BANK OF ENGLAND

Speech

The Economic Outlook: Fading global tailwinds, intensifying Brexit headwinds

Speech given by

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Resolution Foundation

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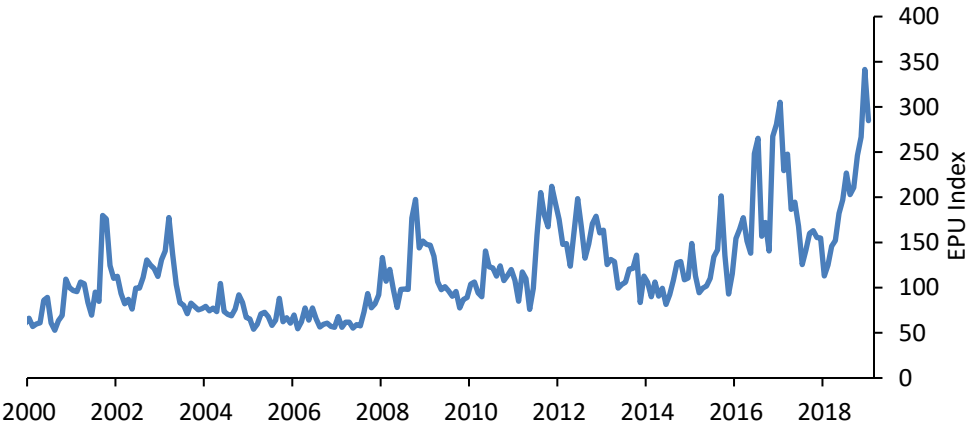
We are in a period of unusual uncertainty around the economic outlook.

There is a tendency to say every quarter that things are more uncertain than before, and of course that cannot always be true. It must be that sometimes uncertainty is less than it was before.

But where we are today, in the middle of the Brexit debate, and with the world economy slowing meaningfully relative to a year ago, I do believe the UK outlook is unusually uncertain, and the nature of the uncertainty is different (**Figure 1**). In addition to uncertainty about different economic drivers of demand or supply across the economy, for which we have models and data, the range of current geopolitical risks is both less amenable to quantifying in our framework and has more uncertain policy implications. And these risks have been playing an increasingly important role in the evolution of the economy in recent months.

Figure 1: Global Economic Policy Uncertainty Index



Notes: Global Economic Policy Uncertainty Index (EPU) is a PPP-weighted average of national EPU indices for 20 countries: Australia, Brazil, Canada, Chile, China, France, Germany, Greece, India, Ireland, Italy, Japan, Mexico, the Netherlands, Russia, South Korea, Spain, Sweden, the United Kingdom, and the United States. Each national EPU index reflects the relative frequency of own-country newspaper articles that contain a trio of terms pertaining to the economy (E), policy (P) and uncertainty (U).
Source: 'Measuring Economic Policy Uncertainty' by Scott Baker, Nicholas Bloom and Steven J. Davis at www.PolicyUncertainty.com

Setting monetary policy requires making decisions even when the outlook is uncertain. As I have said before[1], we do not need to anticipate perfectly all future changes in the economy in order to set monetary policy appropriately to meet our inflation target. Rather, we need to respond to news about the economy as we receive it, in a systematic and predictable way that agents in the economy can factor into their decisions. Monetary policy will do what is needed to bring inflation back to target, whatever the path for Brexit and the world economy.

I will discuss what news we have had about the economy in recent quarters, and how that has changed my thinking about the appropriate path of monetary policy. This will involve a discussion of the world economy as well as a discussion of the economic impact of Brexit-related news so far. Before wading into a Brexit-related discussion during a period of heightened political sensitivity, I want to make something very clear.

[1] See Vlieghe (2017).

For the UK's voters and politicians, the Brexit debate is about decisions with significant long-term economic and political consequences, and there is an important democratic debate on the possible trade-off between them.[2] Even if there is a strong consensus on the negative economic impact of Brexit, the magnitudes are highly uncertain, particularly over the longer term. It is perfectly reasonable to have a debate about whether it is worth incurring these aggregate economic costs to achieve certain political objectives. As an MPC member, I am making no comment on this debate, which is clearly beyond the scope of monetary policy. I will only discuss the short term impact on the economy, i.e. on growth, slack and inflation, because that is the MPC's mandate. It is important to be absolutely clear that my comments on the economic impact of Brexit-related news over the monetary policy-relevant horizon, meaning the next two to three years, are not a comment about desirability of certain Brexit outcomes over others. But the MPC does have to set monetary policy while the Brexit debate is happening, and monetary policy works best if its rationale and intentions are well understood.

1. World Economy

The MPC sets interest rates for the UK economy, not the world. But I will nevertheless start by discussing the state of the world economy.

When the global economy is doing well, the UK usually tends to do well too. When the global economy is sluggish, the UK economy tends to be sluggish too. Demand for our exports depends on the strength of global demand, which in turn also influences UK business investment spending. Major financial markets are highly integrated internationally, and because of the particularly large financial sector in the UK, developments in international financial conditions are important for the UK economy.[3]

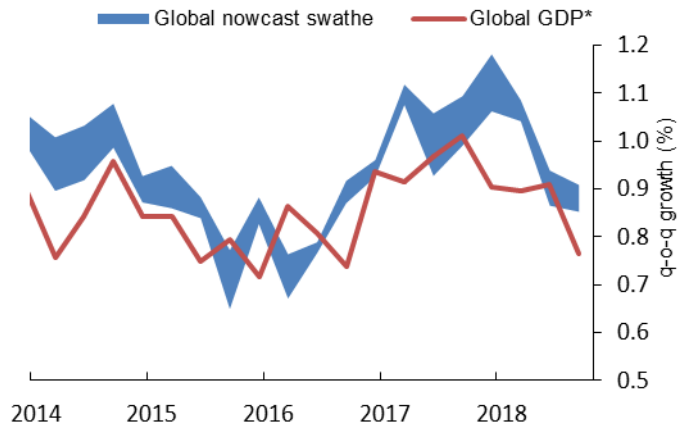
Since 2016, and throughout 2017, we had seen a remarkable acceleration in global growth. 2017 saw the highest global growth in six years (3.8%). More than 80% of the world was growing above trend. The Euro Area, our biggest trading partner, accelerated from just below 2% to nearly 3% GDP growth. And across the world, growth was increasingly investment driven, not consumer driven, which makes for more sustainable recoveries.

This strong global backdrop provided a global tailwind for the UK from the middle of 2016, just at the right time, when a headwind of Brexit uncertainty started weighing on the economy.

But over the past year, the global economy has lost some of its momentum (**Figures 2 and 3**).[4] Euro Area growth has fallen back to just above 1%. Growth disappointed in emerging markets too. The US was the outlier initially, with growth even accelerating in H1 2018. But in recent months, the data has shown some loss of momentum in the US as well.

[2] This is what economist Dani Rodrik (2007) coined the "political trilemma of the global economy". For a country to achieve an increase in democratic power and national sovereignty, it is necessary to reduce the extent of its integration into the global economy. We cannot have all three – democracy, national sovereignty and global economic integration – in full measure.
[3] See Gerko and Rey (2017).
[4] See also Carney (2019).

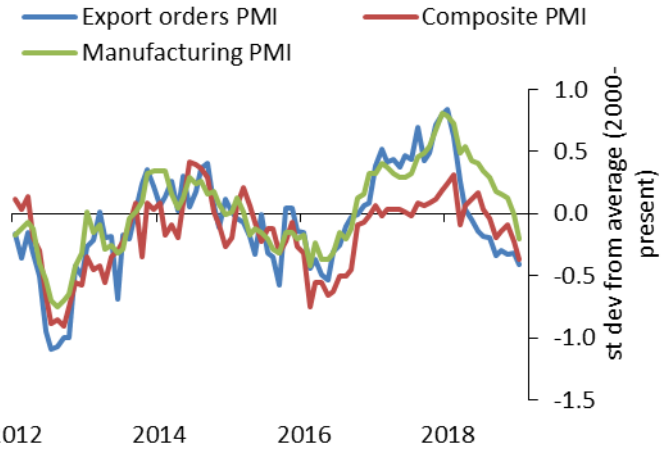
Figure 2: Global nowcast swathes from BoE models



Notes:*Global GDP is PPP-weighted. The swathe consists of a range of the Bank's global nowcasting models. The models contain a range of global and country-level survey measures and asset prices. Further information can be found in "Gauging the globe: the Bank's approach to nowcasting world GDP, Quarterly Bulletin, Q3 2018".

Sources: National and International data sources, Bank calculations.

Figure 3 : Breakdown of World PMIs

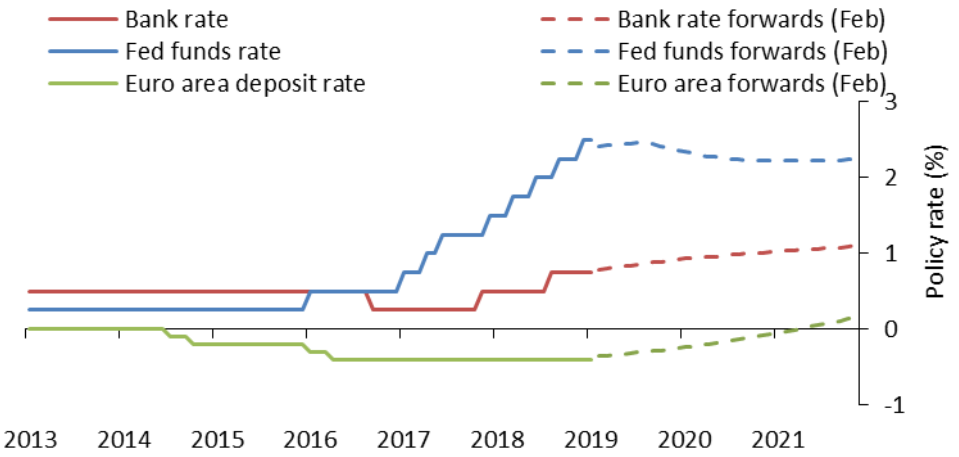


Sources: Eikon from Refinitiv, JP Morgan, Bank calculations.

To make sense of this, I think we need two stories. One is about US fiscal expansion, the other is about the trade war and geopolitical risks more widely.

The US economy has been going through a very large fiscal expansion. The total government deficit in the US (adding up Federal and State budgets) is set to increase by 1.9ppts between 2017 and 2019, according to the OECD. For comparison, over the same period the UK deficit is set to shrink by 0.5ppts, and the Euro Area budget deficit is set to be little changed.

Figure 4: UK, US and Euro Area policy rates and market forward rates



Notes: Forward curves are estimated using instantaneous forward overnight index swap rate. Numbers are average of last 15 business days. Fed funds rate is the target upper bound. Data as of 11 February 2019.

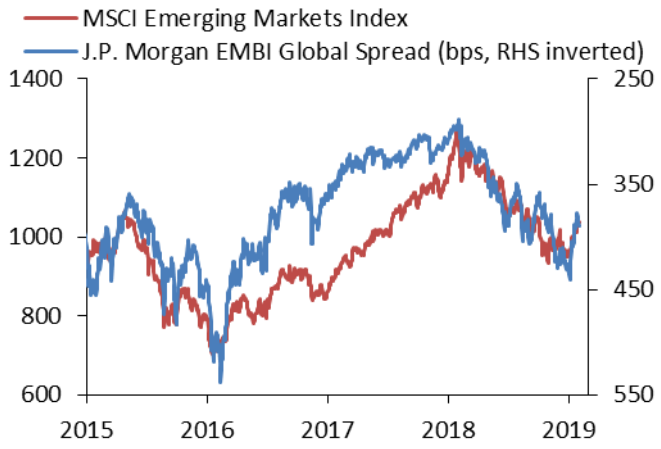
Sources: Bank of England, Bloomberg, ECB and Federal Reserve

The US fiscal expansion occurred when the unemployment rate was already at or near a 50-year low, which led to US interest rates rising much faster than elsewhere in the world (**Figure 4**). This was a normal monetary policy response to a stronger economy, and was appropriate for the US. But higher interest rates

and a stronger dollar do put a lot of pressure on emerging market countries which borrow in dollars and pay dollar interest rates, and whose economies were not strong enough to withstand such pressure. As a result, we have seen emerging markets lose 19% of their stock market value from the peak in early 2018, and the premium their governments have to pay to borrow in dollars has risen by 0.9 percentage points over the same period (**Figure 5**).

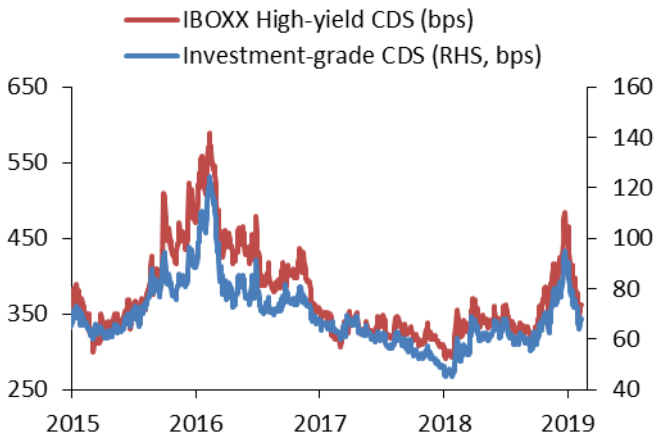
The rise in US interest rates also started to affect some domestic borrowers in the US. The premium that corporate borrowers have to pay for market borrowing has risen, and this rise comes on top of the increase in risk free rates (**Figure 6**).[5] A pattern of rising corporate spreads when risk-free interest rates increase is not unusual.[6] The Fed has now signalled it may pause its policy tightening cycle, which has partially unwound the spread tightening, but total borrowing costs including risk spreads remain higher than they have been for most of the past seven years.

Figure 5: Emerging market equity and bonds



Sources: Bloomberg, MSCI, Bank calculations

Figure 6: US credit conditions



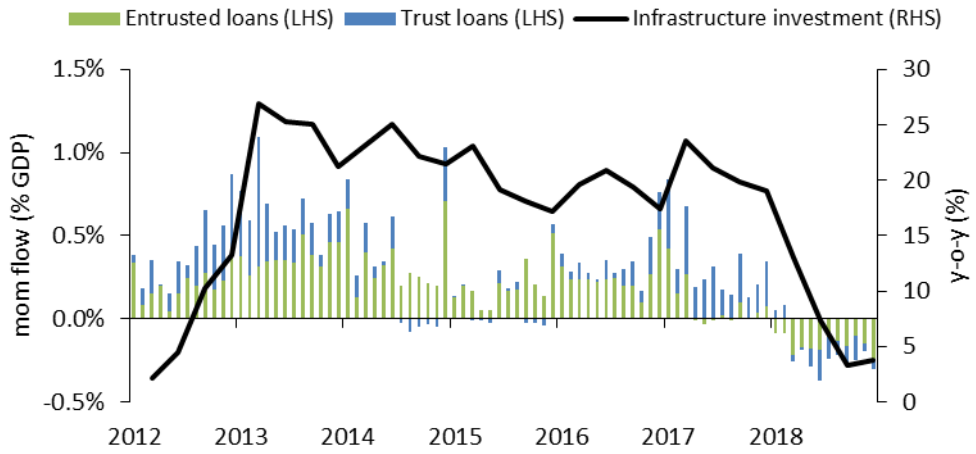
Sources: Bloomberg, MSCI, Bank calculations

The second main global growth story is the trade war and a rise in geopolitical risks more widely. The trade war started just over a year ago when the US announced tariffs on washing machines and solar panels. Since then, a series of tit-for-tat measures have resulted in a growing share of global trade facing steadily rising tariffs. In an economic sense, nobody wins trade wars. You are just raising taxes on imports, and then your trading partners do the same. Each country impoverishes their consumers, collectively they damage global trade.

Bank of England staff estimate that the tariffs announced so far are already high enough to take 1% off Chinese GDP and about 0.5% off US GDP over the next three years.

[5] The chart shows credit default swaps, closely correlated with the premium over the risk-free rate that corporate borrowers have to pay in corporate bond markets.
[6] See Gertler and Karadi (2015) for evidence for the US and Cesa-Bianchi, Thwaites and Vicondoa (2016) for the UK.

Figure 7 : China aggregate financing by type



Notes: Monthly GDP series is calculated using a linear interpolation between annual nominal GDP values in RMB.
Source: National Bureau of Statistics China, PBOC, OEC D, Bank calculations

Moreover, the trade war has hit a Chinese economy that was already slowing in response to official policy measures to reduce financial excesses in the shadow banking sector. Growth in trust loans and entrusted loans, two key vehicles for off-balance sheet financing, slowed in late-2017 and then turned negative in 2018, constituting quite a sharp deleveraging[7] (**Figure 7**).

And the combined effect of this deleveraging and the trade war on China seems to be contributing to the slowdown in the Euro Area via weaker exports in response to weaker Chinese imports (**Figure 8**).

Figure 8: Manufacturing PMIs – Euro Area and China

Sources: China National Bureau of Statistics, Institute of Supply Management

Politically, the trade war is not taking place in isolation, it is taking place against a background of more fundamental political shifts, generally involving an erosion of trust in official institutions and a bifurcation towards the extremes of the political spectrum. The US government just ended the longest shut-down in its history, Italy's debt dynamics are once again a focus for financial markets, and France is experiencing a

[7] See the speech by PBC Governor Yi Gang on 13 December 2018.

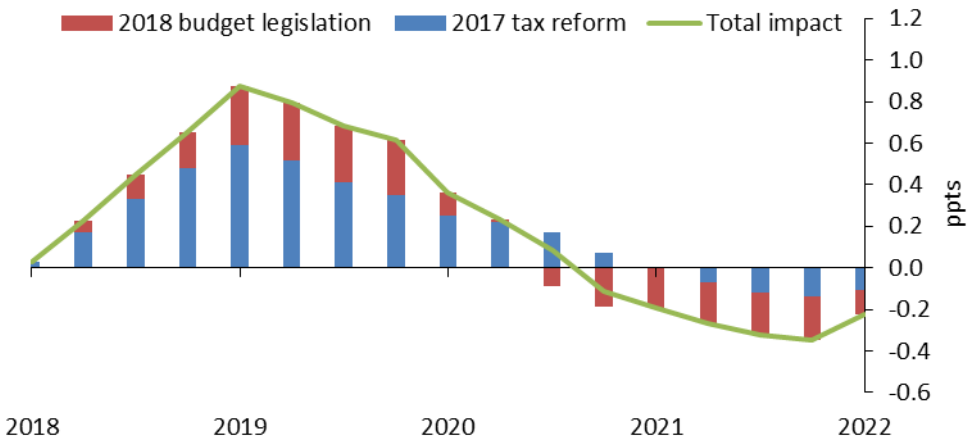
prolonged period of protests. An increasing number of countries have elected leaders that explicitly question principles of free speech and due process of law.

Overall, these economic and political developments have led to a noticeable slowing in global growth.

Thinking about where we go from here, there are some reasons to be optimistic that global growth will soon bottom out and improve a little. In recent months, the anticipated response from the Federal Reserve, reinforced by Fed communications, has resulted in a 70bp fall in the forward policy rate[8]. The expected Euro Area policy rate at the same horizon has fallen by 50bp. Forward rate paths for other central banks have also been revised lower. Chinese policymakers have put in place significant stimulus measures in the monetary, banking and fiscal sphere, and might add more.

But there are downside risks too. The US fiscal impulse has only just peaked, and is set to fade from here (**Figure 9**). Uncertainties about the trade war do not appear to be close a resolution. And the wider political uncertainties that may be weighing on financial market sentiment and investment decisions may well persist for years to come, and could yet worsen.

Figure 9: BoE estimate of the impact of US fiscal expansion on US growth



Sources: US Congressional Budget Office, Joint Committee on Taxation of the "Tax Cuts and Jobs Act", Bank calculations

2. The impact of Brexit

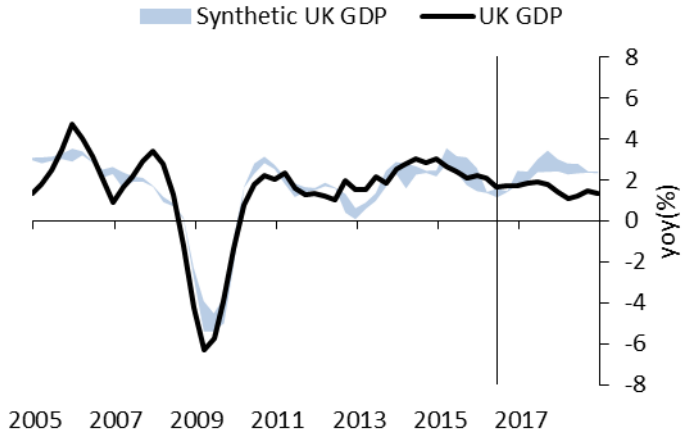
Given the performance of the global economy – acceleration in 2016 and 2017, followed by some slowing during 2018 – we would have expected a similar economic performance in the UK: a strong acceleration, followed by some slowing.

Instead, we have seen UK GDP growth slowing throughout this period, from an annual pace of around 2% to less than 1% annualised in Q4 2018 and Q1 2019.[9] The reason for this underperformance relative to the rest of the world is, I believe, the uncertainty surrounding the prospect of Brexit since the referendum in June 2016.

[8] As measured by the 3Y-1M overnight interest rate swap.
[9] Based on data for 2018 Q4 (first release of 0.2% qoq) and our current forecast for 2019 Q1 of 0.2% qoq.

Consider the following thought experiment: What if nothing unusual had happened in the UK domestically and UK growth had been in line with its close historical relationship to the rest of the world? **Figure 10** quantifies this thought experiment with what is known as a "synthetic" UK economy without Brexit.[10] What is shown here is how much weaker the economy has been relative to what we might have expected, given the global growth data. The different lines in **Figure 11** show estimates using different country groups, just to show that the result is robust to which countries are used to proxy "the rest of the world". The analysis suggests that since the vote in June 2016, we have lost 2% of GDP relative to a scenario where there had been no significant domestic economic events. That amounts to around 40 billion pounds per year, or 800 million per week of lost income for the country as a whole.[11]

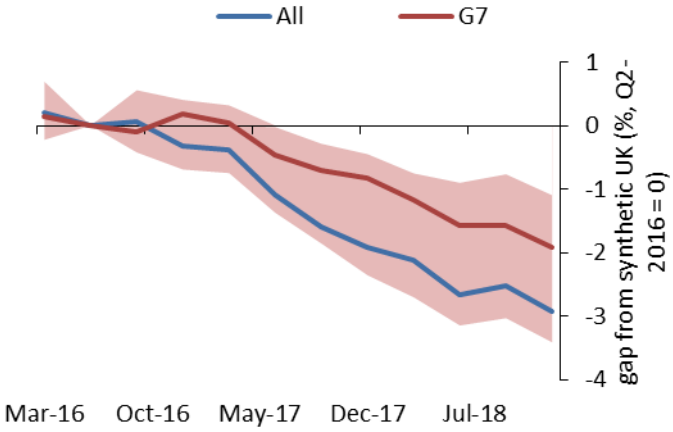
Figure 10: Synthetic UK growth versus data



Notes: Blue swathe indicates the range of synthetic controls from All and G7 control pools.

Sources: OECD, ONS, Bank calculations

Figure 11: UK GDP Brexit shortfall versus "synthetic UK"



The pink swathe indicates the 95% confidence band for the Brexit shortfall.[12]

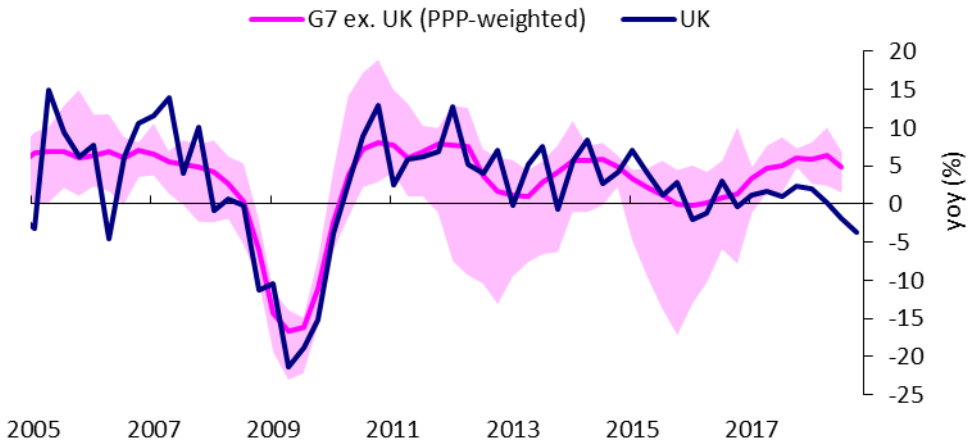
Sources: OECD, ONS, Bank calculations

Of course nothing in our trading relationship with the EU has actually changed over this period. These costs are only related to expectations of future changes, and uncertainty about future changes. To better understand how the economy has responded to these changes in expectations and uncertainty, it is instructive to look at two large subcomponents of GDP, namely business investment and household consumption.

During a period when business investment in the rest of the G7 has accelerated to around 6% annual growth, the UK has been stuck around zero, deteriorating to -3.7% y/y over the course of 2018 (**Figure 12**).

[10] I follow the methodology outlined by Born et al. (2018) and Abadie et al. (2003) to construct a synthetic control for UK GDP. The synthetic control methodology is a constrained quadratic programming problem of which the counterfactual is more robust to model-selection than that of an OLS regression. See the Appendix for a detailed description.
[11] GDP shortfall is calculated as the median (50th percentile) estimate from the bootstrap methodology described below. Sterling equivalents for the shortfall are calculated using annual 2018 nominal GDP for the UK.
[12] The pink swathe represents 95% confidence bands for the Brexit shortfall, obtained by bootstrapping 1,000 synthetic controls from a donor pool of 10 uniformly drawn countries (without replacement) from the 28 potential control units. Andrews (2000) shows that the traditional bootstrapping methodology is inconsistent in the case of a constrained minimisation when the constraint binds. Born et al. (2018) implements Andrews (2003)'s end-of-sample instability test as a solution to this problem and finds that Brexit has had a significant effect on the level of UK GDP

Figure 12 : UK Business Investment relative to other G7 countries

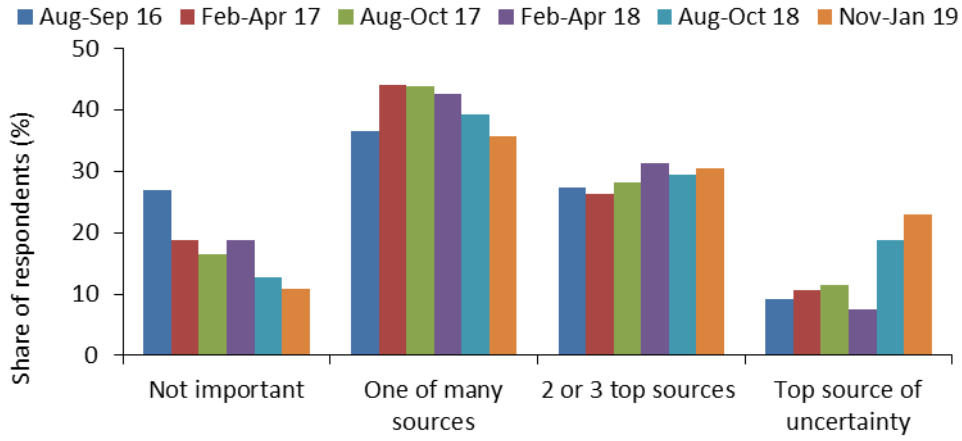


Notes: Swathe denotes the range of business investment growth in G7 ex. UK countries.

Sources: Eikon from Refinitiv, National Statistics sources, Bank calculations

Firms have been saying in a number of surveys that the uncertainty about our future relationship with the EU is a source of concern for them that has been weighing on their investment spending, as plans for expansion have, on average, been scaled back (**Figure 13**).[13]

Figure 13: Decision Maker Panel results of Brexit as a source of uncertainty



Notes: Bars show responses to the question "How much has the result of the EU referendum affected the level of uncertainty affecting your business?"

Source: Decision Maker Panel, Bank of England calculations

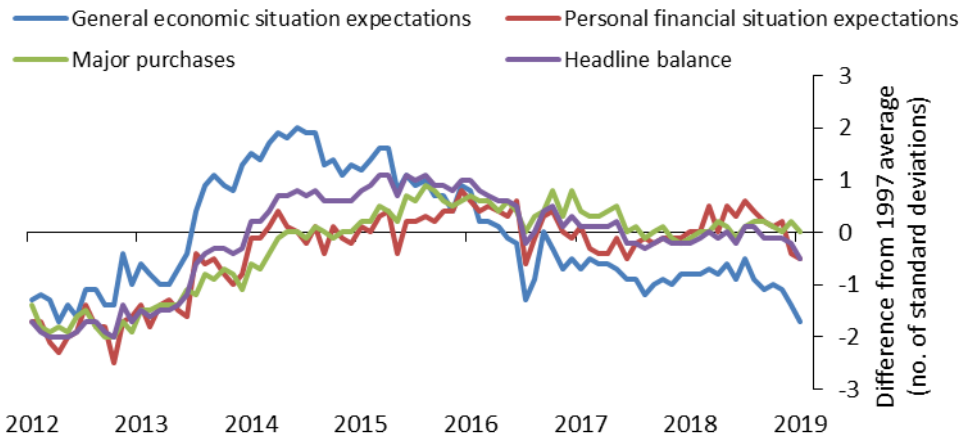
Moreover, as we approach the March 2019 deadline without a clear way forward, concerns have intensified and investment has weakened further. That is not too surprising: when any potential change to the future relationship was still many quarters away, there was relatively little firms could or wanted to do in

[13] Evidence from the Deloitte CFO survey confirms the significance of Brexit as a major driver of risk facing UK businesses, who continue to rank Brexit as the top risk facing their business. The survey also notes an increasing number of participants expect Brexit to weigh heavily on businesses' decisions to invest and hire. In addition, the January 2019 IHS/Markit PMI press-release notes: "The survey results indicate that companies are becoming increasingly risk averse […] in the face of weakened customer demand and rising political uncertainty. Such worries were in turn most commonly linked to heightened Brexit anxiety, though wider global political and economic factors were also seen to have been taking their toll on demand". See also Inflation Report – February 2019 for more details: https://www.bankofengland.co.uk/inflation-report/2019/february-2019

anticipation. As many firms have told me during my regional visits in 2017, it was too costly for them to sit on their hands and postpone major investment decisions for long periods. Business must carry on. But as we get closer and closer to the moment when we will – or least might – learn more about what the future relationship looks like, and how smooth the transition is, it makes sense for firms to put more spending on hold. The cost of postponing investment by several years may be prohibitively high, but the cost of postponing investment by a few quarters is a precaution that many find worth taking given the vastly different scenarios possible.

The response of household consumption, on the other hand, has been quite different. Consumer confidence had been fairly steady in the post-referendum period, with only tentative signs of deterioration in recent months (**Figure 14**).

Figure 14: Consumer confidence in their own finances

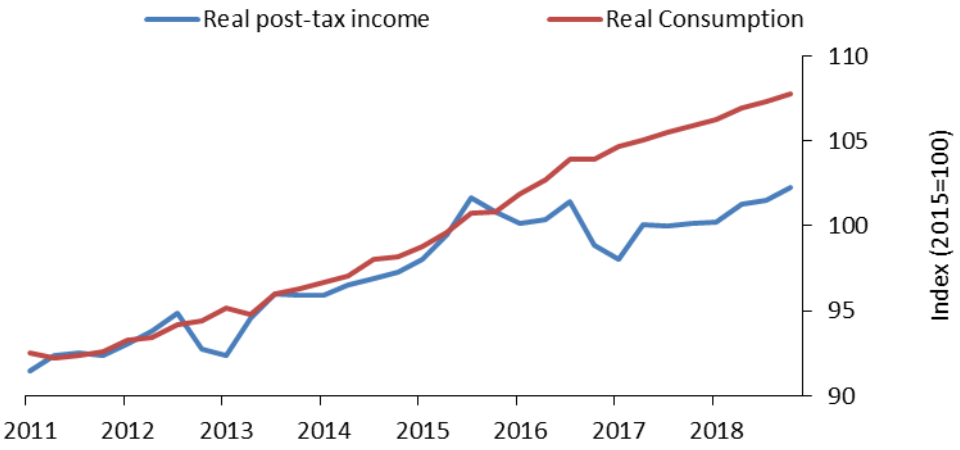


Notes: Average of the net balances of respondents reporting that: their financial situation has got better over the past 12 months; their financial situation is expected to get better over the next 12 months; the general economic situation has got better over the past 12 months; the general economic situation is expected to get better over the next 12 months; and now is the right time to make major purchases, such as furniture or electrical goods.

Source: GfK (research carried out on behalf of the European Commission) and Bank calculations

Even though households' confidence was little changed for most of the post-referendum period, their real income has taken a hit. The mechanism by which this took place was as follows. After the vote financial markets took a dim view of the UK's relative future economic prospects. Sterling fell by around 15%, and the share prices of UK-focused companies underperformed by a similar amount. A weaker exchange rate meant imports became more expensive. With some lags, this fed into consumer prices since around 30% of what we consume comes directly or indirectly from abroad. Higher consumer prices eroded households' purchasing power. But what **Figure 15** shows is that even though household spending growth eased back a little, it did not weaken nearly as much as real income. Households dipped into their savings to sustain their spending over this period. That may be a sensible thing to do if the reduction in purchasing power is temporary. But if it is permanent, we may at some point see households rebuilding their savings, which would mean weaker consumption demand for a period.

Figure 15: Household consumption and real incomes



Source: ONS, Bank of England calculations

So UK growth in the past two years has been weaker than we would have expected based on the performance of the global economy alone. Based on what happened in the rest of the world we would have expected UK growth to accelerate, but actually it slowed. Brexit uncertainty weighing on business investment was one factor. Brexit uncertainty weighing on the exchange rate, and therefore household spending power, was another factor.

But despite the slowing in the economy, the labour market performance has been remarkably robust. The unemployment rate has kept falling slowly over the past two years, reaching lows not seen since the 1970s.

Usually, as the unemployment rate falls, we would expect to see upward pressure on wages. It becomes increasingly difficult for firms to find additional workers, so they end up having to bid them away from their competitors. It becomes increasingly easy for workers to find jobs, so they feel more secure in making higher wage demands by threatening to go work elsewhere.

In the initial phase of the labour market recovery, from 2012 to 2016, the MPC was generally surprised at how little upward pressure on wages there appeared to be, despite the steady decline in unemployment. And we have not been alone. This puzzling weakness of wages despite sharply lower unemployment has been seen in other countries as well.[14]

As I argued in an earlier speech,[15] my interpretation of this finding was not that wages had become permanently disconnected from unemployment. Rather, I highlighted a number of factors that had pushed down on wages for a given rate of unemployment. But I also showed evidence that, other things equal, lower unemployment still pushed up on wages. In economist terminology, I argued that the Phillips Curve had shifted down, but was still upward-sloping.[16]

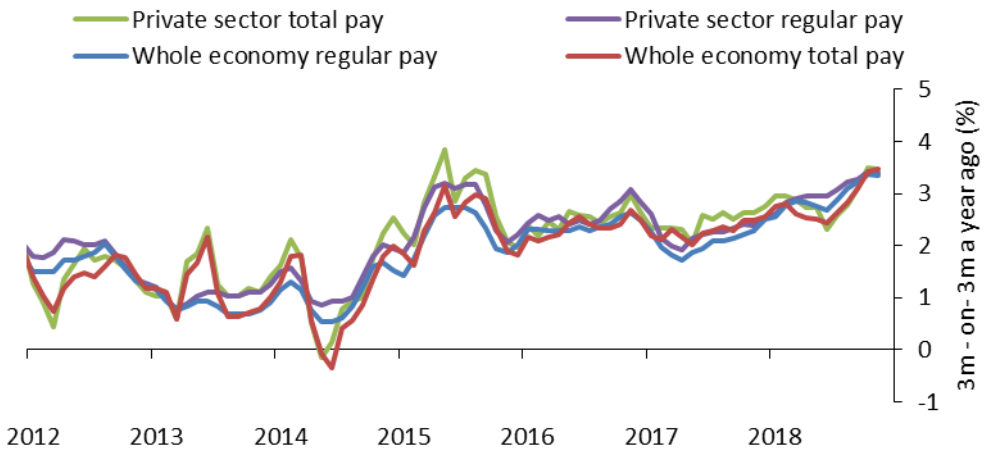
[14] See BIS (2017) and IMF (2017).
[15] See Vlieghe (2018).
[16] See also Broadbent (2017), Carney (2017) and Haldane (2017) among many others who have reached similar conclusions.

I also argued that some of the factors that had pushed down on wages for a given rate of unemployment had mostly run their course[17] so that upward pressure on wages should re-emerge.

Since the autumn of 2017, my MPC colleagues and I have described in successive Inflation Reports that evidence of upward wage pressure resulting from a tight labour market has become increasingly apparent. Wage growth accelerated from 2% in mid-2017 to 3% in mid-2018, and is now running at a pace close to 3½% on the most recent data (**Figure 16**).

This has been reassuring, in the sense that the mechanisms that have historically pushed up on wages still seem to matter.

Figure 16: Average Weekly Earnings growth



Source: ONS, Bank of England calculations

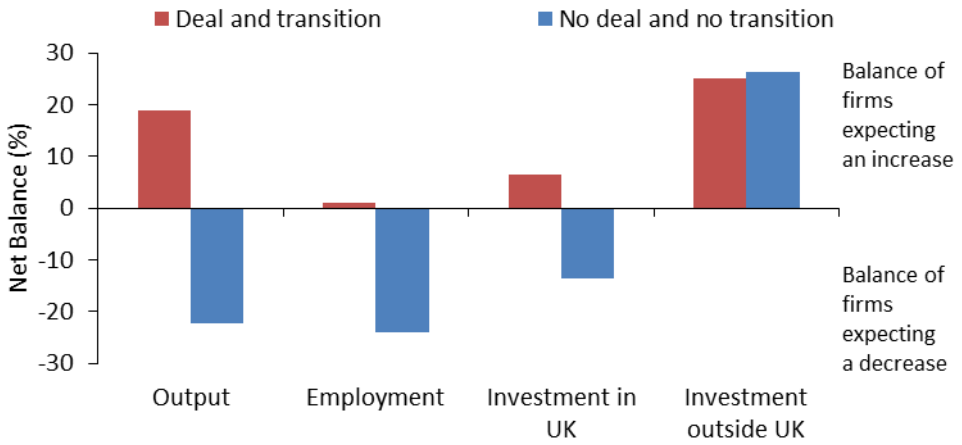
What has been more surprising is that employment growth has remained robust even as business investment has been falling. I do not have a confident explanation for this divergence. Historically, although both data series are noisy, the two have moved together, as you would expect: when businesses are confident about their prospects, they hire new employees and they invest in new equipment and buildings.

My tentative explanation for why we have seen divergent trends between employment and investment in recent years is related to how firms deal with uncertainty: the reason why business investment is sensitive to uncertainty is because much of business investment is irreversible, or at least costly to reverse.[18] Buying specialised equipment, or spending on specialised fitting out of new buildings, are costs which cannot be fully recovered if economic circumstances change. Firms want to avoid making such investments at the wrong time or in the wrong sector, so when uncertainty rises, it pays to wait. But employment decisions are less costly to reverse. When uncertainty rises, but demand is still robust (from the world, from households), it makes sense for businesses to meet that demand by expanding their workforce rather than by increasing investment spending.

[17] Among these were downward nominal wage rigidity (DNWR) no longer binding, underemployment falling towards pre-crisis level, and public sector wage growth starting to pick up. See Vlieghe (2018) for details.
[18] See Pyndick (1991), Abel and Eberly (1994) and Abel et al (1996) for the theory; Banerjee et al (2015) for some global evidence and Smietanka, Bloom and Mizen (2018) for UK evidence on investment in the aftermath of the Great Recession; and Redl (2018) and Jens (2017) for the role of political uncertainty.

If that is the correct diagnosis, it has several implications: first, the robust employment growth relies on robust demand from the rest of the world and from households, at least one of which is slowing, so the continued strength of employment growth cannot be taken for granted. Second, if we do get some resolution of Brexit uncertainty, I would expect to see a pick-up in business investment growth, but not necessarily in employment growth. Our own Bank of England Agents' survey is consistent with this interpretation: on the assumption of a Brexit deal, firms expect to expand output and investment, but not employment (**Figure 17**).

Figure 17 : Agents' survey on Brexit expectations



Notes: Companies were asked "Relative to the last 12 months, what is the likely impact on the following for your business over the next year in each scenario: (a) a deal and transition period and (b) no deal and no transition period?" For each relevant business factor, respondents were asked to choose between "Fall greater than 10%"; "-10 to -2%"; "Little change"; "+2 to+10%" and "Rise greater than 10%". Net percentage balances of companies reporting increases or declines in each factor, weighted by employment. Half weight was given to the +/- 2-10% response and full weight was given to those that responded "Rise / fall greater than 10%".

Source: Bank of England Agents' Survey

Note also that irrespective of the outcome of the negotiations, firms expect to increase investment outside of the UK. That is consistent with the idea that even though firms expect investment will be stronger under a deal scenario, we are unlikely to get back all of the investment that has been deferred over the past two years. For now, however, employment growth has remained resilient, and it is leading to a tightening in the labour market that is pushing up on wage inflation.

Ultimately, the MPC's objective is consumer price inflation, not wage inflation. Consumer price inflation has been coming down since late 2017 from a peak of 3.1% to 1.8% on the most recent data referring to January. The decline reflects two factors: the temporary boost to imported price inflation from the 2016 depreciation is fading, as we expected. Second, the recent drop in oil prices is pushing down on inflation temporarily, largely via lower petrol prices. But the MPC is mostly focused on persistent trends in inflationary pressure, so the fact that one temporary upward effect (the weaker exchange rate) is fading, and another temporary downward effect (lower oil prices) is manifesting itself, is not the most important consideration for the medium-term inflation outlook. Much more important is the extent to which upward pressure on wage growth will continue, and the extent to which this will ultimately lead to sustained upward pressure on consumer price inflation as firms pass on the higher wage costs into the prices of their products and services.

3. Monetary Policy

So far, the reduction in labour market slack and the rise in wage pressure, against a background of only modestly slowing domestic growth and robust global growth and the assumption of a smooth Brexit, had been sufficient to justify a modest tightening of monetary policy, with a first 0.25% hike in Bank Rate in November 2017, and another in August 2018.

When I first spoke about the future path of Bank Rate a year ago, I thought one to two quarter point hikes per year in Bank Rate was the most likely central case. But since then, the economic outlook has changed. Global growth has slowed more than expected, and sooner than expected, so will contribute less to UK demand. Domestic growth has slowed somewhat more than expected, especially around the turn of the year. The only significant recent upside economic news has been the government's announcement of increased fiscal spending over the coming years.

And while pay growth has picked up broadly as expected, this has not so far led to any upward pressure on consumer price inflation. For example, services inflation, which is less affected by the exchange rate and oil prices, has remained close to historical lows.

I judge that the net balance of economic news has been to the downside. I therefore consider that the appropriate pace of monetary tightening is somewhat slower than I judged it to be a year ago. On the assumption that global growth does not slow materially further than it has so far, that the path to Brexit involves a lengthy transition period in line with the government's stated objectives, that pay growth continues around its recent pace, and that we start to see some evidence of pay growth leading to upward consumer price pressure, a path of Bank Rate that involves around one quarter point hike per year seems a reasonable central case.

If a transition period is successfully negotiated, and a near term "no deal" scenario is therefore avoided, I would expect the exchange rate to appreciate somewhat. The degree of future monetary tightening will in part depend on how large this appreciation is.

As before, this future rate path is a forecast not a promise, and just as there is considerable uncertainty around the forecast for growth and inflation, there is considerable uncertainty around my forecast for the policy rate path. Given that the data even in the past few weeks are suggesting the slowdown is continuing into the early part of this year, both domestically and globally, a lot needs to go right for this forecast to come to pass. I feel I can probably wait to see evidence of growth stabilising and inflation pressure rising before considering the next hike in Bank Rate.

So far, I have discussed an economic outlook where the path to Brexit is smooth, i.e. involves a lengthy transition period. There is of course, the risk of a no deal outcome. Such an outcome is likely to lead to some economic disruption, which could possibly be severe. This will not be the case for all sectors of the economy, but some are clearly more exposed than others. The risk of a disruptive outcome, not just uncertainty per se, is one of the key factors that are affecting business investment and financial markets. Reducing uncertainty

by making a no-deal scenario happen therefore does not produce net economic gains; it results in actual economic disruption.

The question for monetary policy will still be: how do businesses, households and financial markets react to such a scenario? The exchange rate is likely to fall further. That will create a temporary boost to inflation, just as it did after the 2016 depreciation. Our mandate allows us to balance the likely temporary inflation overshoot against the need to support the economy if a margin of slack were to open up. How much flexibility we have depends on how much slack opens up, which is to say, how much demand falls relative to the disrupted lower level of supply.

One can imagine scenarios where households and businesses expect the negative effect on the economy to be quite persistent, so would lower their consumption and investment demand by more than the supply disruption itself, given the extreme uncertainty and the fact that some disruption will actually be taking place, rather than being faced merely with the worry about potential future disruption. Such a scenario would imply that monetary policy should be kept on hold or even eased as long as inflation expectations remain well anchored, and the exchange-rate driven overshoot in inflation can be weighed against the actual or prospective economic slack, in line with the MPC's mandate. One can also imagine scenarios where households and business spending remains robust, if they expect the economic disruptions to be only short-lived, so demand and confidence is affected less. That might imply that monetary policy might have to be tightened.

All of these paths are possible, although not all are equally likely in my view. In the case of a no-deal scenario I judge that an easing or an extended pause in monetary policy is more likely to be the appropriate policy response than a tightening. We will have to judge in real time how well inflation expectations remain anchored, and how households and businesses are reacting to the disruptions. Even if the direction and scale of monetary policy changes are unknown beforehand, monetary policy will do what it needs to do to bring inflation back to target within a horizon that is consistent with our mandate.

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Appendix: The Brexit counterfactual

Quantifying the causal effect of the Brexit vote on the UK economy naturally requires comparing the data outturn to a counterfactual. I address this problem, following Born et al. (2018), by creating a synthetic control for UK GDP using a weighted average of a pool of other country GDPs. The identifying assumptions of the analysis is two-fold. First, the outcome of the Brexit vote should not have had a meaningful effect on the GDP of countries in the control pool. Second, the outcome of the Brexit vote should not have been tied to the UK's relative economic performance. The assumptions appear to be mild given the plethora of non-economic reasons provided in favour of exiting the EU (see Born et al. (2018) for a further discussion on the validity of the assumptions). Importantly, this approach simply exploits the statistical relationship between the UK's and other countries' GDP and does not require having the correct economic model for the UK or the World.

Data

The main data source for this analysis is the OECD November 2018 Economic Outlook projections.[1] I take quarterly data of real GDP in market prices starting from Q1-1995 of all the countries for which data exist, and transform real GDP levels into log-deviations from the 1995 average. In the case of the UK, I update the OECD projections for Q3- and Q4-2018 with the ONS data outturn.[2] I redo the analysis for two control units – "All" and "G7"– to check for robustness against control pools. Table 1 shows the countries that make up the different control pools.

Methodology

Similar to Born et al. (2018), we use the methodology in Abadie et al. (2003) to construct a synthetic control for UK GDP, defining Q2-2016 as the treatment period. Let the $\mathbf{X_1}$ be a $(T \times 1)$ vector of the treatment variable, $\mathbf{X_0}$ be a $(T \times N)$ data matrix of the units that make up the control pool, and $\mathbf{V}$ be a $(T \times T)$ positive definite diagonal matrix, where T is the length of the pre-treatment sample and N is the number of units in the control pool. Define $\mathbf{Y_0}$ and $\mathbf{Y_1}$ as the post-treatment analogues of $\mathbf{X_0}$ and $\mathbf{X_1}$. The synthetic control is a weighted mean of the units in the control pool, with weights $\mathbf{W} = (w_1, \ldots, w_N)'$ a $(N \times 1)$ vector. Choosing $\mathbf{W}$ is therefore equivalent to choosing a synthetic control. I estimate $\mathbf{W^*}$ such that:

$$\mathbf{W}^* = \underset{\mathbf{W} \in \mathcal{W}}{argmin}\ (\mathbf{X_1} - \mathbf{X_0}\mathbf{W})'\mathbf{V}(\mathbf{X_1} - \mathbf{X_0}\mathbf{W}) \tag{1}$$

where $\mathcal{W} = \{\mathbf{W} : \mathbf{W} \geqslant 0; \|\mathbf{W}\|_1 = 1\}$.[3] It is easy to see that the solution of equation (1), $\mathbf{W^*}$, depends on

[1] Since OECD November 2018 outlook was released before the availability of Q3 data, the synthetic control for Q3- and Q4-2018 is calculated from OECD projections.

[2] The results are almost identical when using OECD projections for the UK.

[3] I implement this constrained minimisation in MATLAB using the *quadprog* function that is part of the Optimization

$\mathbf{V}$, whose diagonal elements reflect the relative importance of the data in $\mathbf{X_0}$ and $\mathbf{X_1}$ in the T dimension for the minimisation. Abadie et al. (2003) estimate $\mathbf{V}$ consistent with $\mathbf{W}^*$ that best reproduces the treatment variable in the pre-treatment period. For simplicity, I set $\mathbf{V} = \mathbf{I}_N$ in the preceeding analysis. The results are the qualitatively unchanged if I also estimate $\mathbf{V}$ as in Abadie et al. (2003) and Born et al. (2018).

The synthetic control for UK GDP is calculated as $\mathbf{X_1^*} = \mathbf{X_0}\mathbf{W}^*$, and the causal effect of the Brexit vote on UK GDP is given by $\mathbf{Y_1} - \mathbf{Y_1^*}$.

Comparison with OLS regression

A natural alternative of the synthetic control methodology is a simple OLS regression of UK GDP on the control pool, defining the fitted values as the counterfactual. The key difference between the synthetic control and regression methodology is that the synthetic control is a constrained minimisation with non-negative coefficients that sum to one. The importance of this constraint lies in the possiblity that the regression estimates can be negative, implying fitted values that are outside the convex hull of the data. This leads to well-known problems of extrapolation with regression models. It can also be shown that inference of counterfactuals outside the convex hull are more model-dependent. By constraining the regression such that the weights are non-negative and sum to one ensures that the counterfactual is always inside the convex hull of the data, and hence less model-dependent. This can be seen from the robust nature of the results in Figure 11. See Abadie et al. (2015) and King and Zeng (2005) for a fuller discussion and formal proofs.

toolbox. $\|\cdot\|_1$ is usual 1-norm in the linear space $\mathbb{R}^n$.

Table 1: Input countries used in estimation of synthetic control

All	G7
Australia	Canada
Austria	France
Belgium	Germany
Canada	Italy
Chile	Japan
Czech Republic	United Kingdom
Estonia	United States
Finland	-
France	-
Germany	-
Hungary	-
Iceland	-
Ireland	-
Israel	-
Italy	-
Japan	-
Korea	-
Luxembourg	-
Netherlands	-
New Zealand	-
Norway	-
Portugal	-
Slovak Republic	-
Slovenia	-
Spain	-
Sweden	-
Switzerland	-
United Kingdom	-
United States	-