

Lower bound, inflation target and the anchoring of inflation expectations

One of the outcomes of the financial crisis has been an in-depth debate on possible lessons for monetary policy, including the question of whether central banks should raise the inflation target in order to widen the safety margin to the lower bound, thus broadening monetary policymakers' scope for action.

From the perspective of a central bank, choosing the targeted inflation rate is a decision involving a trade-off between the costs of a higher general rate of price increase and the benefits of a greater distance to the effective lower bound on the nominal interest rate. Such an assessment is complex and has numerous facets. The present article addresses this issue in the currently prevailing paradigm of monetary analysis, the New Keynesian model. This means that two aspects are placed at the centre of the analysis: first, the costs of inflation due to a distortion of relative prices in an economy, and, second, the benefit of greater room for manoeuvre for monetary policy in the light of a binding effective lower bound.

Those who favour raising the inflation target emphasise the latter. However, what is often neglected is the fact that, in this model framework, a higher inflation target has wider implications, since it changes the price-setting behaviour of firms. As a result, the central bank has to adopt a more aggressive interest rate policy response to economic developments, which means losing part of the room for manoeuvre that has just been gained, while the costs of inflation caused by distortions in relative prices continue to exist.

What is likewise largely ignored in the current debate about a higher inflation target is the associated risk that inflation expectations become unanchored. However, a firm anchoring of inflation expectations is of crucial importance for monetary policymakers being able to steer aggregate demand effectively. The present article therefore also discusses this aspect explicitly in the framework of a New Keynesian model.

Overall, it becomes clear that – even within a homogeneous model framework – the underlying implications of raising the inflation target are more complex than they appear at first sight. Even though monetary policy research on this issue is still in its infancy, a strong case can be made at present for not abandoning the monetary policy consensus within the developed economies that aims to keep the inflation rate at about 2% per year over the medium term in favour of a higher target rate of inflation.

Financial crisis calls into question a number of prevailing paradigms

Reaching the lower bound launches debate on raising the inflation target

■ Introduction

The financial and economic crisis led to a contraction of economic output worldwide that was unprecedented in the post-war era and prompted governments and central banks to take exceptional countermeasures, some of which came in for heated discussion. Soon after the outbreak of the crisis, far-reaching questions were raised about the long-term lessons to be drawn from it. In the meantime, many decisions have been taken on strengthening the long-term resilience of the financial and banking system.¹ Monetary policymakers have also found themselves faced with new challenges.² In view of the severe economic downturn and the sharp declines in inflation rates, their monetary policy mandate has also been subjected to critical examination.³

After reaching the effective lower bound (see the chart on page 33), not only did a number of central banks take a series of accommodative non-standard (“unconventional”) monetary policy measures such as the asset purchase programmes;⁴ a matter also raised for discussion – looking ahead to the time after the period of low inflation – was a revision of their mandate in terms of raising the target inflation rate. As a result, monetary policymakers should have more room for manoeuvre in terms of interest rate policy in the future.⁵ At first sight, a raising of the inflation target⁶ *per se* reduces the probability of the lower bound being binding, as the average level of nominal interest rates – the sum of the real interest rate level and the (expected) inflation rate – increases, resulting in a greater scope for any (nominal) interest rate cuts.⁷ In the event of a further escalation of the crisis, with the risk of very low or even negative inflation rates, monetary policymakers could then intervene in economic activity in future for longer and with a stronger stabilising impact by making cuts in interest rates.⁸

Basically, there are various reasons that – each on its own terms – might argue in favour of

choosing a positive target inflation rate (see the box on rigid nominal wages, measurement errors etc on pages 34 to 36). The present article, however, focuses below chiefly on two key aspects, comparing the respective costs and

Article discusses advantages and drawbacks of raising the inflation target ...

1 To be especially highlighted in this context are the creation of the banking union with the Single Supervisory Mechanism (SSM), the Single Resolution Mechanism (SRM), and (in future) a deeper harmonisation of the national deposit protection schemes, the European Deposit Insurance Scheme (EDIS). The regulations of the Basel Committee on Banking Supervision within the Basel III framework should also be mentioned in this context. See Deutsche Bundesbank, European Single Supervisory Mechanism for banks – a first step on the road to a banking union, Monthly Report, July 2013, pp 13-31; and Deutsche Bundesbank, Implementing Basel III in European and national law, Monthly Report, June 2013, pp 55-71.

2 See Deutsche Bundesbank, The implications of the financial crisis for monetary policy, Monthly Report, March 2011, pp 53-68.

3 For more information, see Deutsche Bundesbank, The importance of macroprudential policy for monetary policy, Monthly Report, March 2015, pp 39-71.

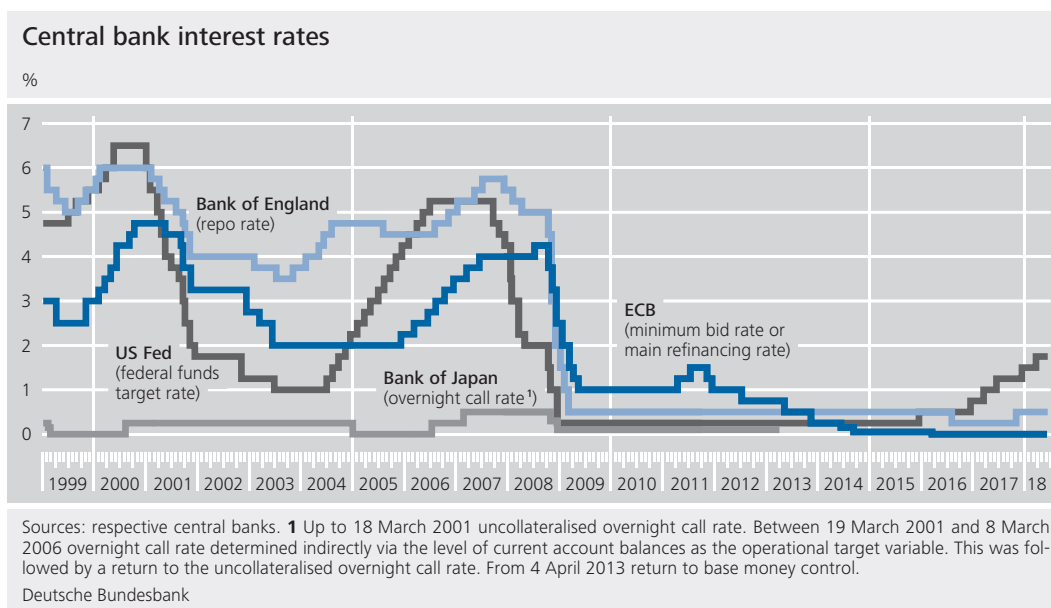
4 However, major uncertainty exists at present regarding their effectiveness compared with the traditional interest rate instrument. For a detailed discussion of the effects of unconventional measures in the euro area, see also Deutsche Bundesbank, The macroeconomic impact of quantitative easing in the euro area, Monthly Report, June 2016, pp 29-53.

5 See, in particular, O Blanchard, G Dell’Ariccia and P Mauro (2010), Rethinking macroeconomic policy, Journal of Money, Credit and Banking, Vol 42, pp 199-215; and P Krugman (2013), “The Four Percent Solution”, The New York Times; as well as P de Grauwe and Y Ji (2016), Animal spirits and the optimal level of the inflation target, available at <https://voxeu.org/article/animal-spirits-and-optimal-level-inflation-target>. Recently, a number of US economists also wrote an open letter calling for a rethink of the Fed’s 2% inflation target, see “Rethink 2%” of 9 June 2017 at <https://equitablegrowth.org/rethink-2/>

6 The terms “inflation target” and later also “target inflation rate” are used below purely for the sake of linguistic simplicity. As is well known, the Eurosystem aims for an inflation rate in the euro area that is below, but close to, 2% over the medium term. The Governing Council of the ECB therefore does not pursue an inflation target in the strict sense. As a synonym for “inflation target” and “target inflation rate”, “targeted inflation rate” is also used below.

7 These considerations are based on the Fisher equation (named after Irving Fisher (1930), The theory of interest, Macmillan, New York), according to which the sum of the real interest rate and the expected inflation rate roughly corresponds to the nominal interest rate. As the real interest rate is independent of the inflation rate over the long term (as is typically assumed in the literature), the nominal interest rate, taken in isolation, rises (1:1) with the rate of inflation in the long term.

8 This is based on two considerations: First, the greater scope for interest rate cuts reduces the likelihood of reaching the effective lower bound. Second, the lower bound tends to become less restrictive if inflation expectations have adjusted to the higher level. This means that the real interest rate at the effective lower bound, taken in isolation, can fall more sharply than with lower inflation expectations (owing to a lower inflation target).



benefits of a higher target inflation rate. The costs and benefits are weighed against each other in the context of the currently prevailing model of monetary policy analysis, the prototypical New Keynesian model. Confining the analysis to this model framework means forgoing individual aspects of the cost-benefit analysis which it has so far not been possible to integrate comprehensively into this type of model. It does, however, allow a consistent discussion of arguments within the theoretical framework that plays a prominent role in the international debate.

The main macroeconomic costs of inflation arise from nominal rigidities, leading to price stickiness. These, in turn, imply a distortion of relative prices, which ultimately brings an inefficient allocation of resources in a given economy in its wake. The main advantage that raising the inflation target is thought to offer, after the experience of the financial crisis, consists in the enlarged scope for monetary policy action in light of a binding effective lower bound. Both aspects can be weighed against each other in order to derive from them the quantitative implications for the “optimal” target level of inflation. Such a trade-off is inherently complex because higher inflation rates not only result in greater room for manoeuvre for monetary policy; they simultaneously reduce that

scope by affecting how firms set their prices. Yet, to the degree that the hoped-for additional room for manoeuvre is lost as quickly as it is gained, while the allocative distortions of a higher inflation target continue to exist in the form of costs, the balance of the pros and cons of raising the inflation target will be skewed more to the downside as the target inflation rate increases. The key mechanisms of this are to be presented in this article.

In the debate about a higher inflation target, what is also mostly ignored is the associated risk of inflation expectations becoming unanchored from the inflation target. However, from a monetary policy perspective, the firm anchoring of inflation expectations is of crucial importance. The expected rate of inflation is a major determinant of the actual path of inflation. Thus, anchored inflation expectations are a major prerequisite for being able to steer aggregate demand effectively. If economic agents expect, say, a longer-term rise in inflation on account of a protracted increase in commodity prices, they will demand higher wages “today” in order to compensate for the expected threat of a loss of purchasing power. As a consequence, firms will attempt to pass on the higher wage costs in their prices. In a worst-case scenario, a price-wage spiral could emerge, ultimately jeopardising the objective

... and also looks at the possibility of inflation expectations becoming unanchored

Further reasons to select a positive target rate of inflation

This box highlights a number of further reasons to select a positive target rate of inflation other than to secure sufficient room for manoeuvre when there is a binding zero lower bound on interest rates.¹ Furthermore, the literature shows that a positive rate of inflation can reduce existing inefficiencies in the economy.^{2,3} In this context, selecting an optimal inflation target can be understood as a trade-off between various inefficiencies.

While the main article focuses on inefficiencies as a result of the effective lower bound and distortions in relative prices, the literature also discusses additional inefficiencies such as nominal wage rigidities, differences in productivity between firms and heterogeneities in the monetary union.⁴ In addition, distortions in the measurement of inflation are commonly cited.

- Measurement errors arise, for instance, from difficulties in correctly recording the price equivalent of changes in quality or to the basket of goods underlying the measurement. Experience has shown that measurement errors make it difficult to adequately assess changes in prices. For this reason, in the past, positive inflation targets have traditionally been attributed to measurement errors when recording statistics for the Harmonised Index of Consumer Prices.⁵ This is based on the idea that, in principle, the target rate of inflation should be around 0%. However, as the statistics cannot fully reflect improvements in the quality of goods or changes in consumer demand, in particular, promptly and accurately enough, the officially reported inflation rate is considered to be somewhat overstated, meaning that “zero inflation”

measured according to the price index would mean a *de facto* fall in the aggregate price level. The monetary policy inflation target should thus be adjusted upwards in order to allow for these

¹ Due to the abundance of different reasons in favour of a positive rate of inflation, this box can discuss only a few selected arguments. For a more comprehensive overview, see S Schmitt-Grohé and M Uribe (2011), The optimal rate of inflation, Handbook of Monetary Economics, Vol 3, pp 653-722.

² See M Friedman (1969), The optimum quantity of money and other essays; and ES Phelps (1973), Inflation in the theory of public finance, The Swedish Journal of Economics 75, pp 67-82, which discuss the effects of taxation on the optimal rate of inflation. According to the Friedman rule, under flexible prices, the opportunity cost of holding money should equal the marginal cost of creating money. The long-run optimal rate of inflation is therefore deflation equal to the real interest rate. This assumes lump-sum taxation. However, an “upward” deviation from the Friedman rule may actually be optimal if only distortionary taxation is available to finance public spending. For a list of further considerations, see A Diercks (2017), The reader’s guide to optimal monetary policy, mimeo; available at https://papers.ssrn.com/sol3/papers.cfm?abstract_id=2989237

³ A positive target rate of inflation may prove to be optimal if, for example, interest paid on debt is tax-deductible for firms with credit or debt constraints; see D Finocchiaro, G Lombardo, C Mendicino and P Weil (2018), Optimal inflation with corporate taxation and financial constraints, Journal of Monetary Economics, Vol 95, pp 18-31. Arguments to the contrary can be found in M Feldstein (1999), The costs and benefits of price stability, NBER Books, National Bureau of Economic Research, Inc. For information on the significance of inflation for the tax burden, see Deutsche Bundesbank, Return on private financial assets taking into account inflation and taxes, Monthly Report, July 2017, pp 69-75.

⁴ However, due to the absence of a harmonised valuation framework, it is not possible to simply cumulate the optimal rates resulting from the respective arguments in order to arrive at the optimal rate of inflation.

⁵ In 1995, a committee of experts in the United States tried to approximate the measurement errors made when recording US statistics; see also MJ Boskin, E Dulberger, R Gordon, Z Griliches and D Jorgenson (1996), Toward a more accurate measure of the cost of living, Final Report to the Senate Finance Committee, 4 December. They discovered that the measure of inflation overstates actual inflation by around 1.1 percentage points as a result of improvements in quality or substitution effects that have not been taken into consideration.

measurement errors.⁶ However, in monetary policy practice, the quantitative significance of measurement errors is now of minor importance only due to an improvement in statistical methods.⁷

- A positive average rate of inflation (adjusted for measurement errors) is also recommended to ensure more flexible labour market adjustments in the case of constraints stemming from “downward” rigidity in nominal wages. Empirical studies suggest that it is much more difficult to cut nominal wages than it is to raise wages.⁸ If, for instance, an adverse shock (for example, triggered by negative productivity growth), taken in isolation, advocates a reduction in real wages but nominal wages cannot be cut, the necessary wage adjustments in the labour market will be delayed, leading to an increase in unemployment and a loss of economic activity. By contrast, a positive average rate of inflation can make it easier to reduce real wages even in the absence of a decrease in nominal wages.
- Differing levels of productivity across firms can also justify positive target inflation rates. If there are sector-specific productivity growth rates (which is confirmed empirically on a regular basis), these generally also imply different sector-specific price trends.⁹ Such differences in productivity can also occur for the manufacture of new goods compared to those already existing on the market (“old” goods). New products (or products with substantial quality improvements) are often manufactured using state-of-the-art technology and this technology requires extended learning phases before efficiency gains can unfold over time. Once production has been switched over to the new technology, firms’ production costs initially rise

and these costs – as described in the main article – are passed on to consumers in the form of higher prices. This ultimately drives up the optimal rate of inflation.¹⁰ Therefore, when selecting its inflation target, the central bank should take account of the fact that, when taken in isolation, positive inflation induced by differences in productivity does

6 However, the mere fact that measurement errors exist is not necessarily significant when selecting the inflation target. From the point of view of optimal monetary policy, greater attention should be paid to whether prices subject to measurement errors are able to react relatively flexibly or not. If, for example, these prices react very flexibly, having a positive inflation target would mean adjusting those prices that are not subject to measurement errors, but associated with production inefficiencies, to the general price level. See also S Schmitt-Grohé and M Uribe (2012), On quality bias and inflation targets, *Journal of Monetary Economics*, Vol 59, Issue 4, pp 393-400.

7 For the quantitative significance of measurement errors for the United States, see DE Lebow and JB Rudd (2003), Measurement error in the consumer price index: where do we stand?, *Journal of Economic Literature*, Vol 41, pp 159-201. A corresponding analysis for the euro area and for Germany can be found in M Wynne (2005), An estimate of the measurement bias in the HICP, Working Paper 0509, Federal Reserve Bank of Dallas; as well as J Hoffmann, Problems of inflation measurement in Germany, Discussion Paper 1/98, Economic Research Group of the Deutsche Bundesbank.

8 See, inter alia, S Basu and CL House (2016), Allocative and remitted wages: new facts and challenges for Keynesian models, *Handbook of Macroeconomics*, Elsevier, Vol 2, pp 297-354; or J Tobin (1972), Inflation and unemployment, *American Economic Review*, Vol 62, pp 1-18.

9 For more information for the USA, see AL Wolman (2011), The optimal rate of inflation with trending relative prices, *Journal of Money, Credit and Banking*, Vol 43, Issue 2-3, pp 355-384.

10 Over the production lifecycle, the marginal costs of older goods decline on the scale by which production becomes more efficient due to the new technology. Firms take this into account in their pricing and thus set a lower price over the production cycle, which gives rise to adjustment costs, however. Yet as firms have to set prices in any case as part of the product substitution process, these costs (which are otherwise to be expected) do not need to be factored into the pricing of new goods. Therefore, a positive rate of inflation helps keep the relative prices of new vis-à-vis old goods in line with the production lifecycle and thus the respective cost development of the firms. Quantitative studies suggest that product substitution provides notable explanatory power for positive target rates of inflation. For more information, see K Adam and H Weber, Optimal trend inflation, Deutsche Bundesbank Discussion Paper, No 25/2017.

not necessarily have to be accompanied by production inefficiencies.¹¹

- Whereas monetary policy in a monetary union targets an average rate of inflation for the currency area as a whole, the member countries naturally have different national inflation rates. Such differences between country-specific inflation rates can be found when the business cycle is not synchronised across all member countries.¹² Those countries where economic activity is “more robust” than in the rest of the currency area tend to have higher inflation rates. Conversely, the countries where economic activity is slowing down tend to have lower rates of inflation. The inflation target for the monetary union as a whole should therefore be sufficient to protect those countries with below-average inflation rates from the threat of deflation. Even if

monetary policy cannot resolve prolonged or even permanent inflation differentials, the central bank should not hinder adjustments in the real economy by setting the inflation target too low.

¹¹ For the sake of simplicity, the main article, on the other hand, assumes firms have uniform productivity technologies. If all firms are equally productive, inflation results in production inefficiencies.

¹² For more information, see Z Enders, P Jung and G Müller (2013), Has the euro changed the business cycle?, *European Economic Review*, Vol 59, pp 189-211. In addition, the level of development may also vary across the member countries. As part of the convergence process, there is an increase in productivity and wages in the traded goods sector and subsequently in wages in the non-traded goods sector, too, which in turn puts pressure on the general price level. However, a number of studies indicate that this effect (called the Balassa-Samuelson effect) is not significant in the euro area. For more information, see B Égert (2011), Catching-up and inflation in Europe: Balassa-Samuelson, Engel’s Law and other culprits, *Economic Systems*, Vol 35, pp 208-229; as well as ECB, Monetary policy and inflation differentials in a heterogeneous currency area, *Monthly Bulletin*, May 2005, pp 65-82.

of price stability. Monetary policymakers therefore have to create confidence through credible policymaking in order to keep inflation expectations in line with their target. Therefore, the potential implications of a higher inflation target for the anchoring of inflation expectations are discussed.

Proposal of higher inflation target does not relate to the current situation of low inflation rates

In light of the low inflation rates at present and the at times hotly debated unconventional measures, the proposal to raise the monetary policy inflation target, which is shaping the international debate, may come as something of a surprise. Given the persistently low rate of price increase at present, it might – on the surface – seem the obvious thing to lower the inflation target rather than raise it. Tailoring the definition of the monetary policy target to prevailing circumstances would not only again be risking a loss of credibility; the ensuing debate about the advantages and disadvantages of raising the inflation target would also inevitably reflect those arguments which are relevant to

lowering it. Lowering the targeted rate of inflation would thus mainly increase the likelihood of a binding effective lower bound. A further point to consider is that such a fundamental change of monetary policy strategy should not be geared to the prevailing inflation environment. Rather, it calls for a comprehensive and self-contained appraisal of the relevant arguments.

The following remarks therefore focus on the call for raising the targeted rate of inflation that is under discussion in the international context.⁹ Given modern industrial countries’ limited experience of higher quantitative inflation tar-

Remarks do not represent a comprehensive analysis of the choice of inflation target

⁹ One argument that is frequently cited in the international debate as a justification for raising the target inflation rate is a potentially lower natural interest rate, as a result of which the effective lower bound, taken in isolation, would be binding more often; see K Holston, T Laubach and JC Williams (2017), Measuring the natural rate of interest: international trends and determinants, *Journal of International Economics*, Vol 108, pp 59-75; and Deutsche Bundesbank, The natural rate of interest, *Monthly Report*, October 2017, pp 27-42.

gets and their implications, conceptual and thus model-based considerations and analyses play a central role in the present article. Some simplifications have to be made so as to be able to study the interaction of the cited aspects in a model in a consistent manner. For instance, non-standard monetary policy measures are not considered, and the key interest rate is assumed to be the sole monetary policy instrument.¹⁰

■ The choice of inflation target

It is widely accepted that monetary policy should be geared in particular to achieving price stability. In the longer term, price stability is a fundamental prerequisite for the smooth functioning of the economy, for sustained economic growth and greater economic welfare.¹¹ Price stability makes it easier to distinguish relative price changes from changes in the general price level, which means that prices are better at signalling the relative scarcity of goods and services. This plays a significant part in economic decision-making, leading to resources being allocated to where they can be used most productively – and thus efficiently.

Price stability also has additional, welfare-enhancing effects. With stable inflation rates, creditors have no reason to demand significant inflation risk premiums to compensate for holding nominal long-term assets. The resulting, relatively lower interest rates increase the incentives for additional, growth-enhancing investment. Furthermore, firms can use their resources for productive purposes, rather than employing at least some of them for hedging inflation risks. Similarly, stable inflation rates reduce distorting effects in the nominal tax and transfer system that stem from a lack of indexation. Finally, stable price developments reduce an implicit (inflation) taxation of cash holdings as well as an arbitrary redistribution of nominal incomes and wealth. Altogether, it follows from such efficiency considerations that the inflation target should basically be 0% because

the welfare-enhancing effects of stable prices are then at their greatest.¹²

Owing to the efficiency gains associated with stable prices, the central banks of the industrial countries have made an explicit commitment to safeguarding price stability.¹³ Yet the quantitative inflation targets in a host of currency areas are not 0%, but around 2% (see the chart on page 38). One of the key reasons for this, as will be explained in more detail below, is to create a certain safety margin to guard against the risks of deflation.

The Governing Council of the ECB also targets a euro area inflation rate of below, but close to, 2% in the medium term.¹⁴ Strictly speaking, therefore, the Eurosystem has not defined an explicit number for the target inflation rate, but has set a range of inflation rates that the Governing Council deems compatible with its notion of price stability.¹⁵ This range does not rule out medium-term inflation rates of over 2% and a persistently falling price level – or, in other words, negative inflation rates.

The risk of deflation looms, in particular, when a general price drop becomes entrenched or

... but central banks in industrial countries typically set their inflation targets at over 0%

Good monetary policy characterised by price stability

Low interest rates are welfare-enhancing in many respects, ...

¹⁰ Especially at the effective lower bound, asset purchase programmes are one way of providing additional monetary policy stimuli. For more on this subject, see the Annual Report of the Deutsche Bundesbank for 1996 and Deutsche Bundesbank, Monthly Report, June 2016, op cit.

¹¹ Price stability does not mean, however, that individual prices remain stable, as these have to change in a market economy in order to be able to respond to developments in supply and demand. Such price signals constitute important information for consumers and producers, who coordinate their behaviour and help to create a balance between supply and demand.

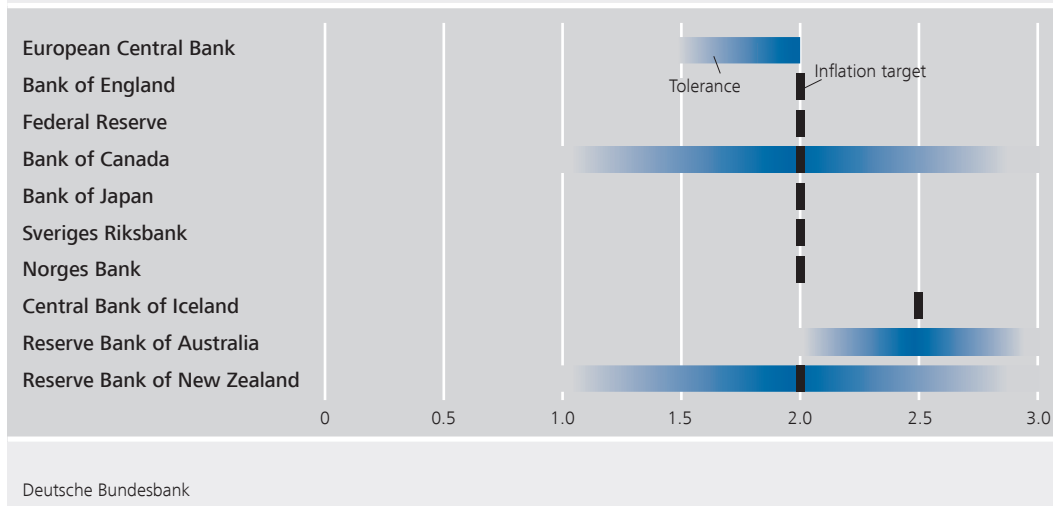
¹² This holds if it is assumed that the initial allocation is efficient to begin with. If it is not, the optimal inflation rate would not completely stabilise the relative prices, but would support the transition to an efficient allocation of resources; see, for example, T Yun (2005), Optimal monetary policy with relative price distortions, *American Economic Review*, 95, 89-109.

¹³ To an extent, the mandate of the Federal Reserve is one exception, as it gives the objective of maximum employment a prominent role alongside the objective of stable prices.

¹⁴ See ECB, press release of 8 June 2003, available at https://www.ecb.europa.eu/press/pr/date/2003/html/pr030508_2.en.html

¹⁵ For didactic reasons, however, the concept of a clear-cut target inflation rate will continue to be used.

Inflation targets of selected central banks



Safety margin owing to lower bound ...

even self-reinforcing because, for example, inflation expectations become unanchored on the downside. This kind of downward scenario could arise if monetary policy were to run out of effective instruments to counter such a development. In running monetary policy, central banks are faced with an effective lower bound on interest rates, which is often defined as 0% for the sake of simplicity but is actually likely to be lower; as a result, their remaining room for monetary policy manoeuvring shrinks, all other things being equal, as the policy rate drops.¹⁶ The lower bound therefore limits the scope to lower nominal (and hence real) interest rates, which means that once the effective lower bound has been reached, aggregate demand can no longer be stabilised sufficiently using the interest rate instrument.¹⁷ Although monetary policy can still intervene to provide stimulus, even at the lower bound, using alternative, non-standard measures, it is evident that a core stabilising instrument is lost once the effective lower bound has been reached.¹⁸ Thus, it is generally more difficult for a central bank to effectively prevent a persistent deflationary phase than to counter a sustained increase in the inflation rate by raising interest rates as appropriate. The effective lower bound therefore plays a role in the fact that monetary policy stabilisation ability is subject to asymmetry.

Compared with a target of 0%, a positive inflation target provides a wider safety margin to the lower bound thanks to the higher average nominal interest rate level it entails, and thus – taken in isolation – reduces the risk of deflation. Looking solely at the safety margin to the lower bound, this gives monetary policy broader scope for its stabilisation policy. How-

... can be widened by a higher inflation target

¹⁶ As economic agents always have the option of exchanging their deposits for cash, which has a 0% nominal interest rate, they may switch to hoarding cash when faced with negative nominal interest rates. However, the experiences of various central banks show that the effective lower bound is somewhat lower than 0%, because holding large quantities of cash also entails costs, such as the costs of storage or insurance. See Deutsche Bundesbank, Monetary policy indicators at the lower bound based on term structure models, Monthly Report, September 2017, pp 13-34.

¹⁷ The real interest rate is key to stabilising demand. When economic agents expect declining inflation or even deflation, the real interest rate rises when taken in isolation (via the Fisher equation), slowing down investment and growth. The central bank can lower the real interest rate by reducing the nominal interest rate. If it is unable to make further interest rate cuts at the effective lower bound, the real interest rate is ultimately determined, approximately, by inflation expectations. This can produce a deflationary spiral, because the expectation of deflation pushes up the real interest rate, which in turn reduces demand and hence the inflation rate, potentially causing deflation to become entrenched.

¹⁸ In addition, it is unclear how effective unconventional measures are, compared with the conventional interest rate instrument, and on what scale unwanted side effects may materialise. These include, for example, increasing overlap between monetary and fiscal policy, risks to the profitability of financial institutions, and excessive risk-taking. See Deutsche Bundesbank, Monthly Report, June 2016, op cit.

Conceptual considerations regarding the macroeconomic implications of different inflation targets

Firms take various aspects into account when setting their prices. Put simply, there are three factors which stand out.

- First, they incorporate the current economic environment and thus the (expected) demand for their goods into their calculations. If a firm opts to meet an increased demand for its goods, the production costs increase with each additional unit produced. Generally speaking, it will then seek to pass on these higher costs to the customers by raising the sales prices so as to maintain its profit-maximising margin.
- However, owing to adjustment costs and other factors, a firm will not immediately adjust its prices every time there is a fluctuation in demand. Once a price has been set, it will therefore normally be valid for a certain period of time.¹ Since firms act in a forward-looking manner, they will already take this time dimension of their profit calculation into account when setting their prices today. Product prices therefore also partly reflect future expected demand.²
- Lastly, general price developments – ie the level of the average inflation rate – play a pivotal role in choosing prices, as sales prices are not typically indexed to the inflation rate and thus the price (once set) erodes, in real terms, over time.³ Since not all firms adjust their prices with full flexibility in every period in response to fluctuations in demand, there are differences between the relative prices of individual firms.⁴

To sum up, a firm's price setting therefore depends on the current and expected de-

mand for its goods as well as on the expected inflation rate. Aggregating these microeconomic decisions results in the aggregate supply curve. This (New Keynesian) Phillips curve describes – from a macroeconomic perspective – the relationship between the current inflation rate, the current aggregate output gap⁵ and inflation expectations. In formal terms, the (log-linear) Phillips curve for positive target inflation is composed of an equation for describing the inflation rate

$$\begin{aligned}\hat{\pi}_t = & \lambda(\bar{\pi})\hat{Y}_t + b_1(\bar{\pi})E_t\hat{\pi}_{t+1} \\ & + \kappa(\bar{\pi})(\varphi\hat{s}_t \\ & + \zeta_t - (\varphi + 1)\hat{A}_t) \\ & + b_2(\bar{\pi})(\hat{Y}(1 - \sigma) - E_t\hat{\psi}_{t+1}),\end{aligned}$$

a law of motion for the marginal costs

$$\begin{aligned}\hat{\psi}_t = & (1 - \theta\beta\bar{\pi}^\epsilon) \\ & (\varphi\hat{s}_t + (\varphi + 1)(\hat{Y}_t - \hat{A}_t) + \zeta_t) \\ & + \theta\beta\bar{\pi}^\epsilon E_t(\hat{\psi}_{t+1} + \epsilon\hat{\pi}_{t+1})\end{aligned}$$

¹ This form of price stickiness contributes significantly to economic decisions being taken that lead to resources not being allocated to where they can be employed most productively – and thus efficiently.

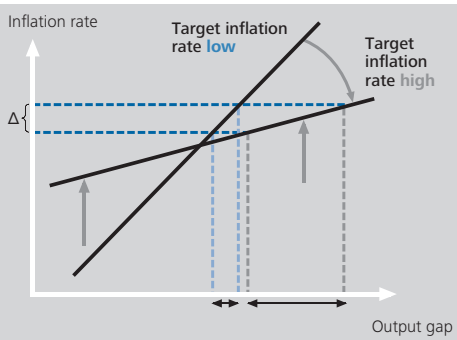
² It is usually assumed that economic agents do not make any systematic errors when forming their expectations and that they use all of the information that is available to them. They thus form their expectations in a rational and model-consistent manner.

³ Studies for the United States, for instance, indicate that prices are only incompletely indexed (if at all) to the average rate of inflation because they do not adjust in every period. See E Nakamura und J Steinsson (2008), Five facts about prices: a reevaluation of menu cost models, *The Quarterly Journal of Economics*, Vol 123(4), pp 1415-1464, and T Cogley and AM Sbordone (2008), Trend inflation, indexation, and inflation persistence in the New Keynesian Phillips curve, *American Economic Review*, Vol 98(5), pp 2101-2126.

⁴ This is due to the respective demand for the goods and to the technology employed.

⁵ The output gap is the difference between actual and potential economic output.

Relationship between Phillips curve and target inflation rate*



* Higher target inflation rate leads to shift and flattening of the Phillips curve. With a given change in the inflation rate, a flatter Phillips curve implies a bigger change in the output gap.
 Deutsche Bundesbank

and an equation for the dispersion of relative prices (price dispersion)

$$\hat{s}_t = \left[\frac{\epsilon \theta \bar{\pi}^\epsilon}{1 - \theta \bar{\pi}^\epsilon} (\bar{\pi} - 1) \right] \hat{\pi}_t + \theta \bar{\pi}^\epsilon \hat{s}_{t-1},$$

where \hat{Y}_t is output, $\hat{\pi}_t$ is the rate of inflation and \hat{s}_t is price dispersion, each relative to their respective equilibrium value.⁶ Furthermore, $\hat{\psi}_t$ represents the marginal costs and \hat{A}_t productivity, again relative to their long-term equilibrium values. Lastly, ζ_t represents an exogenous process (shock to the labour supply). The notation $x(\bar{\pi})$ makes it clear that individual parameters of the Phillips curve are directly dependent on the level of the target inflation rate. Both the position and the slope of the Phillips curve are therefore directly dependent on the level of the target inflation rate (see the chart above).

In the special case of an inflation target of zero ($\bar{\pi} = 0$), the three equations are reduced to a single equation:

$$\hat{\pi}_t = \lambda \hat{Y}_t + \beta E_t \hat{\pi}_{t+1} + \kappa (\zeta_t - (\varphi + 1) \hat{A}_t).$$

Given higher average inflation rates, it is especially the relative importance of the ex-

pected price level – and thus the expected inflation rate – that increases for firms when choosing their profit-maximising prices. The lack of price indexation means that the nominal sales price and thus the purchasing power of the nominal profits erode faster when the average rate of inflation is higher. Firms take the associated fall in the profit margin into account in their price-setting calculations and adjust their prices more strongly to compensate.⁷ This has two macroeconomic implications:

- First, the differences in relative prices between firms increase. The associated larger shifts in demand lead to adjustments in the volume of goods produced by the firms if not all firms are entirely flexible in adjusting their prices to fluctuations in demand.⁸ But these shifts in demand induced by price stickiness are accompanied by production inefficiencies.⁹ Such inefficiencies become even larger with higher rates of price increase, ie given a higher target inflation rate.

⁶ See G Ascari und AM Sbordone (2014), The macroeconomics of trend inflation, *Journal of Economic Literature*, Vol 52, pp 679-739.

⁷ This makes it harder for economic agents to distinguish relative price changes from changes in the general price level.

⁸ For the sake of simplicity, the literature normally posits a Calvo price-setting mechanism, assuming that, in each period, firms only have a given, exogenously determined, probability of being able to change the price of their product. Goods prices are therefore not perfectly flexible and are, to a certain degree, sticky. See GA Calvo (1983), Staggered contracts in a utility-maximizing framework, *Journal of Monetary Economics*, Vol 12, pp 383-398.

⁹ The literature mostly assumes a constant elasticity of substitution (CES) production function, according to which the end products are composed of a weighted mean of intermediate goods. In the prototypical new Keynesian framework it is assumed, for the sake of simplicity, that all firms have a uniform production technology. On grounds of efficiency, it is therefore optimal if all firms produce the same volume of goods. For more details, see, for example, S Schmitt-Grohé and M Uribe (2007), Optimal inflation stabilization in a medium-scale macroeconomic model, *Monetary policy under inflation targeting*, pp 125-186.

– Second, in relative terms demand becomes less important for firms' price setting, as they now give a stronger weighting to the inflation path. This means that when the target inflation rate is higher, the current output gap loses some of its importance as a determinant of the inflation rate, making the Phillips curve, figuratively speaking, flatter (see the chart on page 40).

These two implications of a higher target inflation make it harder for monetary policymakers to stabilise the economy and thus ensure price stability because it is ultimately through its effect on aggregate demand that monetary policy influences the inflation rate.¹⁰ With a higher target inflation rate, the Phillips curve is flatter and aggregate demand, taken in isolation, is accordingly less important as a determinant of price developments. As a result, the price adjustment in the wake of an interest rate hike is less pronounced. In line with this, in the event of an economic downturn, a cut in interest rates has less of an effect on aggregate demand than it would if the inflation rate were lower. Or, to put it another way, in order to bring about a necessary change or desired correction to the inflation rate, larger changes to the monetary policy interest rate are required. But when major interest rate adjustments become necessary, the zero lower bound, taken in isolation, narrows monetary policymakers' room for manoeuvre.¹¹

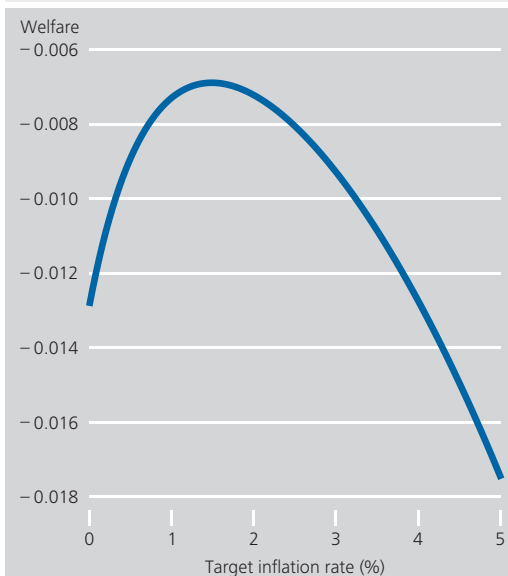
We can conclude from the discussion above that it is *a priori* not absolutely certain that the room for manoeuvre created by a higher target inflation rate actually helps to improve monetary policy's capacities for stabilisation. Once the inflation rate target reaches a certain level, the increased room for manoeuvre associated with a larger safety margin to the lower interest rate

bound can actually backfire – not just because of the greater interest rate adjustments that become necessary, but also, and in particular, on account of the increasing price dispersion that comes with a higher target inflation rate and which is a crucial factor in economic decisions being taken that lead to resources not being allocated to where they can be employed most productively.

10 This is why the inflation rate falls following a rise in interest rates: the associated dampening of economic activity prompts firms to raise their prices less sharply so as to boost demand for their products.

11 Too small an adjustment of interest rates heightens the risk of self-fulfilling expectations and – linked to this – multiple equilibrium paths. These arise if, for example, a rise in inflation expectations that is not justified by the fundamentals leads to a rise in the actual inflation rate on account of an inadequate monetary policy response so that the original expectations are "validated" *ex post*. In this sense, inflation expectations are then no longer firmly anchored. In the prototypical version of the new Keynesian model, the Taylor principle is a sufficient criterion for ruling out such self-fulfilling expectations. See R Clarida, J Gali und M Gertler (2000), Monetary policy rules and macroeconomic stability: evidence and some theory, *The Quarterly Journal of Economics*, Vol 115(1), pp 147-180. This does not necessarily hold true with higher target inflation rates because the flatter Phillips curve means that a given interest rates move will have less of an impact on the actual inflation rate. To offset the reduced effectiveness of a given interest rate impulse and thus ensure stability, the central bank thus has to adjust its monetary policy rule and take more decisive interest rate measures. For more details, see G Ascari und T Ropele (2009), Trend inflation, Taylor principle, and indeterminacy, *Journal of Money, Credit and Banking*, Vol 41, pp 1557-1584, examining the occurrence of self-fulfilling expectations depending on the monetary policy response for different target inflation rates. Nevertheless, even when the monetary policy response is adjusted specifically in the case of (model) uncertainty, the risk of inflation expectations becoming unanchored fundamentally continues to exist. See also TA Lubik and C Matthes (2016), Indeterminacy and learning: an analysis of monetary policy in the Great Inflation, *Journal of Monetary Economics*, Vol 82, pp 85-106.

Cost-benefit trade-off of higher inflation targets



Source: Bundesbank chart based on Coibion, Gorodnichenko and Wieland (2012), The optimal inflation rate in New Keynesian models: should central banks raise their inflation targets in light of the zero lower bound?, *Review of Economic Studies* 79, pp 1371-1406. The blue line shows welfare for a stylised model economy dependent on the target inflation rate. As such, the target inflation rate that would maximise welfare is a little below 2%.

Deutsche Bundesbank

ever, these are not the only possible implications of a higher inflation target. Amongst other things, the level of an inflation target, and thus the average rate of price increase, influences the price-setting behaviour of firms and consequently the monetary policy transmission process (see the box on pages 39 to 41).

Target inflation rate – a trade-off decision

Inflation target is the outcome of a trade-off

Thus far, this article has outlined why, on the one hand, an inflation rate of 0% results in the greatest possible allocative efficiency given the existing considerations. On the other hand, the lower bound restricts monetary policy's ability to stabilise the economy, especially when the use of unconventional monetary policy measures (as assumed so far) is not taken into account. In principle, a higher inflation target can therefore provide greater leeway. Thus, a positive target inflation rate not only gives rise to

costs (in the sense of the aforementioned production inefficiencies), but also brings a benefit in the form of a reduced risk of deflation.

As such, the choice of an appropriate target inflation rate can ultimately be seen as the outcome of a trade-off. To examine this kind of trade-off process in greater depth, relevant model analyses have to be conducted, in which different inflation targets and their macroeconomic effects can be compared.¹⁹ The adjacent chart shows what this trade-off might look like, based on costs in the form of production inefficiencies (caused by nominal rigidities and associated price dispersion) and the benefit in the form of a greater safety margin to the lower bound. The result is an optimal target inflation rate in low positive territory, typically around the 2% mark.

The case for low positive target inflation rates despite a binding lower bound is ultimately founded in the fact that, at least until the financial crisis, the lower bound was historically a rather rare and relatively short-lived phenomenon.²⁰ Even though this means that a period with a binding lower bound entails sizeable economic costs in principle, the permanent efficiency gains of low inflation rates outweigh these on average.

Experience gained during the financial crisis has shown, however, that the lower bound can be binding for long periods – longer than was considered realistic or plausible before the crisis.²¹ In turn, the duration of a binding lower

Increase beyond 2%?

¹⁹ In most cases, a New Keynesian model is used, which has become standard in monetary policy analysis. Further information about the New Keynesian model can be found in the following sources, amongst others: Deutsche Bundesbank, Development and application of DSGE models for the German economy, Monthly Report, July 2008, pp 31-46; and widely used textbooks such as J Gali (2015), *Monetary Policy, Inflation, and the Business Cycle*, Princeton University Press, 2nd edition; or CE Walsh (2017), *Monetary Theory and Policy*, 4th edition, MIT Press.

²⁰ Coibion et al (2012), for example, assume in their baseline scenario a binding lower bound of three years, because at the time of publication the lower bound was binding for three years in the United States.

²¹ The euro area has been at the effective lower bound since 2014, for instance.

bound affects the trade-off, as less room for monetary policy manoeuvring due to a longer binding lower bound is associated with greater macroeconomic costs.²² On its own, a longer average episode of a binding lower bound might therefore suggest that it could make sense to raise the inflation target.

This kind of isolated analysis neglects two key aspects, however. First, the greater scope for action created by a higher inflation target is simultaneously limited because the higher inflation target makes it necessary for a stronger interest policy response to safeguard price stability. Furthermore, higher target inflation rates entail stronger distortions (see the box on pages 39 to 41). In the terminology of the New Keynesian model, a higher inflation target is said to “shift” the Phillips curve of the economy (making it “flatter”) and distortions caused by higher price dispersion increase. As these aspects gain in importance, the argument of greater room for manoeuvre becomes less persuasive.

A second aspect that is often neglected in the cost-benefit trade-off concerns the key role of inflation expectations. Higher target inflation rates mean higher inflation expectations. Whether these actually remain anchored at the new level when the target inflation rate is raised is not apparent, however. But since the firm anchoring of inflation expectations is central from a monetary policy perspective, the risk of inflation expectations potentially becoming unanchored due to higher target inflation rates is subsequently pushed to the foreground.

The possible risk of an unanchoring of inflation expectations

Economic agents’ inflation expectations play a prominent role for monetary policy because expectations affect the setting of wages and prices by the individual economic agents and are thus themselves an important determinant of the path of inflation. If inflation expectations

are not firmly anchored, it is harder to stabilise the inflation rate. In a worst-case scenario, the central bank would fail to achieve its inflation target even in the medium term.

As will be shown below, a higher inflation target can increase the probability of inflation expectations becoming unanchored and, in extreme cases, result in them being inconsistent with the central bank’s new target even in the long term.²³

Whether or not inflation expectations become unanchored, which is to say that they deviate from the target inflation rate over the long term, crucially hinges on how these expectations are formed. Therefore, the first thing to consider is how expectations are formed (and thus, ultimately, how to model them).²⁴ Using these considerations in the New Keynesian analytical framework, it is possible to illustrate the costs of a higher target inflation rate which could arise if doubts materialise over the credibility of monetary policy.

How expectations are formed largely determines how expectations can be influenced, ...

Risk of inflation expectations becoming unanchored is often neglected

Inflation expectations a key variable for monetary policy

²² Two studies – M Dordal-i-Carreras, O Coibion, Y Gorodnichenko and J Wieland (2016), Infrequent but long-lived zero lower bound episodes and the optimal rate of inflation, *Annual Review of Economics*, Vol 8, pp 497-520; and K Lansing (2017), Endogenous regime switching near the zero lower bound, Federal Reserve Bank of San Francisco Working Paper No 2017-24 – consider a longer binding lower bound than Coibion et al (2012), although the methodological implementation of each approach differs. Both studies show that a longer duration implies a higher optimal inflation rate, as expected.

²³ Influential monetary policymakers have voiced such fears, including Ben Bernanke, although he put this down to the loss of credibility caused by changing the inflation target. This could arise because central banks had invested a great deal of time in anchoring inflation expectations at 2%. Even if the target was raised only moderately from 2% to 4%, he feared that this could raise doubts about the credibility of a stated inflation target. Economic agents might ask themselves why, if the target can be hiked to 4%, it could not also be hiked to 6%. Bernanke felt that this kind of scenario would hinder the effective steering of inflation expectations. See B S Bernanke, The economic outlook and monetary policy, Speech at the Federal Reserve Bank of Kansas City Economic Symposium, Jackson Hole, Wyoming, 27 August 2010, Board of Governors of the Federal Reserve System.

²⁴ These considerations are confined to the conceptual level since the leading central banks of the industrial countries only aim for low inflation rates. There are no target inflation rates in the order of, say, 4% or more, rendering it effectively impossible to make estimates based on empirical findings.

Generally, economic agents can form their inflation expectations by various ways and means. For example, they could form their expectations in a forward-looking way based on all information available to them. In doing so, they are ideally aware of the underlying macroeconomic relationships (including all the relevant probability distributions) and can form their expectations on this basis, without making systematic errors – in this sense, they behave “rationally”. Given rational expectations, a credible central bank is able to effectively steer the inflation expectations of economic agents by announcing its monetary policy strategy. To the economic agents, the level of the inflation target forms part of the available information to be factored into the formation of their expectations. A key condition for the effective steering of these expectations is the credibility of the central bank.²⁵ If these conditions are met and assuming there is no binding lower bound,²⁶ inflation expectations formed in a rational way will normally match the central bank’s inflation target over the long term and, in this sense, will always be firmly anchored.²⁷

... whether expectations can become unanchored, ...

However, rational expectations are a textbook case of expectations formation that is unlikely to predominate in practice. For one thing, it would appear doubtful whether economic agents do indeed have all the relevant information about macroeconomic relationships (eg owing to the cost of procuring information). In practice, therefore, expectations are likely to be formed in different ways. For instance, economic agents might base their expectations more on past events. It is precisely because they only have incomplete information that they rely more heavily on past economic developments for guidance so they can only form a picture of the economic correlations in this way. In economic theory, this type of expectations formation can be described using the adaptive learning approach.²⁸ According to this approach, a new, higher inflation target will not be fully factored into the formation of inflation expectations at first, but needs to be “learned” over time from the observed inflation

rates. As will be discussed below, it is then generally possible for economic agents to form inflation expectations that are not consistent with the central bank’s inflation target in the long term, meaning that they are effectively unanchored.²⁹

If economic agents increasingly base their expectations on past observations, the central bank must first have implemented its decisions so that these decisions, along with their impact, become “visible” and thus learnable for

... and how effective monetary policy measures are

25 See, for example, the discussion in R Clarida, J Galí and M Gertler (1999), The science of monetary policy: a New Keynesian perspective, *Journal of Economic Literature*, Vol 37(4), pp 1661-1707 on optimal monetary policy with commitment and under discretion. Based on a New Keynesian model, the authors show that credibility gives monetary policy the ability to effectively “accommodate” exogenous shocks over a longer period. Where there is a lack of credibility, shocks lead to stronger economic losses.

26 Additionally, a “suboptimal” monetary policy is disregarded, which, under the assumption of rational expectations, can go hand in hand with the existence of multiple equilibria.

27 Accordingly, a situation in which economic agents do not believe in the long-term inflation target and where their inflation expectations do not match the central bank’s inflation target over the long term – which is to say, inflation expectations are unanchored – is incompatible with the concept of rational expectations.

28 This approach typically assumes that although the agents are generally familiar with the structure of the economy, they are not aware of its underlying structural parameters. See GW Evans and S Honkapohja (2001), *Learning and expectations in macroeconomics*, Princeton University Press; and S Eusepi and B Preston (2018), The science of monetary policy: an imperfect knowledge perspective, *Journal of Economic Literature*, 56 (1), pp 3-59.

29 In this context, it is assumed that the economic agents behave like econometricians, basing their forecasts on the perceived law of motion (PLM), which (in the simplest case) has the same structure as the minimal state variable (MSV) solution that can be derived under the assumption of rational expectations (see: BT McCallum (1983), On non-uniqueness in rational expectations models: an attempt at perspective, *Journal of Monetary Economics*, 11(2), pp 139-168). Using this approach, they forecast the future path of inflation based on existing observations. In each period for which additional data become available, the agents review their forecast model and modify it accordingly in order to form their expectations for the next period.

the economic agents.³⁰ As a result, the central bank can no longer influence the path of inflation directly by steering inflation expectations, but only “indirectly” via its impact on macro-economic developments.

Because adaptive learning means that central bank announcements of changes to monetary policy strategy – such as the communication of a higher target inflation rate – can no longer directly influence the formation of inflation expectations and thus the current inflation rate, the inflation expectations of learning economic agents will tend to respond less dynamically than under rational expectations. In this way the effectiveness of conventional monetary policy measures is reduced.³¹

Higher target inflation rate increases the risk of unanchoring ...

Beyond the hypothesis of learning agents, a higher target inflation rate changes the stabilisation capacities of monetary policy because the Phillips curve – as outlined above in the context of rational expectations – flattens given a higher average rate of inflation (see the box on pages 39 to 41).³² Since, under the adaptive learning approach, monetary policy interest rate stimuli only have an effect on the inflation rate via developments in the overall economy, but economic activity has less of an impact on the current path of inflation when the target inflation rate is higher and the Phillips curve is flatter, the effectiveness of the conventional interest rate instrument on the inflation rate decreases when target inflation rates are higher. And when the central bank can exert less influence on the actual path of inflation, this raises the risk of inflation expectations becoming unanchored.³³ This becomes a particular risk if, when the actual inflation rate deviates from the inflation target, the monetary policy interest rate response is not strong enough to steer the inflation rate back towards the inflation target via a corresponding change in the real interest rate. Absent sufficient stabilisation, inflation expectations could then diverge from the inflation target over the long run as well, leaving them unanchored in a

30 Under the learning approach, in each period, agents update the coefficients of the PLM, (typically) by estimating and updating them using the recursive least squares method. They learn from past (forecasting) errors by comparing their forecast with newly added observations in order to obtain a new (improved) forecast. Individual approaches often differ when it comes to the weighting of new data for the purpose of determining the coefficients of the PLM. In the decreasing gain algorithm, all observations are given the same weighting, meaning that the information gain from a new observation decreases relative to the previous observations. By contrast, in the constant gain algorithm, past observations are discounted, meaning that the information gain from a new observation remains constant in comparison to the previous observations. Furthermore, the underlying structure of the learning process, too, can adapt over time; see, for example, J Arifovic, S Schmitt-Grohé and M Uribe (2018), Learning to live in a liquidity trap, *Journal of Economic Dynamics and Control*, 89, pp 120-136; F Buseti, D Delle Monache, A Gerali and A Locarno (2017), Trust, but verify. De-anchoring of inflation expectations under learning and heterogeneity, ECB Working Paper (No 1994); or C Carvalho, S Eusepi, E Moench and B Preston (2017), Anchored inflation expectations, mimeo, accessed on 14 May 2018 at: https://papers.ssrn.com/sol3/papers.cfm?abstract_id=3018198

31 Here, as in the following remarks, the lower bound is disregarded for the sake of simplicity.

32 The following information is based on the anticipated utility approach, in which subjective decisions are made under the assumption that the subjective expectations do not change, even though they are in effect renewed in each period. The explicit inclusion of a potential revision of future expectations would be reflected in today's decision by way of the associated uncertainty. In more complex model structures, however, it would be very difficult as things stand, if not impossible, to implement an approach such as this. However, highly simplified models can be used to show that the anticipated utility approach is a fairly good approximation. See, for example, T Cogley and TJ Sargent (2008), Anticipated utility and rational expectations as approximations of Bayesian decision making, *International Economic Review*, 49(1), pp 185-221; and S Eusepi and B Preston (2018), The science of monetary policy: an imperfect knowledge perspective, *Journal of Economic Literature*, 56 (1), pp 3-59.

33 The type of unanchoring very much depends on the underlying assumed formation of expectations. In the case of rational expectations, unanchoring is characterised by the emergence of self-fulfilling expectations. Given that economic agents nonetheless tend to act rationally and thus continue to regard the structure of the economy (as well as the inflation target) as plausible, they will bring their expectations (in the context of a local analysis) into line with the inflation target over the long term. By contrast, according to the adaptive learning approach, inflation expectations formed on the basis of forecasting are compared to the inflation target in the long term. Only if the expectations match the target inflation rate (to a sufficient degree) will inflation expectations be considered to be anchored.

sense.³⁴ As a result, then, it would be possible for inflation expectations to still be anchored given a low inflation target, but for a higher target rate of inflation – for a given monetary policy rule – to cause this anchoring to be lost because of the associated reduced effectiveness of the interest rate stimulus.

... if monetary policymakers do not respond more aggressively to inflation

To still generally be able to steer the inflation rate in the “right direction” when the inflation target is higher, and thus prevent inflation expectations from becoming unanchored, the central bank will therefore need to adapt its monetary policy response. For the sake of simplicity, this is formulated in the following as a prototypical Taylor rule. This rule describes how monetary policymakers set the nominal interest rate \hat{i}_t (as a deviation from the long-term equilibrium) depending on changes in the real economic situation \hat{y}_t (typically in the form of the output gap) and the deviation of the inflation rate from the inflation target ($\hat{\pi}_t = \pi_t - \bar{\pi}$):

$$\hat{i}_t = \phi_\pi \hat{\pi}_t + \phi_y \hat{y}_t$$

where ϕ_π and ϕ_y represent the respective monetary policy response coefficients. Since both response coefficients are greater than 0 (consistent with the literature), the interest rate rises if, for example, the inflation rate is higher than the target value ($\hat{\pi}_t > 0$). If the target inflation rate $\bar{\pi}$ rises, the central bank, prompted by the change in firms’ price-setting behaviour and the flatter Phillips curve this creates, has to respond more “aggressively” to deviations of the inflation rate from the inflation target and select a higher ϕ_π accordingly.³⁵ Therefore, it can prevent the inflation rate from potentially drifting away from the target by making larger interest rate moves.³⁶ Furthermore, when the target inflation rate is higher, it should smooth any fluctuations in macroeconomic developments more gently and select a lower ϕ_y accordingly.³⁷ An adjustment like this would, in principle, allow the central bank to steer the inflation rate effectively even if a higher target rate of inflation has been set.³⁸

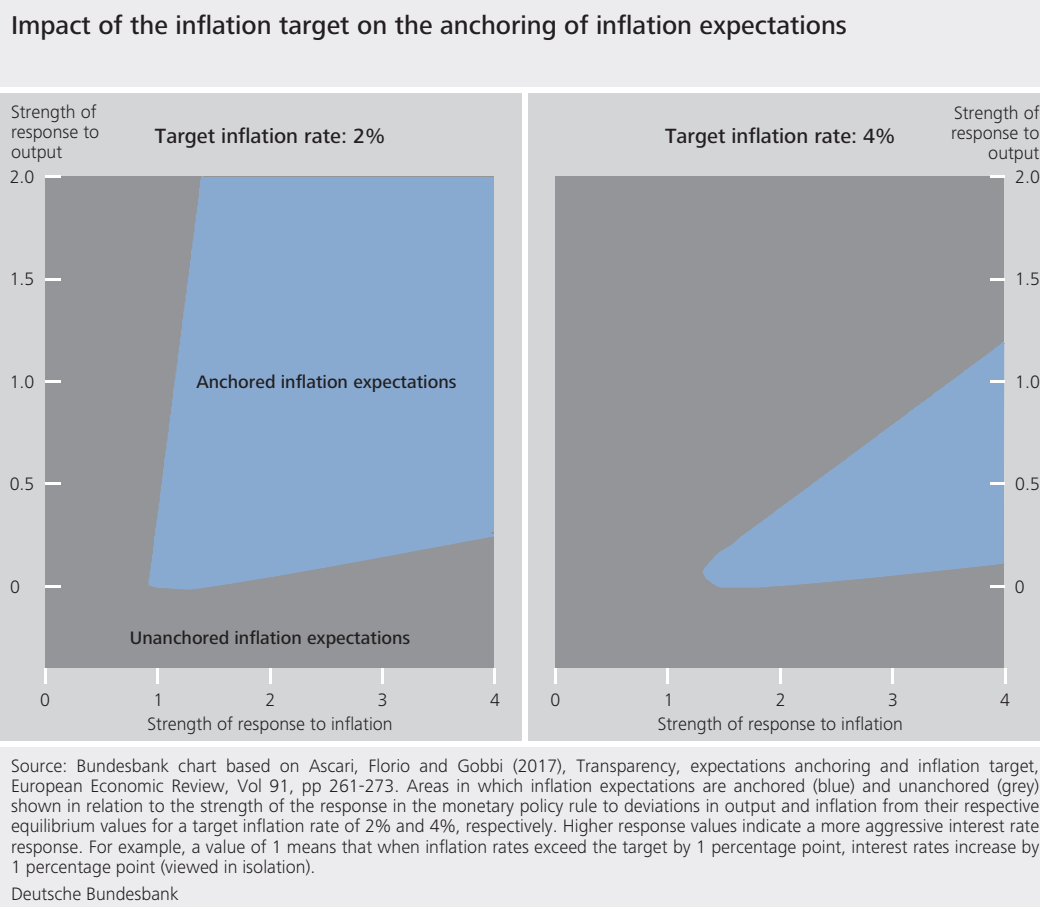
34 In the learning approach, the actual law of motion (ALM) is created once the agents have formed their subjective expectations (using their forecasting model, the PLM) and made their decisions on this basis. The ALM therefore describes the stochastic process which the economy follows if expectations are formed on the basis of the PLM. The ALM is thus dependent on the PLM. The estimated coefficients of the PLM produce the coefficients of the ALM, which depend on the estimated parameters themselves as well as other model parameters (that are unknown to agents) such as the inflation target. This process, from the estimated coefficients of the PLM to the resulting coefficients of the ALM, can be interpreted as a mathematical mapping process known as the “T-map”. The condition for a stable equilibrium (“e-stability”) is met whenever the MSV solution is a fixed point of the T-map because this means that the equilibrium under rational expectations is learnable in the long term and thus stable.

35 If price stability is interpreted as meaning zero inflation, the Taylor principle, which states that adjustments to nominal interest rates should be greater than the divergence of the inflation rate from the inflation target, is a sufficient criterion for macroeconomic stability when viewed from a rational expectations perspective. With a positive inflation target, this no longer applies because higher accompanying inflation rates diminish the effectiveness of conventional interest rate moves. Given a monetary policy rule, then, an increase in nominal interest rates according to the Taylor principle might no longer be sufficient, for example, to prevent an unexpected rise in the inflation rate: the Taylor principle would therefore effectively be “too weak” if the target inflation rate were positive. Hence the need, when the target inflation rate is positive, for the central bank to adjust the nominal interest rate more aggressively than suggested by the Taylor principle, ie the response coefficient to deviations in the inflation rate from the inflation target needs to be greater. See O Coibion and Y Gorodnichenko (2011), Monetary policy, trend inflation and the great moderation: an alternative interpretation, American Economic Review, Vol 101, pp 341-370.

36 Frequent and more pronounced interest rate fluctuations are associated with an increased likelihood of reaching the lower bound, which is linked *per se* to losses in stability and therefore welfare losses. In addition, high levels of interest rate volatility will probably prevent households from making (optimal) consumption and savings decisions. As a rule, monetary policymakers should therefore look to avoid unnecessary interest rate volatility and aim for a certain degree of continuity (referred to as “history dependence”); see M Woodford (2001), The Taylor rule and optimal monetary policy, American Economic Review, Papers and Proceedings, 91(2), pp 232-237.

37 Intuitively, the central bank will attempt to prevent economic variables diverging from the target value by making a more aggressive interest rate response. Because monetary policy can only steer the inflation rate via macroeconomic developments in the context of adaptive learning, it would be counterproductive to smooth the business cycle aggressively because this would run counter to its influence on inflation. See G Ascari, A Florio and A Gobbi (2017), Transparency, expectations anchoring and inflation target, European Economic Review, Vol 91, pp 261-273.

38 However, if a lower bound were explicitly included (it having been excluded owing to methodological complexity), stabilisation could be complicated or, at worst, be prevented altogether if the central bank can no longer cut interest rates strongly enough and if unconventional measures are disregarded.



The risk of inflation expectations becoming unanchored due to a higher target inflation rate and the resulting adjustment that would need to be made to monetary policy strategy can be illustrated graphically (see the chart above). Here, based on the New Keynesian model, different monetary policy rules are compared which differ from each other in terms of how strongly they respond to changes in output (plotted on the vertical axis) and inflation (plotted on the horizontal axis). The area is coloured blue where a given monetary policy rule is sufficient to anchor inflation expectations under otherwise identical economic conditions, otherwise it is grey. One can see that the area in which expectations are anchored shrinks significantly when a target inflation rate of 4%, say, is assumed, rather than 2%. This is due to the more aggressive response to changes in the inflation rate (shift in strength of response to the right), which is necessary for anchoring when there is a higher target rate of inflation, and the less aggressive response to output

(shift in strength of response downwards). Even though the area of anchored expectations does not disappear altogether in this illustration, the central bank is exposed to the risk that its monetary policy response may be insufficient for anchoring in light of the existing (model) uncertainty, which would be depicted in the chart by the fact that it would no longer be possible to clearly identify the outlines of each area.³⁹

³⁹ The areas are affected by the choice of assumed monetary policy rule, its coefficients and by the structure of the model economy (including the model parameters). The central bank therefore cannot mechanically ensure anchoring by choosing a specific response. See also TA Lubik and C Matthes (2016), Indeterminacy and learning: an analysis of monetary policy in the great inflation, *Journal of Monetary Economics*, Vol 82, pp 85-106. In this paper, the authors trace the cause of the volatile growth in the United States in the 1970s and 1980s back to an insufficient monetary policy response due to model uncertainty, amongst other factors.

The role of communication and transition to a new inflation target

Even good (transparent) communication cannot rule out potential unanchoring of inflation rates

So far in this article, it has been assumed that the learning economic agents (initially) do not believe the central bank's communication to be credible and that, for that very reason alone, the higher target inflation rate does not have a direct impact on inflation expectations. However, a transparency-enhancing approach to communication could generally help forge a deeper understanding of monetary policy, especially in a situation where economic agents have no more than incomplete information on macroeconomic relationships. This ought to have a positive impact on the anchoring of inflation expectations.⁴⁰

Ideally, credible communication would be able to prevent the risk of inflation expectations potentially becoming unanchored.⁴¹ Model simulations carried out in this regard do indeed point to the beneficial role which communication plays in anchoring inflation expectations because it enhances the effectiveness of monetary policy, all other things being equal.⁴² Communicating additional (beneficial) information on the aims and strategy of monetary policymakers thus makes it easier to steer inflation on its path towards the inflation target.⁴³ This does not eliminate the risk of unanchoring altogether, however. This is again due to the mechanism described above, which, by flattening the Phillips curve, persists in curbing the central bank's stabilisation capacities in spite of the transparency. As a result, the costs of higher target inflation rates remain even if communication is more intensive.

Credibility at risk if inflation is not anchored to new target in time

Thus far, this article has confined itself to comparing situations in which target inflation rates differ over the long term – that is to say, explicit consideration has not yet been given to the transition from a low inflation target to a higher one (eg from 2% to 4%). Model calculations on this topic show that this kind of transition may unintentionally result in high inflation

rates.⁴⁴ These analyses point to the risk that an increase in the inflation target may cause inflation expectations to diverge very persistently from the new inflation target, accompanied by periods of very high inflation that exceed the inflation target. However, the longer a period of divergent inflation rates persists, the more likely it will be that the central bank's credibility will suffer. This would reduce the effectiveness of monetary policy stabilisation measures still further and again increase the risk of unanchoring.

⁴⁰ Transparent and "good" communication generally helps a central bank to stabilise aggregate demand. Explicit announcements by central banks regarding their monetary policy objectives and strategy can reduce uncertainty in the economy, increase the credibility of central banks and thus make it easier to anchor inflation expectations. See CJ Erceg and AT Levin (2003), Imperfect credibility and inflation persistence, *Journal of Monetary Economics*, Vol 50(4), pp 915-944.

⁴¹ See, in particular, L Ball (2014), The case for a long-run inflation target of four percent, *IMF Working Papers* 14/92.

⁴² See G Ascari, A Florio and A Gobbi (2017), Transparency, expectations anchoring and inflation target, *European Economic Review*, Vol 91, pp 261-273. This study presents two distinct scenarios with respect to the degree of transparency. In the first, the economic agents are unaware of the monetary policy response function, meaning they also have to draw up an interest rate forecast as well as an output and inflation forecast. In the second (transparent) scenario, the central bank reveals its response function, meaning there is no need for an interest rate forecast. This reduces (forecast) uncertainty, and the central bank increases its influence on the path of inflation.

⁴³ Since, in the assumed context, economic agents have incomplete information about the economy, they still have to forecast the macroeconomic impact on inflation and output caused by monetary policy interest rate stimuli, even if they do in fact have knowledge of these stimuli. The criterion of anchoring is then only met, however, once inflation expectations match the inflation target over the long run.

⁴⁴ See WA Branch and GW Evans (2017), Unstable inflation targets, *Journal of Money, Credit and Banking*, Vol 49(4), pp 767-806. The authors assume an increase in the inflation target from 2% to 4%. As the private sector initially has incomplete information about the new target level or the central bank's commitment to the new target, it has to "learn" the inflation target based on past outcomes. After the central bank has announced that it will raise its target, it conducts an interest policy conducive to raising inflation to the new target level. Over time, the higher inflation rate is also reflected in the private sector's inflation forecasts, though the agents (falsely) assume that the target will continue to be adjusted upwards. This assumption materialises when the inflation rate rises far beyond the target to as high as 8% before ultimately converging towards the desired inflation rate of 4%, as originally intended.

■ Additional considerations

Conclusive assessment not yet possible because, inter alia, ...

Calls to raise the inflation target can only be classified and assessed on the basis of a comprehensive and detailed cost-benefit analysis. Most of the analyses available consider only some aspects, however, such as comparing the efficient allocation of resources when inflation is low with the greater room for manoeuvre for monetary policymakers given the lower bound when inflation is higher, or they focus on the risk of unanchoring without, however, explicitly taking the lower bound into account.⁴⁵ One major hurdle, then, is the lack of a uniform analytical framework that covers all aspects, including the benefits and drawbacks, simultaneously, thus facilitating a comprehensive assessment along these lines. Since the effects of a higher inflation target that have been outlined are, to a large extent, based solely on selected, albeit important, factors, there should also be a final brief discussion of other aspects that have not been afforded explicit consideration in this article so far.

... most commonly assumed price-setting models are not beyond dispute, ...

As explained above, positive inflation rates are accompanied by production inefficiencies, the extent of which, however, is affected by firms' price-setting behaviour.⁴⁶ If the model simulations generally assume a higher degree of price flexibility given greater volatility in demand or a higher average rate of inflation, firms will adjust their prices more quickly and more frequently.⁴⁷ This reduces the differences in relative prices in the economy caused by a positive inflation rate, reducing the intensity of inefficient shifts in demand since firms make adjustments not only to quantities but to prices as well. Therefore, when prices are adjusted more frequently, it is generally possible to reduce the production inefficiencies caused by higher inflation rates on average. Taken by itself, this would, in principle, suggest that the optimal inflation target is higher.

Another caveat that should be borne in mind when considering the points made thus far is that this article assumes that central banks

have a narrow set of policy tools focused exclusively on short-term interest rates. As a result, once policy rates have reached the effective lower bound, monetary policy cannot provide further stabilising impetus. In reality, however, central banks have responded in a variety of ways at the lower bound, stabilising aggregate growth not least by using unconventional monetary policy measures. These include both the asset purchase programmes and long-term refinancing operations. Fraught with long-term risks and hotly debated though these measures are, they do put the significance of the lower bound into perspective when viewed in isolation and thus reduce the need for a higher inflation target.

Furthermore, the improvements to financial regulation initiated during the crisis and the introduction of a new policy area (specifically, macroprudential policy) ought to have diminished the likelihood of future financial crises and thus the probability of reaching the lower bound, which alone reduces the need to increase the inflation target still further.

In addition to the aforementioned reasons worth considering in the trade-off surrounding a target inflation rate, there are still more factors which could gainsay any increase in the inflation target. For example, surveys suggest that the public generally do not favour exces-

... unconventional monetary policy measures are disregarded, ...

... and public aversion to high inflation rates remains ignored

⁴⁵ For example, in Coibion et al (2012), anchoring is always guaranteed in the long and short term because they assume rational expectations and exclude multiple equilibria.

⁴⁶ In the literature, the Calvo pricing model has emerged as the standard method for describing price stickiness. There are good reasons to doubt the plausibility of this type of model, however, because it assumes, for example, that firms lack the possibility to adjust their prices more frequently when inflation is higher. Thus far, this article has assumed that the intervals between a firm's price adjustments when inflation is positive are exactly the same as when inflation is zero.

⁴⁷ Menu cost models, for example, imply a more frequent adjustment of prices. See E Nakamura, J Steinsson, P Sun and D Villar (2017), The elusive costs of inflation: price dispersion during the U.S. great inflation, Quarterly Journal of Economics, forthcoming. However, this type of pricing has thus far attracted little coverage in the literature, and in particular there has not been sufficient analysis of the issue of unanchoring in this context.

sively high inflation rates.⁴⁸ The welfare costs of higher inflation will be underestimated inasmuch as this aversion is not fully considered in the trade-off, which may result in a tendency to set a low inflation target, all other things being equal.

■ Conclusion

It therefore seems premature to question the inflation target in principle

The issue of setting a higher inflation target as a lesson learned from post-financial crisis developments, in particular the stubborn persistence of policy rates at the effective lower bound, has sparked international debate on whether the monetary policy consensus from before the financial crisis is still appropriate. This debate has often brought forth calls to raise the inflation target as a lesson from the crisis.

Monetary policy inflation targets are essentially the outcome of a complex trade-off. Though they are not laws of nature, they do constitute key elements of monetary policy strategy which are ultimately crucial for the credibility of monetary policy. Viewed from this angle, there would need to be a very strong rationale for

changing the inflation target. This article illustrates that proponents of a higher inflation target commonly neglect to consider that this diminishes the effectiveness of monetary policy (because it flattens the Phillips curve) and that, in addition, more attention ought to be paid to the question of monetary policy credibility and the risk of inflation expectations becoming unanchored. Both of these points tend to suggest that a higher target rate of inflation will come with additional costs.

As a final point, considering that there are still further trade-offs that cannot be adequately factored into this model framework – such as public inflation aversion and unconventional monetary policy instruments at the effective lower bound – which suggest it would not be wise to set higher inflation targets, the arguments put forward for raising medium-term rates of price increase as a monetary policy objective are incomplete and unconvincing.

⁴⁸ See RJ Schiller (1996), Why do people dislike inflation?, in C Romer and D Romer, eds, Reducing inflation: motivation and strategy, National Bureau of Economic Research and University of Chicago Press.