes one can simply use the mean or median measure usually referred as consensus forecast. For instance, it can be enough for a model comparison or an analysis of the macroeconomic effects of expectation shocks, where individual values may be too much informative and a summary is preferred.

At the same time many authors support the utility of individual responses and contrast the aggregate measures which can lead to many problems. We saw that the panel composition might not always be fixed. We will see that not only the respondents can leave and enter over time (and even occasionally give non-response and missing values), but also that in different quarters the number of the panelists is really volatile. On the other hand, aggregate gives a continuous and uninterrupted series of the variables forecasts whereas individual respondents do not for the reasons I have listed above. An obvious reason to prefer individual to consensus is for research on expectation formation and studies on personal beliefs; lots of arguments sustain the necessity of using single responses to test hypothesis of rationality or concerning individual forecasts optimality.

Here I will use both kinds of sources to conduct different types of studies and also to verify the possibility of conditioning some measures according to the different number of participants over time.

3.4.1 Does panel composition influence aggregate measure?

Recently, some scholars have begun to reflect and test the possible imperfections and problems that the continuous movement of the composition of the panel can cause. Some studies have been conducted even if in a different way for the SPF of the Fed and the ECB, trying to establish the possible damages of an unbalanced panel. The number of survey participants definitely varied over time, but it may be not informative about the panel composition movements. If the number of forecasters is unchanged between two quarters, it need not necessarily mean that precisely the same experts contribute to the survey in both periods: not all forecasters will join in the survey habitually and they do not automatically reply to all survey interrogations.

Clements proposed in an academic article[25] a study based on the differences in the aggregate histograms of GDP and inflation for American SPF. The key question is "*Are newcomers and leavers different in terms of forecast accuracy?*"

So, he considered whether newcomers or inexperienced forecasters are systematically different from experienced forecasters since the key assumption he used is "learning by doing" as the driver factor for professional performance.

His conclusion states: *"There are differences between joiners, leavers, and the rest. Joiners are relatively more disadvantaged at forecasting inflation than GDP growth when it comes to histogram forecasting, especially if we allow that learning takes time."*

The Bank of Finland Research Discussion Papers examined the same topic using different techniques and relying on the data provided by the ECB SPF.

It is argued that if expectations are very assorted and sample size is relatively small, it is likely that changes in aggregate forecasts might partially reflect changes in panel composition. They ponder persistence of expectations by sightseeing how aggregated point forecasts and individual uncertainties relate to their own histories; and then compare aggregated forecast revisions in two data sets: in the original

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[25] Michael P. Clements. *"Do survey joiners and leavers differ from regular participants? The US SPF GDP growth and inflation forecasts"*- International Journal of Forecasting

unbalanced panel data set with moving panel composition and in a set of sub-panels of fixed composition.

The analyses suggest that the impacts of changing panel composition on aggregated survey material is very restricted. It means that the original unbalanced panel data appears to embody the whole forecaster population reliably.

For the studies I conducted, I simply proposed to verify how the trend in the number of participants can influence, or can be a hindering factor, the variance or standard deviation, and therefore in general the level of disagreement.

Figure 3 -Level of participants of the surveys over time

As we can better observe from the chart, the number of agents who participate in surveys every quarter is very fluctuating, going from a minimum of 9 in 190 to a maximum of more than 50 and which sees considerable differences not only in the long term, but also between a quarter to the other.

Correlation itself expresses the degree of association between two variables or whether there is a relationship between them (but not necessarily a causal relationship).

If, on the other hand, we want to predict the value of a variable based on the values of another variable, and therefore if it is assumed that a variable is contingent on another variable, then regression is used.
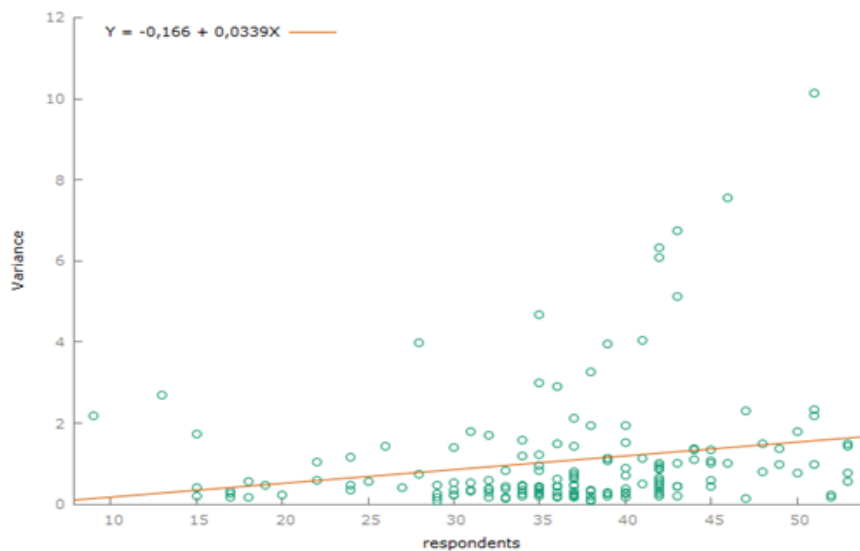
Figure 4 -CPI variance respect to respondents (line of least squares)

Finding the correlation matrix and testing (t-test) the null Hypothesis of non-correlation we obtain the p-value equal to 0.0094. The response is to reject the hypothesis of non-correlation: corr(Variance, Respondents) = 0,20462324.

The correlation is then positive, when the number of respondents is higher it is associated generally higher level of variance, but the value obtained is not particularly worrying.

The same result appears in case of GDP variable; here I tested both the variance to compare with the CPI correlation, and the standard deviation that will be used subsequently in the next chapter. The latter presents t(158) = 2,238, with p-value 0,0266, henceforth with a very low correlation: corr(St.deviation, Respondents) = 0,17528934. The former, instead, not rejects the null hypothesis with a p-value equal to 0.3552 and a correlation near to zero.

CHAPTER 4

In this section I will describe the main characteristics that we can observe by practicing an experimental study on SPF data. The aim is to try to provide a framework that can give a precise description of the characteristics of the survey expectations and how they behave in their specific cases.

4.1 POINT PREDICTIONS' DISPERSION OF CPI

In the first step I compare the individual point forecast for the CPI variable. I used this instead of the core measure or PCE because of its longevity that let us see a longer history movement. An important way to look at doubt over the respondents is the simple variance as a measure of divergence with respect to their individual thoughts.
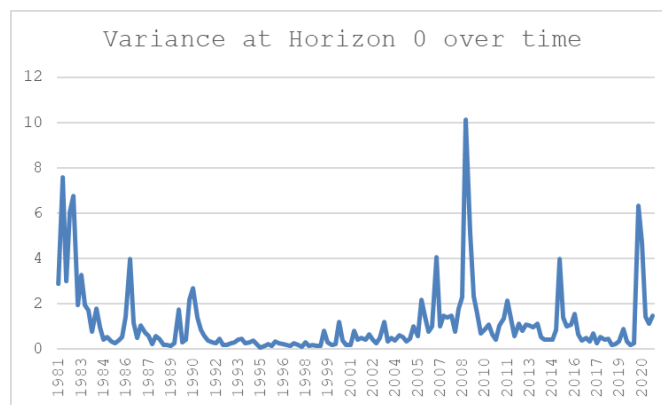
Figure 5 -CPI variance of individual point predictions

In the picture the line represents the variance trend since the starting point of forecasts for the nowcasts, thus this represents the CPI expectation for the quarter in which the surveys were made respect to the previous quarter.

We can immediately notice the different peaks that over the years have represented great discord among agents. In the first years the variance is remarkably high, starting from a value of almost 8, and then progressively decreasing and reaching a near plateau for almost the whole '90s.

The subsequent peaks that come out of the blue obviously indicate the various crises that have hit America and often also the world economy. Immediately after the future of the 2008 financial crisis, for example, opinions on inflationary trends were extremely divergent, reaching a variance of over 10. As well as in correspondence of the Covid-19 Pandemic, when in the second quarter of 2020 the variance was 6. Unfortunately, the pandemic shock is still in act and we cannot assess the situation in its entirety.

The graphs in the next image represents the following four quarter to quarter forecasts history, thus, the first one is the variance for individual point projections of the next quarter respect to the present one and so on for the other three graphs.
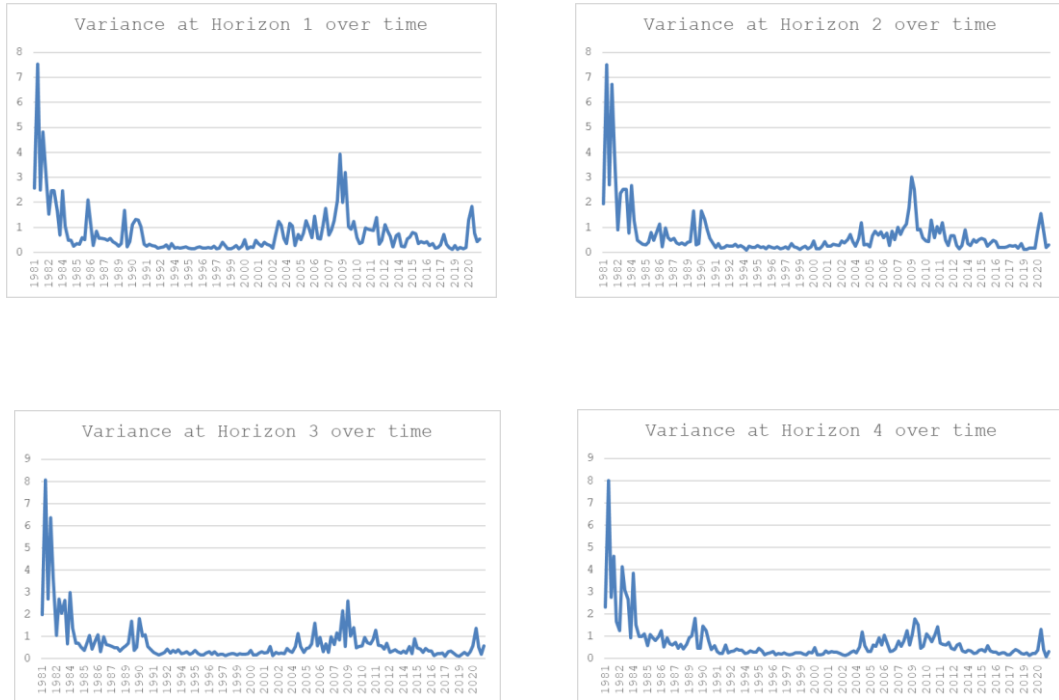
Figure 6 -CPI variance of individual point predictions from t-1 to t-4

As we can see, comparing the trend over quarters variance with respect to the nowcast in the first survey years the peaks are more evident as the target goes on. This could simply mean that in the past agents used different models and information sets to build their opinions creating a larger divergence. But as time goes on, there is a clear trend to reduce the disagreement of agents if the quarter target increases. In the last two decades the peaks of horizon 1 and horizon 2 are absolutely dissimilar; in fact, the variance gradually decreases as the target increases. E.g., if we compare the H0 history and H4 history and compute the

difference it is distinguishable by a fist period up to 1999 when the longest target manifests a bigger variance and a second period when the nowcast variance enormously overcomes the H4 one.
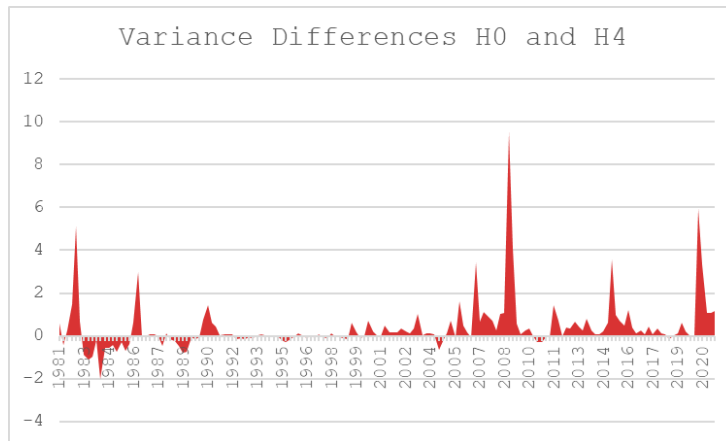
Figure 7 -CPI Variance difference over time between Horizon 0 and Horizon 4 projections.

The same results are stressed by the dispersion measure proposed by the Fed, which use the dispersion as the difference between the 75th percentile and the 25th percentile.

$$X\_D1_{t+k|t-1} = \dot{X}_{P75_{D1_{t+k|t-1}}} - \dot{X}_{P25D1_{t+k|t-1}}{}^{26} \qquad k = 0,1 \dots ,4$$

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[26] Where $X\_D1_{t+k|t-1}$ represents the inter-quartile forecast dispersion for the level of the variable X in period t+k made on the basis of observations known through period t−1, and $\dot{X}_{P75_{D1_{t+k|t-1}}}$ and $\dot{X}_{P25D1_{t+k|t-1}}$ represent the corresponding 75th and 25th percentiles for the level forecasts.

Figure 8 -CPI Dispersions at different Horizons provided by Fed

Here it is equal as before and the difference of horizons' dispersion rise as time of the expectation increases too.
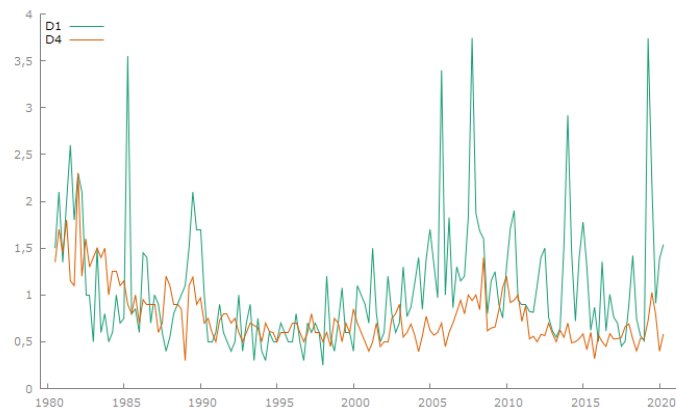

Figure 9 -Comparison of Fed values of CPI dispersion H0 and H4

To better understand the variance trend in certain periods and what influence the target has in terms of horizon, I have also graphically arranged the main characteristics in a different way. So, again I am focusing on the huge shocks which have more confused the investigations of the experts, but also common and peaceful periods to compare the differences.
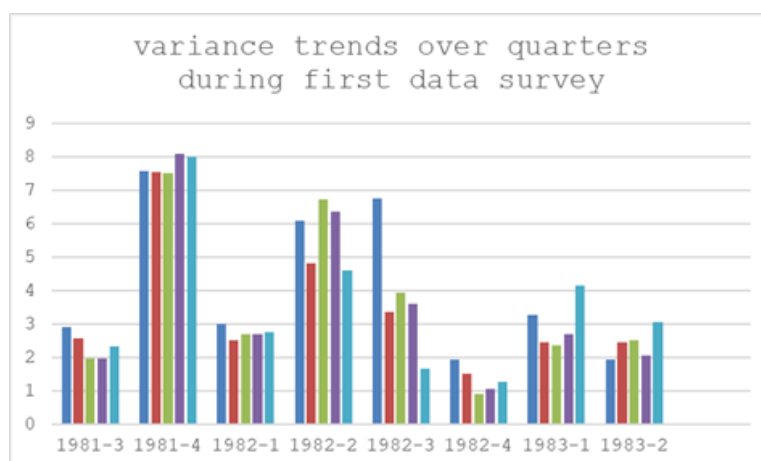
Figure 10 -Variance trends over quarters for the first surveys

On the abscissa axis each block of columns represents a different survey carried out in the undersigned year and fourth. Each block has five columns of different colours representing a different horizon (the first column, the blue one, is the nowcast, the red one is the variance of the projection with H 1, and so on.)

In this case as we noted before agents had pretty different opinions about the price movement; it doesn't seem to follow a precise rule or path, but it is clear that agents

often debate on the third and fourth quarter ahead of inflation. In the first survey years in fact the variance generally didn't change as quarter targets move, but if it does so, it usually occurs in the latest projections or in H 0 and H 4. For instance, in 1981:4, 1983:1, 1983:2.

In the next graph it is represented the same thing, but it is clearer how the variance can rise, or rarely falls down, in the latest quarter asked to the respondents.
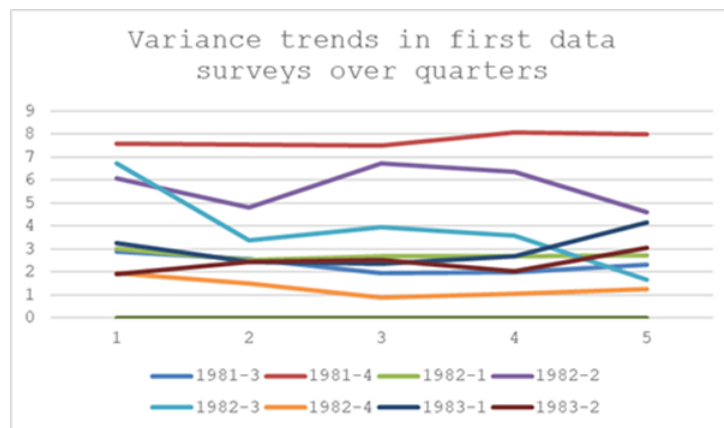

Figure 11 -Variance trends over quarters for the first surveys

During the Financial crisis scenario, the disagreement of the agents appears disproportionate especially in current expectations, therefore, while in H 0 the contrast between the parties is evident, going forward with the projections the variation falls significantly.

As the survey ask for longer ahead quarters, as we can see in the second image, the variance level get flat.
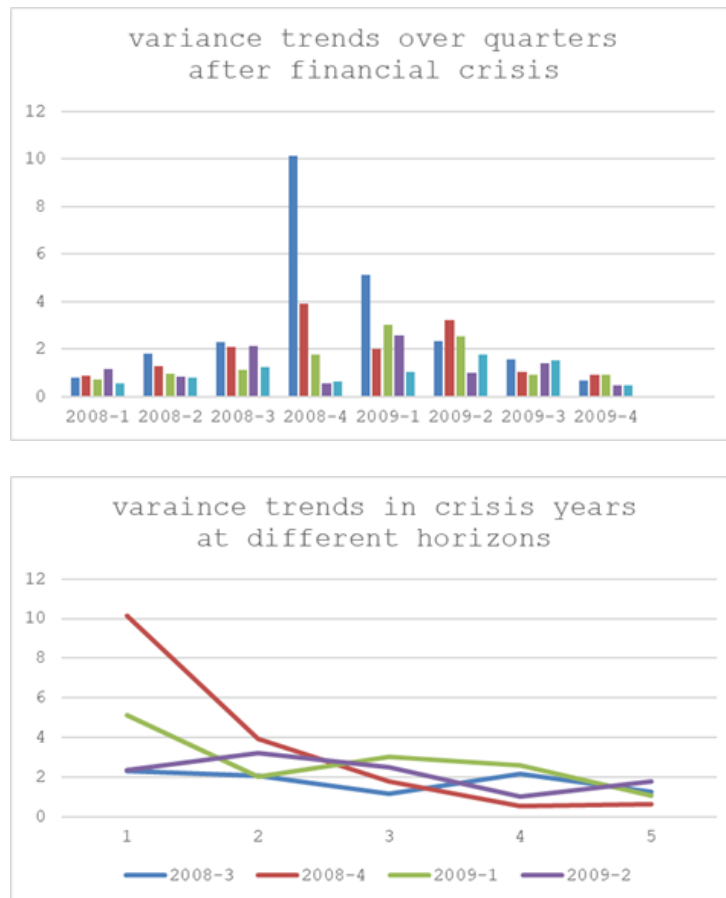
Figure 12 -Variance trendsover quarters for the financial crisis

Variance in covid pandemic period appears really variable but, in each survey, agents confirm a spread disagreement for the current quarter estimation; after that the level drop dramatically and tends to come back to normal values. The first impact is that of a huge change in volatility from the 2020:1 and the following survey: in the first one in normal period the variance is flat for the whole 5 projections, while the nowcast of the 2020:2 flies up to 6 points.
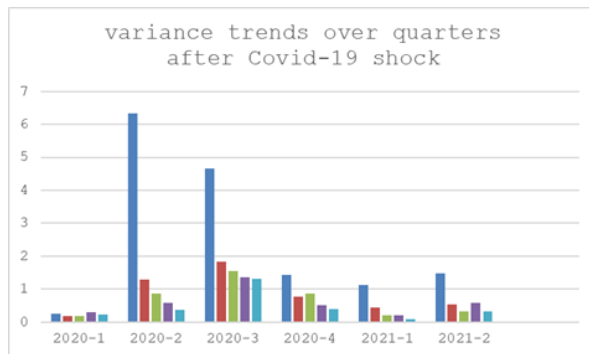
Figure 13 -Variance trendsover quarters for the covid pandemic

The graphs below show how the trend is usually in "normal" periods. the variance values are particularly low compared to the crisis periods, but still, generally speaking, the respondents show more uncertainty in the estimates of current inflation than the values of the following 12 months.
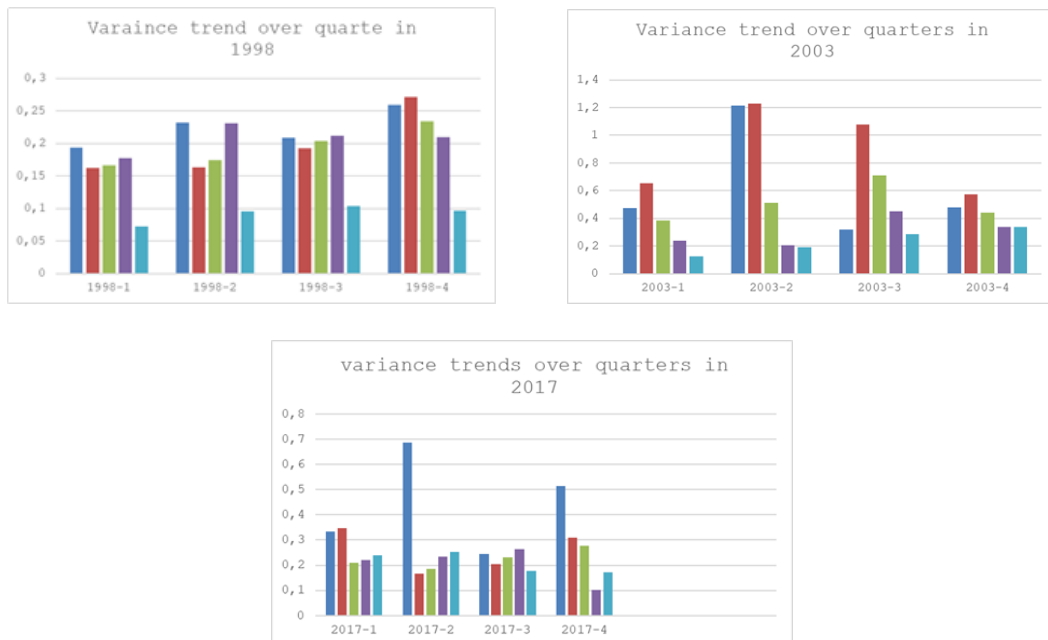

Figure 14 -Variance trendsover quarters in "normal" years (1998,2003.2017)

Here I report the graphs for the mean and median CPI, aggregate measure of inflation expectation, from which we can deduct some interesting things.
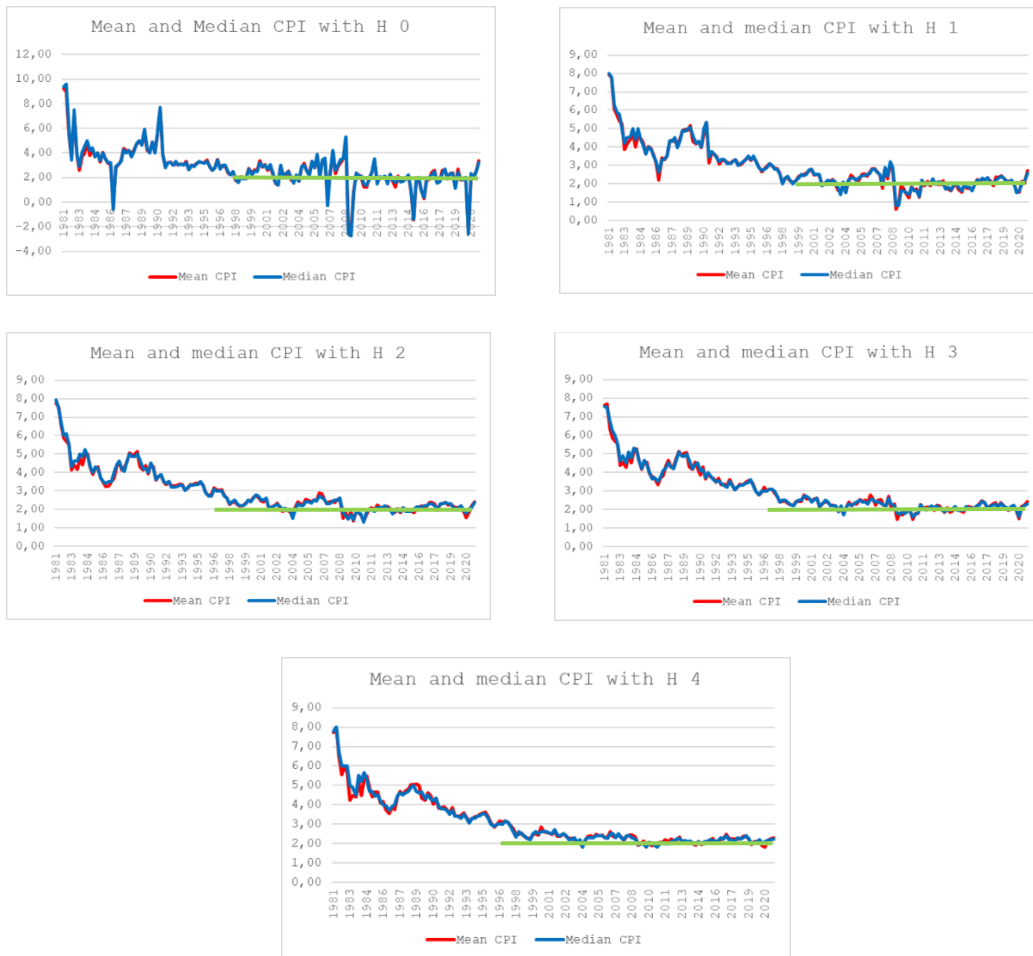

Figure 15 -Mean and median CPI history over the five horizon targets

First of all, we see that there are marginal differences between the mean value and the median value. In almost all polls they differ by only a few decimals and sometimes even cents. So, for the kind of work I have to do I can easily approximate both as a single trend.

If we compare these graphs with the variance ones, we can see a negative correlation between the two values. As explained before in the shock period, when inflation is stagnant or a deflationary period occurs, agents show a very wide range of opinions about the current value of CPI value.

In fact, in the first graphs there are a lot of ups and downs to confirm the actual state of the economy through by the economists, and generally when there is a peak or a valley the respective variance is higher. As we go on with the time predictions the agents' uncertainty is translated with more rigid point predictions with lower forecasts values.

What the analysis purpose wants to establish is the way in which agents formulate their opinion and in the sense thanks to the mean or median we can see the kind of path that expectation of CPI takes over time. Behaviours depend on the political background and the information available by the respondents.

Since 1996, Fed policymakers have used monetary policy (undeclared) with the aim to keep inflation around 2%. In January 2012, Chairman Ben Bernanke[27] made this implicit inflation target explicit and official, thereby aligning the Fed's inflation target with that of all the major central banks. Among these are the Canadian Central Bank, the ECB, of Japan, and more strictly the Bank of England.

Successively, Jay Powell[28] announced a revision to the Fed's long-run monetary policy framework by re-framing this goal as an average inflation target of 2% over the long-run. With this new framework, it will tolerate inflation above its target for a period of time to offset periods when inflation was below its target.

I need to remember that respect to many other Countries, in USA there is a dual mandate and regards the final objects of the Central Bank: inflation target is, as usual, the main framework to face with, but American institutions enlarge the scope to preserve and encourage employment, thus, inflation fight have to continuously match with the Unemployment rate fight. For this reason, the Taylor principle is useful to understand the future fed operations.

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[27] Ben Shalom Bernanke is an American economist at the Brookings Institution who served two terms as the 14th Chair of the Federal Reserve, from 2006 to 2014.
[28] Jerome Hayden Powell is the 16th chair of the Federal Reserve, serving in that office since February 2018.
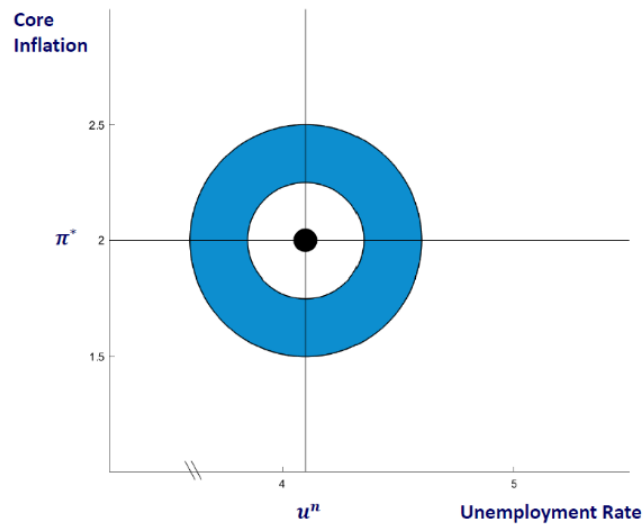
Figure 16 -Fed Dual mandate Bullseye (percent points)
Source: Federal Reserve Bank of Chicago

Maximum employment is the highest level of employment or lowest level of unemployment that the economy can sustain while maintaining a stable inflation rate. According to the Board of Governors of the Federal Reserve System: "*Over the past few decades experience has shown that it is possible to keep unemployment low and the jobs market strong without leading to an unwanted increase in inflation.*"
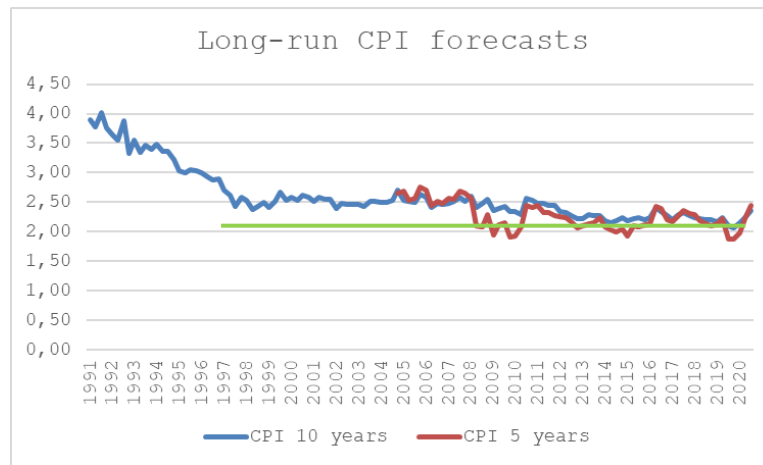
Figure 17 -Five- and Ten-years CPI forecasts

In the previous graphs, as well as in that of expectations at 5 and 10 years, I highlighted with a green line the target imposed by the Fed, starting from 1996 onwards, we can see how the expectations themselves tend to get closer and closer to the final target.

While initially the average and median expectations on the CPI were much higher, recently the trend takes the form of a plateau, proposing as a conclusion a widespread credibility of agents towards the bank and the tools it uses to fight inflation. In the long-run expectation, more precisely, 5 and 10 years after the fourth in which the survey took place, the values are slightly higher and only rarely below the green threshold. It is more common to return to the target in the medium term, in the third-fourth quarter ahead.

4.2 POINT PREDICTIONS' DISPERSION OF GDP

As far as the Nominal GDP is concerned, we can observe a different path. In this case I used the standard deviation as a measure of dispersion, which I considered more appropriate for the excessively high values of the output. it should be noted that the nominal GDP by definition also incorporates price movements and therefore does not exclude inflation, unlike the real value. But I still preferred to use it for a longer and more complete data availability (even if the survey database started from 1968, I still started from 1981 as well as for the CPI).
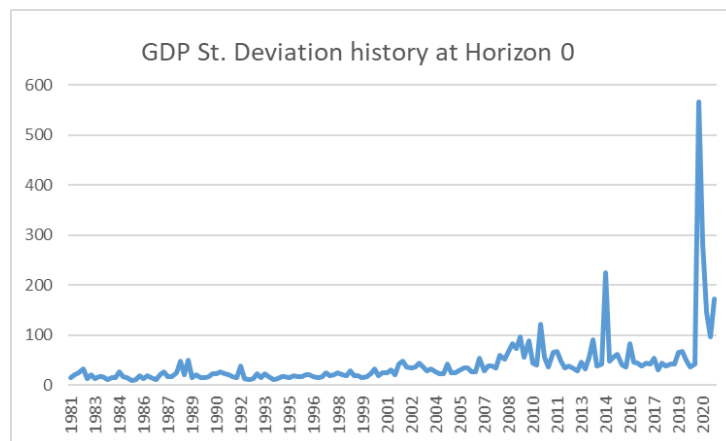

Figure 18 -GDP standard deviation of individual point predictions for t-0

For the nowcasts the standard deviation was minimal in the first surveys, maintaining itself always below the level of fifty. Important movements match the inflation forecasts variance, coinciding with very big shocks: in particular during the financial crisis and even more today with the global pandemic which makes

great confusion among agents. In fact, for the second quarter of 2020 the standard deviation recorded was incredibly over 500.
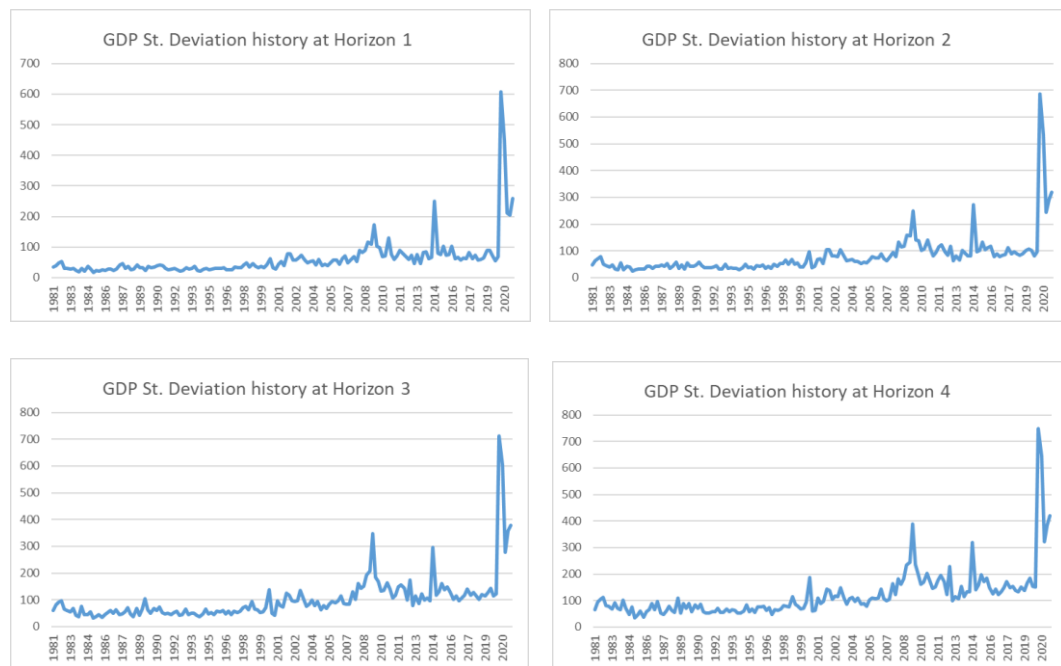

Figure 19 -GDP standard deviation of individual point predictions from t-1 tot-4

The further projections of the N GDP for the following horizons, turned out to be even more complicated, in fact the level of discord between the agents increases as the target increases. This aspect is confirmed in contrast with what we have seen for inflation. if before the variance decreased with increasing time, now there is a positive correlation between the projection time and the standard deviation.

Yet, during the '80's and '90's in the H4 expectations the level of disagreement was approximately 100. In crisis periods achieved also almost 400 and more than 700, in 2009 and 2020 respectively.
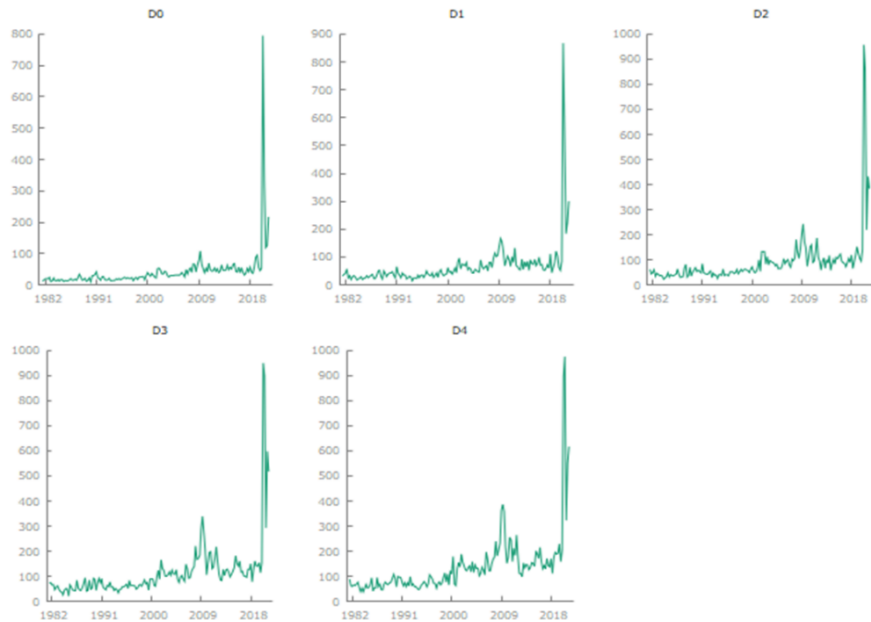
Figure 20 - GDP Dispersions at different Horizons provided by Fed

The dispersion measure used by the Fed, described before, confirms the evolution of disagreement proposed with the standard deviation, with huge peak in correspondence of Coivd-19 period.

Figure 21 -Comparison between D0 and D4 dispersion

Figure 22 -Standard deviation for GDP fro financial crisis and covid periods

For both periods, the graphs shown above allow us to focus on the progressive increase in discordance: in each single quarter the surveys report a higher standard deviation for the subsequent targets rather than for the current one.

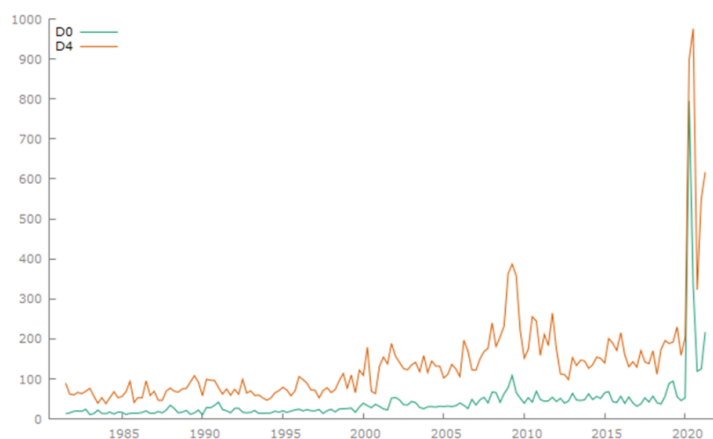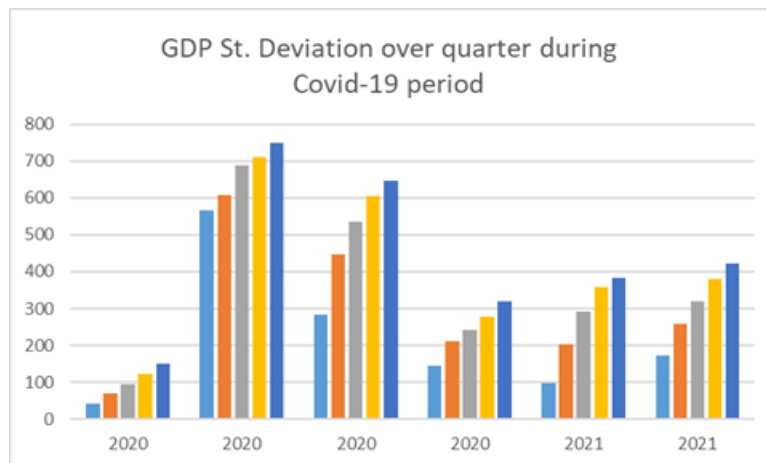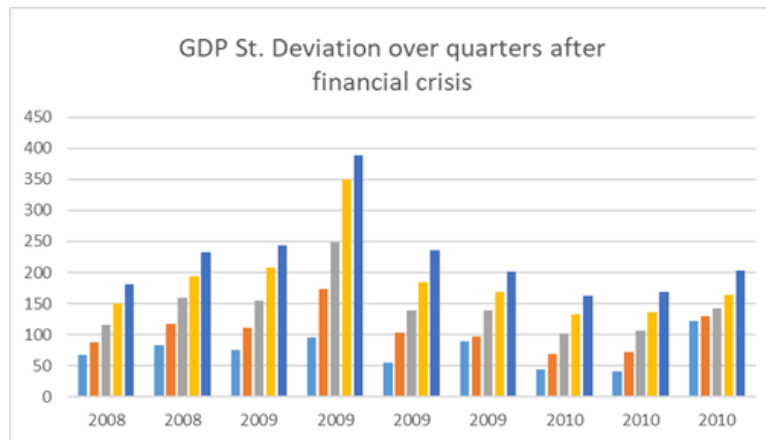It is conceivable that the data manipulation process, especially for future ones, is different between the infliction and the GDP.

In the first case we can suppose that the expected values for the following quarters is also and above all linked to the Fed's imposition which, with press releases and operations in the market, guides expectations in a more or less rigid way. What the survey participants have to do is process the information and review it in their own reviews. Point predictions are often distant from each other because there is a different view of how a measure adopted by the central bank has an effect; for example, size or time lag.

Therefore, in addition to the possibility of a cheaper data update, a valid motivation is the ability of the individual agent to interpret the actions and reactions of the economy to certain stimuli, all this is evident that it is more complicated during periods of shock.

The situation changes for the GDP forecasts, where future values may be more subject to the influence of several variables.

The potential GDP is a measure the limit of economic growth that an economy can achieve without a consistent inflation, it represents the value of GDP that a country could have in a scenario of maximum implementation of capital and use of labour force. So, it is expressed as a trend which reflects the growth of inputs and their productivity. Usually, the actual output tends to lag the potential one, forming the output gap or generally defined also as business cycle.

In positive periods when the potential GDP is overcome from the actual it is more likely that inflation occurs, conversely, in negative periods could happen a contraction in the demand level, in the labour market and a reduction of local and foreign investments.

The projection of the potential output is really complex and the actual one is so, since it regards the interaction of many components; moreover, not all of them are directly observable. In personal sophisticated models, agents have to consider key variables such as labour, capital but also intrinsic or residual terms as productivity factor. In 2020 scenario the complexity of the calculation is enormous, in fact a crisis deriving from the real market of this size does not allow the damage to be immediately observed. The lockdowns imposed all over the world have brought down the actual hours worked, the internal but also the external supply and demand. It is therefore difficult to concretely imagine the future conditions despite the potential stimuli and aid from the government.

4.3 EXPECTATION ERRORS

Having in mind the expectations of the agencies, the most natural question to ask is how valid the reported expectations are, and therefore ask how good the forecasts are both in absolute terms and in relative terms if compared with alternative models or other agencies publications, or even respect to a given set of benchmarks build ad hoc for evaluating the appropriability of the point predictions.

The evaluation literature may therefore require a comparison to decide if one set of forecasts is more accurate than another or simply if a given set possesses certain properties including efficiency. Going over Clements' work I can say that generally the work done by the authors mainly concerns the truthfulness or accuracy of the density functions, thus working with probabilities and histograms and operating a multitude of tests.

In this section my work consists, instead, in the evaluation of the reliability of the inflation point predictions (using as usual the CPI value) by simply measuring the error by observing the characteristics that recur over time and then going to judge when the Fed and the entire business world working with this fundamental data can have more confidence in the responses.

Also for this important aspect, the Fed provides its own study accompanied by tables and explanatory texts. In the specific case of CPI, it reports error statistics for median projections from the Survey of Professional Forecasters and reports the

mean forecast error [ME(S)], the mean absolute forecast error [MAE(S)], and the

root-mean-square error [RMSE(S)] for the median level from 1997:1 to 2018:4. For

the bank, it is often interesting to compare such statistics with those of alternative,

or benchmark, forecasts. In the documents available on the official website, there

is the ratio of the root-mean-square error of the SPF forecast to that of four

benchmark models[29] which are statistical equations that are estimated on the data.

What the documents express is the evolution of error measures with the progressive

revisions of vintage data. from the initial releases, one, five, nine quarters from the

release, the latest release.

```
                    History: Initial Release
1997:01-2018:04
        1   0.04   0.98   1.31       0.48         0.53         0.53          NA   88
        2   0.01   1.42   2.13       0.67         0.87         0.88          NA   88
        3  -0.06   1.48   2.16       0.69         0.91         0.90          NA   88
        4  -0.12   1.47   2.14       0.70         0.92         0.93          NA   88
        5  -0.16   1.49   2.14       0.76         0.92         0.94          NA   88
   H       ME(S)  MAE(S) RMSE(S) RMSE(S/NC) RMSE(S/IAR) RMSE(S/DAR) RMSE(S/DARM) Nspf


                    History: Latest Vintage
1997:01-2018:04
        1   0.05   0.87   1.25       0.48         0.52         0.52          NA   88
        2   0.01   1.37   2.04       0.65         0.85         0.87          NA   88
        3  -0.05   1.42   2.08       0.69         0.90         0.89          NA   88
        4  -0.11   1.39   2.06       0.68         0.91         0.92          NA   88
        5  -0.15   1.40   2.05       0.75         0.91         0.94          NA   88
```

Figure 23 - Forecast Error Summary Statistics for SPF CPI,
Source: Federal Reserve Bank of Philadelphia

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[29] A RMSE ratio below unity indicates that the SPF consensus (median) forecast is more accurate.
The first is the no-change model "NC". In this model, the forecast for quarter T, the current-quarter
forecast, is simply the historical value for the prior quarter (T - 1).
The second and third benchmark models generate projections using one or more historical
observations of the variable forecast, weighted by coefficients estimated from the data; using an
iteration method to generate the projections beyond the current quarter "IAR", or we can directly
estimate a new model for each forecast horizon "DAR".

The analysis they report contains only the various averages in the medium-long term, without specifying the situations year by year; therefore, I focus my analysis on a different way, since the forecast error statistics from the SPF are of interest in their own right.

A forecast error is defined as the difference between the historical value and the forecast, and obviously, forecast with a mean error close to zero is better than one with a mean error far from zero. Many authors prefer the absolute terms of the measures because it does not allow large positive errors to offset large negative errors giving a cleaner estimate of the size of the errors.
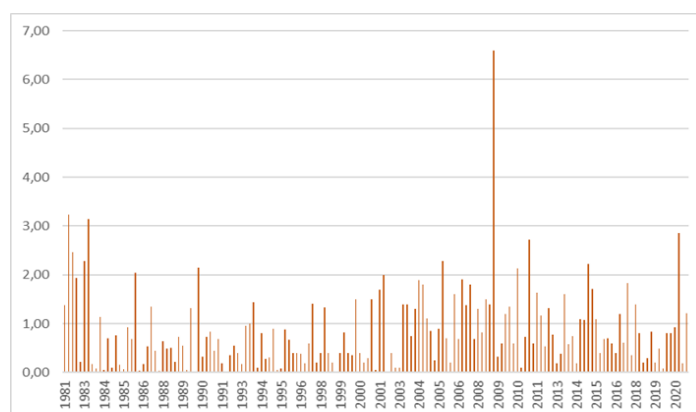
Figure 24 -Absolute values of the consensus (median) forecasts errors for H 0

The graph shows the history of absolute errors in the form of the median[30], for the period corresponding to the survey.

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[30] Using the median instead of the mean is usual in the related empirical literature. The justification is that it eases concerns about outliers and/or data-entry errors, which could be rather influential in the forecaster cross section, from driving the results.

Each bar, therefore, represents the difference in absolute terms of the estimate provided by the BEA and the median of the forecasts for that period. We can see that there is a close correspondence between these values and the variance values reported in the previous paragraphs. In periods of shock and uncertainty, the error is considerably higher: for example, in 2009 it reached a peak of 6. What we must remember, however, is that the values under consideration are the quarter-over-quarter inflation levels and therefore represent the movements of the level prices by a quarter of the previous one: the longer the target the more difficult the anticipation of the values since the unpredictability of immediate shocks.

The graph below emphasizes this; in the projections four quarters away from the time of the survey, the error, in almost all points, doubled. For simplicity and synthesis, I have not entered the other three degrees of horizons, but it is clear that the error trend is increasing, as the target increases, the error value is higher.
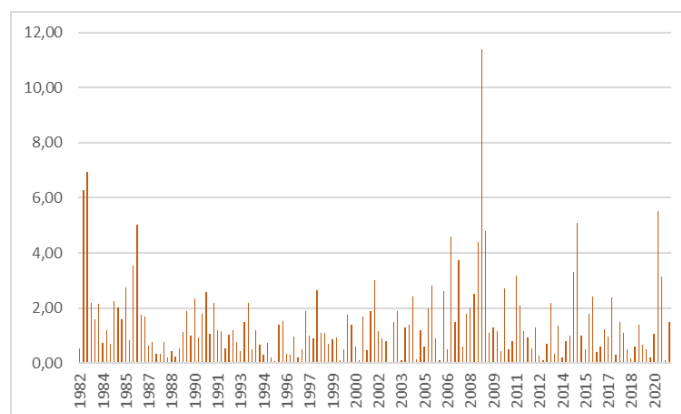
Figure 25 - Absolute values of the consensus (median) forecasts errors for H 4

Although little used in past studies, I believe that even the exact values, without absolute value, can be useful and informative. From this type of values and using the simple average (The mean error for each horizon is simply the average of the forecast errors at that horizon)[31], it is possible to perceive how the error trend in the presence of shocks is.

Figure 26 -Consensus (median) forecast errors for H0 and H4

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[31] Analysts and academicians may care not only about the average size of the errors but also about their variability, or variance. The root-mean-square error for the SPF [RMSE(S)], reflects the influence of the mean error and the variance of the error. Despite its wide use in this study, I will not deal with it.

Again, I only reported the error at the first- and last-time degree, the graphs represent the same values shown on the previous page but obviously where it was necessary the sign has been reversed.
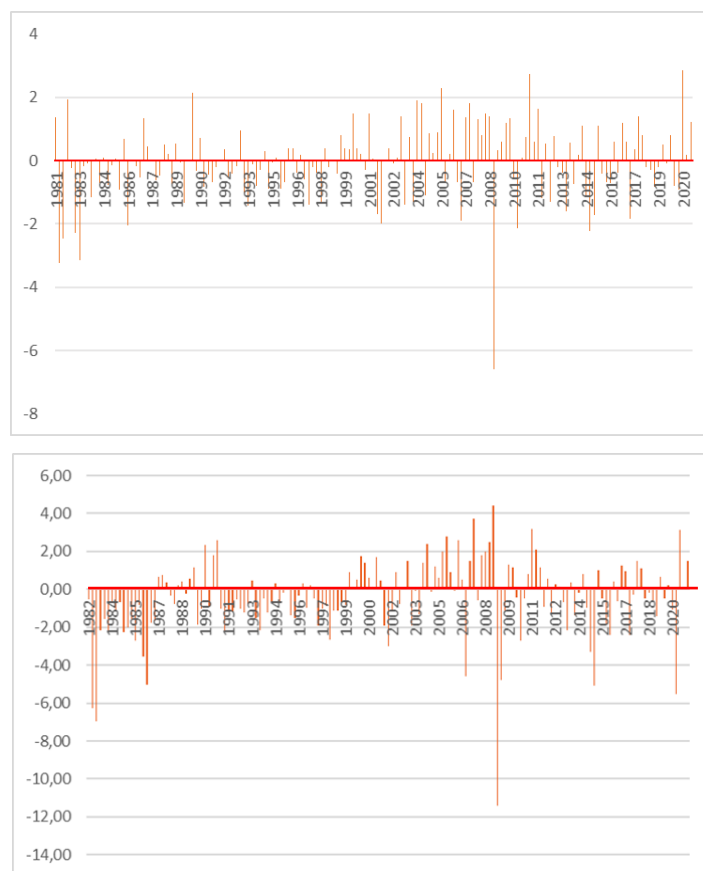
What I want to do now is to observe the average of the error (always considering the median as an aggregate value), trying to establish its main characteristics.

I initially wanted to recreate a summary of the average error and also in absolute terms as already done by the fed. In this case, however, I wanted to offer a broader view, starting from the beginning of the history of the variable CPI. Although in some ways not very useful, as not to mark a specific period to evaluate the trend but the whole story, we see that the standard error occurs in all five horizons with a negative sign and increasing magnitudes as the distance between the survey date and target grows. Verily, to observe and evaluate the magnitude better, it is certainly better to use the absolute values, avoiding giving more to the sign to obtain the average; the results, by the way, remain similar, with a progressive increase of the errors mean as the future date is more far. The table[32] below summarizes these average values.

1982:3-2021:1	H0	H1	H2	H3	H4
[ME(S)]	-0,06	-0,19	-0,29	-0,39	-0,48
[MAE(S)]	0,83	1,31	1,38	1,41	1,46

Table 3

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[32] The number of observations is 155, starting from 1982: 3 and not before to allow to have the same number of values for each horizon.

The errors show a negative sign in all cases if seen as an average in the history of SPF CPI, the overestimation in long periods as observed may reflect the precarious confidence in the ability of the monetary government to stabilize prices, also because in the last few decades they do not present a strict regulation of the target as there can be today on inflation targeting.

Dividing the history table in two sub periods, we can compare the influence of the inflation targeting (implicit since 1996 and explicit since 2012).

In the first period agents made, as average ($[ME(S)]$), estimations higher than the real realizations with an increasing error magnitude as the target goes on. The error mean after the inflation targeting, conversely, resulted positive for the current estimation of the surveys, then it let us suppose a condition of the FED measures to the economist opinions.

Year range	H0	H1	H2	H3	H4
1984-1996	-0,20	-0,41	-0,53	-0,65	-0,76
1996-2021	0,07	0,00	-0,06	-0,13	-0,18

Table 4

In the shocks caused by the change in the economic cycle, perhaps by technological advances and innovations, there is a tendency to underestimate in the early periods, inflation is seen as lower than the actual one, but subsequently there is a delayed over-reaction, that is in the following steps there is an overshooting thinking that

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the inflation is higher than expected as well as continuous, all of which leads us to believe that the shock will persist in addition to the real time.

Inflation expectations have an initially inactive answer to the shocks that drive most of the business-cycle variation. But over medium horizons, forecasts tend to overshoot the actual outcomes.

In negative shocks such as those examined so far, the opposite can happen but with the same under-reaction effect. In the first periods of the covid, as well as for the financial crisis, there was an overestimation of inflation (forecasts> realizations) but then in the following quarters the average error is positive (realizations <forecasts) and therefore the agents believed there was a prolonged persistence of the effects of covid.

In both scenarios, what can explain the estimation error is a friction of information or even an under-reaction to the news. Another explanation is the construction of models underlying the economic reality and on which agents use to represent future conditions; as the economic, political, and technological scenario changes, the economic reality should be exemplified with other types of models which, on the other hand, can remain unchanged for many respondents.

Very good and deep argumentation and instruments of analysis are explained in "Imperfect Macroeconomic Expectations: Evidence and Theory" an academic article thanks to a collaboration between Yale University and MIT.

The same table shown before can be built for the covid period, but still, it cannot be extremely explicative since many predictions cannot be evaluated in terms of error.

2020:2-2021:1	H0	H1	H2	H3	H4
[ME(S)]	0,83	0,12	-0,10	-0,20	-0,19
[MAE(S)]	1,30	2,87	2,70	2,57	2,56

Table 5

The negative signs in the most distant forecasts indicate a limited reaction to events, for horizon 4 instead we should not dwell on it more from time to time when it also includes values prior to the covid and therefore makes it impossible for agents to modify their opinions even minimally. The underestimation as well as the following persistence in the shock impact can be more accurately seen in the current and one-step-ahead errors in these quarters.

year: quarter	H0	H1	H0-H1 mean
2020:02:00	-0,923	-5,5019	-4,61
2020:03:00	2,8611	3,6976	3,15
2020:04:00	0,1933	0,5897	0,22
2021:01:00	1,2065	1,7027	1,61

Table 6

4.3.1 Individual error

In addition to seeing the bias of the aggregate measures as done so far, it may also be important to take a look at how the agents differ from the actual value individually.

The table below is a summary of the respondents' bias level concerning the estimates proposed by the BEA. For each row, the year and the fourth to which the estimate refers is reported. Therefore, moving horizontally, we observe the percentage of agents who propose very good projections (with an error of less than 0.5) and the percentage of those who instead show particularly high errors (with a score of 3.00 or higher). The columns instead show the quarterly distances of the observations with respect to the quarter of the estimate. moving from left to right then we have the predictions of the current period up to the predictions made 4 quarters ago.

The analysis refers only to the two major crises, starting from 2008: 1, the financial one, and, starting early with 2019: 4, the still ongoing shock of the Covid-19 pandemic.

Y-Q estimation	percentages of agents with low or high errors at t-h									
	0		1		2		3		4	
	low error	*high error*	*low error*	*high error*	*low error*	*high error*	*low error*	*high error*	*low error*	*high error*
2008-1	4,17	8,33	0,00	22,45	0,00	16,98	0,00	10,20	0,00	56,86
2008-2	4,00	12,00	0,00	36,73	0,00	24,49	0,00	24,49	0,00	19,23
2008-3	6,38	17,02	0,00	74,00	0,00	94,00	0,00	97,92	0,00	91,84
2008-4	0,00	86,00	0,00	100,00	0,00	100,00	0,00	100,00	0,00	100,00
2009-1	27,91	18,60	4,00	60,00	0,00	91,49	0,00	92,00	0,00	80,00
2009-2	25,49	5,88	37,21	6,98	28,00	0,00	12,77	0,00	6,52	2,17
2009-3	26,47	8,82	7,84	21,57	4,65	16,28	6,00	0,00	19,15	2,13
2009-4	0,00	0,00	11,76	8,82	9,80	5,88	6,98	9,30	16,33	0,00
2010-1	26,19	0,00	45,00	0,00	64,71	2,94	45,10	1,96	27,91	2,33
2010-2	0,00	13,64	0,00	21,43	0,00	7,50	2,94	17,65	0,00	31,37
2010-3	61,11	0,00	59,09	0,00	54,76	0,00	48,78	0,00	30,30	6,06
2019-1	23,08	0,00	45,71	0,00	55,00	0,00	68,42	0,00	56,76	0,00
2020-1	24,32	0,00	15,38	0,00	0,00	91,67	17,50	0,00	13,16	0,00
2020-2	23,81	30,95	0,00	100,00	0,00	100,00	0,00	100,00	0,00	100,00
2020-3	2,86	42,86	0,00	73,81	0,00	51,35	0,00	56,41	0,00	62,86
2020-4	51,35	8,11	28,57	11,43	50,00	4,76	72,97	0,00	76,92	0,00
2021-1	7,89	7,89	5,71	0,00	3,13	12,50	2,50	5,00	2,70	5,41

Table 7

Thus, referring to complicated periods in which the causes have been violent and often sudden, it is clear that the trend is of a widespread high level of error. Despite this, in some precise moments, the agents were able to correctly approach the

historical moment and to read and interpret the initiatives of the state, the central bank, and the circumstances.

starting from the beginning I try to summarize the events: in the first three quarters of 2008 inflation is perpetually higher than the target set, growing quarter by quarter (4.30, 5.00 and 6.70), in fact, especially in 2008: 3 the percentage of agents which report an error greater than 3 goes over 90% at horizons 2,3 and 4. However, in all three periods, the nowcast has minimal hints of high errors and some low levels. Things get worse in the following quarters where inflation collapses below zero reaching even the -9.20% growth rate. Obviously, these values, especially with distant target predictions, were impossible to predict. In fact, we reach 100% of individuals who are placed with an error <3 (in this case some agents reach error peaks greater than 12).

In 2009, however, the situation seems to be rebalancing and for close targets (nowcast and t-1), many agents seem to have a clearer picture of the scenario and the new structure of the American economy: about 25% manage to minimize the bias for the first quarter, while in the following ones, individual responses have a quite good accuracy with a peak of 37% for 2009:2 at t-1.

What seems to happen is a systematic increase of bad error in periods when inflation deviates from the Fed mandate target, both a rise and a fall in inflation mislead agents in forecasts with a two-quarter horizon or superior. Paradoxically, however, when the estimate shows values very similar to the target of the central bank, the

respondents fall conspicuously into the category of low errors for forecasts with a more distant horizon rather than in the nowcast, to underline a great relationship and trust in the strategies applied by the government institutions.

I also wanted to consider the values for 2019: 4, before the start of the pandemic to also show a "normal" period. With an estimate of inflation growth of 2.60 individuals with an error greater than 3.00 are not present for any of the five-time distances, but here too there is an increase in the percentage of agents that fall below the error of 0.5 as distance. Then again, in the survey carried out a year earlier, the responses for H4 proved to be particularly accurate.

With the onset of the pandemic, as happened during the financial crisis, the collapse of the economy and inflation with a negative sign invalidates the forecasts made in the previous 4 quarters; in 2020:2 the nowcast reports however that 25% of individuals have a minimal error, but from t-1 to t-4 all agents exceed the error threshold of 3.00.

An exception occurs in 2020:4 where inflation settles at 2.20 and where the forecasts provided at time t-3 and t-4 have an error of less than 0.5 for more than 70% to confirm a high influence of anchoring. Even for the other periods (t- 0, t-1 and t-2) there is a good low error rate.

4.4 TESTING FOR OPTIMALITY

So far, to assess the quality of forecasts for different horizons is to compare some statistical measure of the size of the errors for inflation, and thanks to the values obtained we can arrange a sort of judgement even if in some contests can be considered crude.

In this last section, I'm going to apply a simple test for verifying forecast optimality.

There are many tests to evaluate whether forecasters efficiently use all the information available at the time of the survey. Thus, using Gretl as a supportive tool I implemented the Mincer and Zarnowitz test (MZ regression test, 1969), where the forecasters are forecasting different events by fixing the forecast horizon and varying the initial date.

The linear regression used for optimality is:

$$y_t = \beta_0 + \beta_1 y_{t|t-h} + u_t$$

Where y_t is the actual estimates of the (as usual) CPI percentage change respect the prior quarter; $y_{t|t-h}$ are the forecasts of y_t made at time t-h; and u_t is the statistical error.

After obtaining the Ordinary Least Squares, I set the joint restrictions that give the null hypothesis for optimality[33]. The efficiency is got if jointly $\beta_0 = 0$ and $\beta_1 = 1$.

```
Modello 1: OLS, usando le osservazioni 1981:4-2021:2 (T = 159)
Variabile dipendente: estimation

                 coefficiente   errore std.    rapporto t    p-value
      ------------------------------------------------------------------
   const          -0,449155      0,188189        -2,387       0,0182     **
   prediction      1,14605       0,0583483       19,64        3,85e-044  ***

Media var. dipendente    2,740881    SQM var. dipendente      2,221820
Somma quadr. residui     225,6007    E.S. della regressione   1,198727
R-quadro                 0,710755    R-quadro corretto        0,708913
F(1, 157)                385,7927    P-value(F)               3,85e-44
Log-verosimiglianza     -253,4253    Criterio di Akaike       510,8506
Criterio di Schwarz      516,9884    Hannan-Quinn             513,3431
rho                      -0,000732   Durbin-Watson            1,984986
Note: SQM = scarto quadratico medio; E.S. = errore standard
```

Figure 27 OLS model of the regression using $y_{t|t-0}$

I made a first attempt by entering the entire dataset of the historical series of forecasts carried out at the current time (t-0). The result shows a *p value* equal to 0.048 which makes the null slightly rejected. Apparently, the observations included were numerous and concerned heterogeneous historical periods, not only for the economic scenario but also for the carrying out of the same survey and the

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[33] Even if in literature the term optional and rational is often interchangeable, it is important to distinguish the two expressions; with the acceptance of the null hypothesis a necessary, but not sufficient, condition for rationality is established.

construction of the expectations of the respondents. By verifying the efficiency for shorter periods, it is easier to properly understand the response of the test.

In correspondence of covid pandemic and financial crisis the test confirms the absence of optimality with the null rejected for the prediction $y_{t|t-0}$,as the very high error level suggested in the previous section. Also for the period intra crises (2013-2018) the test indicates that the optimality cannot be accepted.

On the other hand, in the absence of global crises but in periods with normal ups and downs typical of the evolution of economic cycles, the efficiency of information is instead confirmed. In the observations from 200:1 to 2006:4 the null hypothesis is not rejected with a *p value* = 0.43, as well as for the previous observations: 1990:1-1999:4 (*p value* = 0.18) and 1981:4-1989:4 (*p value* = 0.33).

For the subsequent lengths, that is for the tests carried out with forecasts with gradually increasing horizons (1,2,3,4), however, the answers in the periods in which the efficiency was previously confirmed are often negative, with *p values* which get smaller and smaller. Not only that, by applying the OLS model, as the horizon increases the significance of the coefficients decreases to the point of categorically rejecting their relevance within the model. In the same way, the index of determination, R^2 index, which defines its quality, remains very low.

CONCLUSION

The past decades have been rich in insights and studies on expectations on the conditions of the future economy. In addition to being interested in the role that these could have, most of the authors tried to understand the foundations, in particular by verifying the truthfulness, and therefore the usefulness of the expectations of households, companies, and experts in various contexts. Among the methodologies for collecting expectations, the one that was most successful for a study approach was that of surveys. These allowed not only to verify the reliability of the forecasts but also to understand how the participating agents attribute probabilities to events. Over the years there have been several theories concerning the formation of the opinions of professionals, based on the rationality of expectations, then falling in favour of limited rationality connected to the learning of past values, up to anchored expectation, strongly influenced by strength and ability of decision makers to get the goals set.

Survey forecasts provide useful information about agents' expectations, and perhaps also about the likely future evolution of the economy. Or at least, policymakers and financial markets appear to perceive this to be the case, judging by the amount of attention that is paid to these survey forecasts. However, since they are released

infrequently, these surveys are often stale, and it would seem useful to be able to measure respondents' expectations, and to predict upcoming survey releases, at a higher frequency.

In the first step of the analysis, I focused on the level of dispersion between the individual point forecasts, observing for the CPI and GDP variables. In the two cases, the variance, and the standard deviation as measures of dispersion indicates two opposite situations:

For the GDP, the more the target of the forecast within the survey increases, the more agents disagree on the future dynamics of the economy.

On the contrary, the variance of inflation forecasts is often wider when the survey questions refer to shorter horizons; this is a factor that may indicate how respondents are generally very attentive to the indications of the central bank target. In support of this, in fact, even the average and median values of the projections see a flattening of inflation joining the explicit mission of average inflation in the medium term of around 2%.

In particular, in shock periods, when inflation is stagnant or a deflationary period occurs, agents show a very wide range of opinions about the current value of CPI value.

Thanks to the 2009 special survey, we know that SPF panelists usually change their forecasting approach with the length of the forecast horizon. They prefer to apply

standard methods for the shortest horizons but as the length goes on, they declare that they prefer personal judgement over models. The plateau shown in the longer term of inflation expectation means an overall trust in government and institutions in facing price movements.

Even if the level of disagreement cannot be directly considered an index of uncertainty, it can still invalidate the overall judgment and therefore not obtain optimal feedback to promote and apply appropriate strategies (both for the FED and for firms attentive to economic trends).

The second step involved an analysis of the deviations of the forecasts compared to the actual realizations. The study of the bias focused on the trend over time with a particular focus on the most critical historical moments, especially the recent financial crisis and the current global pandemic. From the point of view of the aggregate forecast, an agglomeration of peaks coinciding with sudden changes in inflation was observed as expected. In projections with H4, H3, and H2 horizons the highest errors occur. It is clear that in these contexts the errors of such measures are justified by the impossibility of predicting such calamities. Both the famous bankruptcy of the American giant Lehman Brothers and the sudden spread of Covid are unpredictable events at any time: from t-4 to t-1.

Observing data one can argue that in negative shocks can happen an under-reaction effect. In the first periods there was an overestimation of inflation (forecasts> realizations) but then in the following quarters the average error is positive (realizations>forecasts) and therefore the agents believed there was a prolonged persistence of the disturbing effects on economy, or a not complete adjusting result by restoration policies. In general, there is an inclination to underestimate in the early stages of an event; inflation is seen lower than the actual one, nonetheless, subsequently there is a deferred over-reaction.

Finally, I tried to evaluate the optimality of the forecasters' information set and their ability to promote efficient projections. Using the MZ test, I was able to confirm what the errors examined above suggested. For long periods, on average, the available information has been used optimally, in particular using linear regression with reference to time t-0, the only periods for which the hypothesis of efficiency must be strongly rejected are those starting from 2008, after the succession of deflationary events and economic turbulence, together with that still in the progression of the pandemic.

In conclusion, by answering the question about the usefulness and consistency of forecasts and survey expectations, it can be said that their overall contribution is absolutely valid, while making important distinctions in the predictive capacity.

The role and work carried out by the SPF is certainly more accurate and precise in years of the normal evolution of the economic cycle. On the contrary, as we have seen, strong and sudden movements in the financial and economic world do not allow professionals to obtain precise results, this is because of the magnitude, duration, and impact that certain shocks create on the surrounding environment, as well as the difficult reading of certain unconventional political and monetary policy adopted to face dramatic events. Nevertheless, they provide very important and neutral inputs and signals to decision makers, as well as inform households, entrepreneurs, investors and so on about the future developments of the macro variables.

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