

## Centre For Macroeconomics and Department of Economics public lecture

### When, why, and what's next for low inflation?: No magic slippers needed

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What is the most famous example of deflation that you can think of? Japan immediately comes to mind for most people. From 1999 to 2011, prices in Japan fell by an average rate of 0.3% per year. But when I hear talk of deflation, I think of an even more memorable example—Dorothy and the Wizard of Oz. No, I did not misspeak. This famous children's story is believed by some to be an allegory about the challenges of deflation in the United States in the late 19th and early 20th centuries. It even includes a proposal to end deflation. And no, the proposal did not require a wizard. Let me explain.

The US (and much of the world) experienced a period of sharp deflation at the end of the 19th century. Annual inflation was -0.9% on average between 1883 and 1897. Farmers were under particular duress as protracted deflation made it harder for them to repay their debt. One factor contributing to deflation was the gold standard; under the gold standard, a country can only issue additional currency if it is backed by additional gold reserves. Gold reserves had not been growing as quickly as the economy, so not enough money was being issued to support prices. You are probably still wondering how that relates to the Wizard of Oz.

The key character is Dorothy from the farm state of Kansas—representing the plight of the farmers in the Midwest under the gold standard. Her dog Toto was short for the Teetotallers—a political group against the consumption of alcohol and aligned with the farmers. Dorothy's challenges began when she arrived in the land of Oz—with Oz short for “ounce”, the unit of account for gold. She tried following the yellow brick road—representing the gold standard. Along the way she met several characters, each of which represented various political figures and constituencies at the time. For example, the tin woodsmen represented the Eastern workingman competing in a heartless, industrialized society. The Winged Monkeys may have been the Plain Indians who were “once free people”, but had since been enslaved. Dorothy and her friends travel to the Emerald City (i.e., Washington, DC), where all is green to signify that it is dominated by the greenback (i.e., dollars). Despite the fear which he inspires, the wizard of the Emerald City (i.e., the US president) is powerless and unable to help Dorothy get home. The solution, however, was there the whole time: click her magic slippers. In the original story, the slippers were silver (not red)—which signified the proposal to include silver (as well as gold) to back the currency. This switch to a bimetallic system could support increased issuance of dollars, which would cause prices to increase and end deflation.

This period of deflation in the US ended in 1898 as the world's output of gold expanded and the US international trade position improved. There was no need for magic slippers or to switch to a bimetallic standard. But what will happen next in the UK? CPI inflation has fallen sharply from a recent peak of 2.9% in June 2013, to -0.1% in April. We just learned that inflation ticked back slightly to 0.1% in May. But inflation has now been below the Bank of England's target of 2.0% for the last 17 months. Where is inflation going next? Will it return to target? Will "lowflation" or disinflation (falling inflation rates) continue? Could the UK be entering a prolonged period of deflation (falling prices)—possibly inspiring the next great childhood story that is an allegory of economic hardship?

My comments tonight will begin by putting today's low inflation in a historic context—highlighting the dramatic shift from concerns about inflation being too high in the 1970s, to inflation stabilizing around target in most countries, to the recent trend of "lowflation". Then I will discuss which of the concerns about lowflation should, and should not, be taken seriously today in the UK, incorporating several pieces of evidence which I track to monitor these concerns. Next I discuss a more formal empirical analysis of the factors driving inflation in the UK historically and today. I pay particular attention to the role of international factors—including oil prices, the exchange rate, and inflation in other countries. Could the synchronized fall in global inflation—or low inflation rates in the UK's major trading partners and neighbours—create additional challenges for inflation to recover?

The results suggest that some international factors play an important role in determining headline inflation rates today—especially movements in the oil price and sterling. But these effects appear to be largely transitory (albeit with longer effects for sterling than oil prices). Second-round effects on wages and low rates of global inflation (and even low inflation in major trading partners and neighbours) do not appear to create any substantial additional drags on inflation in the UK. The analysis suggests that although we need to be alert to evil witches along the road, inflation appears to be on track to rebound toward target by early 2016—and there is no need for wizards, magic slippers, or other actions.

### **Quick inflation history: too high, just right, too low**

Inflation trends over the last forty-five years have shown a remarkable shift in most developed countries: from being "too high" in the 1970s, to stabilizing to about "just right" from the mid-1990s to mid-2000s, to falling to levels that raise concerns about being "too low" over the last few months. Figure 1 captures these trends by showing median annual inflation rates over this time period.

During the 1970's, the median inflation rate for advanced economies averaged 9.3% (and the mean rate was even higher at 10.7%). Bringing inflation down became a primary economic issue for most governments and citizens—if not THE primary concern. Governments resorted to a range of standard and unconventional policies in this battle. One of the more ridiculed attempts was a campaign by the newly elected President Ford in the United States. When inflation reached 16.4% in October 1974, he launched a campaign asking citizens to wear buttons festooned with the acronym "WIN" for "Whip Inflation Now" (see Figure 2). He encouraged supporters of this campaign to reduce price pressures by taking actions such as to "take all you want but eat all you take" and having each family make a one-hour "trash inventory" to find waste. Not surprisingly, the campaign proved unsuccessful—both in garnering support and reducing inflation. By 1975, the US was in its worst recession since the 1930s and inflation remained above 9%. The White House had printed 12 million of the infamous WIN buttons, but received only 100,000 requests for them—many of which were undoubtedly to spoof the efforts.

The United Kingdom also battled high inflation in the 1970s, a decade during which average annual inflation was 12.0%. Figure 3 shows this challenge—with inflation peaking at just over 25% in August 1975. Early in the 1970s the government tried a number of standard policies to tackle inflation—such as fiscal tightening and restrictions on price increases for government

output and wage increases for public employees. But inflation continued to accelerate, further complicated by miners' strikes and an oil embargo that caused oil prices to rise sharply. In 1974, output plunged by 3.4% and unemployment increased to levels not seen since the 1930s. This made traditional fiscal and monetary tightening less attractive. The Government shifted to less conventional policies to tackle energy shortages and high inflation—such as a “three day week”. This policy limited commercial users of electricity to three specified consecutive days of consumption each week and prohibited them from working longer hours on those days. Even television companies were required to cease broadcasting at 10:30 pm. Stricter speed limits were enforced on roads in order to conserve oil. The electricity restrictions caused many to become accustomed to working by lamp and candle light.

The UK's battle with high inflation was unfortunately not unique to the 1970s. Average UK inflation from 1960 to 1997 (the last year before the Bank of England became independent) was 7.1%. And UK inflation was not only high on an absolute level over this period, but regularly above that in other large developed countries. For example, from 1960 to 1997, annual inflation was higher in the United Kingdom than in the United States and Germany over 80% of the time. UK inflation was also higher than in France for over 70% of this period.

This battle against high inflation began to make progress in most developed countries in the 1980s. Helped by a combination of falling oil prices, more flexible currencies, and more independence for some central banks, the median inflation rate in advanced economies fell to 4.8% from 1985 through 1990. As shown on Figure 1, emerging and developing economies took longer to bring inflation down, with the median inflation rate for this group still well above 10% until the mid-1990s. By 2000, however, inflation had fallen to around target levels for many countries in the world and was remarkably stable for a number of years. This “great moderation” appeared to be solid as inflation rates remained around countries' targets, and the volatility in economic growth and inflation fell to low levels.

This calm ended abruptly with the global financial crisis. Inflation rates in many countries plummeted during the subsequent recession and as oil prices fell, while other countries struggled with sharp increases in inflation as rapid currency depreciations increased import prices.

Since then, as the global economy has gradually recovered, the conversation has shifted to concerns about falling inflation (i.e., disinflation), low levels of inflation (i.e., lowflation), and negative inflation (i.e., falling prices/deflation). As shown in Figure 1, the median global inflation rate for advanced economies was only 0.9% in 2014 and 4.5% for emerging economies. In sharp contrast to the 1970s, countries are consistently seeing inflation below, instead of above, their targets. Figure 4 shows how broadly shared this pattern is. Of the 92 advanced and emerging economies with data available for Q1 2015, just over half had inflation rates below 2%. About 28% of the countries are in deflation. Even if much of this fall in inflation is caused by lower energy prices and should therefore be temporary, are there any risks from such low levels of inflation—especially if occurring in so many countries simultaneously?

### **Low inflation today: what to fear...and not to fear**

This simultaneous fall in inflation around the world, combined with the fact that UK inflation will likely be near zero for several months (and was briefly negative), has raised a number of potential concerns. Several of my colleagues on the Monetary Policy Committee have discussed these risks of low inflation and deflation at length—such as in Broadbent (2015), Carney (2015), McCafferty (2015), Miles (2015), and Weale (2015). I hope you will read their thoughtful speeches, and I will not repeat their arguments. But I would like to quickly summarize my own views on four of the concerns that one hears most often about low inflation and why it might persist. My assessment is that two of these popular concerns are overhyped. One other concern is not currently an issue, but merits close monitoring. And the final concern—on how international influences may be affecting the inflation process—is the area about which I believe we know the least—and to which I will dedicate much of the rest of my comments

The deflation concern about which one hears the most is that consumers and businesses could delay purchases and investment if they expect items to be cheaper in the future. This reduction in demand would not only slow growth immediately, but could cause higher unemployment and further price falls in the future. This argument seems to have gained support from evidence that Japanese consumption slowed during their “lost decade”. There is also some tentative cross-country evidence that inflation expectations affect spending. But I find this argument unconvincing for the UK today. There is currently no sign of major asset price or housing deflation, which has in the past led to deflation being correlated with lower growth. Instead, some convincing evidence suggests that consumers tend to spend more—not less—on items whose prices fall. Figure 5 shows this point clearly with another poignant reminder from US history; it is traditionally HIGHER prices that are correlated with lower real spending, rather than the opposite. And given that some of the largest price declines today are for items such as food, I challenge you to find one parent who will tell their children that there is no food on the table tonight because food will be 0.1% cheaper next year. I don’t think that I need to say any more on this first concern (or lack thereof).

A second concern frequently raised about low inflation and deflation is that consumers, businesses, and governments will have greater difficulty repaying debt. Inflation reduces the real value of debt and can make it easier to repay loans previously taken out at a fixed interest rate. Although these arguments have some merit, any such effects should be small in magnitude today. Interest rates are near historically low levels, credit is readily available for most credit-worthy borrowers, debt-servicing ratios are relatively low, and low inflation is expected to be short lived. Therefore, although low inflation, and especially deflation, can create challenges for debt servicing, this does not appear to be a substantive risk in the UK today.

A third risk, which I believe merits more attention, is that even after the direct effects of lower energy and food prices fade, other “second-round” effects could continue to drag on inflation. For example, lower oil prices could reduce operating costs for companies that use oil intensively, allowing them to reduce their own prices. Or, low inflation today could cause people and businesses to expect low inflation in the future and thereby change their behaviour—such as locking in contracts at low prices. Although both of these second-round effects are generally small, a related concern which worries me more is that workers will have less power to negotiate wage increases in today’s low inflation environment. A pickup in real wages will be crucial to support the continued growth in income that is necessary to sustain the recovery and return inflation to target. Closely related, low inflation could make it more difficult for companies to adjust real wages to match productivity, as employers are usually hesitant to lower nominal wages. This could impede the efficient allocation of resources and further drag on the UK’s already low productivity growth.

On a more positive note, there is not yet any evidence that low inflation has significantly held back wage growth. Instead, wage growth has picked up over the period that inflation has fallen—as shown in Figure 6. Average weekly earnings in the private sector (ex. bonuses) grew by 3.3% in the three months to April relative to the same period of 2014, the strongest increase since 2008 and up sharply from 1.6% in September 2014 (when oil prices started their rapid decline). Moreover, with unemployment at 5.5%, short-term unemployment below pre-crisis levels, increased churn in the labour market by a number of measures, and regular concerns about skill shortages in certain sectors, the rapid normalization of the labour market should continue to support wage increases—even in an environment with low headline inflation.

A final risk related to low inflation today is that low rates of global inflation, or just low inflation in individual countries with strong links to the UK, could create additional spillover effects that drag on UK prices. Figure 4 shows the unusually large number of economies with deflation simultaneously—especially for a non-crisis period. About one-third of the goods and services consumed by UK households are imported, so that falls in prices abroad would reduce the prices UK consumers are willing to pay for certain goods. UK exports currently constitute about 30% of

GDP, which can make it difficult for UK companies to raise prices if competitors located elsewhere are offering similar products at lower prices. These spillovers from inflation rates in other countries may have grown as countries have become more connected through trade flows, as well as due to how the internet has made it easier to compare prices and shop across borders.

This risk that there may be something more than just lower energy and food prices dragging down on inflation in the United Kingdom is apparent in Figure 7. This graph shows a range of the different measures of core inflation that we regularly monitor at the BOE—each of which uses a slightly different method to remove the direct effect of the more short-lived and volatile components of the price index. These core measures of inflation have been somewhat more stable than headline measures (as also shown in the figure in the bright red line), confirming that falls in volatile components of the price index (such as energy and food prices) have played a role in driving the sharp fall in headline inflation to around zero. But even after removing these effects of more volatile components, the various core measures of inflation still show some downward trend and are currently clustered around 1.0% to 1.5%.

Of course, one factor that has contributed to this recent fall in core (and headline) inflation is the exchange rate. Sterling has appreciated by almost 18% since its recent trough in the spring of 2013. Most of that appreciation occurred from the spring of 2013 through July of 2014 (14 percentage points of the total 18% movement). Since exchange rate movements affect the prices of many goods in both the headline and core price indices, and it takes some time for these effects to occur, this past appreciation has undoubtedly played some role in dragging down core inflation. While there is a substantial amount of uncertainty about exactly how long it takes for sterling's movements to pass-through into inflation, it is likely that the greatest drag on inflation from this recent appreciation would be in late 2014 and early 2015. This could explain a substantial amount of the decline in core prices, as well as some of the decline in headline inflation (along with oil prices).

In order to better assess this role of the exchange rate, it is useful to track measures of inflation that attempt to exclude—or at least minimize—the effects of exchange rate movements. This is a straightforward concept, but difficult to do in practice. Exchange rates affect a wide range of goods in many different ways—from the costs of imported consumer goods, to companies' markups, to the price of imported inputs used to produce other items, to the latent competitive effects from foreign prices. Given the challenges in coming up with any one measure to capture inflationary pressures excluding sterling's movements, I find it useful to track a collection of measures of domestically-generated inflation—or DGI. I discussed one set of these measures in a speech last fall. In that speech, I also mentioned the challenges of using these measures for forward-looking monetary policy, as many are reported with substantial lags.

Therefore, I have recently expanded on these DGI measures to include additional statistics that are reported on a more timely basis, as well as that provide additional insight on wages. Growth in wages, and especially unit labour costs, will be critical to sustaining inflation at target over the medium term as the effect of more transitory factors fades. These nine DGI statistics are: a core CPI services measure, inverse-import-intensity-weighted CPI inflation, unit labour costs, unit wage costs, private-sector regular-pay wage growth as reported by the ONS, private-sector regular-pay wage growth adjusted for work force composition, the services GVA deflator, the GDP deflator excluding exports, and services PPI inflation. Full definitions of these variables are in Appendix A.

Figure 8 graphs the most recent values of each of these indicators. The squares show the values from one year ago—before the recent sharp fall in inflation and when headline inflation was at 1.7%. The dashed line is at 2%—the inflation target. The dashed line is simply meant as a reference, as 2% inflation can be consistent with some of these DGI measures persistently above 2%. The figure shows that some measures of domestically-generated inflation have fallen over the last year—such as core CPI services and the inverse-import weighted measure. Some of these measures, however, are undoubtedly affected by the fall in oil prices (either directly or



through its impact on transportation costs). Other measures more closely related to business costs (on the right of the graph) have been more stable, which is somewhat surprising as these also incorporate the fall in energy prices. Perhaps most interesting is the 4 indicators in the middle of the graph, which capture various measures of wages and labour costs. These measures all show an increase in labour costs over the past year. Since unit labour costs are generally a key driver of underlying cost pressure in an economy, and wage costs constitute about 37% of average production costs, this suggests that underlying production costs in the UK have not fallen to nearly the extent as seen for headline and core inflation. In fact, they may even be accelerating. There is a substantial range across these DGI measures, however, and each has its own advantages and disadvantages. Therefore, a useful way to summarize this information is to track the average of these measures, as well as their range. Figure 9 shows these statistics. This graph shows that the DGI measures have been remarkably stable over the past 1 ½ years. This suggests that although sterling's recent appreciation has been dragging on core and headline inflation, it has not had more persistent effects on measures of inflation that put less weight on these exchange rate movements.

To summarize, although UK monetary policy is set to meet a 2% target for headline inflation, this series of graphs is helpful to better understand the dynamics behind and persistence of low inflation in the UK today. Much of the recent fall in headline inflation appears to be caused by the sharp falls in energy and food prices, as well as the past appreciation of sterling. In fact, Bank of England calculations indicate that around ¾ of the deviation of inflation from target today results from energy, food and other goods prices. All of these influences on inflation tend to be fairly transitory, although the effects of exchange rate movements tend to persist longer than the roughly 12-month effects from movements in energy and food prices. The weakness in core inflation, compared to the relative stability of the DGI measures, highlights this impact of the exchange rate. But although the DGI measures have been stable, they are still largely lower than pre-crisis levels and not likely to be strong enough to be consistent with our 2% inflation target. The recent sharp fall in core prices also seems larger than what might be expected from just sterling's past appreciation.

Could there be other factors at play? Could the sharp fall in inflation—even if initially caused by more transitory influences such as oil prices—be having more pervasive second-round effects? Could the low levels of inflation around the world have additional effects on core and headline inflation in the UK? Has the greater integration of the world economy caused global inflation rates to have a greater impact on domestic inflation than in the past? As shown in Table 1, we have little experience of such low inflation. Since 1961 (the earliest available monthly data), the UK has never experienced inflation below 0.5%—except in this year from January. As a result, we must carefully assess the risks of such low inflation rates, as well as how our traditional analysis may no longer apply, during this unprecedented period. This is especially true for those of us on the Monetary Policy Committee, as understanding why prices have fallen so much, and what effects might persist, is critical to forecasting inflation and setting monetary policy appropriately to reach our target.

### **Low inflation today: more formal analysis**

In an effort to better understand why inflation is so low today, whether it should bounce back soon, and whether there are any implications of the simultaneous fall in inflation in many countries around the world, I begin by looking at the raw correlations between inflation rates around the world and several global variables. Figure 10 shows the correlation of quarterly headline inflation rates with global headline inflation, oil prices, and world export prices (excluding oil), from 2000 through 2014. I focus on 14 major economies—the G10 plus Australia, New Zealand and China. (Yes—I can do math, there are 11 countries in the G10.) Correlations tend to be quite high—and often above 50%. In fact, the average correlation between each of these economies' headline inflation rates with global inflation is 63%. The correlation with oil prices is 50%, and with world export prices (excluding oil) is 0.52%. UK headline inflation has had a 56%,

47% and 44% correlation with global inflation, oil prices, and other world export prices over this time period, respectively.

Much of this high correlation in headline inflation rates, however, is driven by movements in global energy and commodity prices (a point which was recently made using a different approach in Weale, 2015). Figure 11 shows correlations for core inflation rates, with global core inflation, oil prices, and world export prices (excluding oil) for the same countries over the same time period. Correlations are much lower—and in some cases even negative. In fact, the average correlation between each of these economies' core inflation rate with global core inflation is only 20%, with oil prices is only 9%, and with other world export prices is only 8%. UK core inflation is only 15%, 17%, and 8% correlated with global core inflation, oil prices, and other world export prices, respectively.

As a more formal test of what may be driving this high comovement in headline inflation rates, but low comovement in core inflation rates, I estimate the first-principal component of quarterly headline inflation rates. This is basically the shared trend or common component behind headline inflation in all of the countries. I estimate this for a larger sample of 48 countries (both advanced and emerging markets). This shared principal component is graphed in Figure 12 and can explain about 30% of the overall variance of inflation rates. The figure shows that this shared component moves closely with oil prices, with a correlation of 54%. This shared principal component is also correlated with global food prices, albeit with a lower correlation of only 28%. Figure 12 also shows that this shared principal component for inflation rates has been negative for an unusually long period and has not reached such low levels in over 15 years—except during the peak of the global financial crisis and alongside another significant oil price fall.

But, even if movements in oil prices (and to a lesser extent food prices) can help explain the high comovement in global inflation rates and low comovement in core rates, movements in oil prices could still have second-round and more persistent effects on inflation, even after the initial, direct effects of the oil price movements have faded. To assess this persistence, Figure 13 shows correlations between the same group of selected economies' headline inflation rates with measures of global inflation, world export prices, and oil prices that are all lagged by two years. These correlations are not only no longer positive, but usually negative. This is far from a definitive analysis—but suggests that movements in global inflation, oil prices, and other world export prices have not traditionally had a persistent impact on headline inflation rates after their transitory effects have faded.

This type of analysis of raw correlations, however, can only take one so far. They are useful to consider patterns in the data, but correlations cannot control for different events that happen simultaneously and may drive any comovement (i.e., omitted variables). Raw correlations also cannot explain which variable is causing which (i.e., endogeneity), or effectively test the different timing by which different effects may occur. Therefore, it is useful to move to a more formal empirical analysis.

In an effort to better understand why inflation is so low today, and to better understand any potential effects of low inflation around the world, I build on a standard New Keynesian Open-Economy Phillips curve formulation—the workhorse model of central bankers. Inflation is estimated as a function of the standard variables in this model: expected inflation ( $\pi_{t+1}^e$ ), past inflation ( $\pi_{t-1}$ ), the output gap ( $OutputGap_t$ ), and supply shocks. To better understand the role of international influences, however, I use more detailed controls for supply shocks and simultaneously control for changes in: the exchange rate ( $DER_t$ ), oil prices ( $DOil_t$ ), and other world export prices excluding oil ( $DWorldExpPrices_t$ ). In standard formulations of this model, these three international influences are usually not broken out explicitly. I focus on the period since the Bank of England's independence (from 1998), and use quarterly changes in each of these variables. The final term for the change in world export prices should explicitly capture any effects from low inflation in other countries—excluding the effects of low oil prices and movements in sterling. More specifically, the equation I estimate is:

$$p_t = \beta_0 + \beta_1 p_{t+1} + \beta_2 p_{t-1} + \beta_3 \text{OutputGap}_t + \beta_4 \Delta ER_t + \beta_5 \Delta \text{Oil}_t + \beta_6 \Delta \text{WorldExpPrices}_t + \varepsilon_t$$

The results of this model predicting headline inflation are shown in column 1 of Table 2. Headline inflation is significantly lower if: inflation expectations are lower, sterling has appreciated, or oil prices have decreased. After controlling for these variables, the level or changes in the output gap do not significantly affect inflation. This is consistent with most recent work finding a “flattening” of the Philips curve, and which has been discussed at length elsewhere. The estimates also suggest that after controlling for oil prices, sterling’s movements, and the other variables, changes in world export prices—a proxy for global disinflationary pressures—do not exert a significant, independent effect on UK inflation.

Figure 14 uses the estimates from this model to better understand recent trends in inflation. The dashed line shows predicted inflation using this model, and the solid line shows actual inflation. The two lines move fairly closely, including during the recent period of disinflation, suggesting that the model fits fairly well. The coloured shading decomposes how much of recent movements in inflation can be explained by the different variables in the equation above. Focusing on the recent period of disinflation, the estimates suggest that sterling’s appreciation was a major factor driving down inflation in 2014, reducing inflation by almost 1 percentage point. Over the last two quarters (2014q4 and 2015q1), however, the drag from sterling’s appreciation has faded and lower oil prices have played a greater role, reducing inflation by around 1 percentage point. Global export prices are also bringing down inflation—but the effect is estimated to be very small at 0.15 percentage points in the first quarter of 2015.

While this analysis is useful to understand why headline inflation has fallen recently, the key question for monetary policy is where inflation is going next. If sterling’s appreciation and then lower oil prices have been the main drivers behind low inflation—for how long will these effects persist? To better understand if these factors appear to be affecting underlying inflation, I use the same model to explain core inflation (which excludes food and energy prices) and domestically-generated inflation (using the index of nine measures discussed above).

The results are reported in Columns 2-3 of Table 2 and show some noteworthy differences. Movements in sterling and oil prices still have a significant effect on core prices, but the magnitude is less than half as large as for headline inflation. Movements in sterling and oil prices do not exert a significant effect on the DGI index, suggesting that this measure is doing a decent job of capturing domestic inflation that excludes these international influences. Inflation expectations continue to have a similar and powerful effect on both core and headline inflation (although not on the DGI index). There appears to be more hysteresis in core inflation and the DGI index—with lower core inflation or DGI in the past acting as a continued drag on the corresponding inflation measure today. Lower world export prices do not seem to exert any additional drag on core inflation or the DGI index. In fact, the estimates of how world export prices affect core inflation have the opposite sign of what one would expect—indicating that lower world export prices tends to increase, not decrease, core inflation over time. A closer look at how world export prices affect UK inflation seems to be merited (and will be done in the next section).

Before analyzing the role of inflation in other countries in more detail, however, it is useful to consider what this estimated model implies for inflation in the future. Even if much of today’s fall in headline inflation results from the transitory effects of oil prices and sterling, how long will it take before inflation begins to recover? The estimates suggest that inflation expectations play a significant role in determining where headline and core inflation settle. Figure 15 shows that some measures of inflation expectations have remained fairly stable despite the fall in headline inflation, while others have softened. But all in all, inflation expectations remain at a level broadly consistent with headline and core inflation around 2% once the effects of transitory factors have faded. However, the significant coefficient estimates on the lagged inflation term when predicting core and domestically-generated inflation also suggest that low inflation today could have



persistent effects. As discussed above, these could occur through some type of second-round effects of sterling's appreciation and lower oil prices, or any effects from lower inflation in other countries that are not captured in the models.

To better assess how all of these forces play out, I use the coefficient estimates in Table 2 to estimate headline inflation over the next year (through June 2016). This requires making assumptions about the path of all of the explanatory variables. To do this, I use market curves when possible, and forecasts from May's *Inflation Report*. The corresponding forecasts of inflation using this simple model are shown in Figure 16, along with forecasts from the more complex DSGE model from May's *Inflation Report*. Both forecasts show a fairly sharp rebound in inflation by early 2016 as the effects of recent movements in oil prices and the past appreciation of the exchange rate fade. In fact the Philips Curve estimates suggest an even faster recovery—but this is a fairly simplistic model and therefore the estimates should be treated as very rough. The key point is that inflation should recover soon, even after controlling for the effects of low global inflation and the lagged effects of having unusually low inflation in the UK today.

### **A closer look: the impact of international prices on UK inflation**

The previous section found that after controlling for the effects of oil prices and sterling, there was little independent effect of low world export prices (a proxy for global inflation) dragging down headline inflation, core inflation, or domestically-generated inflation in the UK. One might be tempted to stop here and conclude that we should not be concerned about today's low global inflation having persistent effects – and thereby not complicating the return of inflation toward our 2% target after the effects of transitory factors fade. But, part of our job on the Monetary Policy Committee is to assess different risks to this forecast. Weale (2015) explored whether unusually low inflation in the OECD given the limited historical precedents might generate more persistent effects on UK inflation than our standard models could estimate. He uses more sophisticated estimation techniques and does not find strong evidence that this should be a concern today. One other risk that has not been previously explored, however, is whether inflation in certain countries might have more pervasive and persistent effects on UK inflation than global inflation measured more broadly. More specifically, could prices in countries that are located closer to the UK (such as France or Ireland) have stronger effects on UK prices than prices in Japan or Australia? Wouldn't it be easier for a UK consumer to fly—or even hop on a train—to get an iPhone if it is cheaper in France (but not in Tokyo), thereby making it harder for a UK store to raise prices above those in France? Similarly, could prices in countries where people speak English, or have better internet connections, be more likely to put price pressure on the UK—as it would be easier to check prices online and arbitrage away any price differences?

To test if inflation in certain countries has a greater effect on UK inflation than broad measures of global inflation or world export prices, I return to the Phillips curve estimates above. I estimate the same model, except add an additional variable measuring inflation in one UK-partner country at a time, say France ( $\Delta FrancePrices_t$ ). This yields a coefficient on inflation for each partner country (i.e.,  $\beta_{France}$ ), which captures any additional correlation between inflation in that partner country with UK inflation, after controlling for any effects of world export prices, exchange rate movements, and the other variables. This would therefore capture any additional spillovers from inflation in the partner country to the UK, although it could also capture similarities in the two countries' structures that lead to more correlated inflation rates. I repeat this regression for each of the 47 partner countries in the sample, to yield 47 partner-country  $\beta$ 's. These partner-country  $\beta$ 's are listed in Appendix B and graphed in Figure 17 for estimates using headline inflation, and Figure 18 using core inflation. The dots reflect the point estimates, and the shaded areas incorporate the standard errors. The countries are grouped with the European Economic Area in the blue section, other members of the G10 in the orange section, and other countries in green. Within each group the countries are ordered by the size of the estimated  $\beta$ , so that the country's with a greater effect on UK inflation are at the start of each group.

These graphs show a number of intuitive patterns. Even after controlling for world export prices and other global variables, UK headline inflation rates tend to move more closely with inflation rates in countries such as Belgium, France, Germany, Canada, Austria, and New Zealand. Many of the countries where inflation comoves more with UK inflation are located close to the UK, or were UK colonies. For most countries in the sample, however, there is estimated to be little additional comovement with UK inflation. Moreover, these estimated comovements are substantially smaller for core inflation rates. Although core inflation in Belgium, Germany and Taiwan may have some additional correlation with core UK inflation, the estimated  $\beta$ 's are generally small and near zero for most countries. In fact, the estimated correlations for core inflation are more often negative and significant than positive and significant across the full set of countries. This suggests that although there may be some additional effects on UK headline inflation from low headline inflation in a few countries, any additional spillover effects appear to be fairly limited and small for core inflation.

Nonetheless, even if UK inflation is not affected by inflation rates in most other countries, is it possible to better understand which countries may have some effect on UK inflation? To answer this, I use the partner-country  $\beta$ 's shown in Appendix B and Figures 17 and 18 to assess exactly which country characteristics determine how much an individual country's inflation rate moves with UK inflation. In other words, I attempt to explain any residual correlation between a country's inflation and that in the UK after controlling for changes in oil prices, the exchange rate, and the other variables in the regression. I attempt to explain this excess comovement based on variables such as: the country's share of UK imports, the country's size (measured by its share of world PPP), the distance between the country and the UK (measured using the log of distance between their capitals), whether the country was a former UK colony, whether English is the country's official language, and the percentage of households with access to the internet (a rough proxy for the locals' ability to arbitrage prices through the internet).

Table 3 shows a summary of results for headline inflation, and Table 4 for core inflation. UK headline inflation tends to comove more with headline inflation rates in countries which constitute a larger share of UK imports and that have more households connected to the internet. No individual variables are significant (at the 5% level), however, when attempting to explain the relationship for core inflation rates. Moreover, when multiple variables are included simultaneously in either set of regressions, coefficient estimates fluctuate in sign and significance (with two examples in columns 7 and 8 in each table). This makes it difficult to draw any strong conclusions. This challenge explaining which countries inflation rates could have greater spillover effects on UK inflation is not surprising given the limited spillover effects that appear to exist.

## Conclusions

So where does this leave us? You are probably feeling as if our journey tonight to better understand today's low inflation rate in the UK has taken us on as many twists and turns as Dorothy's yellow brick road. Hopefully you did not have the experience that Dorothy and her friends had when they entered the field of poppies (i.e., being unable to keep your eyes open). But, just as Dorothy and her friends each learned more about their abilities and strengths on their voyage, hopefully this discussion has also provided you with a better understanding of the drivers of low inflation today and what to expect in the future.

This discussion has highlighted several points. First, today's period of "lowflation" is not only a sharp departure from the high inflation in the 1970s and early 1980s, but unprecedented in the era of floating exchange rates for the UK. Second, although there could be serious concerns if inflation remained negative or near zero for an extended period of time, none of these concerns appears to be a serious risk in the UK today. The evidence on the negative effects of deflation and lowflation—especially when caused by positive supply shocks—is far less convincing than the rhetoric.

Third, the main factors behind the recent sharp fall in inflation should be largely transitory: lower energy and food prices and sterling's appreciation. Therefore, assuming no more sharp movements in the exchange rate or energy or food prices, inflation should bounce back fairly quickly from today's low levels (although the drag from sterling's appreciation will take longer to fade than the year or so from the drag from lower energy and food prices). The stability in the index of domestically-generated inflation, combined with growing evidence of wage and unit labour costs picking up (albeit from low levels), supports this underlying positive momentum in the inflation-generating process.

Fourth, even if the recent fall in inflation was largely due to changes in energy and food prices and sterling, there are still risks that inflation could be slow to recover to the 2% target. Inflation expectations will need to remain consistent with the target. Low inflation today could also have second-round effects. It will remain critically important to monitor developments in inflation expectations, core, and domestically-generated inflation to see if any such drags continue after the transitory effects of oil shocks and sterling's past appreciation begin to fade. Simulations using new results prepared for this talk, however, suggest that even after explicitly accounting for these additional drags from lagged inflation and the simultaneous fall in inflation around the world, inflation should still rebound quickly by early 2016.

Finally, an analysis of spillovers to the UK from inflation in other countries found that low global inflation and low inflation in individual countries with stronger links to the UK should not create significant additional drags on UK inflation. Although headline inflation rates in different countries often move together, this appears to primarily be driven by global shocks (such as changes in oil prices). Inflation in some of the UK's more important trading partners (such as Germany) may have some small additional effects on UK inflation rates. But inflation in many economies with strong ties to the UK—whether through location, colonial linkages, language, or other variables — does not exert any significant effect on UK inflation. Even key trading partners' inflation rates do not seem to generate any consistent and significant spillovers to UK core inflation rates.

The past few years—from the global financial crisis, to a sharp recession, to the rapid depreciation and then appreciation of sterling, to the collapse in global oil prices—have been as tumultuous for UK inflation as the cyclone that whisked Dorothy to the land of Oz. Just as Dorothy had to continually watch for traps and witches while following her yellow brick road, we are also continually assessing risks and ready to respond to surprises. But this analysis suggests that transitory factors have driven most of the recent fall in inflation, and there is no evidence that second-round effects or low global inflation are currently providing any substantive additional drags. Most important, inflation appears to be on track to rebound toward target without any need for assistance from wizards or magic slippers.

## References

Bachmann, Rudiger, Tim Berg, and Eric Sims (2015). "Inflation Expectations and Readiness to Spend: Cross-Sectional Evidence." *American Economic Journal: Economic Policy*, 7(1): 1-35.

Bank of England (2015). Inflation Report. May.

Blanchard, Olivier, Eugenio Cerutti and Lawrence Summers (2014). "Inflation and Activity: Two Explorations, and Their Monetary Policy Implications." Paper presented at ECB Forum on Central Banking, May.

Borio, Claudio, Magdalena Erdem, Andrew Filardo, and Borris Hofmann (2015). "The Costs of Deflations: A Historical perspective." *BIS Quarterly Review*, March.

Broadbent, Ben (2015). "The Economics of Deflation", Bank of England Speech, March.

Carney, Mark (2015). "Writing the Path Back to Target", Bank of England Speech, March.

Citibank (2015). "Is Deflation (and Low-flation) a Threat to the Recovery?" UK Economics Weekly. March 27.

Cloyne, James, Lena Koeber, Martin Weale, and Tomasz Wieladek (2015), 'Firms' expectations and price setting: evidence from micro data', unpublished manuscript.

Domit, Silvia and Chris Jackson (2015). "Do inflation expectations currently pose a risk to inflation?", Bank of England Quarterly Bulletin 2015 Q2, forthcoming.

Forbes, Kristin (2014). "The Economic Impact of Sterling's Recent Moves: More than a Midsummer Night's Dream", Bank of England Speech, October.

Forbes, Kristin (2015). "Risks Around the Forecast", Bank of England Speech, January.

Friedman, Milton and Anna Schwartz (1963). A Monetary History of the United States: 1867-1960. Princeton University Press.

Goodhart, Charles and Boris Hofmann (2007). "House Prices and the Macroeconomy." Oxford University Press.

Hori, Masahiro and Satoshi Shimizutani (2005), "Price Expectations and Consumption under Deflation: Evidence from Japanese Household Survey Data." Hitotsubashi University, Institute of Economic Research, Discussion Paper Series No 98.

International Monetary Fund (2013). World Economic Outlook. Washington, DC: International Monetary Fund. April, Chapter 3.

McCafferty, Ian (2015). "Negative Inflation: the Implications for Monetary Policy", Bank of England Speech, June.

Miles, David (2015). "What Can Monetary Policy do", Bank of England Speech, January.

Weale, Martin (2015). "Telling Tails of Oil and Global Inflation", Bank of England Speech, May.

**END**