



Assessment of the Effect of Oil Price Fluctuations on the Public Finances

14 September 2010

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Executive Summary

'The Chancellor has asked the Office for Budget Responsibility to undertake an assessment over the summer of the effect of oil price fluctuations on the public finances. Informed by this assessment, the Government will examine options for the design of a fair fuel stabiliser' (Budget 2010, paragraph 2.100). A fuller remit for this assessment is provided in Annex 1.

- As noted in the remit for this Report *'a Fair Fuel Stabiliser could support motorists when the cost of living is rising, by reducing fuel duty when oil prices rise (and vice versa)'*. The remit also notes that *'a key principle underlying a Fair Fuel Stabiliser should be that it reduces the sensitivity of the public finances to oil prices and improves the long-term stability of the public finances. Therefore, understanding the size of any windfall accruing to Government as a result of high oil prices (and therefore how much fuel duty can be cut when prices are high, and vice versa) is key to designing a workable Stabiliser that has a practicable impact on the public finances'*.
- This report looks at both a temporary (one-year) and permanent £10 a barrel rise in the oil price, an increase of around 20 per cent. A £10 a barrel rise in the oil price would raise the pump price of petrol and diesel by 7.4 pence a litre if fully passed through. However changing fuel duty by 1p a litre costs or benefits the Exchequer by around £500m.
- Higher oil prices would boost revenues of corporation tax, supplementary charge and petroleum revenue tax from UK oil and gas production, although production is expected to drop by around 5 per cent to 8 per cent per annum. However, there are a number of offsetting effects on the public finances:
 - higher pump prices will reduce the demand for fuel, lowering fuel duty receipts;
 - temporarily higher inflation will push up the indexation of tax thresholds, benefits, public service pensions and index-linked gilts; and
 - higher oil prices are likely to reduce real household income and the supply potential of the economy, with detrimental effects on receipts from labour and capital income as well as from consumer spending.
- Tables 1 and 2 provide an estimate of the overall effect on the public finances from both a temporary (one-year) and permanent £10 a barrel rise in the oil price at current production levels.

Table 1: Overall Effect on the Public Finances of a temporary £10 increase in the oil price¹ (£ billion)

	Year 1	Year 2	Year 3	Year 4
UK Oil and Gas Revenues	2.4	0	0	0
Other Effects ²	-0.6	0.4	0	0
Economy Effects	-1.7	-1.1	0	0
Overall Effect	0.1	-0.7	0	0

1 An improvement in the public finances is shown as positive

2 Includes effect on fuel duty, VAT and from indexation effects

- The overall effect on the public finances of a temporarily higher oil price could be marginally positive in the first year. The effect on the public finances from a more permanent rise in the oil price would be negative, from the second year onwards. The detrimental effect on receipts from lower output more than offsets the boost to UK oil and gas revenues.

Table 2: Overall Effect on the Public Finances of a permanent £10 increase in the oil price¹ (£ billion)

	Year 1	Year 2	Year 3	Year 4
UK Oil and Gas Revenues	2.4	2.4	2.4	2.4
Other Effects ²	-0.6	-0.2	-0.1	-0.1
Economy Effects	-1.7	-3.5	-4.1	-4.5
Overall Effect	0.1	-1.3	-1.7	-2.2
Potential Range	1.2 to -0.7	0.1 to -2.5	-0.9 to -3.1	-1.5 to -3.5

1 An improvement in the public finances is shown as positive

2 Includes effect on fuel duty, VAT and from indexation effects

- The effect of higher oil prices on the economy is modelled using a three factor (labour, capital and oil) production function approach. Using this model, it is estimated that potential output is reduced by just over 0.3 per cent in the first year following a temporary 20 per cent increase in the real oil price (i.e. the price of oil relative to the price of other goods and services in the economy). Beyond the first year, the oil price reverts to its pre-shock level and there is no impact on potential output. In a scenario where the real oil price increase is permanent, potential output is estimated to be around 0.5 per cent lower in the medium term as a result of the real oil price shock.
- These estimates should be broadly symmetrical. A permanent drop in the oil prices would improve the public finances in the medium term, reflecting the rise in potential output. With the exception of the effect on oil company investment decisions and thus on UK oil and gas revenues, which are more likely to be affected by larger and more prolonged changes in the oil price, these estimates could be scaled up or down, depending on the size of any change.

- There are clear uncertainties around these estimates. The potential range in Table 2 allows for different outcomes for the scale of the additional receipts from UK oil and gas production and the size of any economy offset from the effect of lower potential output. UK oil and gas receipts could be boosted if gas prices rose in line with oil prices, but reduced if higher prices pushed up capital expenditure in the industry.
- Likewise, the economy offset figures could be affected by the sensitivity of potential output to changes in the oil price and how quickly actual output adjusts to the change in the oil price. Estimates of the impact of a change in the oil price on the economy in any given year will depend on the speed at which the economy adjusts, the assumed response of the labour market and the response and effect of monetary policy.
- The estimated impact of oil price changes on the public finances depends significantly on whether the higher oil price lasts for one year or whether the increase is permanent. In practice the distinction between what constitutes a 'temporary' and a 'permanent' oil price shock is highly subjective. It is extremely difficult to identify in real time whether movements in the oil price are temporary or are likely to persist beyond the near term. This is particularly the case given that oil prices have shown substantial volatility both within years and between years, with oil prices ranging from \$40 to \$140 a barrel over the last three years.
- In summary and based on central estimates, a £10 a barrel higher oil price would:
 - boost UK oil and gas revenues by £2.4 billion. However offsetting effects elsewhere on the public finances reduce the benefit to close to zero for a temporary rise in oil prices, while there would be a loss to the public finances from a permanent rise.
 - a £10 increase in the oil price could raise pump prices by 7.4p a litre if fully passed through. Changing fuel duty by 1p a litre has an effect of around £500 million. To offset the whole rise in the pump price would cost around £3.7 billion.
 - in the absence of any offsetting effects on the public finances, the £2.4 billion additional UK oil and gas receipts could be used to offset around two-thirds of the pump price rise. Once the offsetting effects are included, very little of the pump price rise could be offset in response to a temporary oil price shock. There is no improvement in the public finances to be used for stabilising the pump price in the case of a permanent shock.

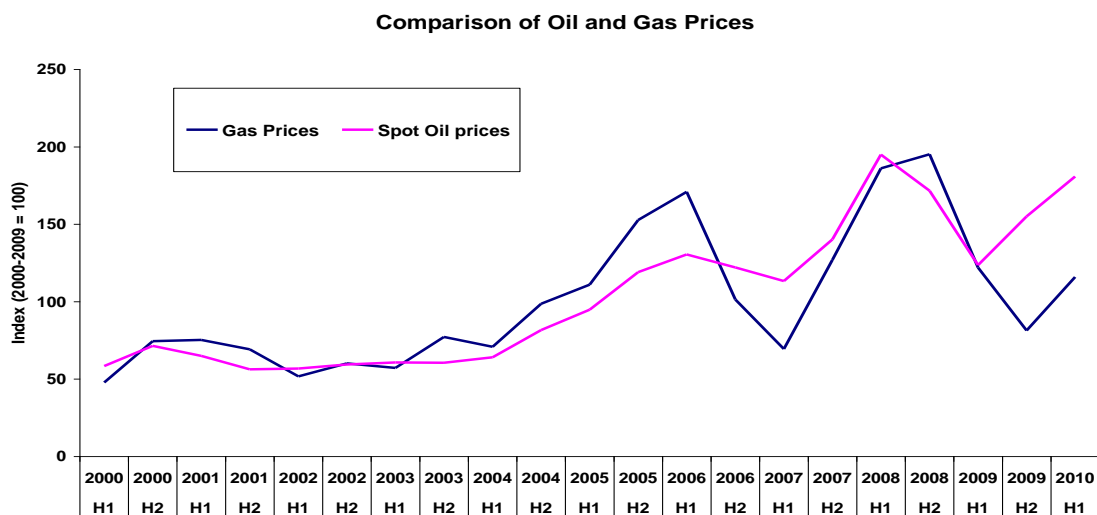
Main Analysis

The analysis looks at the effects of both a temporary and permanent £10 a barrel increase in the oil price¹. With oil prices currently around £50 a barrel, this represents a 20 per cent increase in the oil price^{2,3}. For the purposes of this analysis a 'temporary' oil price shock is interpreted as a one-year increase to £60 a barrel, with the oil price reverting to £50 a barrel from year 2 onwards. A 'permanent' oil price shock is interpreted as a persistent increase in the oil price to £60 from year 1 onwards. In practice the distinction between what constitutes a 'temporary' and a 'permanent' oil price shock is subjective and it is extremely difficult to identify in real time whether movements in the oil price are temporary or are likely to persist beyond the near term.

Impact on UK Oil and Gas Revenues

2. A change in oil or gas prices will affect UK oil and gas revenues. Box 1 looks more closely at the UK oil and gas fiscal regime. A higher oil price would boost ring fence corporation tax, the supplementary charge and petroleum revenue tax. A ready-reckoner from the HMRC model of UK oil and gas revenue indicates £240 million additional receipts per £1 increase in the oil price, other things equal.

3. There are potential upsides and downsides to this estimate. The key upside factor would be if gas prices rise in line with oil prices. This would boost receipts by £50-70 million per £1 increase in the oil price. Historically, oil and gas prices have moved closely in line, but more recently oil and gas prices have decoupled to an extent. Some of the divergences in gas prices reflect supply considerations.



¹ The oil price increase is modelled as an exogenous event. However, different types of shocks may have more complex effects depending on the source of the oil price increase (see Annex 2).

² For the purposes of the scenarios, we have used 2011-12 as the first year of the oil price shock.

³ The sterling price of oil could also be affected by changes in both the dollar oil price and the sterling-dollar exchange rate.

4. The main downside factor is that higher operating and capital expenditure will reduce profits and lower the revenue gain from higher oil prices. This was the case during the run up in oil prices from around 2004 to mid-2008. Capital expenditure rose by over 70 per cent between 2004 and 2006. With 100 per cent first year capital allowances, this had an immediate effect on corporation tax receipts. This in part reflected the fact that higher oil prices made investment in the industry more attractive, but also that there were strong cost pressures. Increased competition and capital constraints in the global oil industry pushed up rig rates and the wages of skilled personnel. Unit operating costs rose from just over £4 a barrel in 2005 to £7.4 a barrel in 2009.

5. Over the longer term, a further downside is that as UK oil and gas production declines, the additional UK oil and gas receipts from higher oil prices will reduce. UK oil and gas production is expected to decline by around 5 to 8 per cent per annum. Changes in oil prices could affect production levels. High oil prices could sustain 'tail end' production from mature fields, while a prolonged reduction in the oil price could lead to fields being closed and decommissioned.

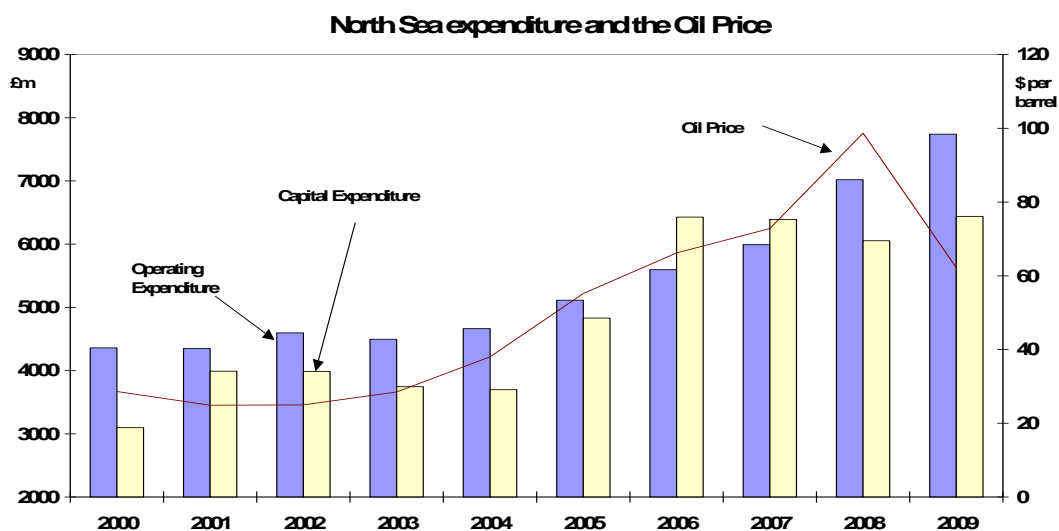
Box 1: UK Oil and Gas Fiscal Regime

This applies to profits earned by companies from the production of oil and gas from the UK and the UK Continental Shelf. It is comprised of three taxes:

- **Ring fence corporation tax.** This is charged at 30 per cent. A 'ring fence' prevents taxable profits from UK oil and gas production from being reduced by losses from other activities.
- **Supplementary charge.** A supplementary tax based on corporation tax. Introduced in 2002 at 10 per cent and doubled to 20 per cent from 2006.
- **Petroleum revenue tax:** Applies only to fields that received development consent before 16 March 1993. Profits are taxed at 50 per cent, but the tax is deductible when calculating ring fence corporation tax and the supplementary charge.

Oil and gas fields face a marginal tax rate of 75 per cent or 50 per cent depending on whether fields are liable to pay petroleum revenue tax.

In addition, there is a special capital allowances regime, whereby most capital investment and de-commissioning expenditure receives tax relief through 100 per cent first year capital allowances.



6. Table 3 provides a range of possible receipts outturns, depending on the extent to which these factors change.

Table 3: Impact on UK Oil and Gas Receipts (£ billion)

	Year 1	Year 2
£10 oil price rise (just oil)	2.4	2.4
If gas prices rise in line with oil prices	0.5	0.7
Maximum Effect	2.9	3.1
5 per cent rise in operating expenditure	-0.2	-0.2
10 per cent rise in capital expenditure	-0.4	-0.5
No gas price effects, expenditure offsets	1.8	1.7
Possible Range	1.8 to 2.9	1.7 to 3.1

7. A temporary change in the oil price is less likely to be accompanied by a change in the gas price or capital expenditure. If the rise or fall in oil prices is more prolonged and sizeable, it could lead to firms reassessing the viability of particular investment projects. When assessing the overall impact of oil prices on the public finances, we use the boost from oil prices alone.

Impact on Fuel Duty and VAT

8. Fuel duty is charged on a pence per litre basis, so reducing the demand for fuel would lower receipts. The HMRC fuel duty forecasting model suggests a short-run demand elasticity of -0.14 with respect to pump prices and a longer-term demand elasticity of -0.22 i.e. a 1 per cent rise in the pump price reduces demand by just over 0.2 per cent. It is possible that over several years, there could be a larger effect from permanently higher oil prices given that this would incentivise drivers to choose and car producers to supply, more fuel-efficient cars.

Table 4: Impact of a £10 rise in the Oil Price on Fuel Duty (£ billion)

Year 1	Year 2	Year 3	Year 4
-0.21	-0.34	-0.34	-0.35

9. While the volume of road fuel sales would fall in response to higher oil prices, the higher pump price would mean that the value of road fuel sales would rise. With VAT paid on the non-duty and duty elements of the pump price, VAT receipts on fuel would rise. A £10 rise in the oil price could raise between £0.4 to £0.5 billion in extra VAT revenues. However many businesses are likely to be able to reclaim the VAT they spend on fuel. In addition, faced with a higher fuel bill, households are likely to reduce expenditure on other goods and services. Road fuel is a standard-rated product, but some of the lower spending elsewhere would be on reduced-rated or zero-rated goods. This could result in a small rise in the proportion of consumer spending subject to the standard rate of VAT. This effect could be up to £0.2 billion, although could diminish over time as fuel consumption is cut back.

10. The wider economy effects of an oil price rise are discussed later in the report. However, it is likely that consumer spending would be constrained by weaker labour income if the oil price rise were permanent, so the overall effect on VAT receipts is likely to be negative, especially in the longer term.

Indexation Effects

11. A £10 higher oil price would raise the pump price by 7.4 pence per litre, if fully passed through. It is likely that it could take four to six weeks for a change in oil prices to be passed through. Road fuels have a weight of around 4 per cent in the CPI and 5 per cent in the RPI basket.

Table 5: Impact of £10 higher oil price on Inflation

CPI	+0.25ppt
RPI	+0.3 ppt
RPIX	+0.3 ppt
ROSSI	+0.35ppt

12. The actual inflation effect will depend on the extent to which petrol retailers pass through the higher oil price or adjust their margins. There could be an additional impact on inflation if higher oil prices lead to a rise in electricity and gas bills. Electricity and gas bills have a weight of 3.5 per cent in the RPI and 4.4 per cent in the CPI, so a similar rise in prices to that of road fuel could roughly double the impact on inflation. In the case of a temporary oil price shock, inflation will be lower in the second year, as oil prices fall back to their original level. In the case of both a temporary and permanent oil price shock it is assumed that the oil price increase has no persistent impact on inflation beyond the near term. This assumes that the monetary policy framework is successful in anchoring expectations to the inflation target such that any potential second-round effects are contained (see Annex 2 for more details).

13. A change in inflation would affect the uprating of tax thresholds and allowances, the revalorisation of excise duties, the indexation of benefits, the cost of servicing index-linked gilts and the multiplier used for business rates.

- the historical practice has been to uprate tax thresholds and allowances for the forthcoming financial year by the September RPI outturn⁴. Higher inflation would push up tax thresholds and reduce income tax and NICs receipts.
- the revalorisation of excise duties in Budgets uses forecast RPI inflation (or RPI inflation + x) for the forthcoming September. Higher inflation would mean bigger duty rises.
- benefits for the following financial year have been historically uprated by the September RPI and ROSSI (RPI excluding housing costs). Higher benefit spending would boost Annually Managed Expenditure (AME) spending. Budget 2010 announced that from April 2011, the government will use the CPI for the price indexation of benefits and tax credits. In addition, Budget 2010 announced that the basic state pension will be uprated by a triple guarantee of earnings, prices or 2.5 per cent, whichever is highest.
- higher RPI inflation would push up the inflation uplift on index-linked gilts. This is mainly a one-off effect in the financial year in which RPI inflation has risen and would push up AME spending.
- business rate bills are calculated by multiplying the rateable value of the property by the multiplier. The multiplier is uprated for the following financial year in line with inflation each year. Higher inflation would boost business rates.

14. In most years, earnings growth will be higher than inflation. This will mean that the basic state pension will be indexed to earnings in those years, as part of the 'triple guarantee'. The economy scenario assumes that the higher oil price would lead to a lower labour share through lower earnings. This would affect the indexation of the basic state pension.

15. Tables 6 and 7 set out the effects from inflation being 0.3 percentage points higher than expected in the first year of the oil price shock. The initial public finance effect is from the inflation uplift on index-linked gilts. The impact from tax thresholds and benefits will come through in the second year.

Table 6: Direct Indexation Effects – Impact on Public Finances from a temporary £10 rise in the oil price (£ billion)

	Year 1	Year 2	Year 3	Year 4
Benefits	0	-0.2	0	0
Tax	0	-0.1	0	0
Basic State Pension (via earnings)	0	0.3	0	0
Public Service Pensions	0	-0.1	0	0
Index-Linked Gilts	-0.6	0.6	0	0
Overall	-0.6	0.5	0	0

⁴ Budget 2010 (paragraph 1.106) notes that the 'Government is also reviewing how the CPI can be used for the indexation of taxes and duties while protecting revenues'.

Table 7: Direct Indexation Effects – Impact on Public Finances from a permanent £10 rise in the oil price (£ billion)

	Year 1	Year 2	Year 3	Year 4
Benefits	0	-0.2	-0.2	-0.2
Tax	0	-0.1	-0.1	-0.1
Public Service Pensions	0	-0.1	-0.1	-0.1
Basic State Pension (via earnings)	0	0.3	0.5	0.6
Index-Linked Gilts	-0.6	0.0	0.0	0.0
Overall	-0.6	-0.1	0.1	0.2

Impact on government spending from higher input prices

16. Government expenditure will come under increased pressure from higher energy costs. However within the government’s spending framework, these cost pressures should be contained within firm, fixed Departmental Expenditure Limits (DELs).

Wider Economy Effects from Higher Oil Prices

17. The effect of higher oil prices on the economy have been modelled using a three factor (labour, capital and oil) production function approach. A more detailed analysis of the impact on the economy can be found in Annex 2⁵. A change in the price of oil relative to the price of other goods and services in the economy will affect the quantity of output that firms wish to supply and so will affect the economy’s supply potential. The persistence of this effect will depend on the extent to which the oil price increase is temporary or permanent.

18. It is estimated that potential output is reduced by just over 0.3 per cent in the first year following a 20 per cent increase in the real oil price (i.e. a 20 per cent increase in the price of oil relative to the price of other goods and services in the economy). In the temporary oil price shock scenario, the oil price reverts to its pre-shock level in the second year and there is therefore no impact on potential output beyond the first year. In a scenario where the real oil price increase is permanent, potential output is estimated to be around 0.5 per cent lower in the medium term as a result of the real oil price shock. This implies an elasticity of output with respect to the oil price of around -0.02 . While this is consistent with a range of estimates of the economic impact of changes in the oil price (Box 2), the impact on output is nevertheless subject to significant uncertainties.

⁵ A technical description of the modelling approach and underlying assumptions is available on request.

Box 2: Estimates of the impact of oil prices on the economy

Persistent changes in the oil price can have a large bearing on economic activity. Oil products are inputs used in the production of other goods and services and therefore help to determine the economy's supply potential. A change in the price of oil relative to the price of other goods and services in the economy will affect the quantity of output that firms wish to supply, and so will affect potential output.

Recent work by Cournede (2010)^a attempts to estimate the effect of oil price shocks on potential output in the US and Euro Area. An increase in the real oil price of 65 per cent is estimated to reduce US potential output by 1.3 per cent, implying an elasticity of output to the oil price of around -0.02 ; similarly, an increase in the real oil price of 59 per cent is estimated to reduce EU potential output by 0.7 per cent, consistent with an elasticity of around -0.01 . Applying the OECD method to UK data would imply an elasticity of around -0.03 .

Duval and Vogel (2008)^b estimate that the impact of a doubling of the real oil price has an initial impact on potential output of around 3 per cent, pointing to an approximate elasticity of around -0.03 . Barrell and Kirby (2008)^c estimate that an increase in the oil price from \$50 to \$63 would reduce UK equilibrium output by just over 1 per cent after 4 years, implying an elasticity of UK output to dollar oil prices of around -0.04 .

Blanchard and Gali (2007)^d use historical data to estimate the long-run impact of oil price shocks on output in a number of countries before and after 1984. They find that an increase in oil prices of 10 per cent reduces UK output by close to 1 per cent over the long-run based on the pre-1984 sample (implying an elasticity of -0.1), although the response of output falls to less than 0.5 per cent when estimated over the post-1984 period. The authors attribute the reduced sensitivity of output to oil prices in a number of countries in the latter period to increased credibility of monetary policy, greater real wage flexibility and reductions in the oil intensity of consumption and production.

^a *Gauging the impact of higher capital and oil costs on potential output*, Cournede, B., OECD Economics Department Working Papers No.789, July 2010.

^b *Oil price shocks, rigidities and the conduct of monetary policy*, Duval, R and Vogel, L, OECD Economics Department Working Papers No.603, April 2008.

^c *The budgetary implications of global shocks to cycles and trends in output: impacts of housing, financial and oil shocks*, Barrell, R. and Kirby, S., October 2008.

^d *The Macroeconomic Effects of Oil Price Shocks: Why are the 2000s so different from the 1970s?*, Blanchard, O.J, and Gali, J., NBER working papers no,13368, NBER, 2007.

19. The effect on actual (rather than potential) output will depend on two factors: the direct impact of higher oil prices on demand, and the speed at which actual output moves back towards its potential level. The squeeze on real household incomes resulting from the oil price rise is estimated to reduce actual output by around 0.1 per cent in the near term. Additionally, it is assumed that the MPC will treat any shock to the oil price as permanent and will act immediately to bring actual output towards potential over a 12-month period

(consistent with the assumption that monetary policy affects output with a lag of one year). Accordingly the reduction in actual output is equal to the reduction in potential output one year after the shock. More details of the assumed output profile are set out in Annex 2.

20. The effect on the public finances from lower GDP will depend on the composition of any reduced GDP. The economic model assumes that a higher oil price will initially result in a higher oil share at the expense of the labour and capital shares. In the medium term, it is assumed that the higher oil share will be entirely offset by a lower labour share. With labour income suffering the worst hit and subject to the highest effective tax rate, much of the worsening in the public finances in response to a permanent oil price shock is the result of reduced income tax and NICs.

21. The public finance consequences of the lower growth have been estimated using ready-reckoners based on HMRC tax models. The overall economy and public finance effects will crucially depend upon the specification of the model. If the lag before the economy adjusts to the lower potential output were longer, the public finance effects in the first and second years would be less acute. Alternatively, if the effect on potential output from higher oil prices were higher than assumed, this would raise the impact of the permanent oil price shock in the medium term. The potential range line in Table 9 allows for a longer lag and a higher effect from oil prices on potential output.

Table 8: Economy Effects on the Public Finances from a temporary £10 increase in the oil price (£ billion)

	Year 1	Year 2	Year 3	Year 4
Lower Labour Income	-1.4	-0.7	0	0
Lower Capital Income	-0.2	-0.2	0	0
Lower Consumer spending	-0.1	-0.2	0	0
Increased Debt Interest Costs	-0.1	0	0	0
Overall Effect	-1.7	-1.1	0	0

Table 9: Economy Effects on the Public Finances from a permanent £10 increase in the oil price (£ billion)

	Year 1	Year 2	Year 3	Year 4
Lower Labour Income	-1.4	-2.7	-3.3	-3.7
Lower Capital Income	-0.2	-0.3	-0.3	-0.3
Lower Consumer spending	-0.1	-0.2	-0.3	-0.3
Increased Debt Interest Costs	-0.1	-0.1	-0.2	-0.2
Overall Effect	-1.7	-3.5	-4.1	-4.5
Potential Range	-1.1 to -1.9	-2.8 to -4.0	-4.1 to -4.7	-4.5 to -5.1

Overall Effect of Higher Oil Prices on the Public Finances

22. Tables 10 and 11 set out the overall effect of higher oil prices on the public finances. They show that the effect from higher oil prices on the public finances depends crucially on whether any rise in the oil price is temporary or permanent. A permanent rise in the oil price would be clearly negative for the public finances from the second year onwards. The detrimental effect on receipts from lower output more than offsets the boost to UK oil and gas revenues.

Table 10: Overall Effect on the Public Finances from a temporary £10 increase in the oil price (£ billion)

	Year 1	Year 2	Year 3	Year 4
Oil and Gas Revenues	2.4	0	0	0
Fuel Duty	-0.2	-0.1	0	0
VAT(standard-rated share)	0.2	0	0	0
Indexation Effects	-0.6	0.5	0	0
Economy Effects	-1.7	-1.1	0	0
Overall Effect	0.1	-0.7	0	0

Table 11: Overall Effect on the Public Finances from a permanent £10 increase in the oil price (£ billion)

	Year 1	Year 2	Year 3	Year 4
Oil and Gas Revenues	2.4	2.4	2.4	2.4
Fuel Duty	-0.2	-0.3	-0.3	-0.3
VAT(standard-rated share)	0.2	0.2	0.1	0.0
Indexation Effects	-0.6	-0.1	0.1	0.2
Economy Effects	-1.7	-3.5	-4.1	-4.5
Overall Effect	0.1	-1.3	-1.7	-2.2
Potential Range	1.2 to -0.7	0.1 to -2.5	-0.9 to -3.1	-1.5 to -3.5

23. These estimates should be broadly symmetrical, although there remain uncertainties around the symmetry of the economic impact of changes in the oil price⁶. The effect from a permanent drop in the oil price should be to improve the public finances in the medium term, as the effect on receipts from higher output more than offsets the fall in UK oil and gas revenues. With the exception of the effect on oil company investment decisions which are more likely to react to larger and more prolonged changes in the oil price, these estimates could be scaled up or down, depending on the size of any oil price change.

24. Changing fuel duty by 1p a litre costs or benefits the Exchequer by around £500 million. With the £10 increase in the oil price raising pump prices by 7.4 pence per litre, offsetting the whole rise in the pump price would cost around

⁶ For example, it may be costly for firms to adjust to both positive and negative changes in the oil price. Such adjustment costs may reduce the positive impact of reductions in the oil price and increase the negative impact of increases in the oil price

£3.7 billion. In the absence of any offsetting effects on the public finances, higher UK oil and gas revenues of £2.4 billion could allow fuel duty changes to offset around two-thirds of the fluctuations in the pump price, without any overall losses to the public finances. Once the offsetting effects are included, very little of the pump price rise could be offset in response to a temporary oil price shock. There is no improvement in the public finances to be used for stabilising the pump price in case of a permanent shock.

Uncertainties

25. There are clear uncertainties around these estimates. This is particularly the case with respect to the size of the additional receipts from UK oil and gas production and the size of any economy offset from the impact of lower potential output. As set out in Box 2, available estimates of the effect of oil prices on the economy can vary markedly. While the size of the effects presented in this analysis are consistent with these estimates, the range of available estimates serves to illustrate the uncertainty surrounding the economic impact of higher oil prices. Estimates of the effect of a change in the oil price on the economy in any given year will depend on the pass-through from higher oil prices to the costs of production, the speed at which the economy adjusts to the oil price shock, the assumed response of the labour market, the response and impact of monetary policy and the source of the shock (Annex 2 discusses some of these specific uncertainties in more detail).

26. The estimated impact of oil price changes on the public finances also depends significantly on whether the higher oil price lasts for one year or whether the increase is permanent. In practice the distinction between what constitutes a 'temporary' or a 'permanent' oil price shock is subjective and it is extremely difficult to identify in real time whether movements in the oil price are temporary or are likely to persist beyond the near term.

27. This is particularly the case given that oil prices have shown substantial volatility both within years and between years. For example, a number of oil price forecasters assumed that a large part of the sharp increase in oil prices seen over the first half of 2008 (to over \$134 a barrel in June 2008) would continue into the following year, with the independent forecasts for the oil price in 2009 averaging around \$110 in July 2008;⁷ oil prices subsequently fell back to an average of just over \$60 in 2009. This episode highlights the difficulty in judging whether movements in oil prices are likely to represent temporary fluctuations or a more persistent trend.

⁷ In July 2008 the average independent forecast (set out in *Forecasts for the UK economy: A comparison of independent forecasts*, HM Treasury, July 2008) for the oil price in 2009 was \$109.8, with individual forecasts ranging from \$80 to \$146.3.

Annex 1: Letter from Economic Secretary to Sir Alan Budd

The June Budget announced that the Chancellor had asked the Office for Budget Responsibility to undertake an assessment over the summer of the effect of oil price fluctuations on the public finances. I am writing to clarify the remit of the assessment.

A Fair Fuel Stabiliser could support motorists when the cost of living is rising, by reducing fuel duty when oil prices rise (and vice versa). A key principle underlying a FFS should be that it reduces the sensitivity of the public finances to oil prices and improves the long-term stability of the public finances. Therefore, understanding the size of any windfall accruing to Government as a result of high oil prices (and therefore how much fuel duty can be cut when prices are high, and vice versa) is key to designing a workable Stabiliser that has a predictable impact on the public finances.

Therefore, I would be grateful if your report could include an assessment of how oil price fluctuations impact on tax receipts, inflation and the wider economy - including the rate at which oil price changes work through the economy into the public finances (Annex A provides further details). In addition, I would also welcome your assessment of the uncertainties associated with these estimates; and what the subsequent risks associated with basing a FFS on these estimates would be in principle.

In line with the interim OBR's Terms of Reference, as set out in the Chancellor's letter of 8 June, the Treasury will provide you with full access to the data, analysis and resources necessary to undertake this assessment. However, the key judgments and assumptions underpinning the assessment will of course be for the interim OBR to determine. In addition, you will have discretion over what material is published.

Annex A

I would be grateful if the OBR assessment would consider the impact of oil prices changes on

- North Sea Oil revenue and gas prices and subsequent revenue
- VAT revenue
- Fuel duty revenue – assessing HMT assumptions for the rate at which oil prices increases pass through into pump prices and demand for fuel
- Inflation – including the revenue implications of uprating tax allowances and benefits, and servicing index-linked gilts
- Wider economy revenues – for example via
 - GDP effects
 - Earnings growth
 - Company profits and impact on corporation tax from higher oil prices reducing profits

In addition we would welcome OBR assessment of the following

- Does the relationship remain constant? Is the impact from a £10 increase in oil price the same as £5 / £20 etc
- The time frame over which changes in oil prices work through the economy and into the public finances
- Uncertainties associated with these estimates; and what the subsequent risks associated with basing a FFS on these estimates would be in principle.

Annex 2: An increase in the oil price: the impact on the economy

Potential output

A.1. The fiscal impact of fluctuations in the oil price will partly depend on the extent to which a change in the oil price affects economic activity. Oil products are inputs used in the production of other goods and services and therefore help to determine the economy's supply potential. A change in the price of oil relative to the price of other goods and services in the economy (i.e. a change in the real oil price) will affect the quantity of output that firms wish to supply, and so will affect potential output. This will in turn have a bearing on tax revenues.

A.2. A relatively simple and transparent way to quantify this effect is to use a production function. Such a function relates inputs or 'factors' - in this case, capital, labour and oil - to output of final goods and services. With additional assumptions about the supply of those factors, the effect of an exogenous change in the real price of oil on the quantity of oil and of other factors employed in the economy can be calculated. The production function can then be used (again) to translate this change in factors employed into a change in output⁸. In this framework, an increase in the real oil price will affect the economy's underlying supply potential. In particular:

1. An increase in the real oil price will increase the costs of production as the costs of oil inputs increase. All else equal, this will lower the level of output firms are willing to produce for a given price.⁹ The size of this effect will depend on the relative importance of oil in the economy or, more specifically, the income accruing to oil inputs as a share of total income.
2. Because firms will wish to reduce their output, they will subsequently reduce their demand for labour, capital and oil inputs into production. The effect from lower demand for each factor will depend on how we can expect the supply of each input to respond.

For example, it is reasonable to suppose that the supply of oil and the supply of capital to the UK are perfectly elastic over the long run. In this case, a reduction in demand for capital will lead to a reduction in usage of capital over the long run but will have no effect on the price of capital.

By contrast, the supply of capital over the short run is likely to be much less elastic: it takes time to scrap or rebuild the capital stock. In this case a more reasonable assumption would be to assume that the supply of capital is perfectly inelastic over the short run. In this case a reduction in demand for

⁸ Technical details of the modelling approach and underlying assumptions are available on request

⁹ i.e. increase in the cost of oil can be thought of an adverse supply shock. Note that the analysis assumes that the oil price shock reduces potential output by increasing the cost of oil inputs used in production and does not include any wider effects from a higher oil price on the cost of non-oil inputs, which could feasibly increase the impact on output.

capital would bring about a reduction in the price of capital but will have no impact on the level of capital in production in the short run.

Similarly, it is assumed that the supply of labour is perfectly inelastic. In this case a reduction in demand for labour would bring about a reduction in the real wage but no reduction in the quantity of labour.

A.3. In assessing the impact of an increase in the real oil price on potential output it is therefore helpful to distinguish between the effect over the short run and the long run. An increase in the real oil price increases the costs of production and causes firms to reduce demand for labour, capital and oil. The supply of oil is assumed to be perfectly elastic, and so the reduction in demand for oil reduces the quantity of oil in production. The supply of labour is assumed to be perfectly inelastic so the reduction in demand for labour reduces the real wage but has no effect on the quantity of labour in production. **Over the short run**, the supply of capital is assumed to be perfectly inelastic so the reduction in demand for capital leads to a reduction in the rental price of capital (real user cost of capital) but no reduction in the quantity of capital in production. **Over the long run**, the capital stock adjusts and supply of capital is assumed to be perfectly elastic, so the reduction in demand for capital brings about a reduction in the quantity of capital in production. Hence, the long-run adjustment will be larger than the short-run impact.

Table A: Impact of a 20 per cent real oil price shock on potential output (levels, per cent from baseline)

	Short-run impact	Long-run impact	Elasticity (short-run)	Elasticity (long-run)
Capital	0	-0.5	0	-0.023
Labour	0	0	0	0
Oil	-7.4	-7.5	-0.368	-0.373
Output	-0.34	-0.45	-0.017	-0.023

Temporary and permanent oil price changes

A.4. An important consideration when assessing the impact of an oil price shock on potential output is the extent to which an increase in the oil price is transitory or permanent. A temporary 'spike' in the oil price might be expected to have very little long-lasting impact on the economy's supply potential and actual output; on the other hand a permanent increase in the oil price would be expected to reduce potential output as the costs of production move persistently higher.

A.5. Table B sets out possible scenarios for a temporary and permanent *real* oil price shock of 20 per cent (i.e. a 20 per cent increase in the price of oil relative to

prices of other goods and services in the economy). A temporary oil price shock is interpreted as a 20 per cent increase in the relative oil price in year 1; thereafter the oil price is assumed to revert to its pre-shock level. In this scenario, potential output would be lower in year 1 but unchanged in subsequent years. A permanent real oil price shock scenario assumes the same 20 per cent increase in oil prices in year 1, but with oil prices remaining at this elevated level in all subsequent years. Potential output would be affected in both year 1 and in all subsequent years in this scenario.

Table B: Real oil price shock scenarios

Year	0	1	2	3	4	5	6	7	8
'Temporary' oil price shock	50	60	50	50	50	50	50	50	50
'Permanent' oil price shock	50	60	60	60	60	60	60	60	60

A.6. In translating the estimates from Table A into an annual profile for potential output for each of the scenarios described in Table B it is necessary to make an assumption about the timing of the short-run and longer-run impacts. It is assumed that the short-run impact on potential output set out in Table A occurs in the first year of the shock in both the temporary and permanent oil price shock scenarios (Table C).

A.7. Beyond year 1 there is no impact on potential output in the temporary oil price shock scenario as the oil price reverts to its pre-shock level in year 2. For a permanent oil price shock scenario potential output is affected in both year 1 and all subsequent years; it is therefore necessary to make an assumption about the transition from the short-run impact to the longer-run impacts set out in Table A. **We have assumed that it takes eight years for the full long-run effect of a permanent real oil price shock to feed through into potential output, and that the transition from the short-run impact to the long-run impact is linear.** These assumptions are to some extent arbitrary and made in the absence of strong priors; however the effects of making alternative ones would be second order.

Table C: Annual profile for potential output

(i) Temporary oil price increase scenario

Year	0	1	2	3	4	5	6	7	8
Oil price (£)	50	60	50	50	50	50	50	50	50
Potential output (per cent deviation from baseline): permanent oil price shock	0	-0.34	0	0	0	0	0	0	0

(ii) Permanent oil price increase scenario

Year	0	1	2	3	4	5	6	7	8
Oil price (£)	50	60	60	60	60	60	60	60	60
Potential output (per cent deviation from baseline): temporary oil price shock	0	-0.34	-0.36	-0.37	-0.39	-0.41	-0.42	-0.44	-0.45

Actual output

A.8. The estimates presented above relate to the impact of a real oil price shock on potential output. The effect on actual output will depend on two factors:

- the direct impact of higher real oil prices on demand;
- the speed at which actual output converges on potential output.

Year 1

A.9. The most direct impact on real demand is the squeeze on real household incomes from the increase in the price of final consumption of oil products. With inelastic demand for final oil products, holding nominal consumption constant means lower real consumption of other goods. **The initial effect on real demand is assumed to be equal to the increase in nominal fuel consumption (using the same elasticity assumption as in the HMRC fuel duty model¹⁰) deflated by the baseline consumer price deflator. This implies an initial direct impact on actual output of –0.1 per cent.**

End of year 1/beyond year 1

A.10. The direct effect of higher oil prices on demand is used to estimate the impact on GDP during the first year of the shock. Over the medium term it is assumed that monetary policy acts to adjust actual output in line with the change in potential output.¹¹ In particular, to keep inflation close to target in the medium term, monetary policy needs to keep actual output close to potential. As the impact of an increase in the real oil price is to reduce potential output, it is assumed that monetary policy acts to bring actual output back towards potential output. This is **not** to assume that monetary policy reacts to

¹⁰The HMRC fuel duty model suggests a short-run demand elasticity of –0.14 with respect to pump prices and a longer-term demand elasticity of –0.22 i.e. that a 1 per cent rise in the pump price reduces demand by just over 0.2 per cent.

¹¹ In theory, if interest rates are at their lower bound, the shock could result in an output gap that is still different after more than a year. If monetary policy cannot stabilise output over a given horizon, then there is no reason that the fall in actual output will mirror the fall in potential output. However, interest rates are not the only instrument that monetary policy possesses to achieve price stability. Since early 2009 the Bank of England has engaged in significant purchases of government debt, and to a lesser extent of private sector debt, with the expressed intention of generating growth in nominal demand.

the shift in the price level; in fact it is entirely consistent with assuming that monetary policy 'looks through' the increase in the price level.

A.11. Assuming that monetary policy takes one year to have its full effect on output, and the Central Bank is fully aware of effect on potential output of the real oil price shock, actual output is lower by the same amount as potential output after one year (i.e. at the end of year 1). In other words, the output gap is the same at the end of year 1. This also implies that the Central Bank **assumes that the increase in the oil price will be sufficiently persistent to reduce potential output at the end of year 1, and responds immediately...** The reduction in actual output for year 1 as a whole is therefore lower by an amount equal to the average of the initial direct hit to demand at the start of year 1 as a result of lower non-oil consumption (-0.13 per cent) and the hit to potential output in year 1 (-0.34 per cent). This implies actual output is 0.22 per cent lower in year 1.

A.12. In the case of a temporary oil price increase, the oil price reverts back to £50 at the start of year 2, implying potential output moves back to its pre-shock level. The Central Bank subsequently acts to bring actual output towards potential output; assuming a lag of around one year between monetary policy and output, actual output is assumed to return to its pre-shock level by the end of year 2. In the case of a temporary oil price shock, the reduction in actual output for year 2 as a whole is lower by an amount equal to the average of the hit to actual output at the start of year 2 (-0.34 per cent) and the hit to potential output at the end of year 2 (0 per cent). This implies that actual output is 0.17 per cent lower in year 2 following a temporary oil price shock.

Table D: Annual profile for actual output: temporary increase in the oil price

Year	0	1	2	3	4	5	6	7	8
Oil price (£)	50	60	50	50	50	50	50	50	50
Actual output (per cent deviation from baseline)	0	-0.22	-0.17	0	0	0	0	0	0
Potential output (per cent deviation from baseline)	0	-0.34	0	0	0	0	0	0	0

Table E: Annual profile for actual output: permanent increase in the oil price

Year	0	1	2	3	4	5	6	7	8
Oil price (£)	50	60	60	60	60	60	60	60	60
Actual output (per cent deviation from baseline)	0	-0.22	-0.36	-0.37	-0.39	-0.41	-0.42	-0.44	-0.45
Potential output (per cent deviation from baseline)	0	-0.34	-0.36	-0.37	-0.39	-0.41	-0.42	-0.44	-0.45

Uncertainties

A.13. Significant uncertainties surround estimates of the impact of a real oil price increase on the economy:

1. The **size of the potential output adjustment** as a result of an increase in the real oil price. The analysis assumes that the oil price shock reduces potential output by increasing the cost of oil inputs used in production. The estimates do not include any impact from the shock on the cost of other (non-oil) inputs into production in the event that the higher oil price is passed on to other producers of intermediate goods. All else equal, such wider effects could increase the impact of higher oil prices on output.

The analysis assumes the quantity of labour employed in the economy does not change as a result of the shock to the real oil price, with lower demand reflected entirely in lower real wages. However, if labour supply was not fixed then a reduction in demand would reduce the level of labour employed, and would imply a larger overall potential (and actual) output adjustment.

2. **The speed at which potential output adjusts.** The estimates presented above assume that the full adjustment of potential supply occurs over a period of eight years as the capital stock takes time to adjust. A quicker speed of adjustment would imply a larger output effect over the near term.
3. **The initial shock to demand:** The initial demand adjustment is informed by the elasticity of nominal fuel consumption. There are both upside and downside risks to this estimate. On the upside, consumers may choose to reduce their saving temporarily (or draw upon savings) to protect their non-oil consumption from the shock (this will be the case if their preferences are characterised by habit persistence, or if there are adjustment costs to altering consumption). On the downside, there could be an immediate impact on investment if firms look forward to the lower equilibrium capital stock.
4. **The transmission of monetary policy:** The lag between monetary policy and demand will determine the adjustment of actual output beyond the near term. The analysis assumes that in response to a reduction in potential supply, monetary policy will act to bring actual output towards potential with a lag of 12 months; accordingly the reduction in actual output is equal to the reduction in potential output after 1 year. A shorter lag would imply a larger reduction in actual output in the first year following the real oil price shock, although the size of the reduction in subsequent years would be unchanged.

5. **The source of the oil price shock:** Different types of shocks may have more complex effects on supply than those assumed here: an increase in oil prices that results from greater demand from emerging markets, for example, could be mitigated by the more general benign effects of globalisation on the price of imports. Such mitigating effects would not necessarily be associated with an oil price shock that results from constraints on the supply of oil. More generally, the particular implications of an oil price shock for the UK economy could differ depending on whether the shock was global or UK specific.

Inflation

A.14. As well as the effect on real demand, there is a nominal effect as firms pass on the incidence of the oil price increase. For consumer prices, it is assumed that the increase in the oil price will be passed through in full to retail prices for fuel, with a lag of around 6-7 weeks. When passed through in full, a £10 increase in oil prices is estimated to add around 0.25 percentage points (ppt) to the annual rate of CPI inflation through the effect on higher fuel prices, and around 0.3ppt to the annual rate of RPI inflation.

A.15. It is assumed the oil price increase will bring about an increase in the price level due to higher fuel prices. In the case of a temporary oil price shock the price level is higher in year 1 only and unchanged (relative to a no-shock scenario) thereafter as oil prices revert to their pre-shock levels; in the permanent oil price shock scenario the higher price level persists beyond year 1. In both scenarios it is assumed that the oil price increase has an effect on the price level, with no persistent impact on inflation beyond the near term.¹² This assumes that the monetary policy framework is successful in anchoring expectations to target such that any potential second round effects are contained. Furthermore, since it is assumed that monetary policy offsets the effect on potential output of the oil price shock perfectly such that the output gap is the same at the end of year 1, the balance of inflationary pressure in the economy is unchanged relative to the baseline once the temporary shock has passed.

A.16. The temporary rise in inflation will have a direct effect on public finances as it increases the indexation of tax thresholds and benefits. Higher inflation also increases the costs of servicing index-linked bonds.

A.17. There is some upside risk to the estimated impact on inflation. This largely arises from the possibility that consumer gas and electricity prices may also increase in response to higher oil prices and the price of a wider range of consumer goods may be affected by higher oil prices. If for example, gas and

¹² In the case of a temporary oil price shock the increase in oil prices increases inflation in year 1 and reduces inflation in year 2 as oil price fall back to their pre-shock levels; inflation in subsequent years is unchanged relative to the baseline scenario. In the case of a permanent oil price shock the increase in oil prices pushes up inflation in year 1 with inflation in all subsequent years unchanged.

electricity prices were to experience a similar rise in prices to that of road fuel, this could roughly double the impact on inflation. Historically, oil and gas prices have moved closely in line, however, more recently oil and gas prices have decoupled to an extent. Therefore, the estimated effect on inflation includes only the direct impact on fuel prices.

Factor shares

A.18. The change in factor shares provides useful information for the public finances as different types of income are taxed at very different rates. The initial effect is to raise the oil share (the elasticity of demand for oil is less than one), and reduce both the labour share and the capital share. Over time, the stock of capital adjusts, and the capital share rises back to its baseline level, at the cost of the labour share. As the cost of capital has not changed, the non-oil capital share remains unchanged from baseline in steady state. In steady state the higher oil share is entirely offset by a lower labour share. **The transition between the initial impact on factor shares and the steady-state is calibrated to have the same path as the transition of actual output.**

A.19. **The effect on potential output does not come about from a terms of trade shock.** In this framework, a country with zero net imports of oil (and therefore no terms of trade shock) would still experience a shock to non-oil potential output. Even a country with net exports of oil would see a fall in the potential output of the non-oil sector that could easily outweigh any increase in oil sector production. A useful way to think about the shock to potential output for an economy that does have an oil producing sector (whether or not this covers domestic production) is that it 'tilts' the economy towards a sector that does not produce at marginal cost, at the expense of the rest of the economy that does.