2010 Rybczynski Prize Entry
Spare a Thought for Spare Capacity

Executive Summary

- Many forecasts of inflation are based on the New Keynesian Phillips Curve approach – put simply, that the current rate of inflation is a function of spare capacity in the recent past, external shocks (such as commodity price and currency movements) and inflation expectations.
- However, these models have shown their limitations in forecasting inflation in the UK over the past few years, with CPI having proved stickier than might have been expected.
- One reason such models might have failed to forecast the resilience of inflation recently relates to the difficulty in measuring spare capacity accurately. Not only that, but any given degree of spare capacity may now be imparting a smaller influence on inflation than was the case in the past.
- The evidence seems to support this hypothesis. To the extent that the move to inflation targeting has been important in anchoring inflation expectations, and that globalisation has reduced the relative importance of domestic influences on prices, inflation may now be more stable for any given variation in output away from its trend.
- So, in understanding inflation's recent stickiness, we can add spare capacity to the explanations of weaker sterling and higher indirect taxes. While it seems reasonable for the central bank to partially overlook the currency and tax effects on inflation (as they are 'one-off' events that are unlikely to be repeated), if inflation turns out to be less sensitive to the output gap this may have more serious policy implications. In particular, if inflation falls by less than it did following previous recessions then the Bank may need to raise short-term interest rates earlier than is currently expected.

1. Introduction

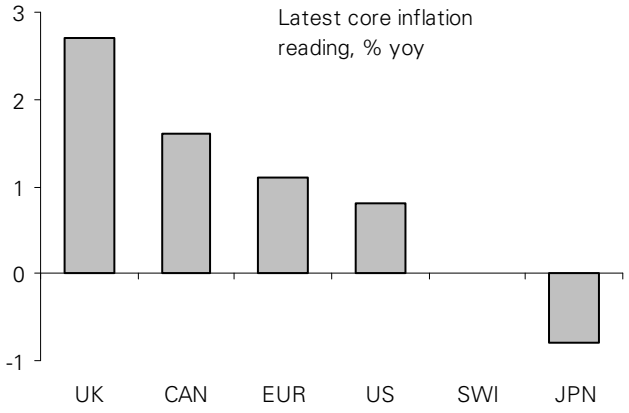
Central banks have, so far, been cautious in taking back the monetary policy easing put in place during the credit crisis and the ensuing "Great Recession". A number have already raised policy rates but, generally speaking, the moves to date have been relatively gradual and hesitant – particularly in developed economies. And in some cases central banks have discussed – or even reinstated in the case of the US Federal Reserve – policies of quantitative easing.

But what will determine the speed at which policymakers take back this easing? Given that many central banks are now inflation targeters, the path – or rather the expected path – of inflation will be crucial in influencing the timing and scale of future interest rate movements.

While there are, of course, a number of key drivers of inflation, New Keynesian Phillips Curve (NKPC) models tend to focus on one above all others – that of spare capacity. Unfortunately, this where there exists the most disagreement among economists. There are important questions not only about how to appropriately measure spare capacity, but whether any given degree of slack has as significant an impact on inflation today as in the past. As a result, the dependence of economic

forecasters on Phillips Curve type models of inflation determination has been put under the spotlight.

Figure 1: *Core inflation in the UK has proved sticky*



Sources: ONS, Statistics Canada, Eurostat, BLS, SNB, MIC

In this article we examine the link between spare capacity and inflation in the UK, how the relationship might have changed and whether this could be an explanation for the relative stickiness of inflation (see Posen (2010)).

2. New Keynesian economics

The history of NKPC-type models dates back to the original Phillips Curve, which stated that wage (and later general price) inflation should be inversely related to unemployment. This 'model' was subsequently denounced by Milton Friedman in the late 1960s who argued that expectations were not properly taken into account. In other words, when governments try to reduce unemployment below its natural rate at the expense of higher inflation, compensatory wage demands will simply end up pushing unemployment back up again and higher inflation becomes embedded.

Moreover, those fully subscribed to the rational expectations view argue this wage adjustment will happen simultaneously – thus the 'real' picture never changes and there is no trade-off (even in the short-run) between inflation and unemployment.

Where does the NKPC hypothesis fit in? This builds price rigidity into the model, implying monetary and fiscal policy have some traction in temporarily reducing unemployment below its natural level. In practice, standard empirical NKPC models assume inflation is determined by a combination of:

- spare capacity, designed to reflect both marginal costs and the amount by which firms mark up their selling prices over those costs (since both are assumed to be pro-cyclical)

- exogenous costs, such as the price of imports which are influenced by global commodity prices, and the exchange rate

- expectations of future inflation, as the prices firms set today will remain in force for a prolonged period of time (the Keynesian price rigidity assumption)

There are a number of issues associated with these models, including their general failure to take account of the financial sector, that asset mis-pricings are assumed to be simply arbitraged away, the questionable relationship between inflation expectations and actual future inflation, and the tendency of such models to converge towards equilibrium.

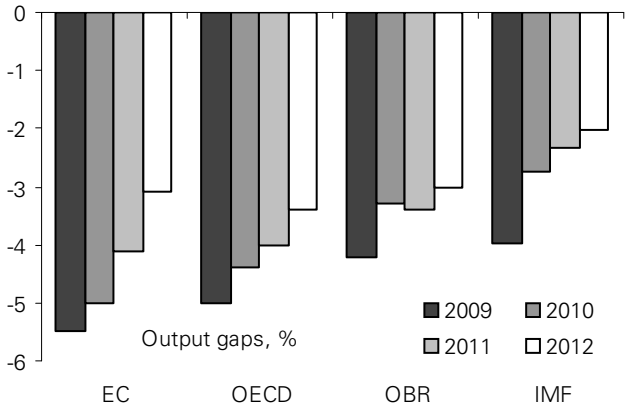
Even if we were to overlook those issues, two of the most important problems are: i) the difficulty associated with measuring spare capacity, and ii) the changing nature of how capacity pressures impact inflation over time. We take a look at these issues more closely below.

3. Measuring spare capacity

The concept of spare capacity is simple: it tells us where we are in the cycle relative to potential. However, putting a number on it is another matter altogether. Not only is it difficult to estimate (since it is essentially unobservable), but there are a number of different methodologies of measuring it.

First, output gap measures calculate the deviation of real output from its trend as a percentage. While an advantage is that they can be compared across countries, they suffer from a number of drawbacks – the most important being that the choice of trend is somewhat arbitrary, leading to potentially significant variations in the estimates (see Figure 2).

Figure 2: *Views on the size of the UK output gap*



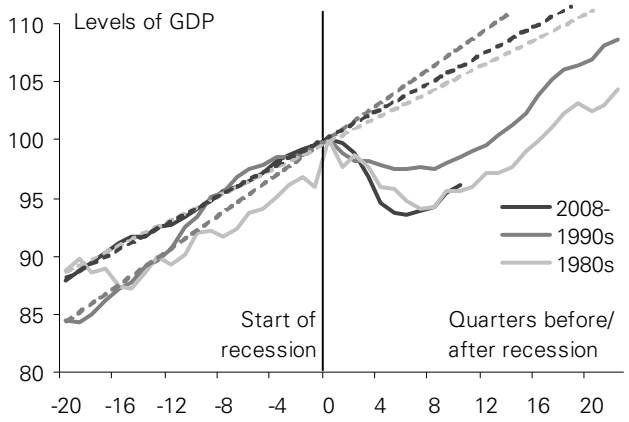
Sources: OECD, IMF, OBR, European Commission

To illustrate these measurement uncertainties, both the OECD and the IMF had forecast the UK output gap during 2010 to be in excess of -6%, but have since pared these back substantially (to -4.5% and -2.7% respectively). Such variations can lead to very different forecasts for inflation when output gaps are used in empirical NKPC models.

Why do such large deviations exist? One explanation relates to the method of calculation. The main distinction here is between the fundamentals-based bottom-up approach, where potential GDP is built up from assumptions about labour and capital inputs (alongside how efficiently those inputs are combined), versus statistical trends (such as Hodrick-Prescott filters) which can be highly sensitive to end points in the data.

More fundamentally, a particular difficulty recently has been discerning the extent to which the credit crunch, the ensuing recession and the sharp rise in oil prices during 2008 have impacted supply potential. Figure 3 shows how UK output during the most recent and previous two recessions fell below its pre-crisis trend. Benito, Neiss, Price and Rachel (2010) take stock of the research on the impact of financial crises globally, and consider studies that estimate the average permanent loss of output to be within a wide range from 1.5% at the bottom end to 10% at the top. The IMF (2009) too discusses cross-country responses of medium-term output to financial crises and their associated recessions.

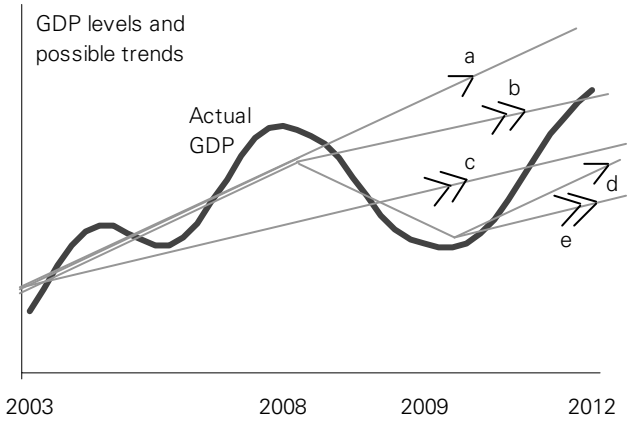
Figure 3: *The long-term hit to UK GDP*



Source: ONS

In Figure 4 we have posited five possible trends for GDP, plotted against a stylised version of actual GDP. Trend line a) was the overly-optimistic view held by many prior to the credit crisis, while trend b) assumes the crisis has had the effect of reducing the *growth rate* of trend GDP. Trend c) may be a reasonable assumption if one believes the credit crisis was simply the corollary of running the economy too quickly in the preceding decade. Finally, trends d) and e) assume the credit crisis reduced the trend *level* of GDP, not just the rate of growth.

Figure 4: *Judging the appropriate output trend*



Choice of trend of course has a significant influence on estimates of the output gap. In this case, moving from trend a) through e) reduces the size of the negative output gap resulting from the recession as we assume a larger hit to supply potential.

In particular, assuming an unchanged trend through the entire period (i.e. line c) suggests the output gap was highly positive in the immediate run up to the crisis – rather than broadly closed, as some measures of the output gap currently suggest[1]. Another way of putting this is that it is arguable whether the trend in GDP was really as strong as some believed in the decade up to the crisis. Strong growth during that period failed to manifest itself in higher inflation, not because the permanent trend in GDP was higher, but rather because of 'temporary' factors including the strength of the currency and rapid globalisation. While these held down imported goods prices, high service price inflation (probably a better indicator of domestic demand pressures) suggested the output gap was positive.

Output gaps are only one way of measuring spare capacity. The business surveys ask firms directly how they are operating relative to full capacity. These may be a better gauge of spare capacity to the extent that they do not rely on an arbitrary trend or GDP data which are often revised. However, they are not without their faults, including survivor bias. In addition to the surveys, some statistics offices publish measures of capacity utilisation (the UK does not, however), although they are typically only available for the manufacturing sector.

The unemployment rate can provide another important indicator of spare capacity. However, what is important here is not unemployment *per se*, but unemployment relative to some notion of equilibrium, such as the non-accelerating inflation rate of unemployment (NAIRU). The problems of judging this unobservable and time-variant equilibrium are similar in nature to selecting an appropriate trend for GDP (see Stephanides (2006) for a discussion of the uncertainty of NAIRU estimates in the EU, US and Japan).

4. The impact of capacity on inflation

While it seems highly likely that the recession produced a significant degree of slack, there is no definitive measure of spare capacity so judging its extent is as much an art as it is a science.

But this is not the only issue when it comes to using spare capacity in inflation models. The second problem is that the relationship between spare capacity and inflation may well be unstable over time. In particular, it seems likely that the influence of spare capacity is less significant now than it has been in the past.

One explanation for this very recently could be that small and medium sized firms which have found it difficult to obtain funding during the credit crisis may have maintained their selling prices at a higher level than economic slack would have implied in order to sustain cash flow. For this explanation to be true, however, the price elasticity of demand for these firms' output would have to be less than one; if

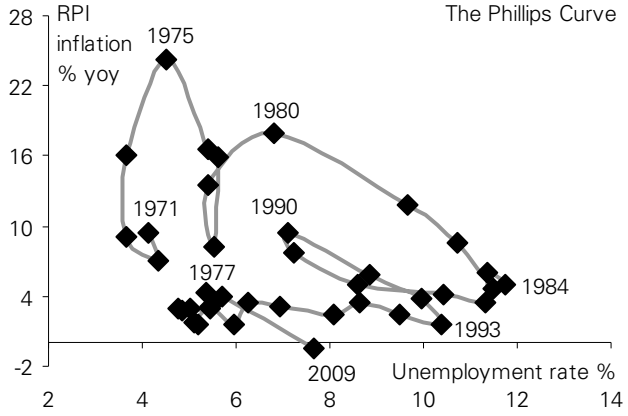
[1] While the IMF believes the output gap was only moderately positive in 2007, both EC and OECD estimates suggest it was around +2.5%.

elasticity were above unity firms could cut their prices and achieve improved cash flow as demand would rise more sharply than the fall in price.

Perhaps a more plausible explanation, however, is that of globalisation. As the markets for goods and labour (and to a lesser extent services) have become more internationally contestable one might reasonably expect the sensitivity of inflation and wages to domestic demand and supply conditions to lessen (see Iakova (2007)).

Another reason is the shift in monetary policy regime. Inflation targeting in the UK is close to twenty years old. It was set up in 1993 following sterling's exit from the ERM, and was subsequently de-politicised in 1997 when the Bank of England was made operationally independent. As a result, over time inflation expectations have become better anchored as trust has been built that the Bank will deliver on its 2% CPI inflation target (and previously RPIX at 2.5%).

Figure 5: *The flattening of the UK Phillips Curve*



Source: ONS

This has been borne out in the flattening of the Phillips Curve in the UK since 1993, as Figure 5 illustrates. With the central bank committed to achieving its inflation target, economic volatility should be concentrated more in activity than in general prices. The result is that shifts in spare capacity should have a smaller effect on inflation as monetary policy attempts to offset these moves to keep inflation on track to meet its target.

5. Some empirical evidence

We estimate a highly simplified single equation NKPC-style model of inflation in order to help understand the changing role of spare capacity on UK inflation over time.

To establish this model, we assume that there are three parts to inflation: i) a domestic component, modeled by the amount of spare capacity in the economy, ii) an external component, reflected by changes in commodity prices (assumed to be driven exogenously by global events) and the impact of currency movements on import prices, and iii) inflation expectations, which should capture the change in the way monetary policy is conducted. This is a similar concept to Gordon's triangle model, in which inflation is assumed to depend on the economic cycle, supply side shocks and inflation expectations (for a description see Gordon (1990)).

The equation we estimate is as follows:

$$\pi_t = \alpha_0 + \alpha_1(SC_{t-x}) + \alpha_2\pi_{t-1} + \alpha_3 FX_{t-y} + \alpha_4 Com_{t-z}$$

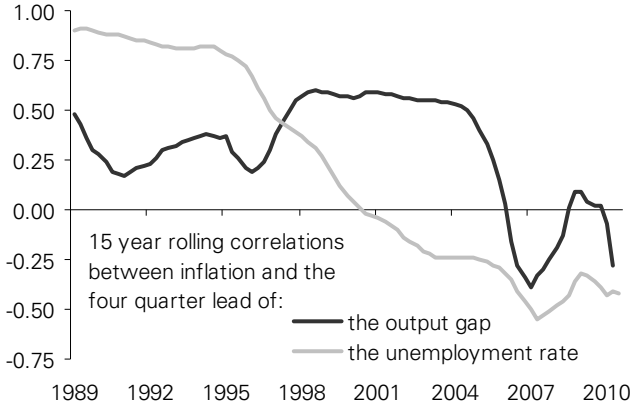
where π is inflation, *SC* is a measure of spare capacity, *FX* is the currency's trade-weighted index, *Com* are sterling commodity prices and *t* denotes time (in quarters). To simplify the analysis we assume inflation expectations are equal to actual inflation in the previous quarter (so expectations are formed adaptively), thus the presence of the term π_{t-1} in the equation.

Spare capacity, the exchange rate and commodity prices should all affect inflation with a lag, but what lag structure is appropriate? The Bank of England's Quarterly Model (BEQM) suggests it takes around a year for the greatest impact of interest rate changes to be felt on economic growth, and around two years to be felt on inflation. That suggests it takes around a year (the difference between the two) before movements in spare capacity have their maximum impact on inflation.

When it comes to the currency and commodity prices, evidence from retailers suggests the typical hedging horizon is around nine to twelve months. With firms often waiting until the beginning of a season to change their prices, assuming a one year lag between changes in commodity prices/exchange rates and inflation seems reasonable. As a result, our prior would be to set the lags *x*, *y* and *z* in our model above each to four quarters.

The results of the model estimated on a rolling basis show both the coefficients and *t*-statistics on spare capacity (using either the OECD's measure of the output gap or the unemployment rate) falling over time. This lends support to our prior that the domestic output gap has, over time, become a less important driver of inflation (Dotsey and Stark (2005) reach similar conclusions based on an empirical model for the US).

Figure 6: *The waning importance of the output gap*



Sources: OECD, ONS

A simple way to illustrate this is by looking at the correlations between inflation and lagged measures of spare capacity, which Figure 6 above shows to have fallen notably over the course of the last two decades. The fact that these correlations have fallen more sharply (relative to their long run averages) in the UK than the US supports the

globalisation explanation, since the UK is a more open economy than that of the US (as measured by exports and imports as a share of GDP).

It has been argued that traditional measures of the output gap during this recession have failed to accurately depict the evolution of spare capacity – in particular that they have overestimated the amount of slack in the economy, and it may be this that accounts for the waning impact of such measures on inflation. Still, our results above (both the regression and correlation analyses) appear robust to the measure of spare capacity that we choose. Indeed, even if we use the unemployment rate (which rose by much less in the UK than the fall in GDP would have suggested) as our indicator of slack, it still exerts less of an influence now on inflation than it once did.

There are a number of reasons for the better performance of the labour market now compared with previous recessions, including: fewer corporate bankruptcies, workers having been willing to accept lower real wages in order to retain their jobs, increased part time employment, reduced net inward migration and higher employment in the public sector during the period of falling GDP.

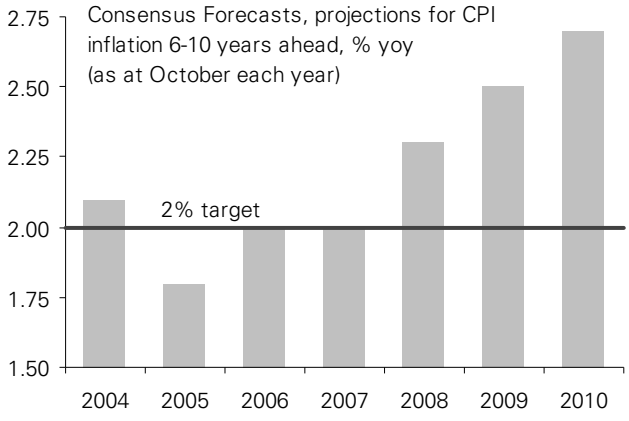
6. Conclusions

According to the OECD the UK currently has one of the largest negative output gaps of all the G7 economies, but at the same time has the highest rate of core inflation. Part of this apparent anomaly can be explained by the sharp fall in sterling since the onset of the credit crunch combined with the rise in indirect taxes. But it seems highly likely that spare capacity can provide an explanation too.

Not only is spare capacity difficult to quantify (there may be less slack in the economy now than is suggested by some of the highly negative output gap indicators), but in addition it seems that such measures are having a smaller impact on inflation now than in the aftermath of previous recessions.

The policy implications of these findings are by no means straightforward. An encouraging conclusion is that if the domestic output gap has less of a downward pull on inflation (because of a more credible monetary policy, the impact of globalisation, or other reasons), then it might also be the case that the reverse is true during the recovery phase – that underlying inflation will not be dislodged as much on the upside.

Figure 7: *Inflation expectations have risen*



Source: Consensus Forecasts

However, a more disturbing implication of inflation's more limited responsiveness to movements in economic slack is that central banks may find it more difficult now to deal with overshooting inflation. Figure 7 above shows that one measure of medium-to-long run inflation expectations in the UK has risen notably above the Bank of England's 2% target (this is a larger increase than for either the euro area or the US). Given that these expectations are far enough ahead (6 to 10 years) to abstract from expected cyclical influences on inflation, it suggests that professional forecasters are questioning the time consistency of monetary policy – whether it be the Bank of England's ability to achieve the target or the government's resolve in sticking to it.

More sizable moves in monetary policy may therefore be required in the future to bring inflation back to its target than has been the case in the past (see Masuda (2009)). This argument might suggest that central banks (and particularly the Bank of England) should be more vigilant when it comes to higher inflation/inflation expectations, and that earlier and swifter rate hikes than are currently priced into the market might be necessary.

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