

May 2016: Leave vote channels and updated illustrative quantification

At the Key Issues 1 meeting, the Committee agreed that it would be helpful to think through the potential channels that might operate in the event that the UK votes to leave the European Union (EU). This is an updated version of the [note](#) that was provided ahead of the Draft meetings – it now assumes a larger supply hit from the change in trading arrangements and adds a few more details underlying some of the assumptions.

It sets out the key channels that Staff expect to operate in the event of a Leave vote. We provide an illustrative quantification for these channels, using the Benchmark forecast as our reference point. Our estimates build on the work done on the risks stemming from uncertainty associated with the referendum for the joint FPC / MPC meeting on 6th April, but are calibrated as a (highly uncertain) central estimate rather than a risk scenario.

The key assumptions and baseline calibration underlying this illustrative quantification are:

- The UK leaves the EU in 2018 and moves onto WTO terms for its trading arrangements – we have no insight here, other than this being the mechanical consequence of leaving absent agreeing any other alternative arrangements.
- A long-run hit to potential supply of 7½% after 15 years, the midpoint of HMT's WTO range in their long-term assessment. We assume 1.5pp of the hit comes in over the next 3 years, compared with 0.75pp in the original calibration. Our new treatment assumes that the mechanisms underlying this supply shock (reduced openness) are independent and additive to the shocks from heightened uncertainty and tighter financial conditions which also impair potential supply over our horizon. Demand responds relatively contemporaneously to this additional hit to supply, in line with our standard forecast treatment.
- A prolonged period of uncertainty: we assume that the principal component indicator increases to 1.5 standard deviations above average and remains there over the next 3 years. The contribution of uncertainty shocks to the indicator increases to 2 standard deviations after the referendum, the same contribution as at the height of the euro-area crisis.
- The UK leaving the EU triggers a reassessment of global financial conditions with US equity volatility (VIX) initially rising by 1.5 standard deviations before falling back thereafter. As a result, UK-weighted world GDP is around 1% lower by years 2 and 3.
- UK credit conditions tighten: bank funding spreads initially increase by 90bps, around half of the increase during the euro-area crisis, and IG corporate bond spreads by 150bps. The majority of this tightening subsequently unwinds.
- Risky UK asset prices are materially weaker than in the May Benchmark forecast: CRE prices are 20% lower, equity prices 15% lower and house prices 6% lower. As a result, annual house price inflation is slightly negative in 2017H1.
- Sterling falls by around 17% from current levels (or 22% relative to the Benchmark's 'remain' path), including an initial overshoot of 5% for the first few quarters after the Leave vote.
- Import prices rise in the third year as new higher tariffs are imposed following the UK's formal exit from the EU.
- Monetary policy is assumed to be held fixed.

Our baseline calibration generates a fall in the level of GDP of just over 4% by year 3 relative to the May Benchmark forecast (**Figures 1 and 2**). That reflects the impact of the likely heightened uncertainty, tighter credit conditions, falls in risky asset prices, weaker supply growth in light of the less favourable trading arrangements and more adverse global financial conditions. These are the underlying economic developments, and explain why output falls substantially despite a large fall in sterling (**Annex 1, Figure E**). Annual GDP growth is 0.3%, 1.7% and 1.3%, respectively, at years 1, 2 and 3 (**Annex 1, Figure A**). The level of GDP contracts very slightly in both 2016Q3 and 2016Q4.

The level of consumption ends the forecast period around 8% lower than in the Benchmark. Around 1/6 of that weakness is the result of the real income squeeze associated with sterling's depreciation. The remainder reflects the other demand and productivity shocks that weigh on private spending.

Around three-quarters of the lower level of GDP is matched by weaker potential supply (**Figures 2 and 3**). Around one-third of that reflects the impact of higher credit spreads, one-half the impact of the new trading arrangements and the remainder hysteresis effects and effects on the capital stock from weaker demand associated with uncertainty, the falls in risky asset prices and the weaker world outlook. Annual potential supply growth is 1.1%, 1.3% and 1.2%, respectively at years 1, 2 and 3.

As a result and despite the significantly lower path for GDP, the output gap only widens by around 1¼pp (**Figure 2**), with unemployment rising to just below 6% (**Annex 1, Figure D**).

¹ With essential help and inputs from other colleagues in MA, FS and ID.

The boost to inflation from sterling's large depreciation – and in year 3 from the imposition of higher tariffs – outweighs the drag from the wider output gap such that inflation is 2.2, 2.6% and 2.7% at years 1, 2 and 3, respectively (**Annex 1, Figure B**), 0.7pp, 0.4pp and 0.4pp higher than in the Benchmark forecast, respectively (**Figures 1 and 2**).

There are large uncertainties around the extent to which the exchange rate might respond in the event of a vote to leave the EU and hence of the size of the depreciation included in our baseline calibration – and also its impact. For illustrative purposes, based on our standard multipliers for moves in the exchange rate, a persistent 10pp larger (smaller) depreciation following the vote than in the baseline case would leave the GDP level 0.7% higher (lower) and inflation rate 0.8pp higher (lower) at the Year 3 horizon.

Our estimates for the impact of a leave vote on GDP are on the more severe end of the range of brokers. The typical external expects the level of UK output to be at least 1-2% lower a year after a leave vote (**Annex 2**) and our central estimate is -2.0% at that horizon. There are fewer estimates at longer horizons, but our assessment of a 4.1% hit to UK output after 3 years is smaller than CBI/PwC, who estimate that UK GDP would be 5.5% lower than baseline in 2020 in the case of the UK reverting to WTO trading arrangements.

Our illustrative quantification is much less severe than the 2014 stress test. The 2014 scenario was predicated on a fall in the level of UK GDP of 8.8% relative to the counterfactual base case, with inflation rising to around 6 ½%. That scenario had a larger exchange rate depreciation of 30%, a pro-cyclical response of monetary policy to counter inflationary pressure, and a 35% peak-to-trough fall in house prices.

Figure 1: Accounting for headline news against May Benchmark

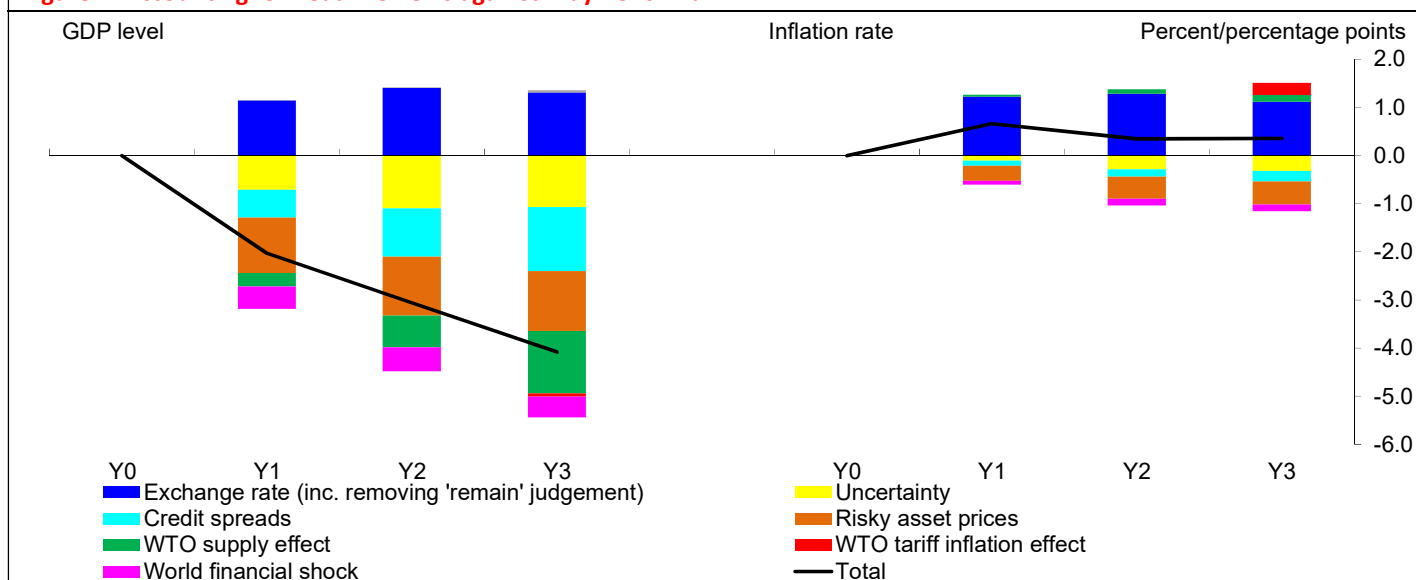


Figure 2: Headline news against May Benchmark

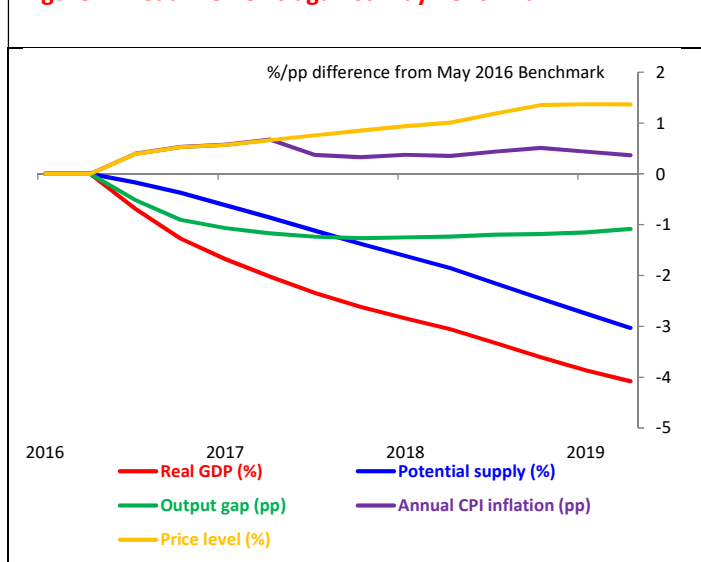
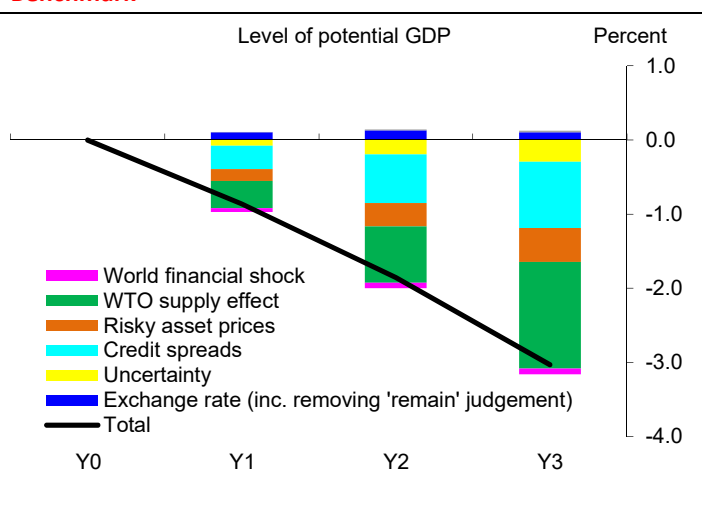


Figure 3: Accounting for news in potential supply against May Benchmark



Section 1: Key channels and calibration

Given the assumptions above, we have calibrated a central estimate over a 3-year horizon. We generally assume that the potential amplifiers discussed at the joint FPC/MPC meeting do not operate. In particular there is no “sudden stop” in financing the UK current account deficit, banks can continue to fund themselves (though at higher spreads), and the credibility of the UK fiscal and monetary policy frameworks is maintained. We do, however, assume that a Leave vote triggers a reassessment of global risk appetite.

We run through the various channels below. The size of the fall in sterling is one of the key judgements, but we build up to that by first considering the underlying shocks to demand and supply. In addition to the exchange rate, the other key judgements are on how quickly the supply hit builds and how quickly demand responds. We have provided some evidence to inform our calibrations, but this is quite limited given the lack of useful precedent.

Uncertainty, credit conditions and risky asset prices – including a reassessment of global financial conditions

Uncertainty: At Key Issues 1 you agreed to treat 50% of the recent increase in uncertainty – as modelled by our in-house principle component indicator – as due to the referendum. Following a leave vote we assume a further increase in the indicator to 1.5 standard deviations above average (**Figure 4**), driven by the contribution of uncertainty shocks rather than a response to other variables. This takes the contribution of uncertainty shocks to around the same level as during the height of the euro-area crisis which, as you touched on at Key Issues 2 and according to our current VAR model, is also similar to the financial crisis peak.

We assume the level of the uncertainty indicator persists at this higher level for at least 3 years. While the shift to WTO terms will be revealed within 2 years (by assumption), uncertainty about what that means – for example to the extent of future regulatory divergence – will persist. Uncertainty around employment prospects – and falls in confidence more generally – might also increase over time as the supply side consequences of leaving the EU become clearer.²

The uncertainty shock hits both consumption and investment, with the latter acting over time to reduce supply. We use the standard responses from our updated uncertainty VAR, but note that the response of households, and perhaps businesses too, could be more heterogeneous than usual. Those who voted to leave the EU might feel more confident about future prospects rather than uncertain about them, but the rest of the population – which could be in the majority depending on voter turnout – might react more strongly than usual. Activity supported by overseas investors may also respond more sharply, with the upcoming referendum judged to already be adversely affecting Commercial Real Estate (CRE) investment.³ Staff estimate that around a fifth of construction output and a quarter of business investment are related to commercial property (both new and improvements to existing property).⁴

Global financial conditions: We assume that the UK voting to leave the EU would have a significant effect on global financial conditions, with the US equity volatility VIX index increasing by 1.5 standard deviations, of which the majority unwinds after two quarters. This is an increase to half to two-thirds the (quarterly average) level of the euro-area crisis. It is greater than the one standard deviation increase assumed in a recent scenario estimating the effects on advanced economies of a sharp slowdown in emerging market growth, focused in China.⁵

While the UK voting to leave the EU is primarily a domestic shock, and as such would likely have a relatively small impact on growth in our key trading partners through standard channels (confidential and preliminary work by ECB staff estimates around 0.5% off euro area GDP by 2020 if the UK moved to WTO trading arrangements), it could have unpredictable political economic consequences for remaining EU members. We assume a Leave vote triggers a reassessment of global risk appetite in the near-term, which feeds through to global financial conditions and reduces the level of UK weighted world GDP by 1% by years 2 and 3. The recent spike in the VIX index which had no clearly identifiable cause, and the potential for market liquidity to evaporate and amplify shocks, support including this channel in our baseline, but the judgement is highly uncertain.

Credit conditions: Bank funding spreads initially increase by 90bps (**Figure 5**). This includes a response to the tightening in global financial conditions, and is around half the size of the increase in the euro-area crisis. We judge this as a plausible central estimate given the improvements in resilience of the UK banking sector. The profile for the Credit Spread Adjustment – which

² That said, our actual indicator might fall back if it fails to capture this more deep-seated uncertainty as implied volatilities tend to spike to elevated levels rather than persist at them, and news coverage may wane.

³ See that latest edition of

⁴

⁵ In our baseline calibration we use the same Cholesky-identified VAR model as used in this exercise, which contains the VIX, credit spreads and world GDP, and suggests that world PPP-weighted GDP would fall by around 0.5% following a one standard deviation rise in the VIX. The UK uncertainty VAR would also suggest similar effects on UK GDP from a rise in uncertainty of this magnitude.

also includes an increase in term premia and assumes some decompression in bank margins as a result of reduced competitive pressures as the UK withdraws from the EU – falls back to around one thirds its initial size at 3-years. Sterling IG corporate bond spreads initially rise by 150bps, based on their historical relationship with term premia and bank funding spreads. UK sovereign bond term premia increase by up to 50bps for 5 year spot rates; we make no explicit assumption about longer horizon term premia.

Figure 4: Uncertainty principle component indicator in May Benchmark and illustrative quantification

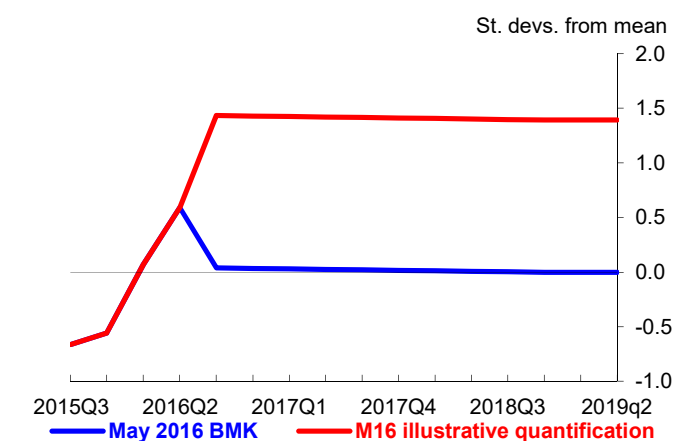
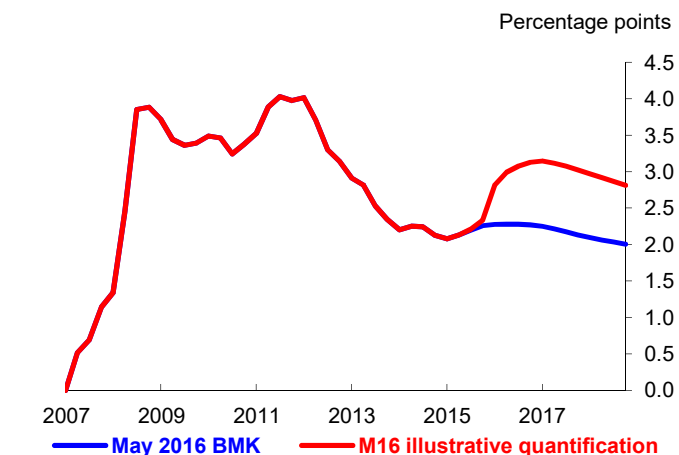


Figure 5: CSA in May Benchmark and illustrative quantification



The uncertainty and credit spread shocks above are the result of two different modelling approaches. We make no adjustment for potential double counting for two reasons. First, the uncertainty VAR includes a measure of credit conditions, which will reduce though likely not eliminate the overlap. And second, it seems plausible that the combined effects of uncertainty – particularly about such an unprecedented event as a major economy leaving the EU – and tighter credit conditions might generate a bigger response than past multipliers would suggest.

Other asset prices: Higher domestic borrowing costs, which include a response to the tightening in global financial conditions, and reduced incomes push down on house prices. We assume that house prices are 6% weaker than in the Benchmark forecast. This is sizeable, but the implied peak-to-trough fall of 3% is much smaller than the 35% fall used in the 2014 stress test or the 20% fall seen over seven quarters following the 2008 financial crisis. In an absolute sense, we assume outright falls in the level of house prices in 2016H2 and slightly negative annual house price inflation in 2017H1. Although in-house analysis has, so far, not clearly identified any negative effect from the referendum news in equity prices we assume a sizeable fall of 15% relative to the Benchmark forecast on a Leave vote itself, including some feedback from the worsening in global financial conditions. In addition to weighing on spending through a wealth effect, lower equity prices may also affect investment decisions via increasing the cost of capital. CRE prices are assumed to be 20% lower than in the Benchmark forecast, which is a little less than half of the fall in the financial crisis. By reducing the value of CRE collateral, this may also tighten borrowing conditions.

Additional supply channels

The combined effects of the shocks above knock around 1¼% off the level of supply at year 3 (Figure 3). These impacts come through the following channels: lower business investment impacting on the capital stock, higher credit spreads impairing productivity and hysteresis channels (whereby elevated unemployment means that U^* is around 0.3pp higher than it would otherwise be, at around 5.2%).

We have made no explicit judgements on labour supply (including migration and population growth) in our baseline calibration. Any fall in migration would affect both demand and supply, with its effects on inflation depending on the balance between the migrants' labour supply choices and their spending/saving choices and how different these are to the average domestic worker. A box in the May 2015 *Inflation Report* discusses – in more general terms – the impact of changes in potential labour supply, and includes a simulation which – after flipping the sign of the exercise – implies that a fall in potential labour supply would increase inflationary pressure, albeit by a small amount.

We do, however, build in an additional supply effect, informed by HMT's longer-term analysis and estimates, to fully take into account the change in trade arrangements resulting from a leave vote.⁶

HMT estimate a loss of output of 7.5% at 15-years under their central estimate for the scenario where the UK leaves the EU and subsequently trades under the World Trade Organisation's (WTO) rules. In HMT's framework, lower supply is largely driven by the loss of productivity due to lower trade and FDI inflows, with an additional impact linked to the prolonged period of uncertainty (which accounts for 1% of the loss), some reduction in the capital stock, and a reduction of trade itself through general equilibrium effects in their modelling approach.

In our baseline calibration we assume a 1.5% reduction in the level of supply at year 3, as reduced openness weighs on TFP. We take this figure from a linear interpolation of HMT's full 7.5% hit, which would imply a 1.5% reduction to supply at the end of our forecast period.⁷ This is an essentially arbitrary judgement. But it can be thought of as a way to balance out arguments for a back-loaded profile and reasons for some more front-loaded effects. Lags in reduced trade openness and FDI inflows feeding through to TFP, or a ratcheting up in regulatory divergence in outer years, would support a later decline in supply; while misallocation effects would tend to bring the additional hit to supply forward.

On misallocation, the prospect of fewer export opportunities may discourage new exporters from entering the market lowering productivity. This dynamic could be exacerbated by financial and credit constraints. Tight credit conditions could also slow the investment in, and introduction of, new innovations and products. And lower competition due to lower trade would also decrease the average level of productivity by reducing the pressure to shift resources from low productivity to high productivity activities and between firms. If, as in the financial crisis, there was some form forbearance the process of reallocation could be slower and effects on supply greater.

We are now treating the supply shock from reduced openness as completely additive to the other shocks in the illustrative quantification that impair supply over our forecast horizon, such as higher credit spreads, hysteresis and capital shallowing from reduced business investment. This treatment effectively assumes that the hit to TFP from reduced openness, which drives HMT's long-term estimates, builds linearly and independently of the more temporary shocks affecting potential supply. We previously assumed there could be some overlap, and hence a smaller 0.75% shock in the original calibration.

Our baseline calibration assumes that demand responds fairly contemporaneously to this 1.5% shock to potential supply, in line with the usual forecast treatment.⁸ So agents don't anticipate the full 7.5% future reduction in supply, but rather react in each period as the hit to supply comes through. This is a key judgement, but balances the idea that those who voted to remain in the EU might well foresee a future loss of income, and react in a more forward-looking manner than past average behaviour would suggest, against those who voted to leave perhaps believing the economic impact to be positive or unimportant to them.

Exchange rate

Trade weighted sterling is assumed to fall by 17% from current levels, including an initial overshoot of 5% for the first few quarters after the Leave vote. That translates to an initial fall of 22% relative to the Benchmark's 'remain' path, of which 17pp persists based on our best assessment of the shift in fundamentals (see below). The judgement on the degree and persistence of the likely overshoot is based on a simple event study analysis of previous large sterling moves – using the ERM and financial crisis depreciations – and the extent to which the currency appeared to have overreacted immediately following the shock relative to where it settled down over a longer period. The relative scale of that effect, on average, is then applied to the fundamental shock in question here.

⁶ Note that HMT have not yet released their transition estimates, so we don't know what they have assumed for the short-run dynamics.

⁷ We assume supply falls by 0.4% in Y1, 0.4% in Y2 and 0.7% in Y3. The slight back-loading reflects the introduction of trade barriers under the WTO rules after two years of negotiations, and the lagged effect of lower openness, both reflecting lower trade and FDI inflows, on productivity.

⁸ To avoid implausibly large and front-loaded responses of demand in response to future supply shocks, we typically impose changes to productivity using unanticipated, rather than anticipated, shocks. This is our usual forecast treatment and results in demand tracking changes in supply quickly, but not quite contemporaneously, such that the output gap and inflation consequences of supply shocks are small. Looking into COMPASS itself: households and firms are forward-looking and view any change in productivity or labour supply as permanent. Consequently the adjustment of GDP and the output gap to a productivity shock is relatively fast. Demand responds to higher potential supply quickly and that process is complete within the three-year forecast period. That said, there are specific frictions in the model which mean that the response of demand to supply is slower than it would otherwise be. First, around 20% of households in COMPASS are assumed to be 'rule of thumb' and only consume out of current rather than permanent income, making them less responsive to supply shocks.

Second, consumers are assumed to display some habit formation and so take time to adjust spending patterns in the face of lower income. Finally, investment adjustment costs prevent firms from instantaneously adjusting their capital stock in the face of shocks. So when a negative productivity shock reduces the return on capital, for example, firms do not immediately respond to that.

The method on which we have placed most weight for assessing the extent to which the (real) effective exchange rate may need to adjust fundamentally following a leave scenario is one based on an estimate of the UK's sustainable current account position⁹ – under an assumption that the imposition of tariffs, loss of EU passporting arrangements for financial institutions, reduced productivity growth, and tighter UK financial conditions all point in the direction of the UK needing to run a persistently smaller deficit. Based on two different techniques – external sustainability and macro balance¹⁰ – we judge that the sustainable current account would need to narrow to around a 1% deficit, compared with the current in-house estimates that put the sustainable deficit at 3-4%. The macro balance approach relates the level of the sustainable current account position to factors including the domestic medium-term growth outlook, such that the weaker outlook for supply growth outlined in the previous section requires a more positive current account position to stabilise debt dynamics, all else equal.

Given that 1% sustainable deficit estimate, a comparative static exercise on the 2015 current account deficit of 5.2% – using a long-run elasticity with respect to the exchange rate of -0.25 (taken from the IMF) – implies a 17% fall in the long-run (real) exchange rate.

As a cross-check, we compare with staff's analysis of how much of the fall in sterling seen so far has been driven by the referendum. This analysis associated a 5pp referendum effect on the level of sterling with around a third probability – based on the betting odds – of leaving the EU. Scaling that up to a 100% chance of leaving points to a 15pp overall referendum effect on sterling which is similar to the estimates above based on a 1% sustainable current account deficit.

As part of the broader modelling exercise, and reflecting the nature of the shocks underpinning this scenario, the effect of the exchange rate – via the usual forecast multipliers – on exports and hence net trade is countered. In particular, the standard boost to exports is offset by the extent to which supply is weaker – both in terms of our assumptions on how much of HMT's estimated 7.5% long run hit to output from moving onto WTO terms occurs over our forecast horizon and by our more standard supply channels.

Import tariffs

We have also made a rough assessment of the likely impact on import tariffs and prices of leaving the EU officially at the end of the second year and reverting to WTO Most Favoured Nations rules. According to the World Bank, over the period 2011-2014 the UK applied, on average, an effective average import tariff (weighted by the product import shares) of 1.15%. With non-EU imports accounting for 49% of total imports over that period, that implies an average tariff on non-EU imports of around 2.4%. If the UK were to impose this average tariff to both EU and non-EU imports after leaving, this would imply an increase in UK import prices of around 1%. Given that the import intensity of the CPI basket is just below 30%, this would lead to an increase in CPI of about 0.25%.

⁹ For more details on these methods see [redacted] and for the current estimates [redacted]

¹⁰ The external sustainability approach assesses the long-run current account position that would stabilise the net foreign asset to GDP ratio, given GDP growth rates and net capital gains on the NFA. Our baseline calibration implies lower annual nominal GDP growth via slower TFP growth and we have also assumed a hit to net capital gains on the stock position (from 4% to 2%). A higher steady state external stock to GDP ratio (as lower inward FDI flows boost the net stock position), and unchanged net capital gains, would also result in a 1% sustainable deficit. Under the macro-balance approach, the UK's degree of openness (gross trade to GDP) relative to abroad affects the sustainable current account deficit. Plugging in the HMT long run WTO estimates of trade and GDP declines in this model would imply a 3.8pp more positive sustainable current account position than is currently the case. That would give a sustainable current account position in the region of zero.

Annex 1: Headline profiles

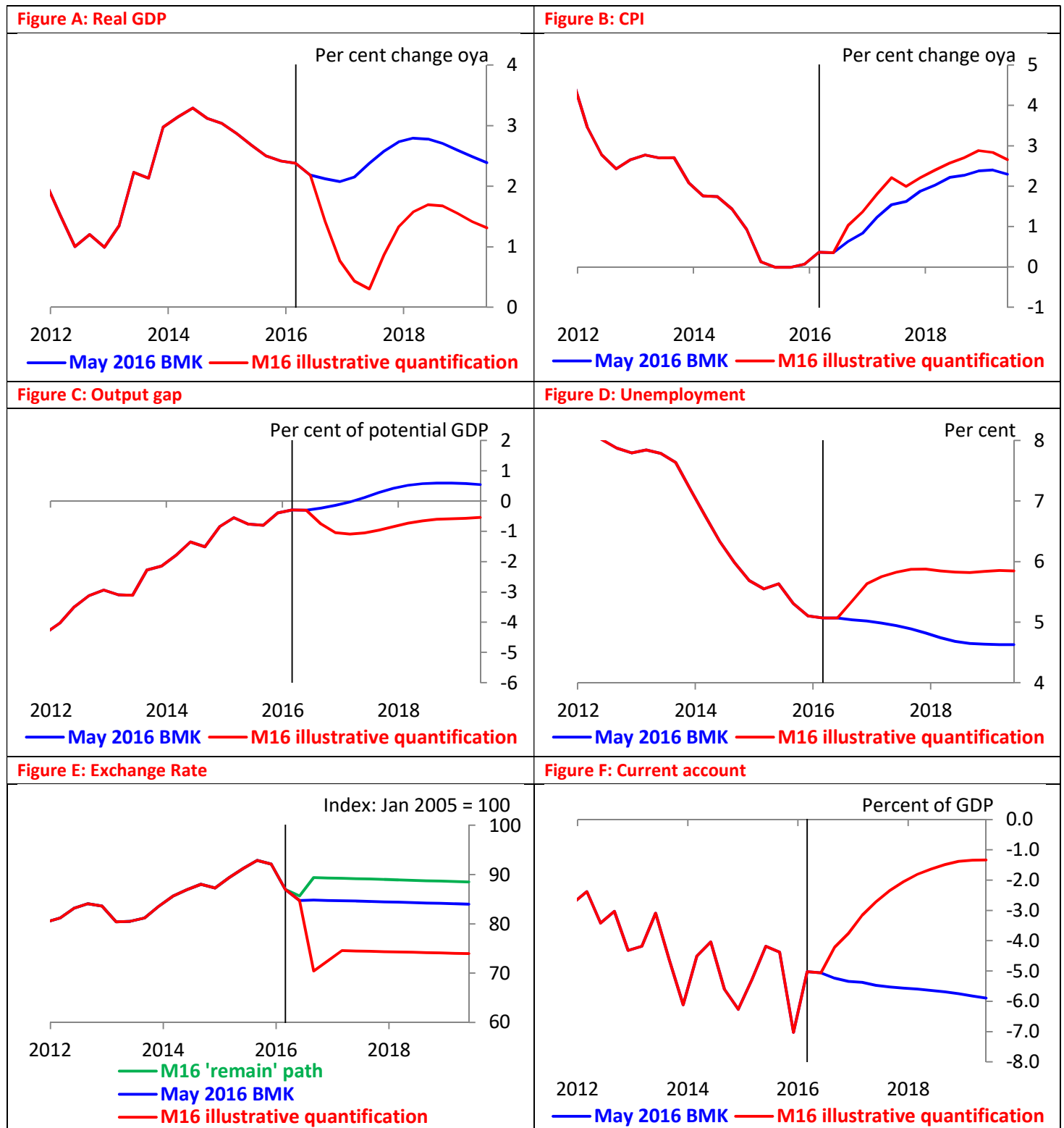


Table 1: Comparison against 2014 stress test scenario

	2014 stress test scenario	Illustrative quantification of 'leave' vote
Real GDP (% deviation from baseline at Y3)	-8.8	-4.1
Annual CPI inflation (pp deviation from baseline at Y3)	4.3	0.4
Annual CPI inflation (%) (peak level)	6.6	2.9
Bank Rate (pp deviation from baseline at Y3)	2.1	0.0 (fixed)
Unemployment (pp deviation from baseline at Y3)	4.8	1.2
Unemployment (%) (peak level)	11.9	5.9
Output gap (pp deviation from baseline at Y3)	-2.8	-1.1
House price (peak-to-trough)	-35	-3
CRE price (peak-to-trough)	-30	-19
Equity price (peak-to-trough)	-28	-12
Exchange rate (peak-to-trough)	-30	-17
IG spreads (peak-to-trough)	184bps	150bps

Annex 2: Recent external estimates of the short and long-run effects of Brexit

Table 1 below shows the GDP impacts of a number of external studies from brokers. All expect a vote to leave the EU to lead to a slowdown in economic growth in the short term. The range of expectations for this decline in growth, relative to counterfactuals in which the UK remains in the EU, is between 1pp and 4pp per annum. Many also flag the possibility of lower potential growth, largely attributable to lower investment and a reduction in labour supply as a result of lower migration inflows. The majority of brokers appear to agree that investment is likely to be materially affected by a vote to leave. Almost all appeal to “wait-and-see” effects from heightened uncertainty as a reason for a fall in investment growth. Medium and long-term impacts are generally not considered in detail, though the duration and progress of exit negotiations, as well as the nature of the future UK-EU relationship, are recognised by most of these studies as key factors in determining the persistence of these effects. Only a few studies include an estimate for inflation.

Table 1: Estimates from investment bank economists

	Effect on level of GDP (%)	Inflation (%)
Citi	-4.0 (over 3 years)	3-4
Credit Suisse	-1.0 to -2.0 (over 2 years)	N/A
Deutsche Bank	-3.0 (over 3 years)	N/A
HSBC	-1.0 to -1.5 (over 1 year)	5
JP Morgan	-1.0 (over 1 year)	N/A
Morgan Stanley	1.5 to -2.5 (over 2 years)	N/A
Nomura	-4.0 (over 1 year)	N/A
Société Générale	-4.0 to -8.0 (over 5 years)	N/A

Table 2 shows the impact on GDP and the GDP cost equivalent per household across a number of more academic studies. These studies assume different channels, scenarios, and modelling techniques but all conclude that a leave vote would lead to a reduction of output compared to a baseline scenario in which the UK remains in the EU, both in the near and the longer term. We very briefly summarise the key points from these studies below, but also provide links to more detailed briefing notes produced ahead of recent parliamentary appearances.¹¹

¹¹ Staff briefings / summaries of OECD: [“The economic consequences of Brexit: a taxing decision”](#); CBI/PwC: [“Leaving the EU: implications for the UK economy”](#) LSE/CEP: [“The consequences of Brexit for UK trade and living standards”](#); and HM Treasury: [“Analysis of the long-term economic impact of EU membership and the alternatives”](#). For a positive case of the benefits, see the report from Economists for Brexit: [“The Economy after Brexit”](#).

Table 2: Summary table of recent longer-term studies from the OECD report

	OECD	CBI/PwC		LSE/CEP		Treasury		
	WTO/FTA	FTA	WTO	Optimistic (FTA)	Pessimistic (WTO)	EEA	FTA	WTO
Outcomes								
Near term	2020	2020		Static				
GDP (%)	-3.3%	-3.1%	-5.5%	-1.3%	-2.6%			
GDP cost equivalent per household	-2200	-2100	-3700	-900	-1700			
Longer term	2030	2030		Dynamic				
GDP (%)	-5.1%	-1.2%	-3.5%			-3.80%	-6.20%	-7.50%
Range	-2.7% to -7.7%			-6.3% to -9.5%		-3.4% to -4.3%	-4.6% to -7.8%	-5.4% to -9.5%
GDP cost equivalent per household	-3200	-600	-1800			-2600	-4300	-5200
Range	-1520 to -5000			-4200 to -6400		-2400 to -2900	-3200 to -5400	-3700 to -6600
Channels								
Uncertainty in short-term	x	x	x					
Tariffs on goods trade with the EU	Until 2023	x		x		x		
Non-tariff barriers on trade with the EU	x	x	x	x	x	x		
Current FTAs with non-EU countries maintained/rep	x from 2026			x	x	gradually replaced		
Fall in migration	x	x	x					
Fall in FDI	x	x	x			x	x	x
Lower private R&D spending	x					x	x	x
Lower managerial skills	x							
Deregulation	x	x	x					
Lower or zero contributions to EU budget	x	x	x	x	x	x	x	x

The OECD study concludes that in the near term, by 2020, GDP would be 3.3% smaller than in the case of continued EU membership, equivalent to a cost per household of £2,200 (in 2015 prices). In their central long-term estimates GDP is more than 5% below the baseline by 2030. This is equivalent to an annual reduction in UK GDP growth of 0.3 percentage points per annum on average over 2016 to 2030.

The CBI/PwC report estimates the impacts on the UK economy in two 'EU exit' scenarios. In the most favourable scenario the UK exits and negotiates a free trade agreement (FTA) with the EU. In the less optimistic scenario the UK exits the EU and then trades with the EU under WTO rules. Relative to a counterfactual in which the vote is to remain in the EU, real GDP growth is judged likely to be 0.8pp-1.4pp per annum lower between 2016 and 2020. Over the medium-term (2021-2025) GDP growth under the two leave scenarios is slightly higher than the counterfactual as the economy adjusts to the new equilibrium. Growth then converges to that of the counterfactual scenario (2.3%) during 2026-2030.

The CEP report sets out two possible scenarios after a vote to leave. The first is an optimistic scenario under which trade with the EU is not subject tariff barriers, but is subject to some non-tariff barriers. The second scenario assumes that the UK is subject to both tariff and non-tariff barriers. Under a static model the effects of Brexit are equivalent to a permanent fall in per-capita income of between 1.3% and 2.6% immediately following Brexit, in the optimistic and the pessimistic scenario respectively. An alternative 'reduced-form' model, which additionally captures longer-run effects such as productivity growth leads to much higher estimates. In this case Brexit may reduce national income by between 6.3% and 9.5 (around £4,200 to £6,400 per household per year).

The analysis by HM Treasury considers the long-run impact (15 years) of a leaving vote under three scenarios: membership of the EEA; a negotiated bilateral agreement; and WTO membership. The analysis focuses on the impact of trade and foreign direct investment (FDI) due to the change from EU membership to each of the three alternatives. All three alternate scenarios reduce the level of trade (between 9% and 17%) and FDI inflows (between 10% and 18%) after 15 years, relative to remaining in the EU. The reduction in the level of trade and FDI inflows in turn reduce the level of productivity by between 2 and 7.7% after 15 years, relative to remaining in the EU. The impact on GDP is a reduction in the annual level of between 3.4% and 9.5% after 15 years, relative to remaining in the EU. This is equivalent to a reduction in GDP per household of between £2,400 and £6,600 per annum.

Annex 3: Summary from HMT's long-term economic impact report of the key features of the alternative arrangements

Figure 2.A: Overview of economic aspects of alternative relationships³

		Access to the single market in goods & services			Obligations	Influence	
		Tariff-free trade	Customs union & external trade	Level playing field/ non-tariff barriers	Other policy & regulation	Financial contributions	Votes on EU rules
EU membership		Full	Full. No customs costs. Access to EU FTAs	Full	Full	Full EU budget contributions	Full
The UK's special status		Full	Full. No customs costs. Access to EU FTAs	Full	UK is not a member of the single currency	UK receives rebate on EU budget contribution	Full
EEA (Norway)		Some tariffs remain on agriculture & fisheries	None. Customs costs apply. No access to EU FTAs	Agriculture & fisheries not substantively covered by the EEA agreement	Accepts most EU rules, including market/product standards, free movement of people, environment, energy, climate & social policy	Pays for EEA Grants, Norway Grants, admin costs & programme costs	None
Bilateral agreements	Switzerland	Some tariffs remain on agriculture	None. Customs costs apply. No access to EU FTAs	Minimises non-tariff barriers in sectors covered. Limited coverage for services. No financial services passport	Adopts EU rules in sectors covered. Participates in free movement of people & EU rules on e.g. environment, energy, climate & social policy	Gives grants to new EU member states. Pays admin & programme costs	None
	Turkey	Only applies to manufactured goods & processed agricultural goods	No customs costs for manufactured goods. Obligation to align external trade policy with EU	Removes most other barriers to trade in goods. No special access for services. No financial services passport	Adopts EU product standards, committed to equivalent rules on competition, state aid etc. & complies with environmental standards linked to goods trade	Turkey is in receipt of some EU funding	None
	Canada	Some tariffs remain on agriculture. Some tariffs on manufactured goods remain for a transitional period	None. Customs costs apply. No access to EU FTAs	Partial liberalisation of services. No financial services passport	Firms trading into EU conform to EU standards. International agreements & standards apply	None	None
WTO membership		EU external tariffs apply	None. Customs costs apply. No access to EU FTAs	International agreements and standards apply. No financial services passport	Firms trading into EU conform to EU standards. International agreements & standards apply	None	None

³ The dotted line in the table broadly shows the scope of the EU's regulatory framework in relation to the Single Market and other relevant EU policies.