MPC MEMBERS

ASSESSING THE TRADE-OFF ASSOCIATED WITH THE LEAVE VOTE

This note assesses the monetary policy trade-off in light of the vote for the UK to leave the European Union. For the purposes of this note, we take the update of the Leave-vote scenario produced during the May forecast round. This includes a projection for inflation that remains below target until mid-2018, before overshooting by 0.4pp in 2019, and an output gap that troughs at -1.4% at the start of 2018 and is still -1% by the end of the projection in 2019.[1] We will revisit this issue during the August forecast round.

- With inflation 0.4pp above target in 2019, but the output gap significantly negative (despite the loosening captured in the market path), the update of the scenario embodies a trade-off for the MPC.
- Based on how the MPC has tended to trade off inflation and the output gap over the past, a better trade-off in the early part of the scenario could be achieved by loosening.
- Where the monetary policymaker places some weight on the output gap, policy rules point to an initial loosening in response to the scenario. These loosenings deliver less negative output gaps, but they also mean larger overshoots of inflation in 2019.
- Estimates of the sacrifice ratio for the UK suggest that the costs of eliminating the 0.4pp overshoot in inflation in 2019 captured in the scenario could mean cumulated output losses of between 0.3% and 1.2% of annual output.

1 Trade-offs: stylised framework

A simple framework for thinking about how to manage the trade off the MPC is facing is shown in Figure 1.[2] The red line in the figure illustrates a hypothetical policymaker's preferred trade off: it shows the size of the negative (positive) output gap the policymaker is systematically prepared to tolerate for a given overshoot (undershoot) of inflation from target. The flatter the line, therefore, the lower the policymaker's weight on output stabilisation (large negative output gaps would be tolerated to achieve small overshoots in inflation). The Phillips curve summarises the structure of the economy and, in particular, how changes in demand, via the output gap, determine inflation. The economy's equilibrium is at the intersection of these two lines.

Starting from the origin, for an inflationary shock that induces a trade off, the Phillips curve shifts up, as shown in Figure 1. Monetary policy needs to tighten to generate a negative output gap to reduce inflationary pressures such that the economy ends up on the red line, consistent with the policymaker's preferences (as shown by the dotted arrows in the figure). The slope of the Phillips curve is, therefore, crucial in determining in the size of the fall in output needed to reduce inflation to an acceptable level – i.e. the *sacrifice ratio*, estimates for which are discussed in Section 3.

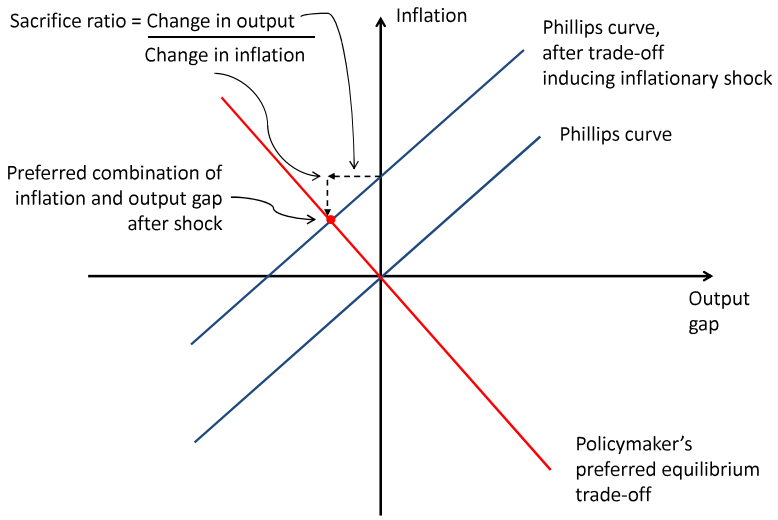
For negative (positive) demand shocks, there would be a tendency for inflation and the output gap to move into the south-west (north-east) quadrant. But because these shocks do not pose a trade-off in this simple setting, policy would respond by loosening (tightening). As a result, inflation and the

[1] Full details of which can be found in .

[2] With thanks to for the diagram, which draws on .

output gap would alway be kept the origin. Hence, we would not expect to see outturns for the output gap and inflation in these quadrants: they would always be along the red line.

Figure 1: Simplified view of the trade-off for monetary policy



2 MPC's trade-off over the past

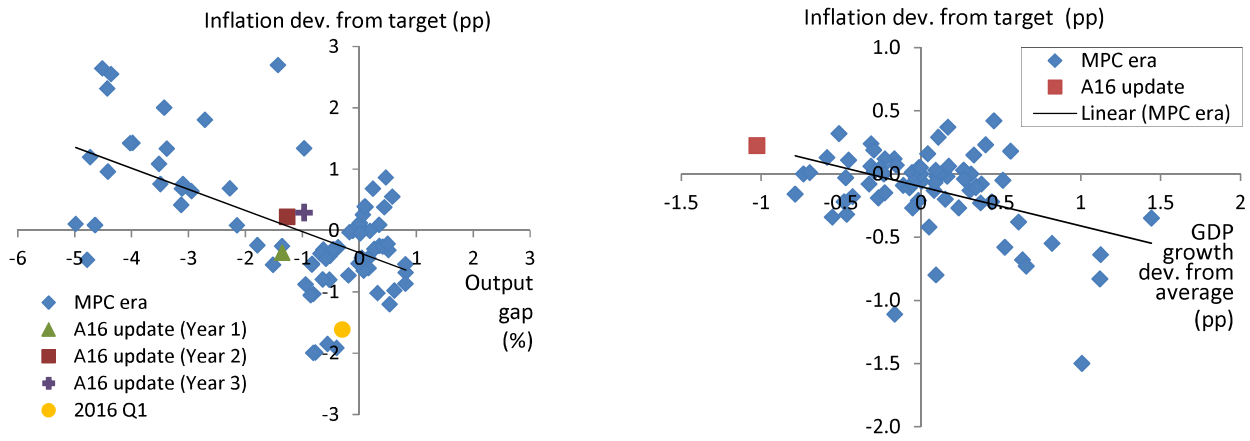
Since its inception, the MPC has, broadly speaking, traded off periods of inflation deviations from target against the output gap in a manner consistent with the framework from Section 1. This is clear from Figure 2a, which plots the combinations of inflation and the output gap (MPC's measure) that have been observed since late-1997. The correlation between deviations of inflation from target and the output gap is around -0.6. In addition, the slope coefficient on the trend line is around -0.35. That is, on average, the MPC has roughly traded-off a 0.35 percentage point overshoot in inflation alongside an opening up of a negative output gap of 1 percent.[3]

We can also use Figure 2a to shed light on the trade off at the current juncture. The yellow dot plots the combination of inflation and the output gap in 2016 Q1. Its position in the south-west quadrant suggests it is some way from the average of the MPC's past trade-off. From this point, it would, arguably, be possible to get better outcomes in terms of both inflation and the output gap by loosening. The green triangle plots the combination of inflation and the output gap in the Leave scenario at the end of Year 1 of the forecast. Again, it ought to be possible to improve the trade-off at this point by loosening. At the end of Year 2 of the forecast in the Leave scenario, the combination of inflation and the output gap (red square) is broadly in line with the average way the MPC has traded these variables off in the past. By Year 3 of the Leave scenario, the trade-off is more in the desirable region prescribed by the simple framework in Figure 1, but involves a bigger overshoot in inflation, given the output gap, compared to the average of the past (purple cross).

But Figure 2a also makes clear that the MPC has not rigidly traded off the inflation and the output gap in the manner outlined in Figure 1: the R^2 associated with the trend line is 0.34. In part, this is likely to be because the simple output gap-inflation trade-off does not adequately capture the MPC's strategy of looking through the effects of price level shocks. For instance, the fitted values from the regression associated with the trend line in Figure 2a (not shown) indicate that the largest deviations

[3]For some additional details on the MPC's trade-off between inflation and the output gap over the past see .

Figure 2: Monetary policy trade-offs since inception of MPC



(a) Inflation-output gap trade-off

(b) MPC forecasts at Year 2

Notes: In left-hand panel: inflation data are for CPI, where it has been assumed at the RPIX-CPI wedge is constant pre-2004 such that the 2.5% RPIX target is consistent with a 2% CPI inflation target. In right-hand panel, pre-2004 inflation data are for RPIX with a target of 2.5%. Modal forecasts conditioned on the market curve. GDP forecasts are less the average growth rate of GDP up to the point at which the forecast was made.

occurred during periods when inflation spiked up around from 2006-2010 and more recently, as inflation has been well-below target. Moreover, Figure 2a plots contemporaneous values for inflation and the (latest estimate of the) output gap. In reality, we might expect there to be lags between policy and its effects on inflation and the output gap that are not captured in the simple framework in Figure 1. And estimates of the output gap may have been revised relative to what policymakers were seeing at the time. As such, the dots in the south-west and north-east quadrants (where, from the viewpoint of the simple framework, policy easing / tightening ought to improve outcomes) are not necessarily suggestive of sub-optimal policy.

Another way we can get a handle on how the MPC have viewed the trade-off over the past that is less vulnerable to these criticisms is to revisit *Inflation Report* forecasts. Figure 2b plots the MPC's inflation forecast (relative to the target) against its forecast for GDP growth (relative to average growth up to the date of the forecast) at Year 2 of the forecast. This is the horizon at which the MPC arguably focuses on the trade-off. The trade-off depicted in this figure is broadly consistent with that in Figure 2a, with a slope of -0.31. Furthermore, from the figure, it is clear that the trade-off embodied in the Leave scenario is well outside of the pack of what the MPC has published in the past. There are a couple of notes of caution in interpreting this scatter, however. First, it is based on output growth rather than the output gap, and there may be good reasons to expect output growth to be below average at Year 2, even if the output gap is closed (such as persistent headwinds). Second, the *IR* forecasts are produced under the assumption that policy follows the market path and are used as a communications device. So, in Figure 2b, when both inflation and output growth are projected to overshoot (undershoot), this is likely to reflect the MPC's desire to shift the market path, rather than being a statement of its preferred trade-off.

3 Sacrifice ratios

The sacrifice ratio provides an estimate of how great the cumulated output loss would need to be in order to deliver a particular fall in inflation.[4] As such, it is closely related to the slope of the Phillips

[4]The sacrifice ratio is typically computed as the ratio of the cumulated output gap losses (as a share of annual output) divided by the change in annual inflation, between the start of the disinflation and the inflation trough. See for more details on approaches and estimates.

curve (as shown in Figure 1). There are a variety of different approaches to estimating sacrifice ratios, such as looking at the evidence from historical disinflationary episodes, estimating reduced-form Phillips curves, or simulating the effects of a contractionary policy in a structural model.

Table 1 sets out some alternative estimates for the sacrifice ratio in the UK, based on past Bank work, COMPASS and the literature. The range of estimates lies between 0 and 3.1. COMPASS has a relatively high estimate of the sacrifice ratio (1.9), which reflects the relative flatness of its Phillips curves (meaning that to deliver a particular disinflation requires a large fall in output). By way of comparison, the version of COMPASS that was described in the 2013 Working Paper, which had steeper Phillips curves, implied a sacrifice ratio of 1.0. There is some evidence from a time varying estimation of COMPASS that the sacrifice ratio for the UK rose between the early 2000s and 2012.

Since 2013, we have been using the sectoral model to calibrate the effect of anticipated monetary policy changes on the forecast, rather than COMPASS. The sacrifice ratio associated with this model (computed to be consistent with the other estimates[5]) is 3.1, and so at the top end of estimates. This partly reflects the slower moving dynamics which mean that the trough in inflation is relatively late (8 quarters compared to 4 for COMPASS), mechanically leading to larger cumulated output losses.

Based on the central estimates for the sacrifice ratio, eliminating the 0.4pp overshoot of inflation in the forecast would require cumulated output gap losses of between 0.3% and 1.2%. That said, Section 2 suggests that, rather than eliminating the overshoot in inflation, the trade-off in the Leave scenario could be improved by accommodating a larger overshoot in inflation in order to reduce the extent of the negative output gap.

Table 1: Estimates of the sacrifice ratio for the UK

	Approach	**Estimate**	**Range**
COMPASS (model)	Estimated DSGE model (1993 to 2013)	1.9	1.4 to 2.1
Forecast multipliers	Sectoral model	3.1	
Ball (1994)	Historical disinflations (1963-1986)	0.8	0 to 1.9
Fernandez-Corguedo (2008)	Review of 6 structural models		0.8 to 2.5
Mumtaz (2008)	Structural VAR		1.7 to 2
Chortareas et al (2001)	Estimated Phillips curves (1990-2000)	0.8	

4 Policy response: simple rules

The realised trade-off between inflation and the output gap will, ultimately, be determined by the response of policy. One way to assess the policy response to the Leave vote scenario is to consider the prescriptions of different policy rules. Figure 3 plots the responses of the output gap, inflation, Bank Rate, and the ex-ante real rate to the shocks implied by the Leave scenario, relative to the May *IR*, under different assumptions about policy. The red line in Figure 3 shows the responses in the scenario conditional on the yield curve at the close of business on 30th June.

The profiles under the alternative policy rules can be thought of as the marginal responses of the macro variables of interest to the Leave-vote shocks, relative to the May *IR*. In other words, we take the May *IR* as our starting point and consider the effect of the shocks associated with the leave vote around that, allowing policy to respond endogenously. These shocks (to demand, productivity, the exchange-rate risk premium etc.) are assumed to be *un*anticipated, consistent with the standard forecast convention.[6] [7] The three alternative rules that we consider are:

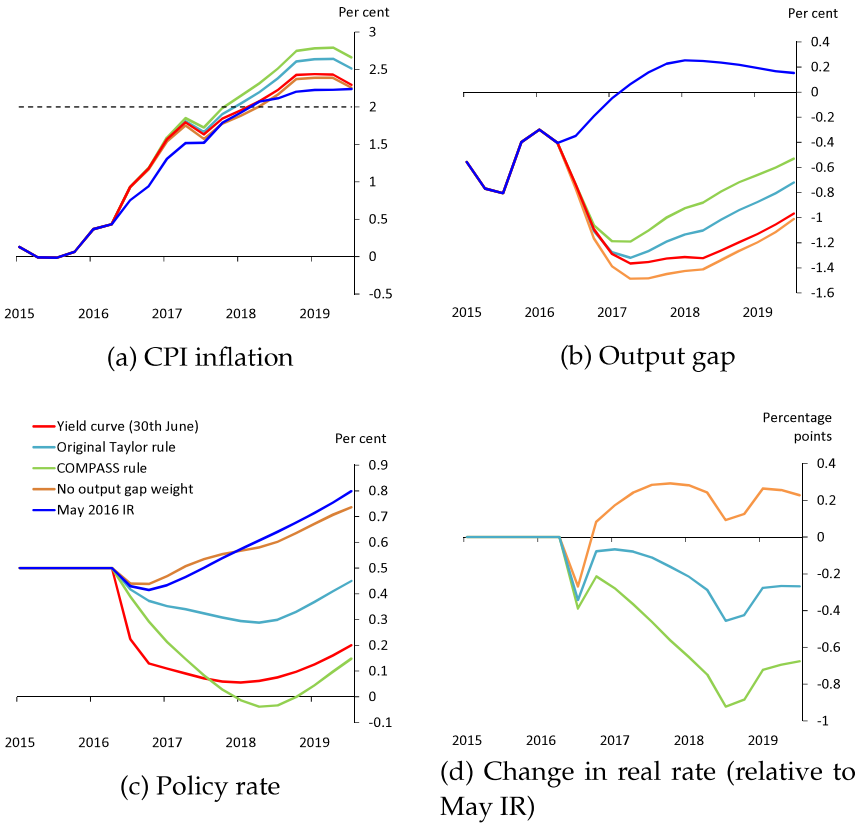
[5]The sectoral model takes an exogenous path for rates. In order to be consistent with the other estimates, we have used the path of rates implied by the COMPASS monetary policy shock impulse response.

[6]This is distinct from the perfect foresight assumption that we have used for our optimal policy projections in the production of the Quarterly Monetary Policy Analysis note.

[7]Technically, to produce the projections under alternative rules involves three steps. First, we replace the COMPASS

- COMPASS Taylor rule: $i_t = 0.91 i_{t-1} + 0.09\left(1.5\left(\pi_t - \pi_t^*\right) + 0.29 Y_t\right)$ (green line)
- Original Taylor (1993) rule: $i_t = 0.91 i_{t-1} + 0.09\left(1.5\left(\pi_t - \pi_t^*\right) + 0.125 Y_t\right)$ (light blue line)
- No output gap weight: $i_t = 0.91 i_{t-1} + 0.09\left(1.5\left(\pi_t - \pi_t^*\right)\right)$ (orange line)

Figure 3: Response to scenario under alternative policy rules



(a) CPI inflation

(b) Output gap

(c) Policy rate

(d) Change in real rate (relative to May IR)

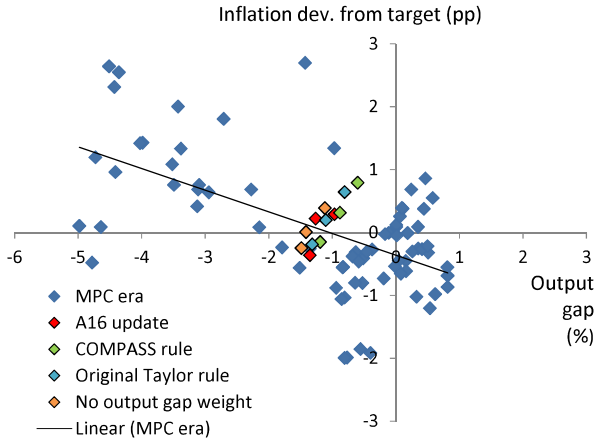
The two rules that place some weight on the output gap point to a looser path for policy than the May 2016 *IR*, although to differing extents. The COMPASS rule (which places the highest weight on the output gap) points to a larger loosening than the standard Taylor rule. This delivers a less negative output gap, but comes at the expense of a larger inflation overshoot (up to 2.8% in year 3). The rule which has no weight on the output gap stabilises inflation better, but at the expense of a more negative output gap. The final panel shows that all rules point to an initial fall in real interest rates relative to the May *IR*, but have different implications for how persistent that fall should be.

There are two features of the rule simulations that warrant discussion. First, as described in Section 3, the sacrifice ratios in COMPASS and implied by the forecast mutlipliers are relatively high. This manifests itself here in relatively little difference between the inflation projections under the alternative rules despite larger differences in the output gap. To the extent that some other estimates of the Phillips curve are steeper (and the sacrifice ratio lower), this could point to upside risks to the inflationary consequences of policies which loosen to support the output gap. Second, note that despite a broadly similar path for interest rates under the yield curve and under the COMPASS rule, the outcomes for inflation and the output gap are higher in the COMPASS case. This reflects the difference

Taylor rule with the particular rule under consideration (e.g. the original Taylor rule). Second, we back out the set of unanticipated policy and non-policy shocks that are consistent with the effects of the scenario for the full set of observable variables in COMPASS holding policy fixed. Third, we remove the policy shocks that kept the policy rate unchanged in the second step. After this final step, we have the responses of macro variables of interest under the assumption that monetary policy responds endogenously to a constellation of non-policy shocks consistent with the Leave scenario according to the rule in question.

between a rule where it is understood that a policymaker will respond systematically to the shocks in a particular way, versus following an exogenously given path (implemented using the off-model forecast multipliers).

Figure 4: Inflation-output gap trade-off since inception of the MPC, with rule responses



Notes: Pre-2004 data are for RPIX inflation with a target of 2.5%.

Figure 4 repeats the historical outcomes for the output gap and inflation reported in Section 2, and adds on the outcomes associated with the alternative policy rules for Years 1, 2, and 3 of the forecast. Those rules which place some weight on the output gap lead to outcomes which return towards the historical relationship more quickly than is encapsulated in the scenario, and for some, points to combinations of the output gap and inflation which are to the top end of historical outcomes.