DISCUSSION PAPER SERIES

DP17850

FOUR MISTAKES IN THE USE OF MEASURES OF EXPECTED INFLATION

Ricardo Reis

MONETARY ECONOMICS AND FLUCTUATIONS

CEPR

ISSN 0265-8003

FOUR MISTAKES IN THE USE OF MEASURES OF EXPECTED INFLATION

Ricardo Reis

Discussion Paper DP17850
Published 25 January 2023
Submitted 22 January 2023

Centre for Economic Policy Research
33 Great Sutton Street, London EC1V 0DX, UK
Tel: +44 (0)20 7183 8801
www.cepr.org

FOUR MISTAKES IN THE USE OF MEASURES OF EXPECTED INFLATION

Abstract

With the profusion of measures of expected inflation (from market prices and from surveys of households, firms, and professionals) it is a mistake to focus on a single one while ignoring the others. This paper discusses four common arguments for a single focus, and finds each of them to be lacking. In the process, it isolates characteristics of different measures that models that combine them should take into account.

JEL Classification: E31, E52, D84

Keywords: Phillips curve, monetary policy

Ricardo Reis - r.a.reis@lse.ac.uk
London School of Economics and CEPR and CEPR

Four mistakes in the use of measures of expected inflation*

Ricardo Reis
LSE

January 2013

Abstract

With the profusion of measures of expected inflation (from market prices and from surveys of households, firms, and professionals) it is a mistake to focus on a single one while ignoring the others. This paper discusses four common arguments for a single focus, and finds each of them to be lacking. In the process, it isolates characteristics of different measures that models that combine them should take into account.

JEL codes: E31, E52, E84.
Keywords: Phillips curve, anchoring, monetary policy, central banking

*Contact: r.a.reis@lse.ac.uk. I am grateful to a UKRI grant for financial support. A companion paper "Expected Inflation in the Euro Area: Measurement and Policy Responses" discusses a complementary set of issues.

What is expected inflation? The right answer to this question is that there are many expected inflations, by different economic agents, with different information and beliefs. Yet, when people discuss which weights to put in each measure, it is common to (i) argue that the weight should rise with some characteristic, (ii) observe that one series is much better in this dimension, and (iii) appeal to simplicity to set its weight to 100%. Superficially, this seems sensible, or even optimal, given limited attention. But using this argument to focus on one "right" measure of inflation typically leads to the wrong answer to the question at hand.

This paper works through four arguments of this type that are increasingly heard in response to the remarkable progress in the past two decades in measuring expected inflation, using both surveys of expectations and models of prices in financial markets (Weber et al., 2022). This work was partly validated in 2021-22, as these measures provided valuable early signals that an inflation surge was on the way (Reis, 2022), so it is important to correct these mistakes early. This way, measures of expected inflation measures can continue to reliably guide monetary policy.

1 Mistake 1: Focus on firms' expectations because firms set prices

A common argument states that firms choose prices in the economy. It is their expectations that matter for how prices are set, and therefore for what inflation will be. In a modern Phillips curve equation, it is firms' expectations that appear on the right-hand side of the equation as a key driver of inflation. Therefore, they should be the sole focus of research.

Because, until recently, the only surveys of inflation that spanned a few decades and included a few hundred respondents were those of households, like the Michigan survey in the US, this argument was used to dismiss them as irrelevant, since households do not choose prices and their expectations do not appear in pricing equations. Looking forward, since the new surveys of firms' expectations find that managers share with households some of their biases and inefficiencies when making forecasts (Candia, Coibion and Gorodnichenko, 2022), a new version of this argument dismisses surveys altogether.

In many models of nominal rigidities there is a partial-equilibrium relation in the goods market, derived from monopolistic firms maximizing real profits, given demand,

and subject to nominal rigidities:

$$\pi = \pi^f + rmc, \tag{1}$$

where π is inflation, *rmc* are expected real marginal costs, and π^f are *firms' expectations of inflation*, all as log-linear deviations from a steady state. Intuitively, firms want to raise their prices relative to the prices that they expect other firms are setting when the cost of producing an extra good is higher. Keeping fixed expected real marginal costs, then yes, firms's expectations drive inflation.

However, *rmc* is not fixed. In fact, say the firm takes as given the nominal prices of the inputs it uses. Then, *rmc* will equal those input prices minus expected inflation by the firm. Therefore, π^f cancels out from the equation, and firm expectations turn out to be irrelevant. Intuitively, if the firm expects higher inflation, it expects that the real cost of hiring inputs is lower, so it can lower its price. This exactly offsets the initial desire to raise prices. Firms care about real profits, but optimal behavior dictates setting a markup over nominal marginal costs so, if these are observed, firm expectations are irrelevant.

Moreover, the input prices depends on other agents' expectations. Assume that firms use capital and labor, with α being the capital share in production, so that real marginal costs are:

$$rmc = \alpha(i^l - \pi^f) + (1 - \alpha)(w - \pi), \tag{2}$$

where the firm pays a lending rate i^l to rent capital, and pays labor a nominal wage w.

Financial institutions make loans at an interest rate that reflects their expectations. The marginal cost of funds to financial institutions depends on the interbank market rate targeted by the central bank i and, with financial frictions that require using some of the bank's net worth, it also depends on the required return on that net worth. Taking that real return to be constant for simplicity, then:

$$i^l = i + \gamma(\pi^m - i), \tag{3}$$

with the parameter $\gamma > 0$ capturing the extent of the financial frictions.

For a given real return on net worth, higher *financial markets' expectations of inflation* π^m raise the interest rate that is charged to the firm. If markets start expecting higher inflation, they will raise the interest rates they charge on loans, which raises the financial costs of firms, leading them to raise prices. This is a general-equilibrium effect, from combining the goods market with the loan market.

In turn, the more labor is used and output produced, the more workers must be paid for their rising disutility of working, with an elasticity of θ. If unions and workers have some bargaining power and set wages subject to nominal rigidities, they also have to form some expectations of inflation. In equations, if the *workers/unions' expectations of inflation* are π^w, then:

$$w = \pi^w + \theta y. \tag{4}$$

Now, if workers expect higher inflation, they ask for higher nominal wages. Ceteris paribus, this raises the real marginal costs of firms, and they respond by raising their prices, which causes inflation. Again, it is general equilibrium, now working from the labor market to the goods market, that makes higher inflation expectations elsewhere in the economy drive the increase.

In practice, these two equilibrium channels are important. The expectations of financial markets quickly affect the financial conditions facing all agents, so they have a fast and powerful impact on inflation that monetary policy relies on. In turn, when expectations of wages move away from the central bank's target, they are hard to re-anchor, and can start wage-price spirals. Arguably, this is the major concern about inflation at the start of 2023.

To conclude, superficially it is firms that set prices and they respond to their expectations. But they respond as well to the costs they face. Those costs depend on the expectations of inflation of workers and financial markets. In economic equilibrium, choices depend on other's actions, and a priori any of the beliefs could be more or less important for the decisions that are made.

2 Mistake 2: focus on the big players as their choices drive aggregates

Large firms, unions, or banks have a large weight in the averages of production, labor, and credit that are behind inflation outcomes. This is especially so in lending, as private credit in most countries is concentrated on a handful of banks. Another common argument is to put a larger weight on surveys of large firms, especially in the financial sector, because they matter more for quantities. In practice, this leads to focus on the Blue Chip survey in the US.

An immediate objection to this argument is that market prices reflect the actions of the marginal agent, not the average over agents. The lending rare i^l is set at the margin where demand and supply for credit meet. The bank that is just indifferent between lending or not may very well be small. In practice, measures of expected inflation from market prices differ systematically from the survey measures of bankers or of dealers in those markets.

Furthermore, consider what determines expected inflation. There are many well-developed models in the literature of how people form their beliefs. At one extreme, if they have rational expectations and perfect foresight, expected inflation equals actual inflation. At the other extreme, expectations are exogenous animal spirits. A reduced-form way to capture an in-between is to write:

$$\pi^f = (1 - \lambda^f)\pi + \lambda^f \hat{\pi}^f, \tag{5}$$

for firms where $\hat{\pi}^f$ are the exogenous spirits, and λ^f is a parameter between zero and one. The same applies to workers and financial markets, with λ^w and λ^m respectively.

The closer the λ's are to zero, the less useful it is to measure expectations through expensive surveys or sophisticated techniques. The measures are just mirrors of what is going on in reality, and researchers are better off measuring outcomes and fundamental shocks. Plausibly, large firms with chief economists will have a small λ^f. Therefore their $\hat{\pi}^f$ spirits will not be so important on aggregate outcomes. The players may be large, and their choices drive outcomes, but the *autonomous* changes in their expectations that could bring a shock to inflation are small, and drive little of the variation that we see in the data.

This can be seen mathematically by combining all the equations presented so far to get the actual Phillips curve for the economy, the structural relation that links real activity to inflation as a result of general equilibrium across markets:

$$\pi = \pi^e + \kappa y + \xi(i - \pi). \tag{6}$$

The coefficients κ and ξ depend on all the other parameters (see the appendix). More interesting, expected inflation π^e is a weighted average that sums to one of the expectations of firms, markets, and workers:

$$\pi^e = \frac{\alpha\gamma\lambda^m \hat{\pi}^m + (1-\alpha)(\lambda^f \hat{\pi}^f + \lambda^w \hat{\pi}^w)}{\alpha(1-\gamma) + \gamma\lambda^m + (1-\alpha)(\lambda^w + \lambda^f)} \tag{7}$$

Each agents' expectation has a larger weight on π^e if their λ's are larger.

Again, in practice this is not negligible. Both in the EA and the US, surveys of chief economists in large banks are usually quite close to the central bank's internal forecast. When inflation is close to target, they do not add much information. When the central bank's model got it wrong in US history—the rise of inflation in the late 1960s, its fall in the early 1980s, and the new rise in 2021-22—the professional forecasters were just as wrong. Instead it was household expectations that seemed to provide an autonomous impetus for the dynamics of inflation, and it was their survey measures that contained useful signals (Reis, 2021).

3 Mistake 3: focus on the measures with smaller forecast errors

Some people do not care about what drives inflation, but are only interested in forecasting it. So, they ignore the economic arguments in the previous sections. Rather, they prefer to compare the forecasting performance of different measures of expected inflation, and focus on the one which does best according to a criteria like mean squared forecast error. The answer in many countries and in many decades is a survey of professional forecasters. A more brusque version of this "inflation desk" view discards household expectations because, since they are biased and have persistent forecast errors, their forecast errors are large.

Even from a statistical perspective, this argument is weak, for at least four reasons. First, if the goal is forecasting performance alone, the best measure in most advanced economies is the forecast published by the central bank. Since this forecast often includes data from other measures of expected inflation, not much is learned from this forecasting horse race.

Second, as a general principle of forecasting, a combination of different measures usually does better at forecasting than focussing on a single measure.

Third, inflation in most countries has historically gone through different regimes. Surveys of professional forecasts do well within regimes, but not during regime changes. A careful evaluation of forecast performance is tricky because it must consider long enough samples with some changes in regime.

Fourth to focus on forecast performance is to confuse concept with measurement. Surveys might be poor, but they can improve through better design. Expectations may be biased, but theories of those biases can de-biase them. A simple direct measure of expected inflation from a survey, like a mean or a median, may seem far off from reality, but a careful statistical model would combine the survey data moments and link them to the relevant concept.

Turning back to economics, models are mostly used, not for unconditional forecasting, but rather for forecasting what will happen conditional on a shock. To close the model developed so far, start by adding an equation for aggregate demand:

$$y = -\omega(i^l - \pi) + \sigma(\pi^c - \pi). \tag{8}$$

The first term captures the fall in current spending (or rise in savings) when returns are higher. For a fixed interest rate, the second term captures the force that higher *consumers' expected inflation* π^c leads them to want to spend more today before prices rise.

Close the model with a standard rule for monetary policy: $i = \phi\pi + \phi_y y + \varepsilon$ with policy parameters ϕ and $\phi_y > 0$ and policy shock ε. Focusing on the response of inflation to a shock to consumer expectations (the same could be done with respect to the other agents's expectations) gives:

$$\frac{\partial \pi}{\partial \hat{\pi}^c} = \frac{\sigma}{\rho + \sigma}, \tag{9}$$

where ρ is a positive composite parameter (see the appendix). The message is clear: shocks to expectations of consumers matter more for outcomes if σ is higher.

In the model, this parameter determines the transmission *from expectations to actions*. A similar conclusion applies to the other expectation shocks with respect to the parameters that capture how much their actions respond to their expectations. In general, this transmission is the key parameter to focus and decide how much weight to put on a measure of expected inflation. When it comes to professional forecasters, often they are are not the key decision-makers in the firms they work for, so their expectations are removed from choices on investment or pricing. They may well turn out to be the least relevant for inflation outcomes, even if they are statistically accurate.

4 Mistake 4: focus on the expectations that policy can move

When policymakers change a tool of monetary policy, or give a speech, financial market expectations of inflation move within minutes. Household expectations, instead, rarely move at all with policies or communications. In fact, many people, including those running firms, usually cannot state what is the goal or mandate of the central bank, or who is currently its head. As a result, asset prices and interest rates are the main transmission channel of monetary policy to the economy. It is then natural for policymakers to focus on financial market expectations, and to devote their energy to managing those (Haldane, Macaulay and McMahon, 2021).

Of course, financial market prices often over-react to them, as well as to noise unrelated to fundamentals. Moreover, market prices reflect both expected inflation and risk premia. Removing the latter is hard and imperfect. A policymaker that responds to every movement in market expectations of inflation may end up propagating shocks to risk attitudes.

In the simple model of this paper, the responsiveness of market expectations π^m to a policy shock ε is captured by λ^m. All else equal, algebra shows that a low λ^m raises $\partial\pi/\partial\varepsilon$. But at the same time, it lowers $\partial y/\partial\varepsilon$. That is, and perhaps unsurprisingly, more responsive expectations make the Phillips curve steeper. Conversely, very sluggish household expectations, captured by a high λ^w or λ^c, make the curve flatter. This changes the trade-offs that policymakers face in stabilizing both inflation and output. The sluggishness of household expectations is not a reason to ignore them, but rather it is what gives the central bank power to affect output. Which measure of expected inflation is more important depends on which macroeconomic variable one focusses on.

Treating the λ's as fixed parameters is a useful approximation when inflation is stable. But across inflation regimes, economists have long known that the responsiveness of expectations to policy is endogenous to policy and the steepness of the Phillips curve changes. With multiple λ's across agents, how much each changes across regimes becomes very important. If financial markets were already very responsive to news over two decades of low and stable inflation, then there is little room for change when inflation becomes high and volatile, or to rect to policy. Instead, since households were so unresponsive when inflation was low and stable, there is more room for them to start paying more attention. Therefore, because λ^c and λ^w change by more across regimes than λ^m, this makes household expectations more important than market ones.

The experience from countries that go through prolonged periods of high and volatile inflation shows that this effect is large. A major task of a central bank in an inflation disaster is to re-anchor expectations. This can in part be understood as trying to convince agents to become inattentive again. Households and workers are often those that need more convincing, as opposed to markets, making the latter less important when it comes to measuring expected inflation.

5 Conclusion

The expectations of firms, large banks, professionals, or financial markets are all very important to measure the state of economic expectations. But, none of them individually has a strong claim to being more useful than the expectations of households in order to understand inflation outcomes or to guide monetary policy. While household expectations are the ones that are more often dismissed, it would be just as mistaken to conclude from this article that one should only focus on household expectations and down-weight the expectations of other agents.

The simple, perhaps obvious, but often forgotten, conclusion is that one needs models to extract as much signal as possible from different measures and to combine them in the better guide. The arguments in this paper noted that those models will take into account: (i) which expectations affect output and input prices, (ii) which expectations give a stronger autonomous push to inflation, (iii) which expectations are more linked to actions of their agents, and (iv) which expectations can be sluggish or fast depending on policy and are therefore prone to being anchored or not.

References

Candia, Bernardo, Olivier Coibion, and Yuriy Gorodnichenko. 2022. "The Macroeconomic Expectations of Firms." In *Handbook of Economic Expectations*. Elsevier: North Holland.

Haldane, Andrew, Alistair Macaulay, and Michael McMahon. 2021. "The Three E's of Central-bank Communication with the Public." In *Independence, Credibility, and Communication of Central Banking*. Central Bank of Chile.

Reis, Ricardo. 2021. "Losing the Inflation Anchor." *Brookings Papers on Economic Activity*, 307–361.

Reis, Ricardo. 2022. "Expected Inflation in the Euro Area: Measurement and Policy Responses." *ECB Sintra Forum*.

Weber, Michael, Francesco D'Acunto, Yuriy Gorodnichenko, and Olivier Coibion. 2022. "The Subjective Inflation Expectations of Households and Firms: Measurement, Determinants, and Implications." *Journal of Economic Perspectives*, 36(3): 157–84.

A Appendix: the formal model

Starting with the micro-foundations, it is standard to derive that a monopolistic firm facing a constant-price-elasticity demand curve would want to set a desired price $p_t + rmc_t$. Production happens according to a Cobb Douglas function of capital and labor, with weights α and $1 - \alpha$, respectively. Capital is chosen one period ahead, while labor is chosen in the period of production.

I assume that a fraction λ^f of firms sets their prices one period ahead, while the remaining fraction observes current variables. A strong assumption in this paper, which makes the model simple, is that when it comes to forecasting prices (or inflation) one period ahead, firms just have an exogenous forecast $\hat{\pi}_t^f$. When it comes to forecasting real marginal costs, I assume that firms face a nominal interest rate set by the banks, but a *real* wage. This is odd, but if one were to assume that firms face a nominal wage, then the firm's expectations of inflation would cancel out entirely as explained in the text.

Combining these assumptions leads to:

$$\pi_t = \lambda^f \hat{\pi}_t^f + (1 - \lambda^f)\pi_t + \alpha(i_t^l - \pi_t) + (1 - \alpha)(w_t - p_t) - \lambda^f \alpha(\hat{\pi}_t^f - \pi_t) \tag{A1}$$

which combines equations (1), (2), and (5).

Workers live hand to mouth, as they do not save, and choose how much labor to supply. Their desired wage then increases with prices (substitution effect) and with their consumption (income effect), which equals their income. I assume that preferences are quasi-linear in labor. Then, as usual, assume a standard set-up where firms are monopolistic sellers of labor varieties, together with the more unusual assumption that a fraction has autonomous expectations of prices, but all of them observe how much they are consuming. This gives:

$$w_t - p_t = \lambda^w(\hat{\pi}_t^w - \pi_t) + \theta y_t, \tag{A2}$$

which in the main text is equation (4).

Banks own all of the capital, but only a fraction of them is matched with a firm and so is able to lend. They can borrow from the unproductive banks, but because of a financial friction, their ability to raise deposits is limited to a multiple of what the return on their net worth will be. Crucially, the leverage constraint applies to their expected real return on interbank credit. Again because some of them set the interest rate on their loans with autonomous expectations on what inflation will be, this implies that unexpectedly high inflation raises the interbank credit that informed banks can raise and lowers the interest rate charged. All combined:

$$i_t^l - \pi_t = (1-\gamma)(i_t - \pi_t) + \gamma\lambda^m(\hat{\pi}_t^m - \pi_t), \tag{A3}$$

where γ is the elasticity of the leverage constraint to the increase in the return on the bank's loans, which maps into equation (3).

Finally, consumers can save in banks, although in equilibrium their net savings end up being zero because capital is fixed. Consumption happens one period after they make their choice, and they obverse the nominal interest rate charged by the banks. Their consumption would therefore depend on $i_t^l - \pi_t^c$ with an elasticity of ω, as well as on expected future consumption. Aggregating with the consumption from the hand-to-mouth agents lads to a TANK-type IS curve: $y_t = -\omega(i_t^l - \pi_t^c) + \omega_y y_{t+1}^c$.

How do consumers form expectations of future income? If all shocks are i.i.d., and consumer make those expectations rationally, then this term disappears. If instead they have some animal spirits with regards to these, then this would be an extra shock. I assume that there is some correlation ζ between the animal spirits on future income and those on future inflation, and focus on inflation expectations in this paper. This leads to:

$$y_t = -\omega(i_t^l - \pi_t) + \lambda^c(\hat{\pi}_t^c - \pi_t) + \omega_y\lambda^c\zeta(\pi_t^c - \pi_t) = -\omega(i_t^l - \pi_t) + \sigma\lambda^c(\hat{\pi}_t^c - \pi_t) \tag{A4}$$

where $\sigma \equiv 1 + \omega_y\zeta$ as written in equation (8).

Finally, the monetary policy rule is just assumed to be:

$$i_t = \phi\pi_t + \phi_y y_t + \varepsilon_t. \tag{A5}$$

Solving the model consists of solving the linear system of five equations (A1)-(A5) in five unknowns $(\pi_t, y_t, w_t - p_t, i_t^l, i_t)$ driven by five exogenous variables $(\hat{\pi}_t^f, \hat{\pi}_t^m, \hat{\pi}_t^w, \hat{\pi}_t^c, \varepsilon_t)$.

Combining the first three equations in the appendix (A1)-(A3) leads to equation (6), repeated here for convenience:

$$\pi = \pi^e + \kappa y + \xi(i - \pi), \tag{A6}$$

where

$$\pi^e \equiv \frac{\alpha\gamma\lambda^m \hat{\pi}^m + (1-\alpha)(\lambda^f \hat{\pi}^f + \lambda^w \hat{\pi}^w)}{\alpha(1-\gamma) + \gamma\lambda^m + (1-\alpha)(\lambda^w + \lambda^f)}, \tag{A7}$$

$$\kappa \equiv \frac{\alpha(1-\gamma)}{\alpha(1-\gamma) + \gamma\lambda^m + (1-\alpha)(\lambda^w + \lambda^f)}, \tag{A8}$$

$$\xi \equiv \frac{(1-\alpha)\theta}{\alpha(1-\gamma) + \gamma\lambda^m + (1-\alpha)(\lambda^w + \lambda^f)}. \tag{A9}$$

Then, combining the last three numbered equations in this appendix gives the solution for inflation as a function of the fixe exogenous shocks:

$$\pi = \Psi[[1 + \phi_y \omega(1-\gamma)]\pi^e + (\kappa + \xi\phi_y)(-\gamma\omega\lambda^m \hat{\pi}^m + \sigma\lambda^c \hat{\pi}^c - \omega(1-\lambda)\varepsilon)] \tag{A10}$$

where

$$\Psi^{-1} \equiv [1 - \xi(\phi - 1)][1 + \phi_y \omega(1-\gamma)] - (\kappa + \xi\phi_y)[\omega\gamma\lambda^m - \sigma\lambda^c - \omega(1-\gamma)(\phi - 1)] \tag{A11}$$

which explains equation (9) with

$$\rho \equiv \frac{[1 - \xi(\phi - 1)][1 + \phi_y \omega(1-\gamma)] - (\kappa + \xi\phi_y)[\omega\gamma\lambda^m - \omega(1-\gamma)(\phi - 1)]}{(\kappa + \xi\phi_y)\lambda^c}. \tag{A12}$$