



BANK OF ENGLAND

Speech

The elusive supply potential: monetary policy in times of uncertainty

Speech given by

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Glasgow

7 March 2019

The views are not necessarily those of the Bank of England or the Monetary Policy Committee. I would like to thank Oliver Ashtari Tafti, Michael McLeay and Manveer Sokhi for their help producing this speech. I would also like to thank Ben Broadbent, Nikola Dacic, Jonathan Haskel, Lizzie Levett, Clare Macallan, Marko Melolinn, Kate Reinold, Michael Saunders, Michal Stelmach, Matt Swannell, Jan Vlieghe and Boromeus Wanengkirtyo for helpful comments and contributions.

Thank you very much for the opportunity to speak today. It is a pleasure to be here in Glasgow to give a talk in a city with such a rich tradition in economics.

My topic today is the UK economy's supply potential. The MPC has just published our collective view on the topic following our annual supply stocktake.¹ I also described my own views on one aspect of supply – productivity – in a speech last year.

Today I will set out how I think about supply in general and how it shapes my outlook for monetary policy in particular. I will then give an update on how I see the evolution of supply and inflation since the EU referendum in 2016.

Looking ahead, the UK's withdrawal from the EU is clearly the overriding event on the horizon.

The MPC has emphasised that the policy response to Brexit will depend on the balance between supply and demand, as well as the response of the exchange rate.² Some of my colleagues on the MPC have recently spoken about the factors underlying currently weak demand.³ Here I will try to elaborate on the supply side of the equation, before explaining how I will judge the balance between supply and demand in real time.

I will make four main points:

- Potential supply is always uncertain, but it has become more so since the financial crisis. Adding to this, depending on the nature of EU withdrawal, Brexit may materially affect supply.
- As supply becomes more uncertain, the price data, stripped of external influences such as the exchange rate, become more important in helping me determine the balance of supply and demand. In turn, this informs me how we should adjust monetary policy to meet our inflation target.
- The recent softening in measures of underlying price inflation suggests to me that supply has been growing broadly in line with demand, and that we may still have some excess supply remaining.
- In the event of a disorderly EU withdrawal, falls in the exchange rate or increases in tariffs or non-tariff costs could all temporarily increase headline inflation. Measures of core inflation will be particularly useful in informing me how supply and demand are evolving in real time, helping assess any short-run trade-off we may face between headline inflation and output volatility.

Before discussing these points in detail, I will first step back and explain how I think about potential supply.

¹ See the February 2019 *Inflation Report*.

² In the February 2019 MPC minutes, for example.

³ Carney (2019) and Vlieghe (2019).

Supply and the stars

What are we talking about when we discuss supply? In our communications, we often use the informal analogy of the economy's *speed limit*: how fast the economy can grow without overheating.⁴

The idea is that our resources are limited. To give a concrete example, if a company wants to produce extra goods or services to sell, it can perhaps hire some extra workers or ask its existing workers to work longer hours. But for the economy as a whole, the number of workers is necessarily limited by the number of people available to work. And there are only so many hours in each day.

Potential supply is the amount of goods and services that can be produced when these resources are fully utilised. It is often variously described as the economy's supply capacity, the natural rate of output, or simply aggregate supply.

The concept of supply is so important in our models and our thinking that it is often given its own label, denoted by * or 'star'. So while demand or actual output is usually represented by the letter Y, potential supply is represented by Y*, or Y star.

It is our job as MPC members to keep inflation in line with our 2% target. Over time, inflation is determined by the balance between supply and demand, and hence we aim to keep the economy's demand for goods and services growing broadly in line with supply: to keep Y in line with Y*. If demand is too great, wages and prices will be bid up and inflation will ensue; too weak and inflation will fall below our 2% target. The gap between Y and Y* is known as the output gap or excess demand. Its negative is the spare capacity.

When we change interest rates, our aim is to influence households' and companies' demand to roughly match potential supply. By contrast, supply is largely unaffected by the stance of monetary policy. It is instead determined by factors like the level of technology; the size and skills of the labour force; the quantity and quality of the capital used in production; and the degree of openness of the economy.

Keeping demand equal to supply is not straightforward, however, since supply is not something we can observe in the data. While national statistics agencies are able to track demand as the amount produced and consumed, the supply potential is an abstract, counterfactual construct. It is how much *would* be produced if resources were not over- or underutilised.

We can and do look at a range of evidence to assess how structural changes might be affecting the supply side of the economy.⁵ But ultimately, we will only know that we have managed to set demand equal to supply if we observe stable inflation over time. Indeed, one general definition of potential output or Y* is the level of

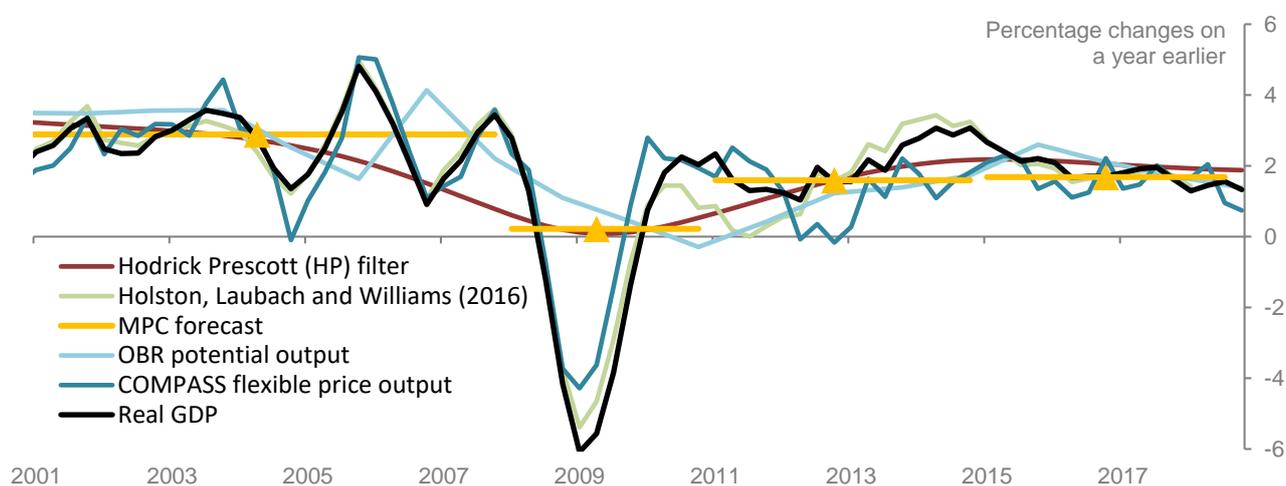
⁴ The Bank of England's [Knowledge Bank](#) resource provides a simple introduction to this idea.

⁵ Berry *et al* (2015) discuss the different components of labour supply, for example.

output for which inflation is equal to expected inflation.⁶ If we are doing our job properly and inflation expectations remain anchored at the target, then output at potential will mean inflation at its 2% target.

There are, however, lots of different precise definitions of aggregate supply. **Chart 1** shows estimates of Y^* calculated using a range of different methods. Each takes as a starting point the raw GDP data and uses a different set of assumptions to strip out some movements that are attributed to demand. At one extreme, purely statistical methods (HP filter in the red line) do so based on whether changes in GDP are transitory (so more likely to be demand) or persistent (more likely to be supply). At the other extreme, COMPASS (blue), the Bank's main DSGE model, conceives of potential very specifically as the level of output that would prevail in a hypothetical world where all prices and wages were completely flexible. It uses the data on a wide set of real-world variables to construct the most likely path for this hypothetical value.

Chart 1: GDP and different estimates of potential output



Sources: Federal Reserve Bank of San Francisco, Holston, Laubach and Williams (2016), OBR, ONS and Bank calculations.

Notes: MPC lines show average growth rates over a number of years in the MPC's February 2019 forecast: see February 2019 *Inflation Report* for details. Holston-Laubach-Williams and COMPASS estimates are more volatile than the other estimates partly because they are different concepts of potential supply: they are estimates of the level of output that would bring inflation to target over a relatively short horizon (in the absence of trade-off inducing shocks). The other estimates are longer-run concepts.

An analogous concept to a star version of supply is also applied to other variables, especially unemployment (U^*) and the (real) interest rate (r^*) – often known as the natural rates of unemployment and interest.⁷ Again, precise definitions vary. But loosely speaking, they are the rates of unemployment and the real interest rate consistent with inflation being at target after a period of time, as long as inflation expectations are anchored.

As with potential supply, we typically think of the other star variables as being unaffected by monetary policy. While monetary policy affects the actual rates of unemployment, interest and output – the stars are tied down

⁶ Phelps (1967).

⁷ Chronologically, the natural rate of interest came first, conceived by Swedish economist Knut Wicksell in the 19th century, before being reformulated as the natural rate of unemployment by Milton Friedman in 1967.

by more structural factors. By moving around unemployment, the interest rate, or demand – monetary policy moves the gaps between those variables and their star counterparts.

Following the stars

A key question for monetary policymakers is how closely we should be guided by the stars.⁸ Our remit requires us to target 2% CPI inflation, and we believe we have a good understanding of how to use monetary policy to steer inflation towards that target. And I have argued that if we are doing our job properly then inflation at target will mean output equal to its potential, at least in the long run. So what are the benefits from also watching the stars?

There are at least two important reasons the MPC might wish to pay attention to estimates of potential supply; in other words, why we might desire to follow the stars.

(i) Timeliness

First, the consensus view has long been that it takes some time for monetary policy to have its full effect.⁹ In the jargon, there were ‘long and variable lags’ between changing interest rates and their effect on the economy. A common teaching analogy is that setting monetary policy is like steering a large ship, where the captain must start steering to avoid any obstacles long before she sees them.

The stars help with this by providing an early warning. If the output gap between demand and potential supply today provides an accurate signal about future inflation, then we as MPC members might want to react quickly, rather than waiting until excess demand feeds through to inflation. If not, we risk being too late, or worse, injecting additional volatility into the economy by responding to shocks and events that have already run their course.

Timeliness is an important concern. There is some evidence, however, that acting slightly later may be less costly than it once was. For the UK at least, some of the latest empirical findings suggest that monetary policy may affect inflation more quickly than it did in the past.¹⁰

Chart 2 shows some recent estimates of the effect of interest rate ‘shocks’ on inflation, constructed using only data covering the (pre-crisis) inflation targeting era in the UK (from 1992 to 2007). The peak impact of interest rate changes on annual inflation comes in the first 18 months (red line), with an initial impact within the first year. This compares to a slower response when estimating including data from the earlier era (blue line). These estimates themselves are highly uncertain – the effect of monetary policy is difficult to

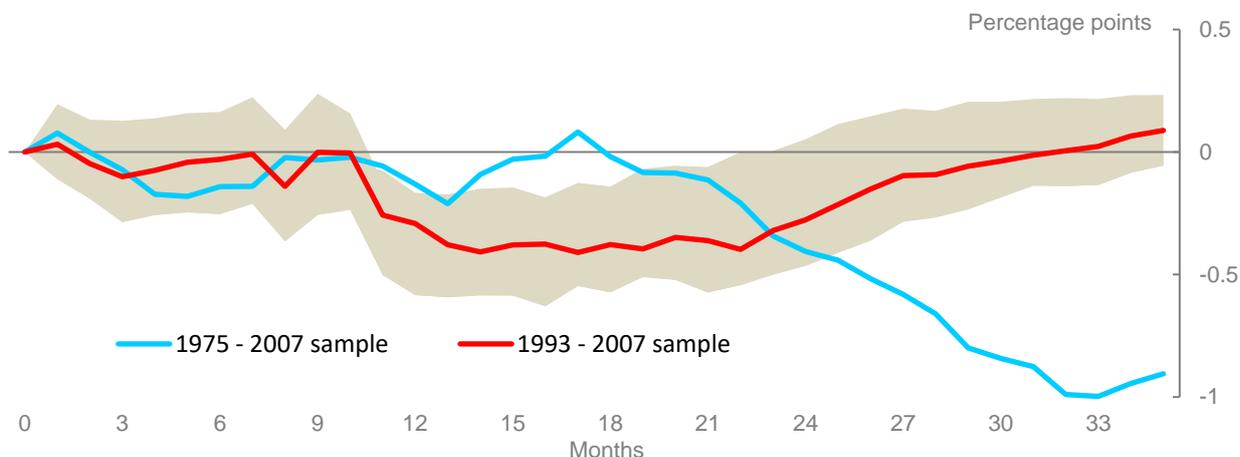
⁸ See Powell (2018) for a discussion of this question for the United States.

⁹ Friedman (1961).

¹⁰ Here I show results from Cloyne and Hürtgen (2016), but similar findings about the speed of transmission emerge in the study by Ellis, Mumtaz and Zabczyk (2014), although differently, they find a larger effect on inflation in the inflation-targeting era.

disentangle from other factors.¹¹ But taken at face value, they suggest that we may have scope to be cautious in responding to imprecise estimates of supply and the output gap.

Chart 2: Response of annual CPI inflation to a monetary policy shock (Cloyne and Hürtgen, 2016)



Source: Cloyne and Hürtgen (2016).

Notes: Impulse responses to a one percentage point contractionary monetary policy shock. The shaded area shows 68 percent confidence intervals for the response estimated using the 1993 – 2007 sample. See Cloyne and Hürtgen (2016, Figure 6) for more details.

(ii) Monetary policy trade-offs

Second, the MPC's remit also requires us to avoid undesirable volatility in output and employment. In normal circumstances, achieving these secondary goals should be equivalent to our primary mandate to target 2% CPI inflation. By setting interest rates that keep demand close to potential supply, or $Y=Y^*$, we should also minimise any movements in inflation away from target. The 'early warning' argument then becomes the main reason why one might wish to follow the stars.

However, our remit also sets out that there may be exceptional circumstances when shocks to the economy create a large or persistent trade-off between achieving the inflation target and our other objectives. In those circumstances we are required to strike a balance between the competing goals. To do that, we need to make an assessment of potential supply or Y^* ,¹² so that we can identify which changes in output are 'undesirable' in the sense that they lead to an output gap, and what the appropriate MPC response is to balance that output gap with any deviation of inflation from target.

The MPC faced such exceptional circumstances following the EU referendum in 2016. The vote triggered a large fall in sterling, which led to a material and persistent increase in imported inflation over the subsequent

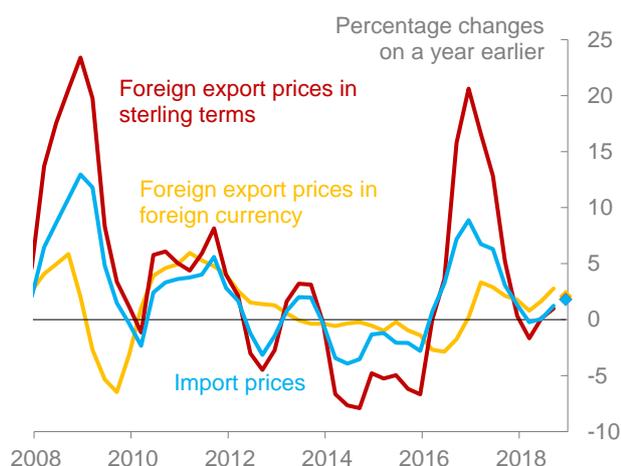
¹¹ Moreover, the average effect of monetary policy shocks may differ from the effect of regular, systematic changes in monetary policy. It is also possible that the way interest rates affect inflation has changed in the period since the financial crisis, but so far we only have a limited sample of *actual* Bank Rate changes since 2009.

¹² Following a long tradition in economics, Carney (2017) explains how the MPC's remit can be represented by a simple 'loss function' each period of the form $Loss_t = (\pi_t - \pi^*)^2 + \lambda(y_t - y_t^*)^2$ that balances the squared inflation deviations from target ($\pi_t - \pi^*$) with the squared output gap between demand and potential supply ($y_t - y_t^*$).

period. Tightening policy to keep inflation at target over 2017-18 would have led to greater excess supply and slower employment growth.

The pass-through of the fall in sterling is now nearing completion. Import price inflation has fallen sharply since 2016 (**Chart 3**), while the impact of higher import prices on the more import-intensive components of the CPI basket has waned since 2017 (**Chart 4**). Consequently, the MPC is now in a situation where we face only a very limited trade-off.

Chart 3: Import prices



Sources: ONS and Bank calculations.

Notes: Foreign export prices in foreign currency defined as domestic currency non-oil export prices of goods and services of 51 countries weighted according to their shares in UK imports. The sample excludes major oil exporters. Foreign export prices in sterling terms are defined as domestic currency non-oil export prices divided by the sterling effective exchange rate. Import prices are defined as UK goods and services import deflator excluding fuels and the impact of MTIC fraud. The diamonds show the MPC's February 2019 *Inflation Report* forecast for 2018 Q4.

Chart 4: CPI inflation by import intensity



Sources: ONS and Bank calculations.

Notes: Higher import-intensive and lower import-intensive CPI components comprise the top half and bottom half respectively of CPI components by weight ordered by import intensity. Data exclude fuel and administered and regulated prices and are adjusted by Bank staff for changes in the rate of VAT, although there is uncertainty around the precise impact of those changes. Import intensities are ONS estimates of the percentage total contribution of imports to final household consumption by COICOP class, based on the *United Kingdom Input-Output Analytical Tables 2014*.

The problem with the stars: uncertain potential supply

While perhaps more timely, the key drawback of using the stars as the basis for monetary policy is that they are inherently uncertain. Potential supply is unobservable, so estimates of the gap between demand and potential supply will always be just that: estimates. Indeed, one quote aptly describes one of the star variables as 'an abstraction; like faith, it is seen by its works'.¹³

This uncertainty means that estimates of the stars are model-specific. As illustrated in **Chart 1**, different models will give you different answers. Estimates will vary depending on the precise concept of Y^* being used; how quickly supply is thought to change over time and how quickly changes in the output gap are

¹³ Orphanides and Williams (2002) quoting Williams (1931).

thought to affect inflation. Moreover, even *the same* model will often give you a different estimate after the fact than it would in real-time, as it takes on information from subsequent data outturns and revisions.

Unfortunately, estimating potential supply in the UK has become even more difficult in the decade and a bit since the financial crisis began. There has been a slowing in the growth rate of labour productivity, of which a part has been either permanent or very long-lasting.¹⁴ But the extent to which productivity growth will recover and the timing over when that will happen has been a source of persistent forecasting errors since the crisis.

Uncertainty also dims the usefulness of the other star variables. The labour market appears to have changed since the crisis in ways that have made the natural rate of unemployment, U^* , more uncertain.¹⁵ Despite unemployment falling to its lowest rate in over 40 years, wages were at first slow to pick up. Various explanations have been proposed, including greater labour market flexibility; capital- labour substitution; increases in desired labour supply; changes in the tax and benefit system; and higher underemployment.¹⁶

Over the past year and a half, labour costs have started to pick up more in line with our expectations. In our February 2019 *Inflation Report* the MPC's collective judgement was that the level of U^* remained at 4¼%, as we had judged a year ago. I share that central case, but would put large standard errors around the estimate. And the natural rate is not set in stone. The current estimate has been reduced twice from the 5% rate used in MPC forecasts before 2017.

If the natural rate of unemployment can be described as uncertain, that is doubly the case for the other components of labour supply. Detailed analysis of demographic trends, microeconomic survey data and statistical filtering techniques all help to inform the MPC's collective estimates of the trend growth rates of average hours worked and labour force participation. But these estimates all come with substantial uncertainty attached, which is compounded when we combine them to produce an overall estimate of aggregate supply.

Moreover, labour is not the only input in production. Tangible and intangible capital, intermediate imported inputs and the efficiency with which various inputs are combined all affect the productive capacity of the economy.¹⁷ Compared to labour, there is even greater difficulty in measuring these inputs and estimating how they combine to affect overall supply.

¹⁴ See Tenreyro (2018) for my view on this slowdown.

¹⁵ In the absence of significant uncertainty over the natural rate of unemployment, placing more weight on unemployment as a measure of slack can help differentiate between changes in aggregate demand and supply. Broadbent (2013) sets out this logic in detail: at times when demand is growing more strongly than workers' productivity, companies can only produce extra output by increasing employment, which typically pushes down on the unemployment rate. By contrast, if demand is growing broadly in line with improvements in underlying productivity, then firms can satisfy that extra demand without increasing hiring and the unemployment rate may not fall. These properties were also one motivation for the MPC's forward guidance policy in 2013, which linked the possibility of future Bank Rate changes to the unemployment rate.

¹⁶ See Saunders (2017).

¹⁷ See Haskel and Westlake (2017) on the importance of intangible capital to the economy.

Crucially, assessing the supply side of the economy will become even more difficult as a result of the UK's departure from the EU. Reductions in openness and labour-market mismatches may drag on supply as the adjustment to a new arrangement takes place.¹⁸ While such effects are usually gradual, under some scenarios supply could fall more sharply. A disorderly withdrawal could lead to supply chain disruptions that would create a more rapid adjustment. It would then become extremely difficult to separate demand and supply in real time.

The solution: focusing on (core) inflation

Uncertainty over potential supply has arguably increased since the financial crisis, and is likely to do so further as a result of the UK's EU withdrawal. But its unknowability is by no means a new problem for monetary policy. One leading hypothesis for the high inflation rates of the 1970s is that monetary policymakers underestimated the natural rate of unemployment and therefore overestimated potential supply.^{19,20}

Faced with supply uncertainty, the traditional solution is to focus our attention squarely back on CPI inflation. Unlike the other equilibrium variables, the 'star' rate of inflation is never uncertain. It is given to us in our remit and is 2% at all times.

Indeed, one interpretation of the MPC's remit is that the primacy it gives to the inflation target is due to the uncertainty over supply.²¹ Over a long enough time horizon our inflation and output goals should be entirely equivalent, as long as inflation expectations remain consistent with the target. Any apparent conflict between the different goals would then simply imply that our estimates of potential supply needed to be reassessed.

The strategy of focusing more on inflation when there is structural uncertainty is backed up by more formal analysis. A general and intuitive result in the academic literature on monetary policy is that when uncertainty about a particular variable increases, we as policymakers should place less weight on it in our interest rate decisions.²² This point has been made forcefully in a series of papers by Athanasios Orphanides and John Williams. They have shown that when policymakers are more uncertain about U^* , they should place more weight on the inflation data when setting policy.²³ To be clear, this does not imply caring any less about the

¹⁸ See the November 2018 *Inflation Report*.

¹⁹ See Nelson and Nikolov (2004) for the UK and Orphanides (2003) for the United States.

²⁰ Uncertainty over the natural rate of unemployment was one factor that led Friedman (1968) to recommend monetary policy should focus on stabilising money growth rates rather than a measure of the output gap.

²¹ Bean (2003).

²² Swanson (2004).

²³ See Orphanides and Williams (2007). More recently, Erceg *et al* (2018) have shown that the general advice is not universally true, by setting out reasons why *at the current juncture* in the United States, better outcomes could be achieved by placing a large weight on uncertain output gap arguments. But it is not clear that those specific circumstances translate to the UK at present. Moreover, focusing more on inflation is not the only solution to uncertainty about the stars. Although the level of potential supply is uncertain, we think it is usually quite slow-moving. As a result, Orphanides and Williams (2002) have advocated that we can infer how the output gap is changing from the change in the unemployment rate over a short period of time, since the star variables are likely to be little changed at that frequency. That information can help us decide whether interest rates should be rising or falling to bring inflation to target. While the unemployment rate has fallen over the past two years, it has been flat over the past two quarters. So at present, an Orphanides and Williams (2002) *change* rule would be invariant to the weight placed on the change in the unemployment rate.

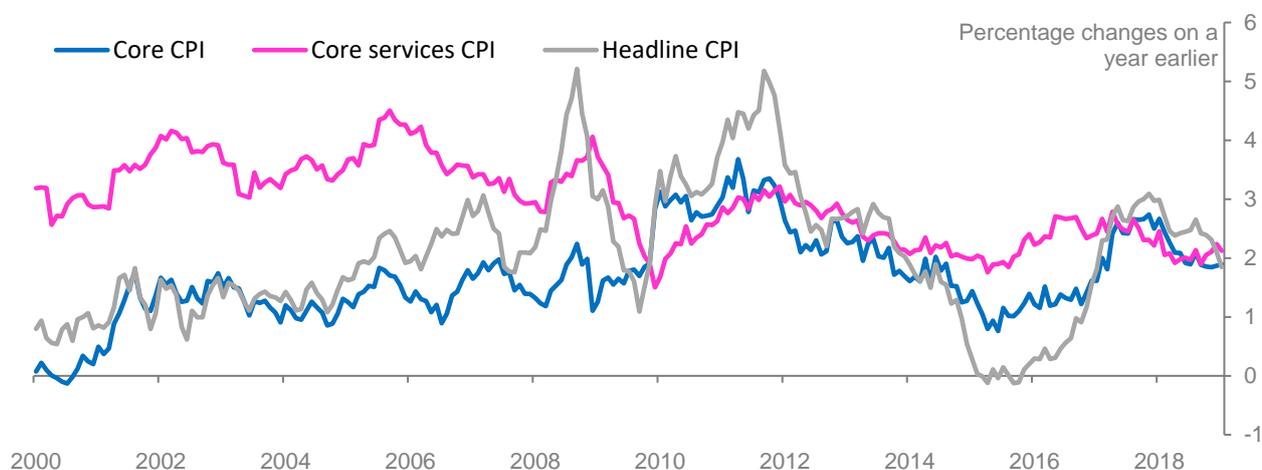
output gap between demand and supply. It is simply that when supply is uncertain, focusing more on inflation becomes a more effective strategy in trying to close that gap.²⁴

Focusing more on the inflation data essentially places more weight on certainty relative to timeliness.²⁵ Weighing up these pros and cons is a difficult balance for policymakers. But for me, with the economy's supply potential particularly uncertain, and evidence that policy transmission may be faster than in the past, the balance shifts towards paying more attention to the observable inflation data.

We also face an extra complication when various shocks move inflation and the output gap in opposite directions. The large fall in sterling following the referendum was an example of such a shock, as higher import prices pushed up on CPI inflation for a given level of demand relative to supply. Further rises or falls in the exchange rate, or even the imposition of tariffs, are examples that could occur in future, depending on the precise nature of EU withdrawal.

Using inflation to infer the balance between demand and supply becomes more difficult in the face of such shocks, but not impossible. Rather than doing so using headline CPI inflation, we typically focus more on various measures of domestically generated inflation (DGI) that try to strip out the effects of external influences such as energy prices and the exchange rate.²⁶

Chart 5: Measures of headline and core CPI inflation



Sources: ONS and Bank calculations.

Notes: Core CPI is CPI excluding food, energy, alcohol, tobacco and non-alcoholic beverages. Core services CPI excludes airfares, package holidays, education and VAT; Bank staff have adjusted for VAT changes but there is uncertainty over their precise impact.

²⁴ Swanson (2004) makes clear this distinction by explaining how the optimal monetary policy is certainty equivalent, in that uncertainty does not change the relative weight placed in the policymaker's *best estimate* of the output gap. But when the output gap is more uncertain, then the inflation data become a more important signal in informing that estimate.

²⁵ Broadbent (2014) discusses this trade-off between information and timeliness in the face of supply uncertainty in the context of choosing how much weight to place on labour market data, relative to *more* timely output data.

²⁶ Focusing on measures of DGI is not costless, since it introduces uncertainty over their relationship with headline CPI inflation. Trends in the relative prices of goods and services can influence the target-consistent rates of DGI, while there is also uncertainty over how much estimates of DGI are still affected by exchange-rate pass through. It will therefore always be essential for MPC members to continue to look at a wide range of indicators to understand how the economy is evolving.

These measures of DGI have been important indicators of demand relative to supply in the period since the 2016 referendum. **Chart 5** illustrates the rise and fall of inflation alongside measures of core inflation and core services inflation. Core inflation excludes volatile components that are less related to domestic demand such as food and energy prices. But many core goods are still strongly influenced by changes in the exchange-rate, so we often focus on only those in the services subset of the CPI basket: core services inflation, which is largely domestically produced. Relative to some other (labour-cost based) measures of domestic inflation, core services inflation has the advantage that it also captures the influences on inflation of non-labour costs and mark-ups over those costs.²⁷

Why have price inflation pressures weakened?

Both core goods and core services inflation fell over 2017 and 2018, and by more than I had initially expected. In the first half of 2018, the effect of that fall on headline inflation was masked by unanticipated increases in energy prices, such that overall inflation came in only slightly below our forecasts. As oil prices have fallen back and energy price pressures have dissipated, the relative softness in core inflation is more salient in the last data outturns for headline CPI inflation, which stood at 1.8% in January.

The upcoming increase in Ofgem's energy-price cap should lead to some further volatility in headline inflation over the next few months. But for me, the behaviour of core inflation, and particularly core services inflation, is likely to be telling us more about the balance of supply and demand over the recent past.

The MPC's best collective judgement, published in our February 2019 *IR*, is that demand and supply are currently broadly balanced. The fall in core services inflation suggests to me that there may be risks to that estimate. Taking the inflation data in isolation, one could infer that the output gap remains negative, and may even have been widening over the past eighteen months.

One does not take any single data series in isolation, of course. And the behaviour of core services inflation seems to be somewhat at odds with labour-market based measures of domestic inflationary pressures, which have been steadily increasing since mid-2017 (**Chart 6**).

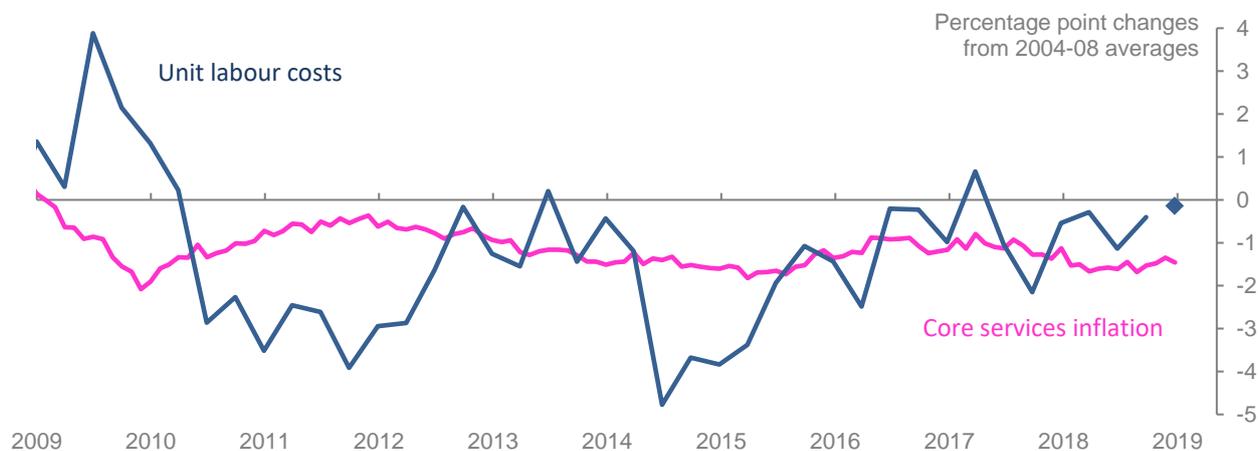
Why have measures of core inflation been weak when wage growth has been strengthening?

To some extent, falls in core inflation can reflect developments in import prices, but I do not think that this is the whole story. Since I joined the committee, we have been forecasting that the temporary effect of higher import prices on inflation would diminish and wage pressures would gradually pick up. By and large, this dynamic has come to pass, and explains much of the fall in inflation in core goods since 2017, since their

²⁷ It is far from straightforward to determine empirically which of these indicators is best able to forecast future inflation. In my own work (McLeay and Tenreyro, 2018), I discuss how monetary policy may blur any Phillips curve forecasting relationship between slack and CPI inflation, but not necessarily with wage inflation, which is not an explicit policy target.

production is quite import intensive. But it is harder to appeal to imports to explain weak inflation in core services, which are largely domestically produced.

Chart 6: Labour cost and inflation-based measures of domestically generated inflation



Sources: ONS and Bank calculations.

Notes: Core services CPI data are monthly and unit labour cost data are quarterly. Core services CPI excludes airfares, package holidays, education and VAT; Bank staff have adjusted for the rate of VAT but there is uncertainty around the precise impact of those changes. Unit labour costs are whole-economy labour costs divided by real GDP, based on Bank staff backcast of the final estimate of GDP. Diamond for 2018 Q4 is estimated by assuming self-employment income grows in line with employee compensation.

I would instead focus on two candidate explanations. First, the weakness in core services inflation may just be another part of the economy's adjustment to the vote to leave the EU in 2016. Second, there may have been a reduction in the price mark-ups that firms wish to charge on their products, or equivalently, as I will come on to explain, stronger underlying productivity.

(i) Relative price adjustment to the decision to leave the EU

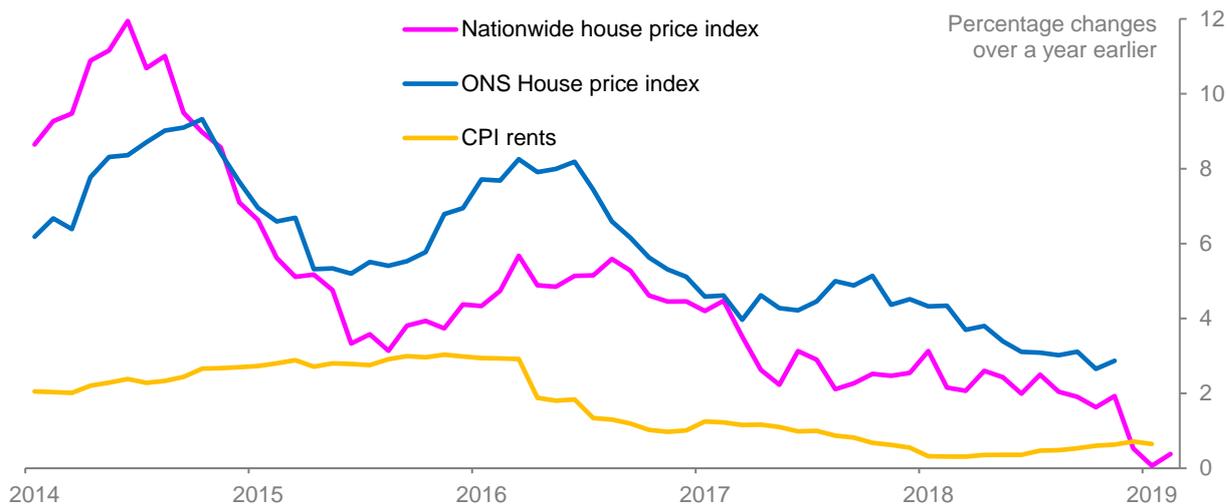
On the first of those, the response of financial markets to the vote, exemplified by the sharp drop in sterling, suggested a belief that Brexit had increased the prospect of losses in international competitiveness.²⁸ The adjustment required an increase in the price of tradeable goods and services relative to non-tradeable ones, such as those making up the core services part of the CPI basket.

We often take it as given that such an adjustment will happen via higher tradeable prices, mediated by a fall in exchange rate. But part of it may equally come via lower non-tradeable price inflation. While the adjustment through tradeables pushes up on inflation, the more protracted adjustment in non-tradeable inflation can exert some downward pressure. The balance depends, among other things, on the demand for (and supply of) non-tradeables; the evolution of firms', households' and financial markets' expectations around Brexit; and ultimately, on the monetary policy set by the MPC.

²⁸ Broadbent (2017) sets out the evidence for this proposition.

This channel has also been evident in the price data on housing, the quintessential non-tradeable. Inflation in housing rents, which make up around one-fifth of the core services CPI basket, has been historically weak (**Chart 7**). And official UK house price growth has also fallen, from an annual rate of 8% in mid-2016 to below 3% in the latest data. The growth rate of the Nationwide house price index, a timelier indicator, has fallen further still. And while that slowing was initially concentrated in London and the South-East, which are more influenced by idiosyncratic factors, it has spread more widely in the recent months.

Chart 7: Rents and house price indices



Sources: Nationwide, ONS and Bank calculations.

(ii) Lower desired mark-ups/stronger underlying productivity

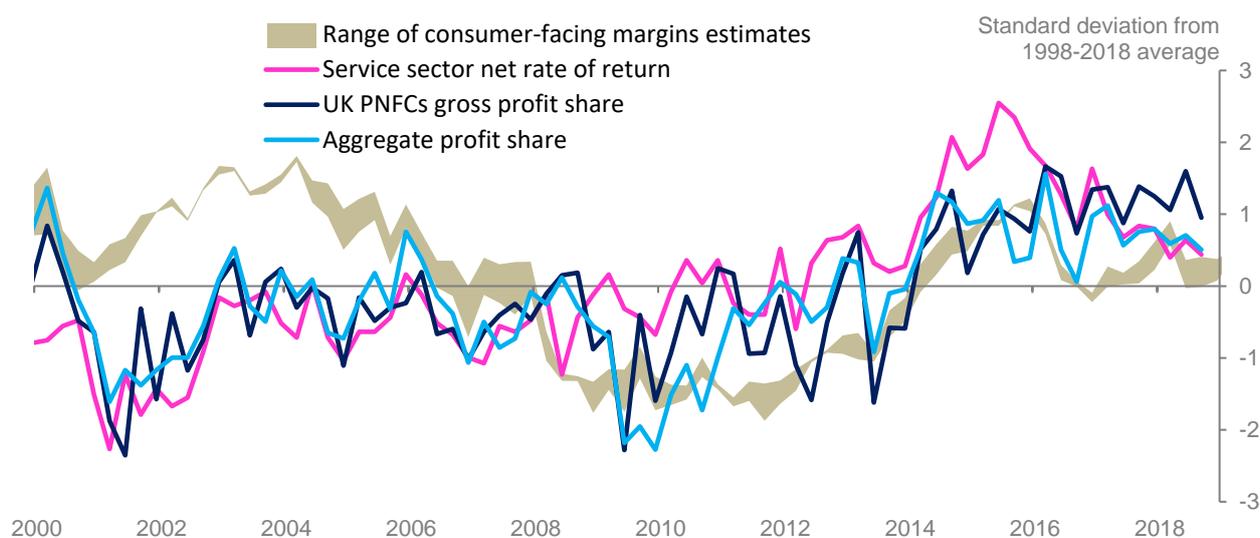
A second possible reason for weak inflation is that firms have opted to reduce the mark-ups they wish to charge on their products. Mark-ups can serve as an indicator of market power: the smaller they are, the closer the economy is to an efficient system.²⁹ The level of mark-ups relative to firms' desired mark-ups is also a key determinant of inflation in our standard macroeconomic models.

Assessing this hypothesis is difficult because accurately measuring mark-ups in the data is challenging. We typically look instead at indicators of *margins* that measure prices relative to average costs facing the firm (**Chart 8**). But in our models and according to survey evidence it is the mark-up over the *marginal* cost of producing an extra unit of output that matters for pricing decisions, not least because this is the mark-up that the firm actually chooses.³⁰ Moreover, it is not only the mark-up of final goods over labour costs for each firm that matters. A more general definition would look at mark-ups of all prices, including intermediates, over competitive prices.

²⁹ See Haldane *et al* (2018).

³⁰ As discussed in Macallan and Parker (2008), the margin depends on both the mark-up and the quantity of goods sold, but firms are not able to directly choose how many goods they sell, since this depends on demand.

Chart 8: Different measures of margins



Sources: ONS and Bank calculations.

Notes: Where the data used to construct the range of consumer-facing margins estimates are not yet published for 2018 Q4, estimates use MPC's February 2019 forecast.

In my own work I have highlighted how lower mark-ups (defined in this way) look similar to improvements in productivity.³¹ To blur the picture, some of the moves in mark-ups seen in some sectors may even be responding to productivity gains elsewhere in the economy.³² For example, gains in so-called 'superstar' companies like Amazon may be weighing on margins and mark-ups in competing high-street retailers.³³ That would accord with some reports on the retail sector we have heard from the Bank's Agency network.

From the perspective of monetary policy, temporary falls in desired mark-ups or temporary increases in productivity both imply lower price pressures and, all else equal, falls in excess demand. In both cases, monetary policy should be accommodative.³⁴ (The distinction between mark-ups and productivity of course matters for other aspects of the economy, including competition and innovation policies, but from the perspective of monetary policy, they have a similar impact in the short term.)

While we do measure productivity, I discussed in a speech last year how doing so is fraught with challenges. Measured productivity growth is also influenced over shorter horizons by cyclical, demand-driven changes in resource utilisation. We can attempt to adjust for this effect by using capacity utilisation surveys, but these are likely to be imperfect measures of true utilisation rates.

³¹ Barro and Tenreyro (2006). See also Haldane *et al* (2018) for a discussion of other possible links between mark-ups and productivity.

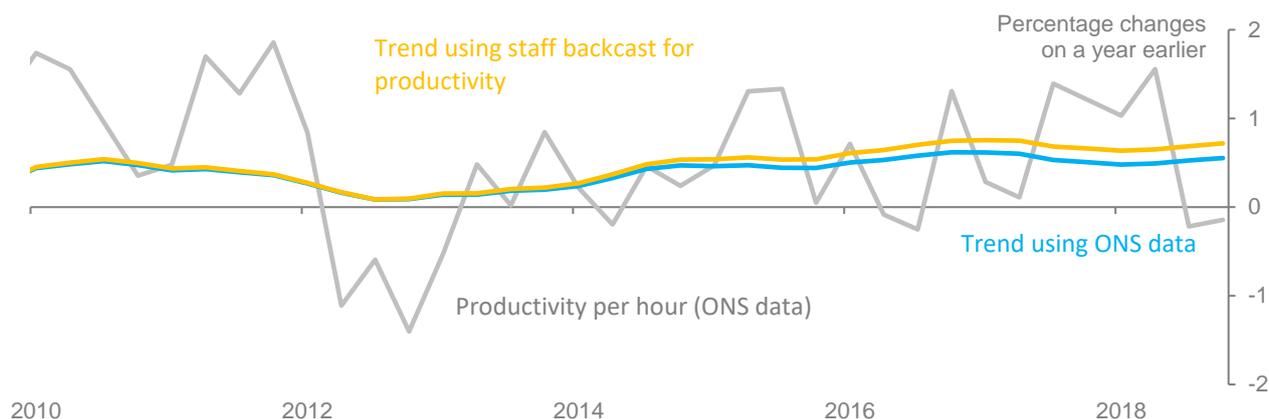
³² Baqaee and Farhi (2018) show how the picture may be blurred further by changes in the distribution of mark-ups, if firms with higher productivity increase their market share, since this will increase both productivity and average mark-ups.

³³ Autor *et al* (2017).

³⁴ Here I am assuming an unanticipated change in the level of productivity. If there were instead a persistent or permanent change in its growth rate, which was also fully anticipated by agents in the economy, then the associated change in the natural interest rate could attenuate or reverse the appropriate policy response. But even for persistent increases in productivity growth, if agents are slow to learn about the change or face binding credit constraints, demand may be slow to respond and policy should remain accommodative.

Nonetheless, this channel could explain some of the measured productivity patterns we have seen in the past few years, as well as some of the recent pickup in wage growth – together with flat or falling core inflation. On the face of it, appealing to stronger productivity might seem unlikely: with GDP weakening and employment growth remaining robust over 2018, productivity has actually *fallen* in the year to 2018 Q4. But the data are notoriously volatile from quarter to quarter, especially given sharp changes in average hours worked, so I prefer to look at trends over a somewhat longer horizon.

Chart 9: Productivity per hour and trend productivity



Sources: ONS and Bank calculations.

Notes: The productivity model is a Bayesian correlated unobserved components model with two variables; productivity and a measure of UK trade openness (the sum of exports and imports, divided by GDP). The model allows for correlation between the trend and the cycle shocks, both within and between the two observable variables.

Smoothing through some of the volatility, there is some evidence of a mildly improving trend emerging. Grouping the data into 4 year averages, hourly productivity growth has increased from 0.1% per year during the crisis (2006 Q4 to 2010 Q4), to 0.4% in its aftermath (2010 Q4 to 2014 Q4), to 0.6% over the past four years (2014 Q4 to 2018 Q4). Moreover, early estimates of GDP (and therefore productivity) are typically revised up over time. Bank staff backcasts predict that upward revisions for the most recent four years will eventually nudge up that 0.6% into 0.8% productivity growth per year. More sophisticated statistical filtering methods tell a similar story to these simple averages, with the trend of four-quarter productivity growth picking up gradually from 0.1% in 2012 to 0.7% in 2018 when using the backcast data (**Chart 9**).³⁵

Digging further into the data also suggests some grounds for mild optimism, should a smooth Brexit scenario transpire. In a speech last year I showed that a large proportion of the slowing in productivity growth since the pre-crisis period was due to falling productivity in the finance sector, much of which may be down to measurement issues.³⁶ Taking the data at face value, the finance sector contributed positively to productivity growth in 2016 and 2017, although there may also be a case for excluding it altogether, given those

³⁵ One drawback of any filter methods is the well-known end-point problem: the trend-cycle decomposition may change significantly as new data become available. The type of model used here is typically more robust to the issue than HP filter decompositions, although the problem will still be present to some degree.

³⁶ Tenreiro (2018).

measurement difficulties. Without the finance drag, only a small pickup in productivity growth in the other sectors would be needed to reach aggregate growth rates of 1% or higher.

Chart 10: Growth accounting decomposition of hourly labour productivity growth



Sources: ONS and Bank calculations.

Notes: Growth accounting decomposition using data excluding the real estate sector and following the method in Tenreyro (2018, see appendix for details). See also Goodridge, Haskel and Wallis (2016) and references therein.

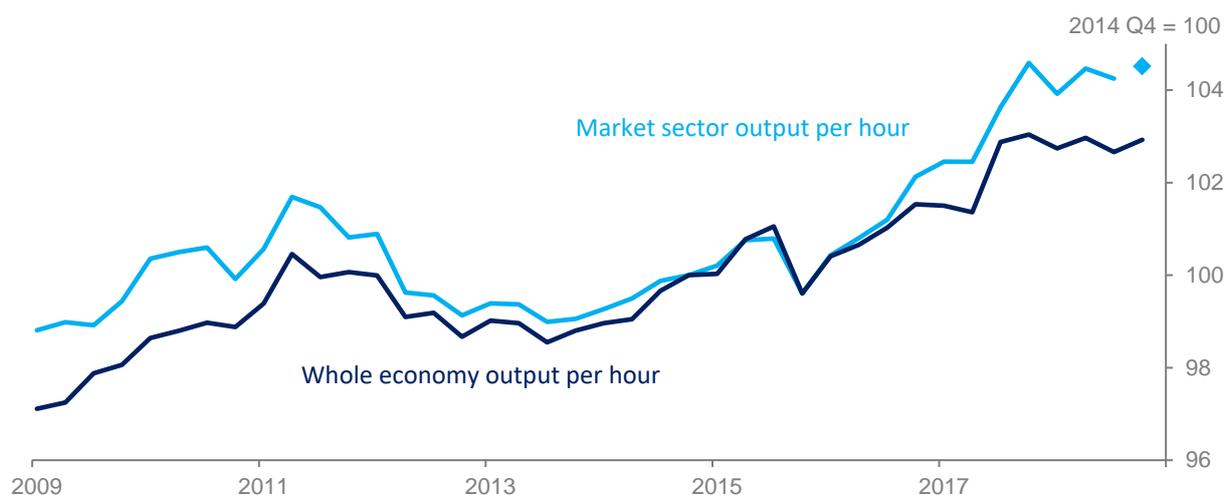
A growth accounting decomposition of productivity growth suggests that capital deepening is one possible source of a pickup in the other sectors (**Chart 10**). The contribution of capital services per hour to productivity growth has picked up over the past few years, although it looks set to weaken again in 2018. But unless the recent decline in investment continues, which seems unlikely under the MPC forecast assumption of a smooth transition to a new trading arrangement with the EU, this positive contribution should return.

Finally, the gentle upward trend in aggregate productivity has been somewhat sharper when we examine productivity in the market-sector (**Chart 11**). Market-sector productivity should be more informative about the effect of cost pressures in the economy on the CPI, which is a basket of marketed goods and services.³⁷ Market-sector productivity increased more rapidly than for the non-market sector over the past few years, reversing trends in the years immediately after the crisis. This might help explain both weak pricing pressures and stronger private-sector pay growth over the period.

Irrespective of the mechanism, the evidence from the inflation data suggests to me that supply has been growing in line with demand over the past couple of years, if not slightly faster. Since we know that at least until recently, demand growth had held up fairly well, I infer that potential supply growth may have been a little stronger than the estimates embodied in our collective forecast. Consequently, I suspect that we ended 2018 with some amount of spare capacity remaining in the economy.

³⁷ See Churm *et al* (2006).

Chart 11: Whole economy and market-sector hourly productivity (output per hour)



Sources: ONS and Bank calculations.

Notes: Whole economy productivity is the output measure of GVA divided by total hours worked. Market sector productivity is market sector output divided by market sector hours worked. Market sector hours worked are forecast for 2018 Q4 by extrapolating the Q3 data based on the growth rate of total hours worked.

Brexit, demand, supply and the policy outlook

UK demand had been holding up since the referendum, but the picture weakened over the second half of 2018. Underpinning the recent weakness has been a marked slowing in the global economy, but also an increasing influence of Brexit uncertainty on households and especially businesses. Both factors have been elaborated on in more detail in recent speeches by my colleagues.³⁸

As far as the world is concerned, 2018 saw us move from a period of synchronised strong global expansion at the beginning of the year, to a growing divergence between the US and the rest, to a synchronised slowdown by the end of the year. Those changes were both reflected and amplified by moves in financial markets, with historically loose financial conditions giving way to increases in corporate bond spreads and sharp falls in equity prices by the end of 2018.

These global trends have been driven by a confluence of factors. Those include the effect of past rises in US interest rates and a strong dollar on some emerging markets, political uncertainty in the euro area, and the impending slowing of US fiscal stimulus. But for me, the biggest driver has probably been increases in trade tensions and the impact of US tariffs on China, the effects of which are now spilling back to its trading partners in Europe.

More positively, the effect of the global slowing on the UK will be mitigated somewhat, as always, by the reaction of monetary policy abroad. Global risk-free interest rates have fallen and equity prices have retraced their earlier losses over the past couple of months. Policy headroom in many areas is still limited, however,

³⁸ Carney (2019) and Vlieghe (2019).

so any further weakening in global momentum may prove progressively more difficult to offset. Moreover, global policy will not respond to the key domestic factor weighing on demand: what the Governor recently described as the ‘fog of Brexit’.³⁹

The effect of that Brexit uncertainty on demand has become increasingly evident in recent months. It is most apparent in businesses: investment has been falling in the UK at a time when it has been growing in our international peers; business confidence surveys have slumped; hiring intentions have fallen back. But we are also starting to see some signs of its effect on households; the housing market is weakening; consumer confidence has deteriorated. This all happened at a time when household real incomes are rising and all else equal, one might normally have expected spending to be rising too.

With inflation close to target, demand weakening and a wide range of possible outcomes regarding EU withdrawal, I saw little case for a policy change in our most recent meeting. Looking ahead, under the MPC’s forecast assumption of a smooth Brexit, we would expect to see some of that uncertainty lift, providing some support to demand.

At the same time, following a smooth Brexit, sterling would be likely to appreciate. Potential supply will also be able to continue on its recent path, free of any immediate constraints. A stronger pound and continued supply growth would both limit the extent that a recovery in demand feeds through into inflationary pressures.

So while I still envisage that in the event of a smooth Brexit we will need a small amount of tightening over the next three years, before voting for any rate rises I would want to be confident that demand was growing faster than supply. As I have discussed today, to be most sure of that I would need to see an increase in domestic inflationary pressures.

Moreover, a more disorderly Brexit outcome could materially affect potential supply, which would call for a reassessment of how we expected the stars to evolve. The response of demand would depend crucially on how households, companies and markets react to the new supply potential. The exchange rate would be likely to depreciate and any increases in tariffs or nontariff costs would push up on prices.

As the MPC has long emphasised, the monetary policy response to such a scenario will depend on the balance of these effects on supply, demand and the exchange rate. In my judgement, a situation where the negative demand effects outweigh those other effects is more likely, which would necessitate a loosening in policy. But it is easy to envisage other plausible scenarios requiring the opposite response.

Supply will also become more uncertain than ever, given the unprecedented set of possible impacts. So while the ‘star variables’ will be useful inputs into my thinking, it will become essential not to lose sight of the

³⁹ February 2019 *Inflation Report* press conference.

observable data on the ground. That will include survey information from the Bank's Agents, sectoral data, but also the data on aggregate prices.

The price inflation data, stripped of the direct influences of the exchange rate and any tariff or nontariff cost changes, will be crucial in informing me how the balance of supply and demand is changing. That balance, coupled with the evolution of headline inflation, will determine the nature of any trade-off we face between our inflation and output objectives. As always, I will also be watching a broad set of indicators to see the complete picture of how the economy is evolving. And however Brexit affects the economy, my monetary policy decisions will continue to be framed by the MPC's remit.

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