



BANK OF ENGLAND

Speech

Oil price falls – what consequences for monetary policy?

Speech given by

Ian McCafferty, External Member of the Monetary Policy Committee, Bank of England

At Durham University Business School

10 March 2015

I would like to thank Marilynne Tolle, David Copple, Gene Kindberg-Hanlon, Delma Essel and Charlotte Adams for their help in preparing this speech. The views expressed are my own and do not necessarily reflect those of the other members of the Monetary Policy Committee.

"In economics, things take longer to happen than you think they will, and then happen faster than you thought they could." Rudi Dornbusch

At \$59/bbl, a barrel of crude oil is roughly fifty percent cheaper than during its peak last June. The dramatic fall of the oil price over the past six months or so seems to have taken almost everyone by surprise. The last time the price fell as sharply was in 2008, as the global economy plunged into recession following the onset of the financial crisis. Yet the economic environment now is markedly different. Global growth may be uncertain, and real risks abound, but the IMF forecasts that global GDP growth will be 3.5% in 2015 and 3.7% in 2016,¹ such that annual demand for oil is rising steadily, if at a somewhat slower pace than pre-crisis.

For those with long memories, the most recent fall in prices, and its underlying drivers, are more reminiscent of events in 1985 and 1998. On all three occasions, longer term shifts in supply were at the root of the sharp price falls, and although each episode had its own detailed narrative, there are sufficient similarities to suggest repeated cyclical characteristics. Together, these three episodes suggest that after a long period of relative stability through much of the twentieth century, the oil market has evolved in a way that leaves it subject to repeated, and fairly regular, 'long' or 'super' cycles.

Such cycles were well recognised in other commodity markets in the 1960s and 1970s, and because of their prevalence in certain markets, were commonly called 'hog cycles'. The defining characteristic of such cycles is the long lag in the response of supply (in the form of investment in productive capacity) to changes in the commodity's price as demand evolves. This characteristic generates conditions in which the market experiences longish periods of relative supply tightness, accompanied by high prices, followed by a build-up of supply which eventually drives the price sharply lower. Supply is then cut back, allowing the market to rebalance, and the price to recover. In the case of agricultural commodities, the pace of the cycle, and the lags in supply, were determined by the time required to allocate new land, grow new crops or breed new animals and bring them to market. For the oil industry, the supply cycle is more complex, but the underlying mechanisms are similar.

As such, I think that there is merit in examining recent oil price developments, and the implications for the outlook for the oil market, through the prism of hog-cycle theory. I will start by reviewing recent developments in oil-market fundamentals, trying to distinguish the relative roles of supply and demand in driving the recent fall in prices. I will also consider the similarities and differences between the current episode and the previous cycles of 1985 and 1998. In so doing, I will yield to a bout of nostalgia; recent developments bring back memories of 1998, when I joined the Strategy and Economics team at BP just a few months before the oil price fell sharply to \$9/bbl. Then, using a hog-cycle framework, and the experience of those previous cycles, I will offer some thoughts on how this cycle might play out.

¹ See WEO Update, January 2015.

You would expect me, as a member of the Monetary Policy Committee (MPC) of the Bank of England, to consider the monetary policy angle in this. Hog-cycle dynamics, together with demand fluctuations, affect not just the amplitude of oil market cycles, but also their likely persistence. And that is a key consideration for the MPC as we strive to return consumer price inflation to its 2% target over the medium term. So finally, I will set out the implications as I see them for the conduct of monetary policy under conditions of exogenous, long-cycle commodity price movements of importance to UK inflation.

Anatomy of the recent oil price fall and some comparisons

Chart 1 shows historical data for Brent oil prices. Perhaps the most immediately striking feature of this chart is the sharp collapse, in nominal terms, of the oil price in the summers of 2008 and 2014, in which prices fell by some \$90/bbl and \$60/bbl respectively – in each case more than halving over the course of six months relative to their previous peak levels. Much less striking are the falls in oil prices in 1986 and 1998, which are less discernible on the chart. However, once we adjust for changes in the consumer price level, the magnitude of previous oil price falls looks more similar. In the 1980s and 1990s cases too, prices fell at least 50 percent below their peak level over the course of the following year.

There are a number of other similarities between the episodes of 1986, 1998 and 2014 that suggest that they are all instances of repeated long cycles in the oil market. In each case, the underlying movements in demand, and in particular, supply, in the years leading up to the price collapse can help to explain the sharp swings in prices.

The roles of total supply and demand

Chart 2 shows annual changes (in million barrels per day) in global oil supply and demand for the three episodes.

I would like to draw your attention to two points. The first is related to demand, which in each case can be seen to have been a proximate trigger for the price collapse. Oil demand growth slowed during all episodes: quite markedly between 1984 and 1985, even more dramatically between 1997 and 1998 – reflecting the Asian crisis – although less so between 2013 and 2014, as the recovery in the euro area and emerging markets lost steam. A mild winter in the Northern Hemisphere also dampened oil consumption in 1998 and last year. The modest decline of oil demand growth in 1985 should be seen in the context of the outright falls of the early 1980s, as the doubling of prices in 1979-80 plunged the global economy into recession and encouraged a shift away from oil for electricity generation.

The second, more fundamental point is about supply. Although there is some annual volatility, in each cycle, the oil price falls had been preceded by a build-up in supply, over several years. In the 1990s cycle, supply had been accelerating over several years before the peak growth of 1997. In the 1980s cycle, world oil

supply actually fell in 1985 on an annual basis, but that masked a sharp pickup in the second half of the year, which continued into 1986. In the most recent cycle, supply growth has been strong since 2010, limited only in 2013 by politically-induced supply interruptions in a number of countries. On each occasion, the level of supply caught up with, and overtook that of demand, giving rise to a build-up of inventories.² This is apparent in **Chart 3**, which shows that OECD total oil stocks built steadily throughout 1998, and in the second half of 2014, and into 2015.

Much of the “narrative” around movements in the oil market naturally focuses on the role played by OPEC.³ OPEC is clearly a very visible and important influence, and in each case, changes in OPEC behaviour have played a part in the sharp fall in oil prices (**Chart 4**).

The 1985 episode featured a sharp rise in output by Saudi Arabia in the second half of the year, as it decided to recapture the previous years’ lost market share to non-OPEC producers, in particular Mexico, the North Sea and Alaska. In what some have called a ‘price war’,⁴ Saudi Arabia abandoned its production cuts, which had seen it bear the brunt of OPEC’s output-restricting policy, aimed at defending the 1979-80 doubling of prices. The sharp fall in the oil price associated with the surge of Saudi production only came to an end when OPEC decided to cut back production in late 1986.

In 1997, the increase in the rate of growth in oil supply was entirely driven by stronger OPEC output, reflecting production increases by non quota-complying members – in particular Venezuela. This in turn encouraged Saudi Arabia to step up production in the second half of the year. There followed a large, concerted, quota increase in November 1997, both as a way to validate previous production increases and based on the belief that demand would continue to hold up. But when oil demand collapsed as the Asian crisis took hold, OPEC quota cuts in 1998 and 1999 failed to stem further declines in the oil price, which continued until mid-1999.

Most recently, OPEC output rose sharply in the aftermath of the financial crisis, through to 2012. By 2013, temporary supply disruptions were a feature for several OPEC producers (including Libya and Iraq). By 2014, these sources of supply were gradually returning to the market. The decision by Saudi Arabia late last year not to act as swing producer and restrain its production caught the market by surprise, and represented a change in the Saudi reaction function.

In each episode, OPEC temporarily relinquished its control of the market. The proximate cause of that temporary loss of control may have been different – an attempt by Saudi Arabia to restore its market share and impose production discipline on other OPEC members (1985), an inability to cut sufficiently to offset the degree of supply overhang (1998), or, in the most recent case, a decision not to cut production, despite

² Inventories data are not available before 1989.

³ OPEC refers to the Organisation of the Petroleum Exporting Countries. Founded in 1960, it currently comprises Algeria, Angola, Ecuador, Iran, Iraq, Kuwait, Libya, Nigeria, Qatar, Saudi Arabia, the United Arab Emirates and Venezuela.

⁴ See Mabro (1998).

falling prices, in an effort to maintain market share and force higher-cost producers to take more responsibility for market adjustment.

But in all three episodes, the market disruption and the sharp price falls were the result of wider, more fundamental economic forces at work.

Of course, OPEC can do little to influence the underlying pace of demand growth, which is determined by growth in the world economy and changes in energy efficiency. But, importantly, neither can it control total supply. OPEC producers represent around 42% of total production, and are surrounded by a series of independent producers (non-OPEC), who each act to maximise their individual supply function. In each cycle, non-OPEC production had been building over several years prior to the crisis, driven by a combination of technological breakthrough and previous high prices encouraging investment. In the 1980s, non-OPEC supply was encouraged by the ability to drill in deeper waters and other hostile environments, including the development of Alaska and the North Sea, as well as the high oil price following 1979. The most recent cycle has similar roots: the exploitation in the United States of new technology to extract “tight” oil (oil that is embedded in low-permeable sandstone and extracted using technologies such as horizontal drilling and hydraulic fracturing) (**Chart 5**),⁵ made economic by the high prices of 2007-13. In the 1990s, a new technology is more difficult to identify, but reductions in exploration and production costs and broader application of technological advances saw significant growth in production in Canada, the United Kingdom, Norway, Brazil, Argentina, Angola and Colombia.

A hog cycle theory of the oil market

But why is the market characterised by dramatic moves in prices, and the long fundamental swings in supply I have described? To achieve such cyclical characteristics, the response of supply to changes in price needs to be both heavily lagged and then quite marked. In other words, the short-term elasticity of supply needs to be low, but the longer-term elasticity substantially higher. So what lies behind these elasticities? In the case of the oil market, there are two characteristics that help determine the supply response.

The first is the capital intensive nature of oil production. Such capital intensity means that oil production involves high levels of fixed production cost, and relatively low variable production costs. Once the fixed production costs have been incurred – the exploration costs and the upfront investment in establishing production facilities – and have become sunk, the low marginal variable cost of production makes it economic to continue to produce in existing fields even as prices fall sharply. Moreover, those variable costs of production are themselves relatively flexible – as prices fall, the oil supply chain comes under intense pressure to reduce costs, rendering existing production economic for longer. As a result, in the short term, oil supply is relatively inelastic to changes in price. The main adjustment comes from changes in investment

⁵ The increase in American total crude oil production was the largest in US history and the fourth-largest increase ever recorded.

plans. These, in turn, affect supply in two ways – first, existing production gradually becomes less efficient unless supported through new investment, and second, cancelled investment plans reduce the arrival of new fields into production. Over the longer term, the price elasticity of supply is higher, as shown by the sharp falls in the rate of growth in production in the year following the price falls of 1985 and 1998 – the impact on production is lagged by a year or so.

The lag in the supply response means that for a while, even after the initial price fall, supply continues to exceed demand, such that inventories continue to build. For the market to rebalance, supply has to be reduced below the level of demand, such that existing inventory levels can be reabsorbed. As inventory levels fall back, the market tightens and prices begin to rise, encouraging supply to recover. But here too, there are noticeable lags – first, it will require a period of higher prices to encourage producers to commit to new investment, and geographical, geological and political issues mean that the lead time to new supply is relatively lengthy.

Recent experience provides a pertinent illustration of this cyclical pattern. For much of the 2000s, oil demand was running ahead of supply, fuelled by strong growth in China and Asia more generally. Prices rose sharply between 2004 and 2008, and would have stimulated increased investment, had not the onset of the financial crisis intervened. The collapse of demand in the ensuing recession delayed the need for such investment in supply, but as the global economy recovered in 2010, and the Arab Spring constrained OPEC production in 2011, prices rose above \$100/bbl. This triggered a sharp increase in investment, particularly in the unconventional oil sector (tight oil, tar sands and shale gas), which had been made economic by the elevated price level and technological advance, and led to the abundant production of recent years.

The second characteristic is the structure of the market. Although the OPEC cartel sits at its heart, some 60% of production is in the hands of non-OPEC producers, who act independently to maximise their individual production. Their reaction to the movement in price is therefore relatively synchronised, in response to previous price conditions, contributing to the long cycles in supply.

In describing these key characteristics, I have just given you a high-level description of a hog cycle, first described in the first half of the twentieth century by American and German economists to explain the cyclical fluctuations of supply and prices in livestock markets. Applied to the market for oil, the basic tenet is that the majority of producers independently base their investment decisions on current prices, but production responds only slowly due to by lags in exploration and extraction. As production lags demand growth, prices rise, encouraging further investment, such that output eventually outpaces consumption, causing prices to decline sharply. This leads to a fall in investment, and, again with a lag, in production. In time, output falls sufficiently to cause prices to rise again. The cycle then repeats itself.

But where do we stand now? What does hog cycle theory, and the experience of the past two cycles, suggest about the outlook for the oil market?

Implications for the oil market outlook

In terms of oil supply, we need to distinguish between the response of investment on the one hand, and that of production – both in the short term and longer term – on the other. Oil prices at around \$60/bbl are certainly sufficient to elicit a dramatic retrenchment in investment. As widely reported in the media, the sharp fall of the oil price has already forced the oil majors to cut back dramatically on capital expenditure. And such falls can be expected to persist over the next couple of years.

The cutbacks in capital spending have affected exploration drilling. The sharp fall in the number of rigs drilling for oil in the US (**Chart 6**) continues to make the headlines, though much of the decline has come from lower-yielding rigs – the low-hanging fruit. The skewed distribution of oil rig productivity, with some wells much more productive than others, means that the relationship between the oil rig count and oil production is not linear. Indeed, US domestic production has so far held up well and US commercial crude stocks have risen to historical highs since the start of the year (**Chart 7**). The cutback in supply will be sure to come – the US Energy Information Administration expects US crude production to fall in the second half of the year⁶ – but, as I mentioned earlier, in the short term marginal costs of production can be downsized rapidly, as oil companies renegotiate prices with oil-service providers.

Chart 8 shows indicative estimates of how much it costs to produce an additional barrel of oil by type of extraction method. As you would expect, non-OPEC suppliers face much higher costs of extraction than the main OPEC producers – for instance, for unconventional oil, such as shale, the break-even prices typically range from \$55 to \$60/bbl, almost twice those of the Middle East. These data suggest that the production cut-backs will be higher for tight oil producers, given higher marginal costs of production. Yet marginal costs for tight oil producers have exhibited greater downward flexibility, making the picture slightly more complex than that. As **Chart 9** shows, break-even prices for shale have been falling over the past few years, and some are now around \$40/bbl. So US shale oil might not be the most expensive to produce. But I think it can be expected to be the most responsive to the oil price falls, reflecting three factors: producers are highly leveraged and raising capital is becoming more difficult; the wells have a very high production decline rate, creating an incentive to postpone drilling until prices have recovered (this no doubt explains the sharp fall of the oil rig count); and finally, the individual investments (wells) are small, making spending more easily scalable.

So overall, we can expect oil production to ease in the second half of the year, consistent with International Energy Agency's (IEA) forecasts of weaker global oil supply growth for the year as a whole (**Chart 2**).

What about oil demand? The IEA expects world oil demand to increase by a bit more this year than last. Lower oil prices can certainly be expected to boost the demand for oil – but by how much is not clear.

⁶ See Energy Information Administration Short Term Energy Outlook, February 2015.

Two forces are at play. The first is the price elasticity of oil demand, that is, the extent to which companies are likely to switch to oil-intensive inputs to take advantage of cheaper oil. Such a 'substitution effect' is likely to be limited in the short term because the oil-intensity of production processes cannot be increased rapidly. In addition, in many non-OECD countries, where much of the growth in oil demand in recent years has been concentrated, governments are using the fall in the oil price as an opportunity to remove subsidies or increase taxes, thus reducing the pass through of the oil price decline to consumers, reducing the lift to oil demand.

The second force is the net effect of lower oil prices on world economic activity, via income effects. Cheaper oil boosts oil consumers' purchasing power, allowing them to increase spending on other goods and services, although it reduces revenues for oil-producing countries, depressing their spending. In the February *Inflation Report (IR)*, Bank staff estimate that the fall in oil prices since mid-2014 could boost the level of world GDP by up to 0.8%, as the positive effect on global oil consumers outweighs the negative effect on global oil producers. In the same vein, based on scenarios with different assumptions about the relative role of supply in driving the oil price falls, the IMF estimates that global GDP could be lifted by 0.3% to 0.8% this year and next.⁷

Overall, it is reasonable to assume that, by the end of 2015, supply and demand for oil will be coming back into balance, although inventories will remain high for a further period. This should translate into more stable yet still relatively low prices. Further out, as investment cutbacks weigh further on future production capacity and output, prices might be expected to recover. **Chart 10** shows the recovery paths of the oil price following sizeable falls over the past thirty years, including the path consistent with the latest futures curve, which sees the oil price at about \$70/bbl in late 2016. That path, at least, conforms to historical precedents. Whether, over the longer term, this cycle more closely resembles that of the late 1980s, in which prices stayed low for a considerable period, or the late 1990s, in which they recovered somewhat more rapidly, remains to be seen.

Impact on inflation

What impact did these oil price falls have on UK headline inflation? **Chart 11** plots twelve-month changes in the consumer price index (CPI), which has been the MPC's target since January 2004, the retail price index (RPI) and the RPIX, which excludes mortgage interest payments, and served as the target before 2004. The chart also shows the percentage point contribution of energy prices, split into petrol and utilities, to RPI inflation from 1980 to 1996, and to CPI inflation thereafter.

The fall in petrol prices that followed Saudi Arabia's output expansion in late 1985 accounted for about one third of the decline in annual RPI inflation from 5.7% in December 1985 to a trough of 2.4% in August 1986.

⁷ See the box 'The Effects of Lower Oil Prices on the Global Economy', p.4, WEO Update, January 2015.

The fall in oil prices during the 1998 episode had a much more muted impact on headline CPI inflation, with the contribution from petrol prices falling to zero but not turning negative.

In the most recent episode, the fall in the oil price was the single most important factor in reducing the annual rate of headline inflation to 0.5% in January, prompting the writing of an Open Letter by the Governor to the Chancellor,⁸ and further to a record low of 0.3% in February. Inflation is expected to flirt with zero this month and next, and remain well below the 2% target for the rest of the year. **Chart 12** shows that energy prices, most notably petrol prices, can be expected to detract a bit more than half a percentage point from headline inflation for the rest of the year, conditioned on the assumption that oil prices follow the latest futures curve.

So the direct impact on inflation can be marked. But the total effect on inflation comes not only from that direct, immediate effect, and any second-round effects, as lower energy costs feed through into downward pressure on other production costs, given that oil is a significant input in the supply chain. It also reflects indirect effects, working in opposite directions.

Some are potentially inflationary, in particular the boost to households' real incomes, which stimulates the demand for, and prices of, non-energy goods and services. The inflationary impact of this boost to demand would be dampened to the extent that the oil price fall were to lift potential output as well, but in my view, the positive effects on potential output of lower prices are likely to be small. While dearer oil typically encourages capital scrapping, cheaper oil does not necessarily lead to increased capital accumulation and greater productivity. And it is not clear whether the rise in real incomes would cause workers to want to work less (income effect), leaving the impact on labour supply hard to gauge.

Others are potentially disinflationary, such as the risk that inflation expectations might drift down and become de-anchored, giving rise to disinflationary pressures – a risk I will return to in a moment.

Implications for monetary policy

How should monetary policy respond to such a sharp oil price shock? As is often the case with monetary policy, the answer depends on the source of the shock. As I argued earlier, and as others have also concluded, supply rather than demand has been the dominant factor behind the recent fall in the oil price.⁹ As such, the shock should be treated primarily as a simple cost or price-level shock. Such price-level shocks affect the price level permanently, but have only a *temporary* effect on the rate of inflation. The typical prescription for monetary policy, therefore, is to accommodate such shocks – that is, to “look through” them

⁸ See <http://www.bankofengland.co.uk/monetarypolicy/Documents/pdf/cpiletter120215.pdf>.

⁹ For example, see ‘Seven Questions about the Recent Oil Price Slump’ (2014) by Arezki and Blanchard and the January 2015 World Economic Outlook update.

in setting policy. And indeed, we have done as much in the past – as recently as a few years ago, when rising oil prices contributed to pushing inflation well *above* the target.¹⁰

But how temporary is temporary? Policymakers need to consider not just the source of the shock but also its persistence. The sharp fall of oil prices over the past six months, particularly if sustained in coming months, will depress annual inflation rates for a protracted period – quite possibly well into next year. This brings the depressive impact on headline inflation into the timeframe over which monetary policy can have an influence on the economy. While it takes some 18 to 24 months for the full effects of any change in interest rates to feed through to the economy, the initial effects can take place earlier.

In judging how far policy makers should react to what are essentially price-level shocks but with more persistent effects on the inflation rate, the ‘optimal policy rule’ is a helpful guide. It states that “looking through” an undershoot of inflation, even a prolonged one, is more justified if the real economy is operating above full capacity, and vice versa. This can be an important guide when the economy is operating with a large output gap – either positive or negative – but becomes harder to interpret when the economy is operating close to full capacity. This is particularly true if one considers not only the current level of spare capacity but also its trajectory over the policy horizon. Whether that spare capacity is diminishing or increasing, and whether the output gap is moving from negative to positive territory over the policy horizon, are also important considerations in judging how far to “look through” the initial price-level shock.

This is important at the current juncture. In the central projection of the February *IR*, the remaining level of spare capacity, currently estimated to be about ½% of GDP, is expected to be fully absorbed by the middle of next year. As I mentioned in a recent speech,¹¹ I also think that the risks around that central estimate of slack are probably skewed to the downside, suggesting that there may be less spare capacity left in the labour market, and that the economy could reach effective full employment somewhat earlier. As labour market slack is absorbed, there is a risk that wages may accelerate to a pace inconsistent with stable inflation, which the MPC could not ignore.

But policy also needs to be set considering the indirect impacts of the oil price shock I mentioned earlier.

First, the potentially inflationary impacts. Bank of England model simulations suggest that a ten percent fall in the oil price increases the level of GDP by just over 0.1% after two years.¹² But this estimate is uncertain, and the precise impact on GDP will depend on the effect of the price fall on consumer and business confidence, and hence the marginal propensity to consume from the income windfall. To the extent that GDP increases by more than the central estimate, inflation pressures would be correspondingly greater.

¹⁰ See McCafferty (2013).

¹¹ See McCafferty (2014).

¹² See the box “The impact of lower oil prices on the UK economy”, *Inflation Report* February 2015, pp32-33.

But, potentially offsetting this is the risk of more persistent disinflationary pressure, caused by shifting inflation expectations and hence wage and price-setting behaviour. As inflation hovers close to zero, there may be less upward pressure on pay settlements, with households possibly willing to accept smaller nominal wage increases in the face of such very-low headline inflation. Such behaviour would prolong the period of inflation undershoot, requiring the MPC react.

Judging the scale of this downside risk is difficult. Some measures of inflation expectations have fallen (**Chart 13**), but others suggest that inflation expectations remain well-anchored, and there are no signs at present that anything approaching deflationary psychology is likely to take hold. In my view, this downside risk is a relatively low probability event, but one that would have adverse consequences on the economy, were it to materialise. It is therefore not a risk that we can dismiss. The need to minimise this risk, at least while inflation remains close to zero, explains the change in my voting pattern, deciding not to vote for an increase in Bank Rate at the January and February policy meetings earlier this year.

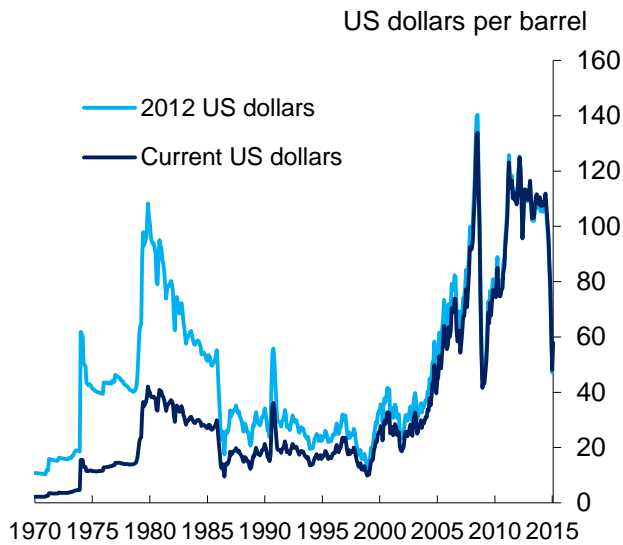
Conclusion

The fall of the oil price since last summer has been spectacular, and has had a dramatic effect on the headline inflation rate, pushing consumer price inflation close to zero. There is no mechanical formula that can tell the MPC how to adjust interest rates to deal with sharply falling oil prices. The appropriate monetary policy response depends on both the nature and the persistence of the shock – in particular how households and businesses respond to it.

Our mandate provides the best guide. The mandate is clear that our inflation target is symmetric, such that we should treat deviations of inflation from the target, whether from above or below, in the same way. The MPC's decision to look through the recent sharp fall in the oil price is consistent with its decision to accommodate the sharp, and persistent, increase in oil prices that occurred a few years ago.

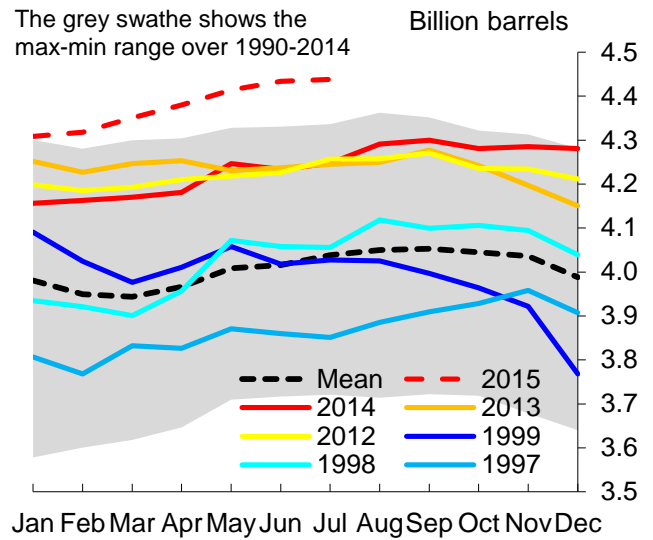
But each situation is distinct and requires that we remain alert to its idiosyncrasies. We will need to watch closely to judge the behavioural responses of consumers and businesses both to the income windfall, and to the period of close-to-zero inflation. There is a great deal of uncertainty about the transmission of such shocks to the economy, but I am confident that flexible inflation targeting provides us with the appropriate framework to conduct monetary policy under these challenging circumstances.

Chart 1: Dated Brent oil price



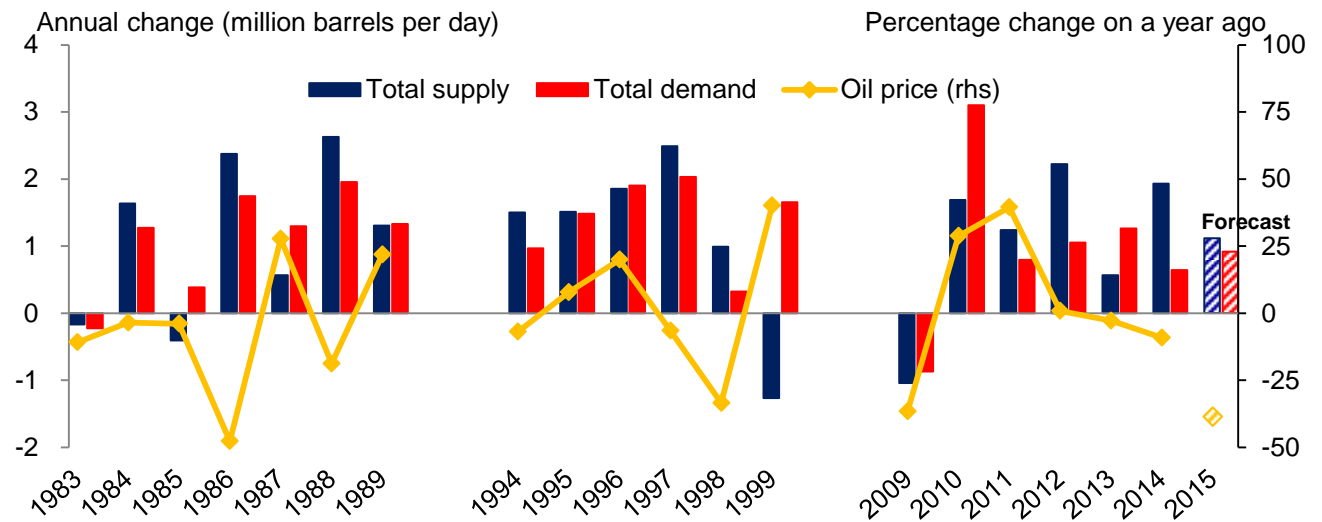
Source: Bloomberg and Bureau of Economic Analysis. Nominal prices are deflated using the consumption expenditure deflator (CED), which is indexed in 2012.

Chart 3: OECD industry and government oil product stocks



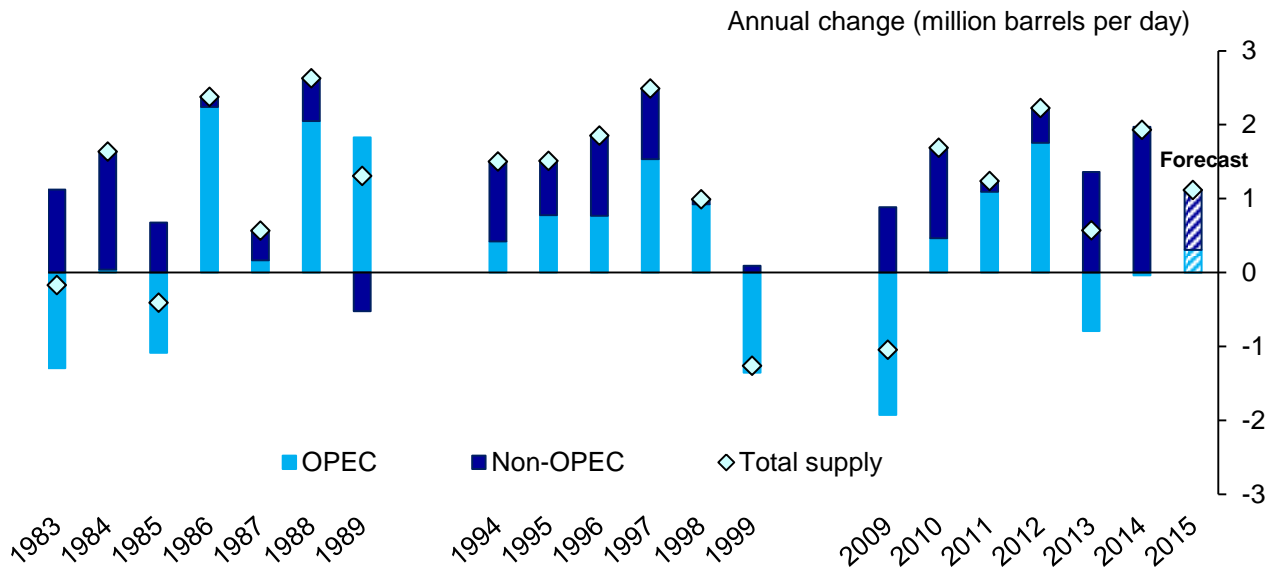
Source: International Energy Agency and Bank calculations. The 2015 forecast is estimated using monthly OECD oil demand and non-OPEC oil supply forecasts and quarterly non-OECD oil demand forecasts. It assumes constant OPEC output and attributes half of the discrepancy between total supply and demand to OECD stocks.

Chart 2: World oil supply, demand and prices



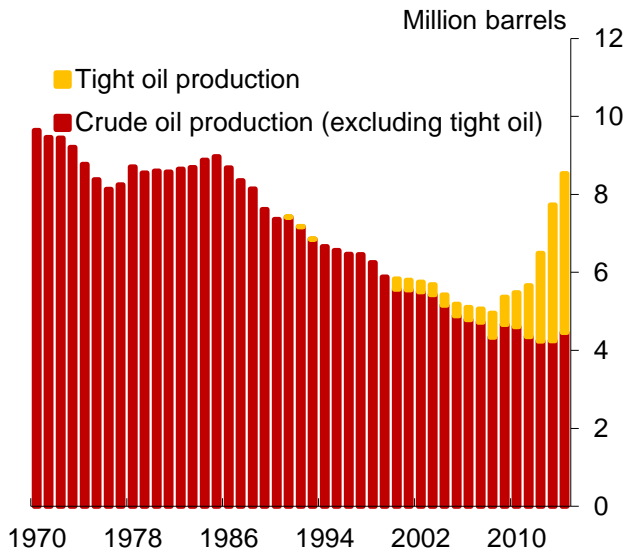
Source: International Energy Agency, Energy Information Administration, BP Statistical Review and Bank calculations. Forecasts for 2015 are from the International Energy Agency. The annual oil price inflation forecast for 2015 is based on the futures curve as of 6 March 2015.

Chart 4: World oil supply – OPEC and non-OPEC contributions



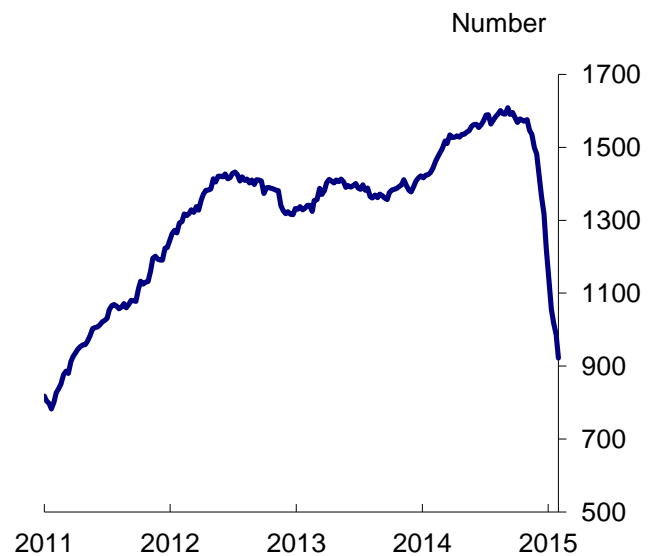
Source: International Energy Agency, Energy Information Administration, BP Statistical Review and Bank calculations. Forecasts for 2015 are from the International Energy Agency, except for OPEC supply, which is assumed constant at its 2014Q4 level.

Chart 5: US crude oil production



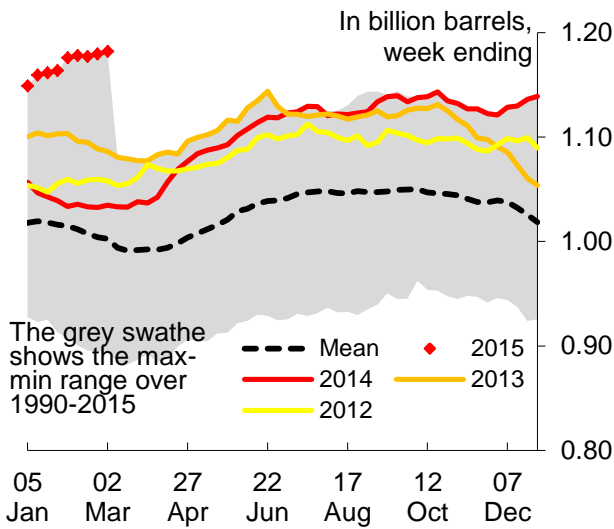
Source: Energy Information Administration Annual Energy Outlook 2014

Chart 6: US total oil rig count



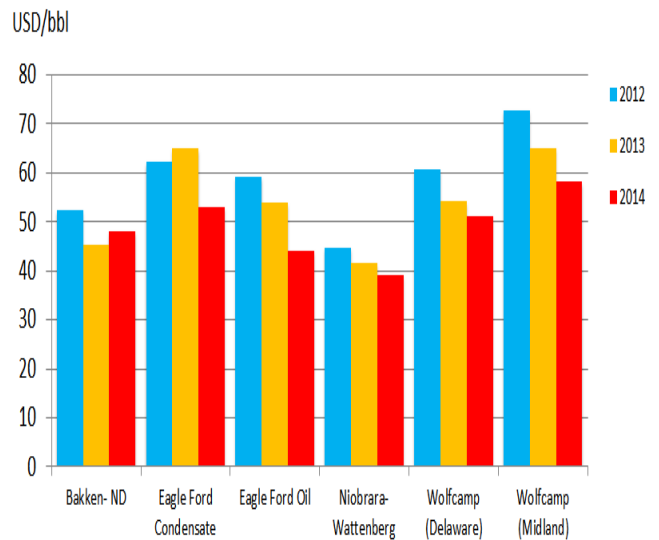
Source: Baker Hughes

Chart 7: US total stocks of crude oil and petroleum products



Source: Energy Information Administration and Bank calculations.

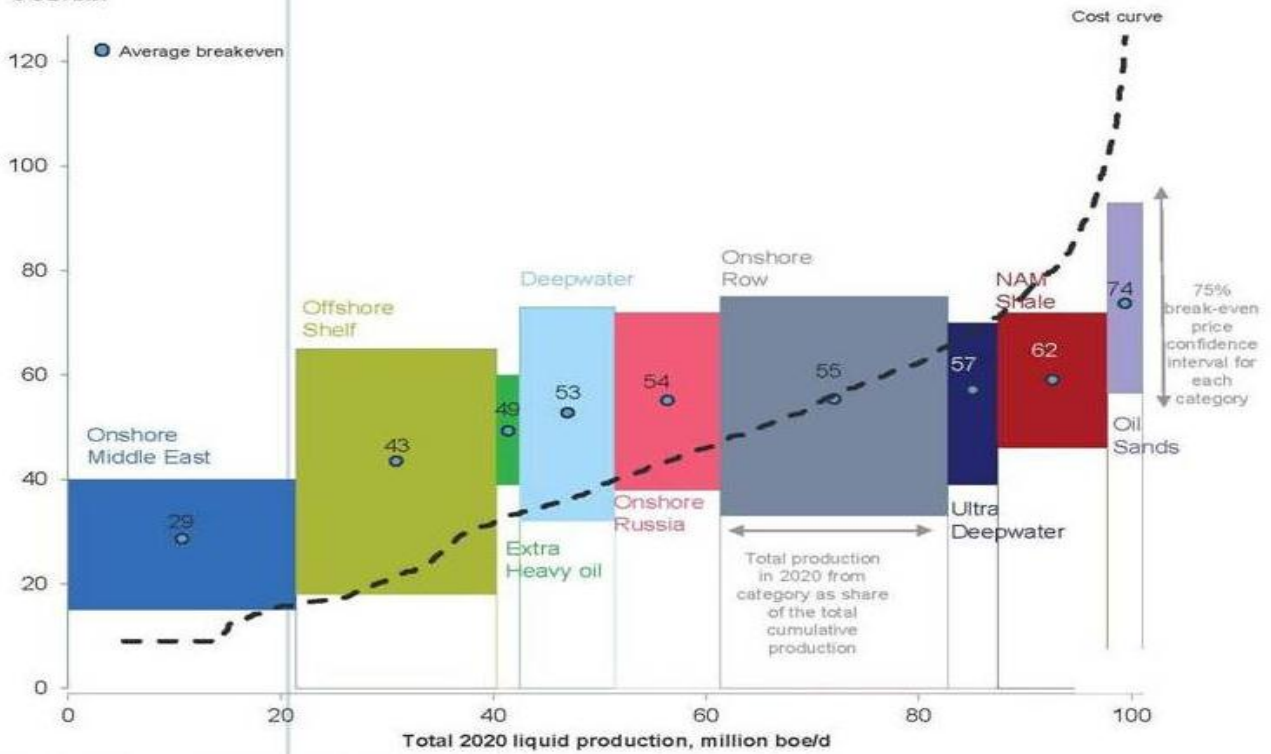
Chart 9: WTI breakeven price per shale play



Source: Rystad Energy Research & Analysis.

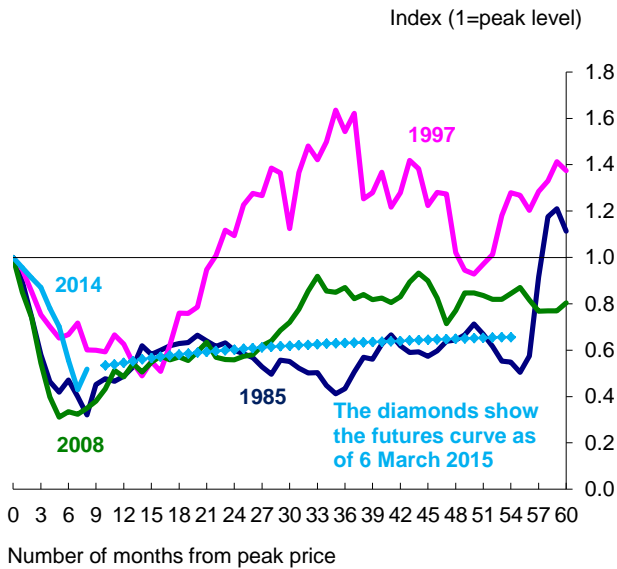
Chart 8: World marginal cost curve

Global liquid supply cost curve
USD/bbl



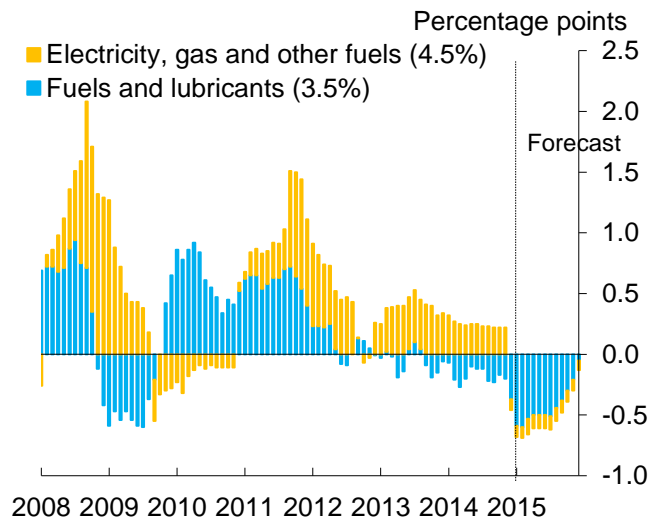
Source: Rystad Energy Research and Analysis. See Chart 4 in 'Seven Questions about the Recent Oil Price Slump' (2014) by Arezki and Blanchard, The IMF Blog.

Chart 10: Oil price recoveries in historical context



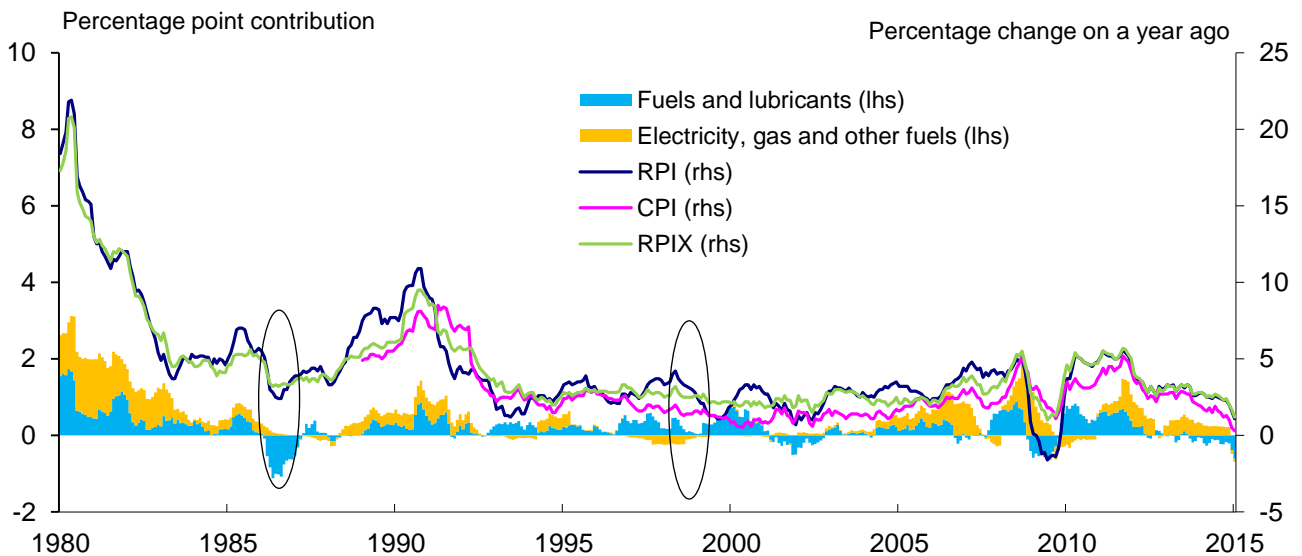
Source: Bloomberg and Bank calculations.

Chart 12: Contribution of energy prices to annual CPI inflation



Source: Bloomberg, Department of Energy and Climate Change, ONS and Bank calculations. See Chart 4.2 of the February 2015 *Inflation Report*. Forecast based on the author's calculations.

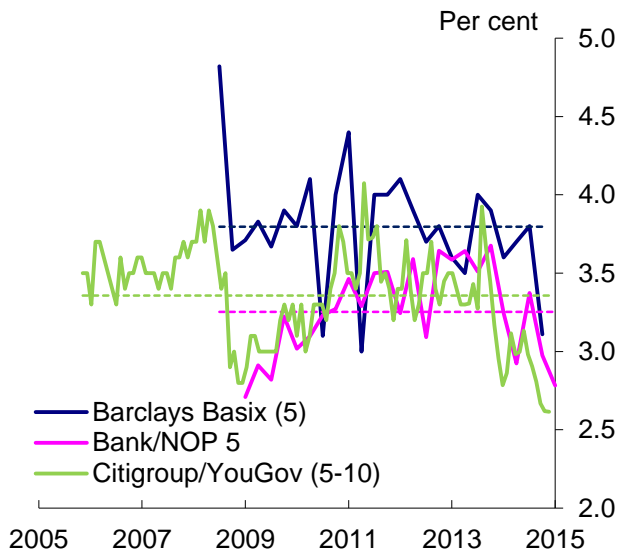
Chart 11: Headline inflation measures and energy price contribution



Source: ONS and Bank calculations.

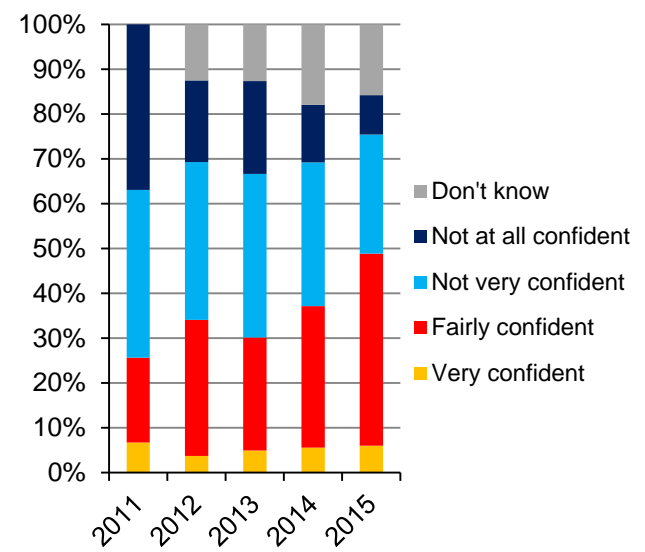
From October 1992 to May 1997, the target for RPIX inflation ranged from 1% to 4%. From June 1997 to December 2003, the target for RPIX inflation was 2.5%. Since January 2004, the target for CPI inflation has been 2%.

Chart 13: UK long-term household inflation expectations



Source: Barclays Basix, Bank/NOP survey and Citigroup/Yougov. The dashed lines indicate whole-sample averages.

Chart 14: "How confident are you that inflation will be close to the 2% target in two to three years' time?*



Source: Bank/NOP survey.
* 'By close I mean that inflation will be between 1% and 3%'.

References

Alkhatlan, K, Gately, D and M Javid (2013), 'Analysis of Saudi Arabia's Behavior within OPEC and the World Oil Market', New York University, 31 May 2013, available at http://www.econ.nyu.edu/dept/courses/gately/KAK_DG_MJ_053113.pdf

Arezki, R and O Blanchard (2014), 'Seven Questions about the Recent Oil Price Slump', 22 December, iMFDirect – The IMF Blog, available at <http://blog-imfdirect.imf.org/2014/12/22/seven-questions-about-the-recent-oil-price-slump/>

Bank of England (2015), Agents' Summary of Business Conditions – February 2015, available at <http://www.bankofengland.co.uk/publications/Documents/agentssummary/2015/feb.pdf>

Bank of England (2015), *Inflation Report*, February 2015, available at <http://www.bankofengland.co.uk/publications/Documents/inflationreport/2015/feb.pdf>

Energy Information Administration (2015), Short-Term Energy Outlook, February 2015, available at http://www.eia.gov/forecasts/steo/pdf/steo_full.pdf

Fattouh, B (2007), 'OPEC Pricing Power, The Need for a New Perspective', Oxford Institute for Energy Studies, WPM 31, March 2007, available at <http://www.oxfordenergy.org/wpcms/wp-content/uploads/2010/11/WPM31-OPECPricingPowerTheNeedForANewPerspective-BassamFattouh-2007.pdf>

Gately, D (1986), 'Lessons from the 1986 Oil Price Collapse', Brookings Papers on Economic Activity, 2:1986, available at http://www.brookings.edu/~media/Projects/BPEA/1986%202/1986b_bpea_gately_adelman_griffin.PDF

Harlow, A (1960), 'The Hog Cycle and the Cobweb Theorem', *Journal of Farm Economics*, Vol.42, No.4 (Nov. 1960), pp.842-853.

International Monetary Fund (2015), World Economic Outlook Update, January 2015, available at <http://www.imf.org/external/pubs/ft/weo/2015/update/01/pdf/0115.pdf>

Mabro, R (1998), 'The Oil Price Crisis of 1998', SP10, Oxford Institute for Energy Studies, available at <http://www.oxfordenergy.org/wpcms/wp-content/uploads/2010/11/SP10-TheOilPriceCrisisof1998-RMabro-1998.pdf>

McCafferty, I (2013), 'Inflation targeting and flexibility', speech given at The Wall Street Journal at Eight Members Club, London, 14 June, available at <http://www.bankofengland.co.uk/publications/Documents/speeches/2013/speech669.pdf>

McCafferty, I (2014), 'Monetary Policy in an uncertain economy', speech given at the Institute of Directors breakfast, Liverpool, 10 December, available at <http://www.bankofengland.co.uk/publications/Documents/speeches/2014/speech786.pdf>

Rystad Energy (2015), US Shale Newsletter Vol.2 No.1, January 2015.