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What to expect from inflation expectations: theory, empirics and policy issues

Policy Department for Economic, Scientific and Quality of Life Policies
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Abstract

We examine the role of inflation expectations in conditioning monetary policy, addressing three of its facets. The first concerns the channels through which inflation expectations impinge upon actual inflation, and their policy implications. The second facet regards the technical and empirical issues involved in keeping track of inflation expectations for monetary policy purposes. The final facet is an assessment of inflation expectations *vis-à-vis* the current upsurge of inflation, wondering whether, after being unanchored on the downside, can now become unanchored on the upside.

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CONTENTS

LIST OF ABBREVIATIONS

AD	Aggregate demand
AS	Aggregate supply
CPI	Consumer price index
ECB	European Central Bank
GDP	Gross domestic product
NAIRO	Non-accelerating-inflation rate of output
NRI	Natural rate of interest
OG	Output gap
RE	Rational expectations

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EXECUTIVE SUMMARY

- **We review the channels through which expectations of future inflation feed onto actual inflation, and their policy implications**. These are traced back to households and firms and the way their expectations go through aggregate demand and aggregate supply.
- First, **different kinds of expectations are relevant for different channels**. Second, granted that future inflation expectations contain valuable information for the policymakers, it **does not necessarily follow that they should be included** in the monetary policy rule. Third, unanchored expectations **do not necessarily imply that inflation gets out of control**.
- **Results of empirical studies about the role of inflation expectations in households' and firms' behaviour are mixed. Likely, they are conditioned by the actual inflation climate prevailing at the time**: low and stable inflation may favour low and stable expectations and induce individuals to disregard the effect of current and future inflation on their economic decisions. The opposite occurs when inflation is on the rise, when disregarding present and future inflation may produce large losses.
- **The overall picture of theoretical and empirical studies is more shadowed than usually believed**. Granted that information on future inflation expectations has to be carefully assessed and processed along with other information about the contingent state and the evolution of the macroeconomy, caution suggests it should not be given the role of polar star of monetary policy.
- **We also suggest that further work is necessary to clarify the theoretical setting and to provide guidance for the interpretation of the various empirical measures of inflation expectations** and their role in the ECB's projection models used for policy purposes.
- **We find that more conceptual clarity is necessary about the degree of anchoring of inflation expectations**, for instance as to whether inflation expectations should be anchored to the central bank target or to its forecasts. **Greater clarity as to the alternate uses of the various metrics** (as well as of survey-based and market-based datasets) could help to reduce complexity and facilitate the interpretation of the empirical evidence.
- **It could appear appealing to policy makers to lower agents' perceived real interest rates by raising their inflation expectations when the nominal interest rates are stuck at the zero lower bound**. Hence, a central bank may be tempted to use strategically its inflation projections for managing agents' expectations. However, this could undermine its credibility.
- **In the light of the current upsurge of inflation, we discuss whether, after being unanchored on the downside, inflation expectations can now become unanchored on the upside**. The evidence is mixed, but the early belief (hope) that expectations remain anchored to the 2% target seems to resist. Yet, we warn that **the key area where the interplay between inflation, inflation expectations, and monetary policy will be critical is that of financial markets**, not so much because inflation is a concern *per se*, but because central banks will deem inflation to be high enough to put an end to the era of easy money.
- **In the current situation, the ECB's problem is to convince the public that, if the current price hikes persisted, it would not permit inflation to steadily rise much above 2%**. Indeed, analysts and market participants could believe that the risk of financial fragmentation and tensions in the euro area's sovereign debt market may make the ECB more reluctant than other central banks to act decisively by pushing up financing costs to dampen inflation.

1. INTRODUCTION

It is a central tenet of modern central banking, backed by mainstream academic research, that the evolution of the inflation rate finds one main driver in its own expectations, and that key to inflation control is "expectations management" with a view at keeping expectations firmly "anchored" to the central bank's target (Woodford, 2003).

These convictions seemed largely supported by, and conducive to, the so-called "Great Moderation" epoch. They also have spurred renewed investigations in search of explanations for the prolonged stagnation across advanced economies, and particularly in the euro area, that followed the 2007-08 global financial crash and the 2008-09 Great Recession, with inflation dwelling quite below the major central banks' targets, and even spells of deflation. The outbreak of the COVID-19 pandemic has replicated the same phenomena on a grander scale. Overall, all along the past decade, there has been substantial convergence in academia and central banks in assigning a significant role to falling, or "unanchored", inflation expectations behind the "reflation fatigue" manifested by conventional as well as unconventional monetary policies (Draghi, 2016; Schnabel, 2020; Lane, 2020).

The second half of 2021 witnessed the acceleration of inflation across advanced economies, quickly approaching or overshooting reference values of 2%-3%, as a consequence of faster than expected recovery from the COVID-19 pandemic and bottlenecks in supply chains, first and foremost in energy. This sudden scenario reversal is challenging central banks in the opposite and symmetric way compared to the way the past decade of low inflation challenged them. Not surprisingly, inflation expectations remain at centre stage in three different, but interrelated, issues: whether or not the **current inflation spike will take hold**, whether or not **economic agents are confident in central banks'** willingness/ability to keep inflation under control, whether or not **central banks will in fact succeed** in this endeavour.

In this paper, we will examine the role of inflation expectations in the present context of the euro area, and hence in conditioning monetary policy, addressing three of its facets. The first, in section 2, concerns the **theoretical channels through which inflation expectations are supposed to impinge upon the actual inflation rate**. These are traced back to households and firms and the way their expectations go through aggregate demand and aggregate supply. Then, we explore the policy implications. We also review available evidence about these theoretical channels, in particular whether households and firms do behave according to their (reported) inflation forecasts. The overall picture is more shadowed than usually believed.

The second facet, in section 3, regards the **technical and empirical issues involved in keeping track of inflation expectations** for monetary policy purposes. We probe into the work done by the Eurosystem's Expert Group on Inflation Expectations (ECB, 2021b) that illustrates in great detail various empirical measures of inflation expectations and analyses their relationships, also in projection models used for policy purposes. Here, acknowledging the great strides forward on this ground, we point out some problems that remain to be addressed.

The final facet considered in section 4 is an assessment of **inflation expectations *vis-à-vis* the current upsurge of inflation in the euro area**, wondering whether, after being unanchored on the downside can now become unanchored on the upside. The evidence is mixed, and difficult to discern, also for the reasons discussed in section 3, but the early believe (hope) that expectations remain anchored to the 2% target seems to resist. Yet we warn that the key area where the interplay between inflation, inflation expectations, and monetary policy will be critical is that of financial markets, not so much because in those markets inflation is a top concern *per se*, but because their true top concern is whether central banks will see inflation high enough to put an end to the era of easy money.

2. DO INFLATION EXPECTATIONS AFFECT ACTUAL INFLATION?

Studies about the role of expectations in the evolution of inflation revolve around three issues:

1) Whose expectations, and through what channels, affect actual inflation?
2) What are the implications for central banks?
3) What is the evidence?

2.1. A review of theory

As to the first issue, ideas can usefully be organised around the double-entry scheme of Table 1. The channels through which inflation expectations affect actual inflation can ultimately be traced back to aggregate demand and supply shifts, where it is generally agreed that inflation responds to demand excesses over supply, in addition to autonomous cost-price shocks. Behind aggregate demand and supply, the relevant agents can be households and firms through their *forward-looking decisions*[1].

Table 1: The channels of inflation expectations

	Aggregate demand (AD)	Aggregate supply (AS)
Households	Demand for consumption and durable goods	Wage indexation
Firms	Demand for capital goods	Wage indexation Cost push Price making

Source: Authors' own elaboration.

On the AD side, the households channel is related to the so-called **intertemporal price effect**, that is to say the effect that expected inflation exerts on the allocation of households' expenditure over time. Expenditure may concern current consumption goods as well as durable goods, in particular houses. For the former, the expectation of higher prices in the future incentivises more purchases in the present, which in turn create a pressure on current prices. For the latter, which are sensitive to the cost of borrowing, expected inflation goes through the calculation of the **real interest rate** along the loan maturity horizon. This falls as expected inflation rises, so that demand for durable goods is boosted.

The firms' AD channel hinges on the real interest rate as the main determinant of the demand for capital goods and operates as with households' demand for durable goods.

On the AS side, the role of households is more complex as it goes through the labour market in interaction with firms, and it depends on the **system of wage indexation** prevailing in the economy. The underlying principle is the absence of monetary illusion in wage bargaining, according to which labour supply and labour demand are regulated by the real value of wages. For labour supply to remain unchanged as consumer prices rise, nominal wages should also rise in parallel, creating the notorious **price-wage spiral**. How this principle works and its effects depend on the institutional features of the labour market.

[1] A comprehensive view of these channels can be found in Rudd (2021), ECB (2021a), ECB (2021b).

The long-lived literature on "nominal rigidities" of Keynesian inspiration of various vintages focuses on the point that wage contracts are set in nominal terms and have a predetermined duration[2]. This feature, in combination with no monetary illusion, has two significant consequences. The first is that wage contracts are necessarily forward-looking, and as a rule they embody a forecast of the future consumer price index (CPI) to which the nominal wage rate is linked in order to safeguard the contractual real wage rate[3]. The second is that, throughout the contract life, the nominal wage rate is not changed, so that *unanticipated changes* in the CPI, also dubbed "**inflation surprises**" determine deviations of the real wage, actually paid by firms and earned by workers, from the contractual one[4].

This view of the labour market introduces the need for a distinction between *future* expected inflation, "**one (contractual) period ahead**", and *previously* expected inflation for the current period, "**one (contractual) period earlier**"[5]. In theory, future expected inflation is relevant only at the time of contract renegotiation; hence future higher expected inflation will be passed onto nominal wages and firms' costs with an effect on *future* CPI and inflation rather than on the current one. As long as a given contractual arrangement is in force, the relevant mechanism is the "inflation surprise" described above, i.e. any difference between the current inflation and the inflation that was expected when the contract was signed. Contingent responses of workers and firms to inflation surprises determine the so-called "short-run" labour supply and demand, and eventually the AS function *vis-à-vis* current inflation. This is generally drawn as increasing in inflation surprises because higher than expected inflation reduces the real cost of labour for firms, which may expand employment and production.

This distinction between expected inflation "one period ahead" and "one period earlier" is important conceptually, though in practice it may be blurred by the simple fact that wage contracts are not perfectly synchronised across the economy. In a given year, wage contracts with future expiration coexist with others that are under renewal. The latter may well bring future expected inflation to the present. Moreover, the extent to which inflation surprises give rise to more employment and production with unchanged nominal wages, or the slope of the short-run AS function, also depends on the response of workers' labour supply. If the reaction in the face of a lower real value of the contractual nominal wage is a shortage of labour supply strong enough, firms may be induced to raise nominal wages to retain workers even in advance of the formal contract renewal[6]. This mechanism, clear symptoms of which are now detected across advanced economies recovering from the pandemic, may well embody into nominal wages and prices not only current but also future higher inflation.

Other sources of shocks to firms' costs of production, most notably those of raw materials and intermediate inputs may have an impact on current prices depending on the goods market structure and firms' pricing policy. Generally, the result is some degree of pass-through from cost shocks to selling prices, which entitles to think that expected future cost shocks may also have an impact on current inflation.

The firms' AS channel is more articulated and encompasses other aspects of firms' forward-looking decisions. The now canonical firms' AS channel of influence of future expected inflation on current

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2 The initial spark is generally credited to Keynes's *General Theory* (1936, ch. 19), while modern elaborations have been produced in the New Keynesian camp (e.g. Taylor, 1980; Hargreaves-Heap, 1992; Galì, 2008).

3 Indeed, absent "rigidities", with instantaneous complete indexation agents would not need be forward looking.

4 "Inflation surprise" is a notion introduced by Monetarists (e.g. Friedman, 1968) to argue that the only way to have real effects of monetary shocks is that the increase in prices is not embodied into nominal wages. The same notion can also be found in the New Classical aggregate supply function put forward by Lucas (1972).

5 See e.g. Rudd (2021). This point is also relevant to the long-lived debates and quarrels about the "expectations augmented" Phillips Curve introduced by Phelps (1968) and Friedman (1968), and both formulations of the expectational term are alternatively used in empirical works.

6 The consequence would be a smaller real effect of the inflation surprise, or a steeper AS function. As explained by Rudd (2021), this outcome is more likely where the labour market is more decentralised and national contracts are less cogent, as in the United States.

inflation is the so-called "Calvo pricing model" (Calvo, 1983) embedded into the New Keynesian macro-models with **monopolistic competition and sticky prices**. The reason is that higher expected inflation is equivalent to a fall in the relative price of, and hence an increase in the demand for, the good produced by each single firm. Profit maximisation under monopolistic competition would lead each firm to match an increase in demand with a combination of higher production and price[7]. However, a share of firms, with some probability, will not be able to change their price in the future, and hence set the current price as a combination between the present and future (higher) optimal price. At the same time, current inflation is also spurred by increases in AD in excess of AS, though less than if the prices of all goods were freely changed at all times.

2.2. Implications for monetary policy

In order to organise ideas a little bit of algebra may be useful. Let us adopt today's benchmark for central banking, i.e. the New Keynesian "three equation model", though it includes some, but not all, of the channels of inflation expectations in Table 1. The three equations determine the **output gap**, the **current inflation rate**, and the **nominal interest rate.**

The output gap (OG) is the percentage difference between the current gross domestic product (GDP) and the potential GDP, or more pragmatically, the reference GDP that the central bank considers consistent with inflation remaining in line with its target (also known as "non-accelerating-inflation rate of output", NAIRO). The output gap is positive (negative) whenever the current real interest rate falls below (rises above) the level consistent with the NAIRO (the so-called "natural rate of interest", NRI). In turn, the current real interest rate results from the nominal rate set by the central bank net of the expected inflation rate. Note therefore that, given the policy rate, the output gap shows a positive relationship with expected inflation[8].

Current inflation is represented as a positive function of expected inflation and the output gap. Though customarily dubbed (New Keynesian) Phillips Curve, this should more properly be defined as an AS function in the setup with sticky prices and/or wage described above. In the canonical form, that we employ below, expected inflation enters as the short-run, "one period ahead", expectation held by price-making firms in diversified goods markets.

The determination of the policy interest rate is typically given by some format of the Taylor Rule, according to which it is pinned down by the nominal value of the NRI (NRI + the inflation target) and is raised above (reduced below) whenever current inflation is above (below) the target, while also taking into account whether the output gap is positive or negative. In cases in which inflation and the output gap send opposite signals, the relevant case being excess inflation and negative output gap ("stagflation"), the dynamic control of the system requires that the reaction to excess inflation should be larger than that to the negative output gap, i.e. the policy rate should be raised by more than excess inflation[9], though less than in the case of "pure inflation targeting" with no consideration at all of the sign of the output gap.

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[7] The split between the two is determined by the demand elasticity of firm's product.

[8] With reference to Table 1, this mechanism is relevant for the share of private expenditure that is sensitive to the real interest rate, which typically includes investment in capital goods by firms and households' purchases durable goods. Households' purchases of consumption goods sensitive to the intertemporal price effect, but not necessarily to the real interest rate (e.g. households inactive in the financial markets: Galì et al., 2007; Bilbiie, 2008), can also be added with a reinforcing effect of expected inflation.

[9] This condition ensures that the *real* interest rate increases above the NRI, which is necessary in order to realign GDP with the NAIRO. Yet this is strictly necessary only insofar as the the real interest rate is the single transmission mechanism between monetary policy, GDP and inflation.

Since the three equations are interdependent, it is possible, and useful, to examine the system solutions, i.e. how each respective variable is determined after all the relevant reciprocal interdependencies have been worked out. In order to focus on the issues of interest here, let us consider that the output gap and the current inflation can be hit by an exogenous shock. The current inflation rate π_t and the policy interest rate i_t, result as follow (for simplicity we leave the output gap in the background):

(1) $\pi_t = \pi^* + a_1(\pi^e_{t+1} - \pi^*) + a_2 u_{pt} + a_3 u_{yt}$

(2) $i_t = r_t + \pi^* + b_1(\pi^e_{t+1} - \pi^*) + b_2 u_{pt} + b_3 u_{yt}$

π^e_{t+1} = expected inflation, π^* = inflation target, r_t = NRI, u_p = price shock, u_y = demand shock, the coefficients a_n, b_n ($n = 1, 2, 3$) are combinations of the parameters of the three equations.

As far as the role of expected inflation is concerned, note the following:

- Current inflation deviates from its target in proportion to the deviation of expected inflation from the target.
- Nominal interest rate reacts to deviations of expected inflation from the target.

It is worth stressing that these two features result from the interdependencies among the three equations, though *they are not present* in their original form. Look in particular at the policy rate: for it to be reactive to deviations of expected inflation from the target, it is not necessary that the central bank includes inflation expectations explicitly into its policy rule. Reacting to the current excess inflation is sufficient to "bring in" the effect of inflation expectations as they impinge upon both the input variables of the policy rule. On the other hand, this finding lends support to the common practice of central banks to monitor the evolution of inflation expectations.

The next key issue is: **how is expected inflation determined**? Various possible answers are available, both on theoretical and on empirical grounds. Let us first introduce the now widely used distinction between "anchored" and "unanchored" expectations.

2.2.1. Anchored expectations

The most common definition of anchored expectations is that they are in line with the inflation target and are insensitive to transitory shocks. These features are easily inserted into our equation (1) by positing that $\pi^e_{t+1} = \pi^*$ independently of the shocks u_p, u_y. Therefore,

(3) $\pi_t = \pi^* + a_2 u_{pt} + a_3 u_{yt}$

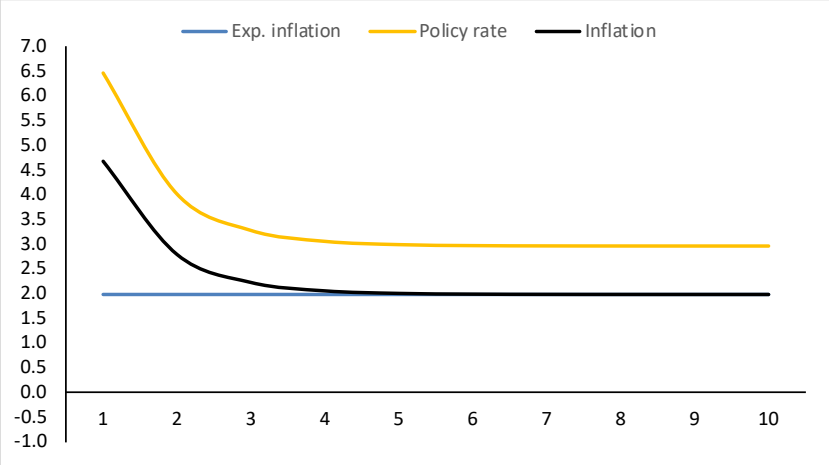
(4) $i_t = r_t + \pi^* + b_2 u_{pt} + b_3 u_{yt}$

Both inflation and the policy rate hover around their respective targets as a consequence of the shocks. Their co-evolution over time is dictated by the time path of the shocks, provided that, in compliance with the definition of anchoring, the shocks are transitory, i.e. they should peter out over time. An example is provided by the simulation in Figure 1.

To begin with, the simulation reproduces the "old normal" regime, with non-zero real and nominal interest rates. The inflation target is 2% and the NRI is 1%, which implies a target policy rate of 3%. The values of the coefficients a_n, b_n are obtained from values of the structural parameters of the three equations commonly found in the empirical literature. The economy is hit by an inflation spike u_{pt} =

3%, which displays low persistence as is presently believed (30% of the previous period's shock is left in each next period)[10].

Figure 1: An inflationary shock with anchored inflation expectations



Source: Authors' own elaboration.

The story told by the graph is that the shock pushes current inflation above its target (4.7% *vs.* 2%) and it triggers an increase in the policy rate (6.5% *vs.* 3%) at a level that generates a higher real interest rate than the NRI (4.5% *vs.* 1%). Subsequently, as is common in this class of models, the economy is driven back to target variables along a path dictated by the (exogenous) dynamic evolution of the shock. The adjustment is completed in few (4) periods. As we will see shortly, anchored expectations make the whole task of inflation control easier and smoother.

Recall that this result hinges on the hypothesis that the shock is transitory; whether the persistence of the shock is low or high may of course have practical implications but is irrelevant to the long-run properties of the system. Finally, the distinction should be kept in mind between the persistence of the shock and the speed of the return to equilibrium (how long is the long run). The former is hard to detect in the data *ex ante* (generally, we cannot track "shocks" but their effects)[11]. The speed of adjustment of the observable variables is instead the true matter of concern, and this may depend on intrinsic features of the economy that generate leads and lags in the adjustment process (an example is the case with adaptive expectations presented below).

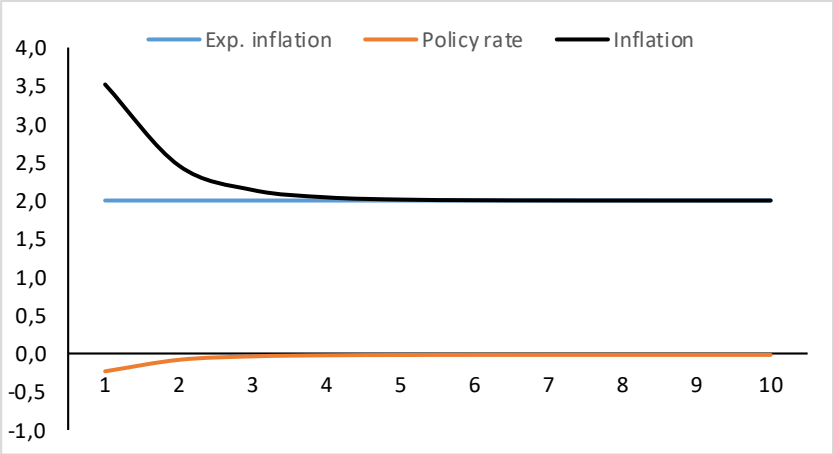
In order to add some more up-to-date features, we also present in Figure 2 a simulation resembling today's stagflationary scenario, such that the inflation spike u_{pt} = 3% is concomitant with a large negative output gap, $u_{yt} = -5\%$, (think of the fallout of the pandemic). The output-gap shock displays the same low persistence as the inflationary one, which captures the widespread observation that the pandemic recession is now recovering at quick pace. We embed this scenario in the "new normal" regime where, in line with much empirical literature, the NRI is set negative, namely at −2%, which implies that the target policy rate is zero.

[10] Technically this figure measures the autocorrelation of the shock over time, how much of today's shock remains tomorrow. The speed of transition is the complement to 1 of the persistence.

[11] For instance, it is seldom clarified whether the persistence of shocks should be interpreted as a single shock (say an oil price increase) that is distributed over time (the total shock is the summation of the each period's bit of the shock) or as a sequence of shocks of decreasing magnitude (like earthquakes).

On impact, the stagflationary scenario is characterised by the fact that the response of current inflation (3.5% instead of 4.7%) is dampened by the concomitant negative pressure of the output gap. The path followed by the policy rate is worth noting. The initial spell of negative values indicates that the negative output gap dominates over the inflation pressure not because the central bank so wishes but because of the intrinsic dimension of the recession. Moreover, starting at the zero lower bound, in order to obtain a negative shadow policy rate some "unconventional" contrivances are necessary. Subsequently, the policy rate remains stuck at the zero lower bound. Again, this is not due to a violation of the Taylor Rule by the central bank, but it is the result of the conflicting pressures of inflation and the slack in economic activity traded-off through the Taylor Rule. As a matter of fact, the inflationary shock (and the output gap) are reabsorbed eventually, over slightly more time than in the previous case, despite the central bank appears to remain passive. As to the persistence of the adjustment process the same caveat as above apply.

Figure 2: A stagflation scenario with anchored expectations



Source: Authors' own elaboration.

2.2.2. Unanchored expectations

Expectations are called unanchored as they are not kept in line the central bank's target, the symptom being that they result to be sensitive to shocks, or better to the consequent evolution of the actual inflation. In this regard, the inflation equation (1) warns that expected inflation has the potential of becoming self-fulfilling, with a pass-through rate given by the parameter a_1 (in our simulation equal to 0.7) interfering with the adjustment process and the reversion to the central bank's target. On the other hand, it would be unlikely that, in the long run, expected inflation remains permanently different from actual inflation, hence the way in which expectations are revised should present some consistency with the long-run tendency of actual inflation.

A natural starting point is the theoretical benchmark provided by the notion of **rational expectations** (RE). For our purposes we may define the (short-run) RE of inflation those obtained by taking the statistical expected value of the evolution of actual inflation dictated by equation (1), denoted by $E(\pi_{t+1})$ i.e.

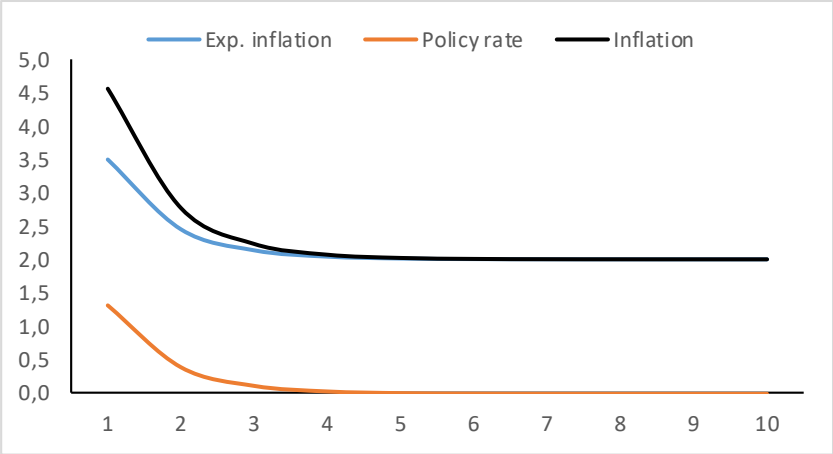
$$(5) \qquad \pi^{e}_{t+1} = E(\pi_{t+1}) = \pi^{*} + a_1(E(\pi_{t+1}) - \pi^{*}) + a_2 E(u_{pt+1}) + a_3 E(u_{yt+1})$$

There are two key implications. First, RE require knowledge of the statistical relationship of future values of u_p and u_y with their current values. Second, RE do retain the potential of being self-fulfilling, but they also have the desirable property that they realign themselves with actual inflation and the inflation target *if* the central bank controls inflation properly as seen above.

This can easily be seen under one of the most common hypotheses about shocks, namely that u_p, and u_y follow a random walk (equivalent to zero persistence), which means that they contain no information about their future values (no business for professional forecasters!). Consequently, $E(u_{pt+1}) = E(u_{yt+1}) = 0$. Then the solution of equation (5) warrants that $E(\pi_{t+1}) = \pi^*$ which brings us back to the case of anchored expectations of equation (1).

Note that the coincidence of RE, which do track the evolution of the inflationary process, with anchored expectations, which do not, only occurs thanks to the hypothesis of random-walk shocks. This however does not seem to fit today's conjuncture, when concern of central banks and forecasters is with the persistence of the shocks. Persistence means that past observations of the shocks do convey information about their future values. This is typically encapsulated in their nonzero autocorrelation coefficient, which in fact we have set to 0.3 in the previous scenarios (see also fn. 10). Therefore, assuming that $E(u_{pt+1}) = 0.3u_{pt}$, $E(u_{yt+1}) = 0.3u_{yt}$, the stagflationary scenario looks like in Figure 3.

Figure 3: A stagflation scenario with short-run rational expectations



Source: Authors' own elaboration.

The most important feature is that now expected inflation does track shocks *and actual inflation*, which seems to fit the definition of unanchored expectations (as the Figure shows, expected inflation is strictly correlated with actual inflation). On impact, expected inflation jumps from 2% to 3.5% as a result of the anticipation of the next period's evolution of shocks, which, recall, decrease over time. As a consequence, also the initial spike of inflation is larger than with anchored expectations (4.6% instead of 3.5%). Differently from the case with anchored expectations, the central bank reacts by setting the policy rate well above zero (1.3%). We can thus draw two interesting lessons.

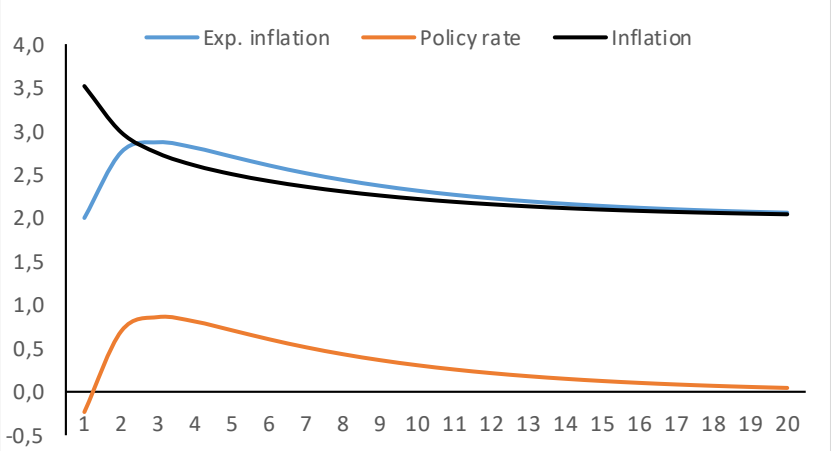
First, central banks may be justified in monitoring inflation expectations. If they are anchored, monetary policy may react more smoothly or even remain passive as in Figure 2. If they are not, monetary policy should be more reactive. On the other hand, as we pointed out in the comment on the policy-rate equation (2), it is not necessary that the central bank targets inflation expectations directly, since even the simplest Taylor Rule triggers, indirectly, the right reaction to the extent that expected inflation is embodied in actual inflation.

Second, the simulation shows that the process, in spite of seemingly unanchored expectations, converges back to the initial equilibrium along a trajectory that, as already explained, is dictated by the path of the shocks. This finding warns that unanchored expectations may not necessarily be synonymous with the inflationary process being out of control. Yet, we may wonder whether this

reassuring result is only due to the hypothesis of RE, one that is highly demanding to be met by forecasters, and has become increasingly questioned also at the theoretical level.

To complete our exploration, we thus turn to another possible form of unanchored expectations, namely the hypothesis that expectations are formed adaptively [12]. In the basic formulation we assume here, forecasters follow an "error correction mechanism": expected inflation elaborated in the present period *t* for next period *t*+1, π^e_{t+1}, is the same as the one elaborated in *t*-1 for *t*, π^e_t, corrected for the forecast error observed in the present period $(\pi_t - \pi^e_t)$ [13]. As is intuitive, this mechanism makes expected inflation entirely endogenous to the inflation process, or indeed unanchored according to the standard meaning. Consequently, the central bank's ability to control the inflation process is brought to the fore. The simulation result is presented in Figure 4.

Figure 4: A stagflation scenario with adaptive expectations



Source: Authors' own elaboration.

As can be seen, the inflationary process changes significantly. In the first place, expected inflation takes a hump-shaped path. Initially, the revision of the expectation lags behind actual inflation, with the result that the latter increases less than with RE. In the second place, there follows a spell of time during which expected inflation accelerates while the actual one decelerates, and at some point expected inflation overshoots actual inflation. In the third place, the hump-shaped path of expected inflation is mirrored by the policy rate.

This pattern is consistent with the different nature of adaptive expectations with respect to RE. These latter *track the shocks* and load the bulk of the shocks, as well as of the inflation spike, upfront. Adaptive expectations *track actual inflation* and catch up with it progressively, and so does the policy rate. Finally, it remains true also in this case that eventually the process converges and inflation is brought under control, though it takes much more time. The reason is that adaptive expectations introduce much

[12] Whilst the early generation of RE theorists condemned the hypothesis of adaptive expectations as irrational, it has been rehabilitated in the successive studies on learning as a basis of rational expectations, where "rational" denotes the consistency of the learning-adaptive mechanism with the actual processes in the economy (Evans and Honkapohja, 2001).

[13] That is to say,

$$\pi^e_{t+1} = \pi^e_t + \alpha(\pi_t - \pi^e_t)$$

The coefficient $0 < \alpha < 1$, also called "gain factor", plays a critical role as it determines the direction and speed of revision of the expectation. Positive α means that higher than expected inflation in this period is translated into an upward revision of expected inflation for the next period. In our simulation we have set $\alpha = 0.5$. In more sophisticated learning algorithms, α can be calibrated so as to optimise the fitness of the process.

more inertia, which is not to be confused with the persistence of the shocks themselves (here it is the same as in the previous scenarios)[14].

The finding that unanchored expectations, at least according to their standard meaning, may not necessarily be problematic for inflation targeting should be understood with some attention. First, it raises the issue of the kind of empirical controls that can be deployed. Even our simple simulations show that, during the adjustment process, expected inflation, actual inflation and the policy rate can find themselves in very different configurations, all consistent with inflation control, but which may be hard to detect empirically with respect to other configurations with inflation out of control (think of the phase in which expected inflation accelerates while actual inflation decelerates in Figure 4). Second, our simulations, beside being simple, embed two critical features that impinge upon the underlying New Keynesian model even at the highest levels of sophistication (the so-called dynamic stochastic general equilibrium models). One is that it is constructed so as to display strong tendency to stability. The other is that the dynamic behaviour of the economy is essentially extrinsic, i.e. it is dictated by the time path of shocks, which are *assumed* to peter out over time[15].

2.2.3. Summing up

The messages of the foregoing review of the theoretical channels through which expectations of future inflation feed onto actual inflation, and their policy implications, can be summarised as follows.

First, **different kinds of expectations** are relevant for different channels. For instance, for one channel generally regarded as critical for the development of inflation, wage indexation, expectations "one period earlier", and expectations "one period ahead", play different roles and may well interact.

Second, granted that expectations "one period ahead" are transmitted to current inflation, and that therefore they contain valuable information for the policymakers, it **does not necessarily follow that they should explicitly be included** in the monetary policy rule. We have seen that even the basic format of the Taylor Rule keeps inflation under control under different hypotheses of expectation formation.

Third, unanchored expectations according to their standard definition of being sensitive to short-run macroeconomic developments may make inflation control less smooth, but they **do not necessarily imply that inflation gets out of control**. However, identifying whether or not this is the case in specific circumstances may be a hard empirical task because the outcome depends, *inter alia*, on how expectations are formed.

Finally, the leading models for policymaking reviewed above focus on short-run expectations (why this is beyond the scope of this paper), whereas central bankers' conventional wisdom focuses on **expectations about inflation in the long run** as key to the control of inflation. Though less currently employed, theoretical models that include formation of long-run inflation expectations support this wisdom (Evans and McGough, 2018; Garcìa-Schmidt and Woodford, 2019; Gobbi et al., 2019; Rudd, 2021). However, these models also show that long-run expectations elaborated consistently with the evolution of the *factors that determine inflation* (e.g., in a New Keynesian setup, future output gaps and interest-rate paths) give relevance to the forecasts of these factors rather than of inflation *per se*[16].

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[14] The degree of inertia depends on the extent of the error correction mechanism, i.e. the gain factor α in fn. 11. Higher α reduces inertia.

[15] These two features have been matter of deep reconsideration and criticisms in the face of the failure of this class of models to anticipate, explain, and manage episodes of high instability such as the global financial crisis of 2008-09 (e.g. Stiglitz, 2011, Vines and Wills, 2020)

[16] Gobbi et al. (2019) show conditions whereby endogenous long-run expectations, i.e. update upon observing the actual state of economy, do drive the system out of policy control.

2.3. Do households and firms behave consistently with their inflation expectations?

Before turning to the empirical evidence about the effects of future inflation expectations on current inflation, it is necessary to dispel a potential source of confusion. From the point of view of the policymakers, the monitoring of inflation expectations may be motivated by two reasons. One may be that they do believe in the theoretical arguments expounded above, and therefore also believe that gauging inflation expectations adds important information to their policy decision making. Note that this motivation would hold even if inflation expectations expressed by agents turned out to be wrong (which is excluded by theory, at least in the long run, but may well happen, at least for a non-negligible time). In fact, what matters is that agents act upon their expectations, and the policymakers need know what economic decisions are made in the economy in response to their own policy decisions. Another motivation may be that the policymakers believe that agents' expectations are right (in some statistical sense), if anything because they possess some self-fulfilling capacity, in which case expectations are gauged as providers of direct information about the future evolution of inflation in comparison with, or in addition to, the information that the policymakers possess.

In *both cases*, whether or not (some) economic agents are good forecasters, the key issue is to ascertain the extent to which 1) agents act upon their forecasts consistently (agents may be good forecasters but may not use their forecasts consistently), 2) their forecasts are transmitted to current inflation (agents may act consistently upon their forecasts, but these do not add relevant information to the evolution of inflation).

With these aims in mind, it is also important to distinguish the forecasts conveyed by ordinary households and firm managers from the ones from professional forecasters. The former are much more volatile and imprecise than the latter, and seem loosely related to policy announcements. Nonetheless, as far as inflation control is concerned, the former are also more relevant than the latter (Coibion et al., 2018).

As a matter of fact, studies aimed at these purposes have been growing over time in parallel with the development of the different theoretical channels reviewed above (Coibion et al. 2018 provide an up-to-date discussion of the literature). It seems fair to notice that, in spite of the widespread theoretical conviction that both conditions 1) and 2) hold true, the evidence is not uncontroversial.

In this field, like others in economics, households' behaviour is particularly contentious. Households' sentiments and forecasts have long been surveyed with increasing accuracy (ECB, 2021a), and recent studies have revived evidence of the predictive capacity of households' inflation forecasts (Coibion and Gorodnichenko, 2015; Reis, 2021). On the other hand, it is well established that households' forecasts display high cross-variability, gross point misperceptions and endemic inattention towards ongoing developments and announcements (Coibion et al., 2018, 3.1). As far as the intertemporal price effect is concerned, the evidence is mixed. Beside findings of positive relationship between *reported* expected inflation and current consumption, other studies cast doubts that households' make consistent use of their forecasts (Schnabel, 2020 expands on this point). Even more blurred is households' behaviour in relation to the real *vs.* nominal interest rate.

This finding adds up to the long-lasting scepticism that the real interest rate is as key to firms' investment decisions as predicted by theories of various inspirations, and therefore that it is the fundamental leverage to control economic activity by monetary policy[17].

As to the channel of inflation expectations envisaged by the New Keynesian Phillips Curve, empirical strategies and results are notoriously contentious (Rudd, 2021). Also, direct investigations of the role of price expectations in firms' decision-making end up with controversial results. One of the most comprehensive studies (Blinder et al., 1998) conveys scepticism that the role of forecasts is systematic and consistent across firms and time. More recent waves of studies (Enders et al., 2021; Coibion et al., 2018, 3.2) tend to be more supportive, although the specific channels and mechanisms remain in doubt, and sometimes firms' reported decisions associated with inflation forecasts are at odds with theory.

An important consideration to be kept in mind is that results of empirical studies are likely to be conditioned by the **actual inflation climate** prevailing at the time. Low and stable inflation may favour low and stable expectations and, at the same time, induce individuals to disregard the effect of current and future inflation on their economic decisions. As a consequence, it is low and stable inflation that creates its own favourable conditions rather than the other way round. The opposite occurs when inflation is on the rise, when disregarding present and future inflation may produce large losses (Heymann and Leijonufvud, 1991; Rudd, 2021)[18].

These notes of caution do not entail the conclusion that future inflation expectations are irrelevant to the actual dynamics of inflation, or that they do not contain useful information for central banks' mission of price stability. Caution is not in contrast with the finding that inclusion of professional forecasts of inflation do improve the predictive power of forecasting models, albeit to a modest extent (Banbura et al., 2021). Caution rather suggests that information on future inflation should not be given the role of polar star of monetary policy, while it has to be carefully assessed and processed along with other comprehensive information about the contingent state and the evolution of the macroeconomy.

[17] Scepticism dates back to White (1956), and recurrently surfaces through time: Dixit (1992), Bond and Jenkinson (1996), Gennaioli et al. (2016), Schnabel (2020).

[18] Similar results have been detected in various contexts as reported by Nakamura et al. (2018), Avarez et al. (2019), Sigurdsson and Sigurdardottir (2016), Grigsby et al. (2021)

3. THE ANCHORING OF INFLATION EXPECTATIONS: CONCEPTS, METRICS, USES

The work done by the Eurosystem's Expert Group on Inflation Expectations led to the publication of an influential analysis (ECB, 2021b) that illustrates in great detail various empirical measures of inflation expectations and analyses their relationships, as well as the role played by inflation expectations in the European System of Central Banks' projection models used for policy purposes.

The report shows, using the results from accurate empirical analysis, that the several factors impact on expectation formation; in particular, the report reveals that inflation expectations depend on the inflation regime, whereby the updating of expectations becomes more or less backward-looking according to the actual inflation regime in which the observers operate. This is in line with the idea, explained in Section 2.3, that the inflation regime may sometimes drive expectations, and not only the over way round (see Rudd, 2021).

A pride of place in the ECB report is given to the anchoring of inflation expectations. The degree of anchoring plays a potentially important role both in macroeconomic models and in the real world if, as discussed in Section 2.2, the long-term expectations act as a gravitation point for people behaviour and actual inflation. Indeed, should long-term expectations stray from the central bank's inflation objective, its ability to achieve the mandate of price stability could be seriously jeopardised in terms of effectiveness and timeliness. For this reason, it is indeed of utmost importance to understand what are the drivers of inflation expectations: are they affected by exogenous macroeconomic shocks or by the inflation regime? Do they respond to monetary policy decisions? Are they altered by central bank's communication? The answers to these questions are of paramount importance as they determine **whether the central bank should somehow engage directly with the re-anchoring of expectations**, thereby creating a re-anchoring channel of monetary transmission.

The abundance of information and evidence provided in ECB (2021b) allows the reader to appreciate the abundance of **alternative statistical metrics** that can be used **to assess the degree of anchoring** of the short- and long-term inflation expectations. Notably, the richness in the set of available metrics seems **more a problem than a boon for policymakers**. As the authors of the report explicitly maintain, different metrics may provide conflicting signals as we lack of a unified framework to understand how to interpret and act upon them. In the attempt at dealing with this issue, the ECB report makes a step forward and presents a "heat map" in real time, a tool that provides a synthetic overview of the multitude of pieces of empirical evidence regarding the different dimensions of the anchoring of inflation expectations at any given point in time over different time horizons.

However, while commendable, this graphical tool to report the available empirical evidence on the alleged degree anchoring of inflation expectations does not help to solve the substantial underlying uncertainty regarding the concept. No general yardstick on how to derive conclusions from the available information is indeed offered to the readers and the policymakers[19]; this would require more theoretical and policy considerations. Clearly, this is not a shortcoming of the ECB report *per se,* as the study does not deal with theoretical issues, but aims at offering all the empirical evidence that one can obtain by employing the state-of-the-art techniques available in the literature. **And yet, if the uncertainty regarding the unanchoring of expectations remains mainly a theoretical issue connected with the vagueness of the concept, no empirical tool alone can truly help**. Notably, while the high uncertainty regarding the concept is explicitly acknowledged by the authors of the ECB

[19] Whether this is a problem depends on the period of observation. All in all, the analysis focusing on the last few years reaches agreeable conclusions about the current situation, but several are the situations in which such signals may be either controversial or inconclusive.

report in several points in the text, the report stops short of deriving a direct policy recommendation: policymakers should use great care in referring to the concept of anchoring unless clear definitions and measures are adopted and macroeconomic models purposefully modified.

In what follows, we summarise the main unsolved issues that emerge from the analysis provided in the ECB report (ECB, 2021b) and we will offer some tentative considerations on the caution that should be used when dealing with the concept of anchoring, and on the theoretical work that would be needed (and that the ECB could help develop).

3.1. Measuring and interpreting the unanchoring of inflation expectations: an unfinished business

Three main approaches have been used in the literature to assess the anchoring of inflation expectations. The first one is **a level-based assessment**, whereby the analyst typically compares long-term expectations to the inflation target. The second approach regards the **responsiveness** of long-term expectations to short-term developments (in actual inflation, macroeconomic news, monetary policy decisions, and the like). The third one, less widespread, refers to **higher moments** of inflation expectations (either their values or their responsiveness). Notably, the first two approaches are well connected with the definitions used in Section 1 of this work, whereas the third one is connected with the impact of second moments deriving from individual heterogeneity (in turn associated with uncertainty and risk).

These three main categories of approaches include a number of different empirical strategies. At risk of oversimplifying a sophisticated topic, the ECB report suggests that the unanchoring of inflation expectations can be identified when one or more of these conditions occur:

- The mean/median value of individual long-term expectations is far the central bank objective (level).
- Unanticipated macroeconomic shocks/news impact on long-term expectations (responsiveness).
- There is a large "disagreement" across individuals around the median estimate (higher moments).
- The distribution of expectations is very skewed, and the skewness changes over time (higher moments).
- The variation in short-term expectations is transmitted to long-term expectations (responsiveness).
- Market-based implicit forecasts and survey-based expectations do not move together (level and responsiveness).

Some of these empirical approaches are clearly distinct and focus on different dimensions: this is the case of the gap between the mean/median value of expectations and the central bank inflation target and the correlation between short- and long-term expectations. Others overlap, as in the case of the responsiveness of higher moments of inflation expectations to macroeconomic news (for instance when the skewness changes over time).

3.1.1. Interpreting individual metrics

While each of these metrics makes sense, their exact interpretation remains partially unclear.

a. Level-based assessment

Even the most straightforward approach, that is the level-based assessment, can be tricky.

As noted by ECB (2021b), the **lack of precision in the definition of price stability** (i.e., around 2% over the medium term) might affect the benchmark against which expectations can be compared with, and it may influence the horizon at which expectations should theoretically be anchored.

However, the ambiguity is much greater if one introduces ***ad hoc* derogations to the very definition** of anchoring as closeness to the inflation target: Domit et al. (2015) (and ECB, 2021b, p. 63) allow for inflation expectations to deviate from the target and be anchored if they are in line with the central bank forecasts.

Moreover, it is not entirely clear whether one should focus on the absolute **divergence** between long-term point inflation expectations and the inflation target or rather on the occurrence of significant **breaks** in the evolution of the time series of inflation expectations. While it is uncontroversial that a large deviation from the target associated with a break-point in the series signals a lower degree of anchoring, it remains unclear how to interpret either the presence of a non-negligible divergence without a break or the presence of multiple breaks associated with repeated oscillations of the expectations around the target.

Finally, considering the existence of **multiple sources of inflation expectations** (i.e., households, firms, professional forecasters, investors), it remains unclear how to combine different empirical findings: should expectations be similar in levels or rather move in the same direction or even be subject to almost coincident structural shocks?

b. Responsiveness-based assessment

One could make similar considerations for the responsiveness-based assessment. For instance, as the results are sensitive to the specification of the regression used to estimate the extent of the responsiveness, the interpretation is conditional on the **specification**. Unless a single specification is adopted, no clear-cut conclusions can be derived. One could argue that finding one specification associated with coefficients of macroeconomic determinants significantly different from zero is enough to conclude that expectations are not anchored. But given that the misspecification of the empirical model biases the estimates of the parameters, this would be incorrect.

Moreover, as well explained in the ECB report, finding statistically significant coefficients may be **interpreted differently in the light of the underlying regime**. A positive response of inflation expectations to macroeconomic news in a period when inflation and inflation expectations are low may signal a re-anchoring, rather than the unanchoring.

This suggests how it is important to interpret level-based and responsiveness-based tests simultaneously, using a state-contingent approach. But this is indeed what makes room for conflicting signals coming from allegedly complementary approaches.

c. The assessment based on higher moments

The assessment based on higher moments of the distribution of expectations is even more controversial. Not only there are several moments to consider, but there is no clear benchmark for the assessment. When the disagreement among observers becomes excessive? How to compare a larger support for a distribution centred on a value close to the target and a small support relatively far from

the target. How are changes over time in any of the moments to be interpreted, and in their relationship?

This is not to say that these higher moments are not important and impossible to interpret. Rather, these considerations suggest that: i) their interpretation can hardly be straightforward and thus central banks have to offer very detailed explanations to the public; ii) the inclusion of higher moments in macroeconomic models and in policy rules remains a real challenge. Both suggestions call for the use of judgement by policymakers, and this may be political controversial and bring about problems in communication.

3.1.2. Combining metrics

As mentioned above, the most reasonable approach is to combine different metrics. But this is indeed a daunting task, especially short of a clear theoretical support. To show the complexity of interpreting multiple sources of information, we offer some **thought experiments** in what follows.

Imagine, to start, a situation in which the median value of the expected inflation is far from the central bank target, but the following conditions hold: i) the distribution is highly concentrated on this value, ii) long-term expectations are unaffected by unanticipated macroeconomic news, and iii) the short-term movements in observed inflation are not correlated with long-term expectations. The first piece of evidence (about the median value) reveals a worrisome unanchoring of expectations from the target, whereas each of the other three metrics is compatible with well-behaved expectations. It is only the combination of these four different pieces of information that makes it possible to conclude that it is plausible that expectations are unanchored. More precisely, they appear as anchored to a value of inflation that is far from the target. In this case, seemingly contrasting criteria can be easily combined by the observer so as to form coherent conclusions, whose direct policy implication is the necessity for the central bank to take action.

Consider, however, other circumstances in which more ambiguous and controversial conclusions may be reached.

Imagine, for instance, the case of a bimodal distribution of expectations that has a median value of 2%. central bank credibility could be measured in two ways: using higher moments of the distribution of expectations, one could consider the low share of population that is convinced that inflation will remain in a small interval around the inflation objective of 2%; using the median value of individual expectations, one could appreciate the limited divergence of expectations from the target. According to the first criterion, expectations are unanchored, whereas the second metric suggests that, on average, inflation expectations are in line with the target. What metrics should prevail? The heat map in ECB (2021b) seems to attribute more weight on the latter, but the interpretation of the evidence would change if the heat map was accompanied by a graph plotting the bimodal distribution of expectations, as this would signal a serious disagreement among observers.

What is worth noticing is that adding a graph with the distribution of expectations to the heat map would not solve the main problem at stake. The problem remains the interpretation of a given state of affairs without a clear theoretical background. For instance, what types of distributions of inflation expectations represent a problem? Recalling the discussion in Section 1.1., what macroeconomic channels could be affected? The entire distribution of individual expectations, for instance, could be immaterial in wage negotiations and price-setting dynamics if these latter reflected only the expectations of the median worker. The impact of a bimodal distribution of individual expectations on consumption and investment could instead depend on the joint distribution of expectations, on the one hand, and of income and wealth of the holders of the expectations, on the other hand.

This trivial example strengthens the case for making progress in the macroeconomic modelling of expectations, as well as in their measurement, as clearly advocate also in the ECB report (ECB, 2021b).

Similar considerations could be offered as to what concerns two distributions of individual expectations that have the same median value, but different degrees of skewness. Although there seems to be a consensus on the interpretation of skewness as a measure of the balance of risks ahead, one could interpret it also as an (inversed) measure of central bank credibility. Again, there is no yardstick to compare a symmetric distribution centred on 2% with a very large support spanning both deflation and high inflation rates, a very skewed distribution centred on 2% with a relatively small support, and a symmetric distribution with values concentrated around a figure that is considerably far from 2%.

While some uncertainty is doomed to remain, we suggest that further work is necessary to clarify the theoretical setting and to **provide guidance for the interpretation of the empirical evidence**. For instance, the ECB could propose some ordering among the tests for assessing the degree of anchoring of expectations. One could first look at the alignment of the point estimates with the central bank's objective, then consider the balance of risks from the probability distribution of individual expectations, and finally look at the responsiveness of expectations to macroeconomic news and to the observed past inflation. Other orderings are possible. Ideally, the integration of some of these metrics in different components of the macroeconomic models used to support policymaking could follow this preliminary clarification[20].

3.1.3. The underlying theoretical and policy issues

It could be argued that our observations over-emphasise the interpretative problems regarding the anchoring of expectations. Whether the alternative signals are either controversial or difficult to interpret is, in the end, an empirical issue.

While we do acknowledge this point, we would like to stress that part of the problems in interpreting alternative metrics remains the product of unsolved theoretical and policy issues. The tension among the alternative criteria stems, for instance, from the lack of clarity as to the reasons why we should be interested in alternative metrics in the first place. The debate about central bank's credibility and the anchoring of expectations often **conflates a number of correlated but independent concepts**.

For instance, when ECB (2021b) discusses the uncertainty and the balance of risk in section 2.2.2 of the report, the section opens with a *proviso* that reveals the need for digging deeper into these concepts: "*if* (emphasis added) central bank credibility depends not only on anchoring mean inflation expectations but also on minimising perceived inflation uncertainty and risks". Clearly, one thing is using the distribution of expectations to assess the anchoring of inflation, and another is being concerned with the dispersion of expectations as a problem in its own merit.

By the same token, as anticipated, more clarity is necessary on whether inflation expectations should be anchored to the central bank target or to the central bank forecasts. If both aspects are important for different reasons, it would help to use different terms and expressions to describe these two diverse types of anchoring.

In a nutshell, we maintain that **greater clarity as to the alternate uses of the metrics** (as well as of survey-based and market-based datasets) could help to reduce complexity and facilitate the interpretation of the empirical evidence.

[20] Clearly, this issue is different from the one addressed in ECB (2021b), that is whether movements in the shape of the distribution of expectations can help to anticipate movements in the central tendencies.

It is worth noticing that we are not suggesting to disregard any available piece of information, and this is why we appreciate the ECB report (ECB, 2021b). Indeed, it is well possible that the tension among alternative metrics cannot be completely eliminated as it stems from the large number of distinct aspects that central bankers need to consider in making informed decisions. To the extent that theoretical concepts, metrics and interpretative keys are clearly spelled out, we believe that this kind of complexity may be managed. This may make it difficult to encompass all kinds of information into a fully-fledged macroeconomic model, but theory-based principles and empirical evidence could certainly help the central bankers to use their judgement, as suggested by modern decision-making theory (Svensson, 2005)[21].

In fact, not only we do not call for using fewer metrics, but we suggest that additional measures that the ECB report does not dwell in and that could be considered as well.

If the disagreement among forecasters about their point estimates is commonly treated as a measure of **aggregate uncertainty**, there are other important dimensions of uncertainty that could be assessed. We refer to the degree of **subjective uncertainty**, that is the dispersion in the distribution of expectations for each individual (Engelberg et al., 2009; Glas and Hartmann, 2016; Lahiri and Sheng, 2010), and the correlated **distributional asymmetries obtained by aggregating** individual probability distributions. The three measures of uncertainty would provide valuable information, for instance, about the central bank's credibility. The first one (i.e., aggregate uncertainty) regards the heterogeneity among the survey's respondents; the second one (i.e., subjective uncertainty) captures cognitive and informational aspects that affect heterogeneous individuals with aggregate implications; and the last one refers to the average individual distribution asymmetry. Distinguishing these components allow policymakers to understand whether uncertainty reflects a situation where individuals have similar point estimates but high subjective uncertainty, from one where individuals have heterogeneous expectations with low subjective uncertainty, or a mixed of the two[22]. The report (ECB, 2021b) distinguishes these metrics when assessing the pre- and post-financial crisis (p. 22). For the conclusion that consumers tend to revise upward their expectations when uncertainty is high, on the contrary, it is not clearly specified what determinant of uncertainty matters the most. This is a minor example about the importance of exploring all empirical metrics while, at the same time, clarifying their individual purposes and their collective interpretation.

In sum, abundance of data and empirical evidence needs to be balanced by a strong theoretical background. The **risk of forcing concepts into metrics, and vice versa,** is very high. If the ECB could lead other central banks and the scientific literature along this line of analysis, it would provide a great contribution to itself and to the worldwide community. If the ECB could develop a clear communication strategy to offer a consistent and comprehensible interpretation of the multiple sources of empirical evidence about inflation expectations and their degree of anchoring, it would make a leap forward in central banking as well.

[21] This exercise is the opposite of what done by those who use macroeconomic models to forecast non-core variables, as in Schorfheide et al. (2010).

[22] Bloom (2014) discusses the role of uncertainty in the minds of consumers, managers, and policymakers. Coibon et al. (2020) show higher inflation expectations on the part of firms generate higher uncertainty about the outlook, and this may contributes to a reduction in employment and investment. Kumar (2020) shows that firms with larger forecast errors incur in larger increases in liquid assets. Fracasso et al. (2021) show that the uncertainty about the exchange rate affects the degree of firms' pricing-to-market strategies.

4. EURO AREA INFLATION EXPECTATIONS: FROM BEING UNANCHORED ON THE DOWNSIDE TO BE UNANCHORED ON THE UPSIDE?

4.1. Are central banks influencing agents' inflation expectations?

In the aftermath of the Great Recession, central bankers were forced to search for policy instruments that could allow them to stimulate the economy in a situation where inflation was persistently below their target and interest rates were constrained by the zero lower bound. Along with quantitative easing and forward guidance about the future path of policy rates, that have been adopted by the main central banks, it could appear appealing to policy makers to lower agents' perceived real interest rates by raising their inflation expectations when the nominal interest rates are stuck at the zero lower bound. This can be thought of as a way to induce households and firms to increase their spending today and to immediately set higher nominal wages and prices, with an upward impact on current inflation (see e.g. Coibion et al., 2018). Although one may be sceptical—as we have seen—about the effectiveness of this channel for boosting the level of economic activity in a recessionary—or anaemic growth—environment, **keeping perceived real interest rates as low as possible in the presence of heavily indebted private and public entities is crucial for avoiding that their position could become unsustainable and trigger destabilising financial crises**.

Given the undeniable advantage that a central bank could reap from steering agents' inflation expectations towards the desired direction, it is worth examining whether and how it can exert this influence, which may differ with respect to the type of agent, the length of the expectation horizon and the period considered. Indeed, the evidence mentioned by Coibion et al. (2018), that indicates a low reactivity of households' and firms' inflation expectations to monetary policy announcements (even major ones), concerns the period between the onset of the Great Recession and the outbreak of the COVID-19 pandemic, where inflation was low or very low in the advanced economies. Hence, as suggested at the end of section 2, it is legitimate to interpret this inattention as people's rational reaction to decades of success by central banks in stabilising inflation at low levels, which made it unnecessary for those not directly or indirectly involved with financial markets to devote time and effort for being informed about monetary policy. Notice that, if this interpretation is correct, inflation expectations of households and firms should become more responsive to monetary policy news once the price level starts moving substantially and persistently upwards.

The greater attention that professional forecasters and financial market participants are supposed to pay to inflation developments and central banks' communications is reflected in the movements of market-based measures of inflation, such as the 5y5y inflation swap rate. Inflationary expectations of these agents appear driven by both backward-looking and forward-looking determinants. In particular, studies indicate that trends in actual inflation and ECB's announced inflation objective influence the longer-term inflationary expectations of the professional forecasters operating in the euro area, while their short- and medium-term inflationary forecasts are consistent with the Eurosystem's projections (ECB, 2021b). This consistency may signal either that private experts recognise the central bank's superiority in making predictions, or that the latter convey relevant information about central bank's preferences and future strategies, or that central bank's experts have the same information as private forecasters and process it in a similar manner (see Hubert, 2015; Łyziak and Paloviita, 2018).

The evidence that Eurosystem's inflation targets and projections affect professional forecasters and financial market participants opens the possibility of their strategic use by the ECB for managing agents' inflation expectations. Granziera et al. (2021) detect a systematic bias for medium-term

Eurosystem's forecasts, suggesting that, when inflation is lower (higher) than its target, the ECB tends to overpredict (underpredict) inflation. They also document that the magnitude of this systematic bias towards the target is larger in absolute value when inflation is above the target. However, the obvious limit to the possibility of a repeated use of the Eurosystem's forecasts for influencing private agents' expectations is that systematic projection errors may undermine the credibility of monetary authorities and unanchor inflation expectations.

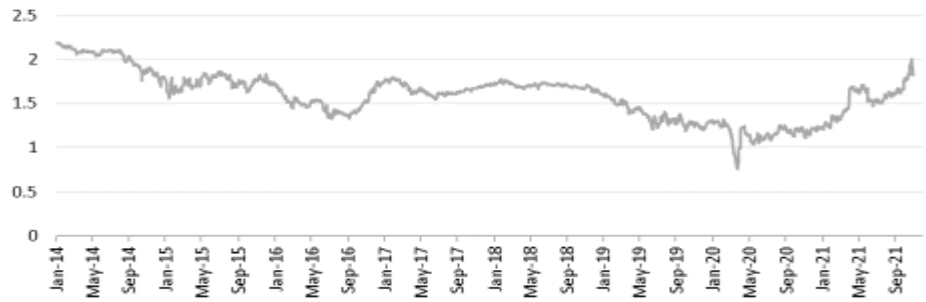
4.2. The ECB credibility problem before and after the pandemic

Signs that euro area long-term inflation expectations had become unanchored on the downside were apparent in the period preceding the COVID-19 pandemic, as a result of repeated downside surprises in inflation outcomes. Thus, one can agree with the report of Eurosystem staff on inflation expectations: "Overall, it is clear that longer-term inflation expectations in the euro area have become less well anchored over the years. This can be seen in both survey and market-based measures and across different un-anchoring metrics (levels, responsiveness and higher moments)" (ECB, 2021b, p. 74).

The decline in longer-term inflation expectations, in essence, reflected the public's loss of confidence in the ECB's willingness and ability to achieve its inflation aim. It is therefore understandable that, after the outbreak of the pandemic, the risk that euro area's inflation expectations could become completely unanchored on the downside was considered high (see, e.g., ECB, 2021b, p. 74). Moreover, it is straightforward that whenever long-term inflation expectations are not aligned with the central bank's inflation objective, the response of these expectations to a monetary policy shock can be desirable (Diegel and Nautz, 2020): **under these circumstances, the effectiveness of monetary policy depends critically on its ability to re-anchor long-term expectations**.

In 2021, it appeared increasingly clear that the worldwide consumer price hikes, mainly due to the high energy prices and supply chain disruptions associated to the pandemic[23], were not going to fade away so quickly as many central bankers had initially affirmed. One after the other, advanced countries' central banks had to revise their short-term inflation forecasts up, announcing their plan to gradually decrease the bond purchases implemented for tackling the pandemic and possibly start rising their policy rates. The ECB, which still in the summer of 2021 insisted on the purely transitory nature of the rise in inflation, appeared quite surprised in the subsequent autumn by the persistence of the upward pressure on prices. In October, for the first time after seven years, euro area's 5y5y break-even inflation reached the 2% threshold (see Figure 5).

Figure 5: 5y5y forward break-even inflation in the euro area



Source: Refinitiv Datastream.

[23] For an assessment of the reasons and implications of the inflation that followed the pandemic, see Bonatti and Tamborini (2021).

By the end of the year, with the euro area inflation touching 5%, the ECB had to raise its forecast for euro area inflation to 2.6% for 2021 and 3.2% for 2022, while predicting a return of inflation below its 2% target in the medium run (1.8% both for 2023 and 2024). Predictions of other international institutions and professional forecasters for inflation in the euro area do not diverge significantly from the ECB's projections (see ECB, 2021c).

Market long-term forecasts implicit in the current pricing of financial assets are consistent with the ECB's projections: at the moment, most market participants seem to prefer believing that the ECB, as the other advanced economies' central banks, is right and inflation will decline sharply in the second half of 2022. The bullish trend that is going on for some time is based on this bet, and it will not take too long to understand if it is well founded, or if—as some fear—it is destined to end in a sharp downward adjustment in asset prices. What is apparent is that, at least for now, markets do not believe that we have entered a new regime, which—for structural reasons—will lead to persistently and considerably higher inflation than we have been accustomed to in recent years[24].

It would therefore appear that markets' longer-term inflation expectations are well anchored and that—thanks to the 2021 inflationary shock—the ECB has overcome the credibility problem due to the prolonged period in which it missed its (close to) 2% target. As a matter of fact, until recently, at the root of ECB credibility problem was that it sought repeatedly and unsuccessfully to push inflation upwards so as to get close to the 2% threshold, and the public became convinced that this was not possible. Indeed, the policy rates were already at zero or negative and the ECB was making extensive use of quantitative easing, but inflation remained stubbornly well below 2%. In other words, the ECB's credibility problem depended on the fact that the tools available to a central bank to raise inflation (even unconventional ones) were already widely in use, but nevertheless proved powerless to reach the target. Its credibility problem amounted therefore to a problem of policy impotence.

Now and in the near future, the ECB's problem is to convince the public that, if the current price hikes persisted, it would not permit inflation to steadily rise much above 2%. On its side, the ECB has the inertia of people's inflationary expectations (after a long period of low or very low inflation), together with the awareness on the part of the public that—in case inflation remained at current levels or rose further—it would have policy tools able to lower it and bring it back to 2%. The credibility problem now lies in the ECB's actual willingness to use these tools, should it be necessary to cool down inflation. In fact, everyone knows that their use would entail greater risks for the ECB than those faced by other central banks that reduce their current bond purchases and raise their policy rates. The reasons are well known: more than the fear of stifling the euro area economic rebound with a premature tightening in monetary policy as in 2011, it is the risk of financial fragmentation and tensions in the euro area's sovereign debt market that may make the ECB reluctant to act decisively by pushing up financing costs if needed to dampen inflation. Only progress in the institutional architecture of the euro area and political developments in the Member States—in particular those whose governments are heavily indebted—can reduce this risk, thus strengthening the anti-inflationary credibility of the ECB.

[24] For a short discussion of the possible structural causes of persistently higher inflation in the future, see Bonatti and Tamborini (2021).

5. CONCLUSION

In this paper, we examined the role of inflation expectations in conditioning monetary policy, addressing three of its facets. The first concerns the channels through which inflation expectations impinge upon actual inflation, and their policy implications. The second regards the technical and empirical issues involved in keeping track of inflation expectations for monetary policy purposes. The final facet is an assessment of inflation expectations *vis-à-vis* the current upsurge of inflation, wondering whether, after being unanchored on the downside, can now become unanchored on the upside.

Our theoretical review offers a picture more shadowed than usually believed. The channels through which inflation expectations impinge upon actual inflation are traced back to households' and firms' behaviour. We highlighted that, first, **different kinds of expectations** are relevant for different channels. Second, granted that future inflation expectations contain valuable information for policymakers, it **does not necessarily follow that they should explicitly be included** in the monetary policy rule. We have seen that even the basic format of the Taylor Rule keeps inflation under control under different hypotheses of expectation formation. Third, unanchored expectations, according to their standard definition of being sensitive to short-run macroeconomic developments, may make inflation control less smooth, but they **do not necessarily imply that inflation gets out of control**.

Do households and firms actually behave consistently upon their (reported) inflation expectations? **The results of empirical studies that we have considered are mixed**. It is important to notice that they are likely to be conditioned by the actual inflation climate prevailing at the time: low and stable inflation may favour low and stable expectations and induce individuals to disregard the effect of current and future inflation on their economic decisions. The opposite occurs when inflation is on the rise, when disregarding present and future inflation may produce large losses.

Therefore, we suggest caution in that **information on future inflation expectations should not be given the role of polar star of monetary policy**, while it has to be carefully assessed and processed along with other information about the contingent state and the evolution of the macroeconomy.

Further work is necessary to **clarify the theoretical setting and to provide guidance for the interpretation of the various empirical measures of inflation expectations** and their role in the ECB's projection models used for policy purposes. In particular, more clarity is necessary on whether inflation expectations should be anchored to the central bank target or to its forecasts. Greater clarity as to the alternate uses of the metrics (as well as of survey-based and market-based datasets) could help to reduce complexity and facilitate the interpretation of the empirical evidence. By leading other central banks and the scientific literature along these lines, the ECB would provide a great contribution to itself and the worldwide community.

It could appear appealing to policymakers to lower agents' perceived real interest rates by raising their inflation expectations when the nominal interest rates are stuck at the zero lower bound. Hence, a central bank may be tempted to use strategically its inflation projections for managing agents' expectations. However, this could undermine its credibility.

Furthermore, in the light of the current upsurge of inflation, **we discussed whether, after being unanchored on the downside, inflation expectations can now become unanchored on the upside**. The evidence is mixed, but the early believe (hope) that expectations remain anchored to the 2% target seems to resist. Yet, we warn that the **key area where the interplay between inflation, inflation expectations, and monetary policy will be critical is that of financial markets**, not so

much because in those markets inflation is a concern *per se*, but because their true top concern is whether central banks will see inflation high enough to put an end to the era of easy money.

Finally, we argued that in the current situation, **the ECB's problem is to convince the public that, if the current price hikes persisted, it would not permit inflation to steadily rise much above 2%**. Indeed, analysts and market participants could believe that the risk of financial fragmentation and tensions in the euro area's sovereign debt market may make the ECB more reluctant than other central banks to act decisively by pushing up financing costs if needed to dampen inflation.

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