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**Recent Oil Price
Movements: Forces and
Policy Issues**

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Luke Willard,
Patrice Ollivaud**

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ECONOMICS DEPARTMENT

RECENT OIL PRICE MOVEMENTS - FORCES AND POLICY ISSUES

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ABSTRACT/RÉSUMÉ

Recent Oil Price Movements– Forces and Policy Issues

Crude oil prices have trended up since the end of the 1990s, peaking at a historic high in mid-2008 that was followed by a steep price correction with a subsequent rebound. This paper considers major forces behind the evolution of the oil price, using a simple model of supply and demand elasticities as a benchmark, highlights implications for inflation and economic activity and draws some conclusions for macroeconomic policy. The analysis suggests that the run-up in crude oil prices since 2003 was due to both vigorous oil demand growth by emerging markets and, from the middle of the decade onward, a weaker than expected oil supply response to rising prices. Prices are unlikely to fall back to levels seen in the first years of the decade either over the short or medium term.

JEL classification: Q41, Q43.

Key words: crude oil price, oil demand, oil supply, macroeconomic issues.

* * * * *

Évolution récente du prix du pétrole – facteurs explicatifs et questions de politiques économiques

Les prix du pétrole brut ont crû régulièrement depuis la fin des années 90, jusqu'à atteindre un plus haut historique à la mi-2008 et ont ensuite été suivi par une baisse significative puis un nouveau rebond. Ce document met en exergue les forces principales derrière cette évolution des prix du pétrole en utilisant comme référence un modèle simple d'élasticités de l'offre et de la demande. Ensuite sont mis en évidence les implications pour l'inflation et l'activité économique. Enfin des conclusions sont tirées pour la politique macroéconomique. L'analyse suggère que l'augmentation des prix du pétrole depuis 2003 provient à la fois d'une croissance dynamique de la demande de pétrole en provenance des marchés émergents, et depuis la seconde moitié de la décennie d'une réaction plus faible que prévue de l'offre de pétrole face à des prix en hausse. Il est peu probable que les prix retombent à des niveaux prévalant les premières années de cette décennie que ce soit dans le court ou le moyen terme.

Classification JEL : Q41, Q43.

Mots clés : prix du pétrole brut, demande de pétrole, offre de pétrole, questions macroéconomiques.

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RECENT OIL PRICE MOVEMENTS – FORCES AND POLICY ISSUES

By Eckhard Wurzel, Luke Willard and Patrice Ollivaud¹

1. Crude oil prices have trended up since the end of the 1990s, peaking at a historic high both in nominal and real terms in July 2008, at \$144 per barrel (Brent). Prices increased by less, but still to record levels, if measured in terms of an international currency basket (SDRs) or in euros (Figure 1, upper panel). While the subsequent price correction -- to a trough of \$34 in December 2008 -- is steeper than those experienced after earlier episodes of high oil prices since the 1970s (with the notable exception of the drop in the mid 1980s in percentage terms) prices significantly rebounded since the end of 2008, with the price of Brent having risen by 70% between December 2008 and September 2009 (Figure 1, lower panel). This paper addresses a number of issues surrounding the recent evolution of oil prices. The first section assesses major forces behind the price movement using a simple model of supply and demand elasticities as a benchmark. The second section highlights implications for external trade, inflation and economic activity, and the last section draws some conclusions for macroeconomic policy.

How are oil prices evolving?

Oil prices and market developments

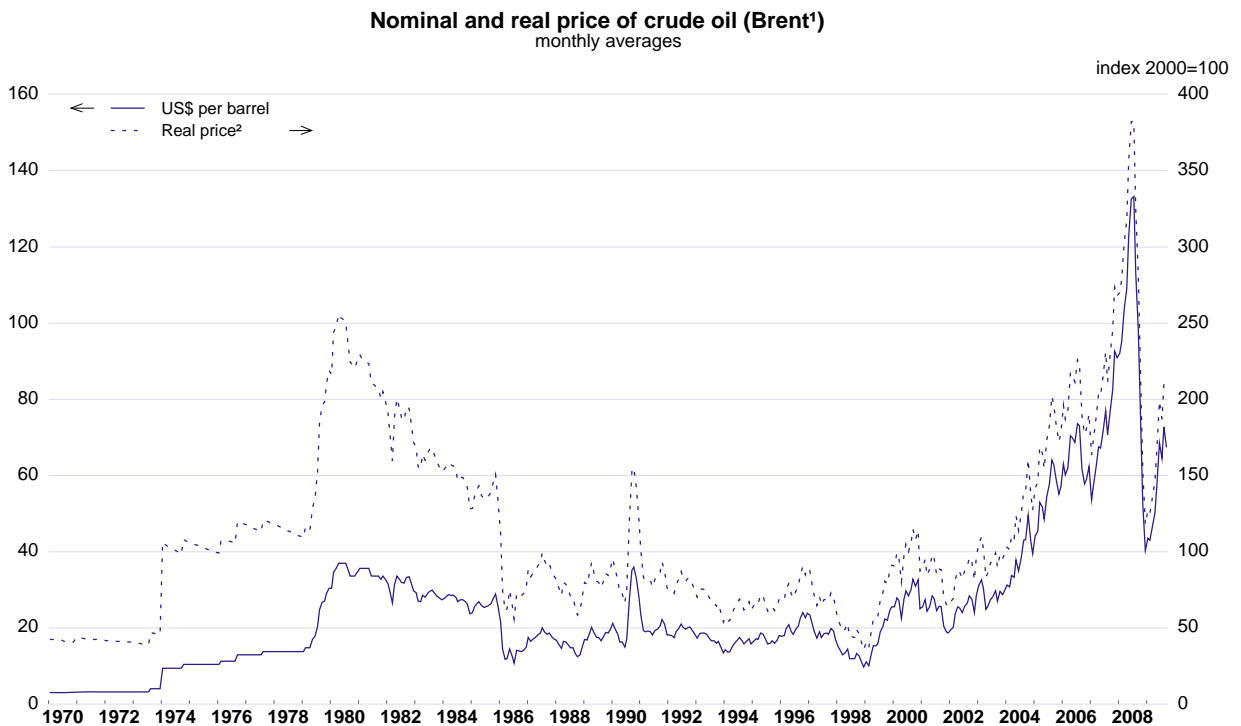
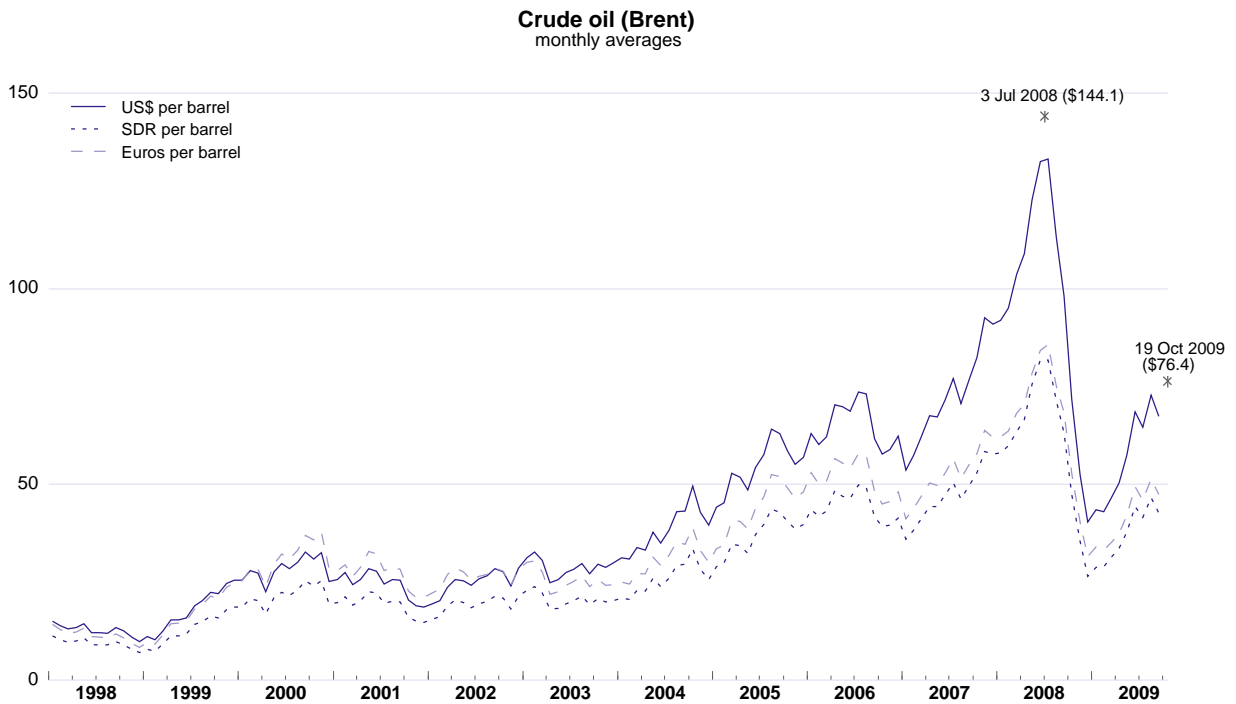
2. The first part of this section looks at how much of the dramatic rise in oil prices seen over the past decade can be explained by recourse to a basic model of supply and demand for oil, calibrated with reasonable values for price and income elasticities. This stylised model is similar to the approach adopted in the baseline scenario of Brook *et al.* (2004). Two versions of the model were calibrated, one in which the price elasticity of demand rises from its short-term to its -- larger -- long-term value over ten years and another in which this process takes 15 years. In each case, the income elasticities of demand were held constant at their estimated long-run values, while the price elasticity of supply was held at its short run value. Oil demand of region c for the ten-year adjustment model is calculated using:

$$D_{c,t} = D_{c,1999} \left(1 + \varepsilon_{Y,c} \left(\frac{Y_{c,t}}{Y_{c,1999}} - 1 \right) \right) \left(1 + \varepsilon_{ST,c} \left(\frac{P_t}{P_{1999}} - 1 \right) + \frac{1}{\theta} (\varepsilon_{LT,c} - \varepsilon_{ST,c}) \left(\sum_{s=t-10}^{t-1} \left(\frac{P_s}{P_{1999}} - 1 \right) \right) \right) \frac{N_{c,t}}{N_{c,1999}}$$

where c and t are region and year identifiers, for $t = 1999, \dots, 2009$; Y is a regional measure of real income *per capita*; P is the real price deflated by the US private consumption deflator; N is the population, ε_Y is the income elasticity; ε_{ST} is the short-term price elasticity; and ε_{LT} is the long term price elasticity (and P_s is assumed equal to P_{1999} for s before 1999) (for more details see the Appendix). Under these assumptions, the simple model roughly accounts for the observed run-up in prices between 1999 and the first three quarters of 2009 (Figure 2).

1. The authors work in the OECD Economics Department. They would like to thank Svenbjörn Blöndal, Jorgen Elmeskov, David Fyfe and Mike Kennedy for helpful comments on an earlier draft, and Anne Eggimann for excellent secretarial assistance.

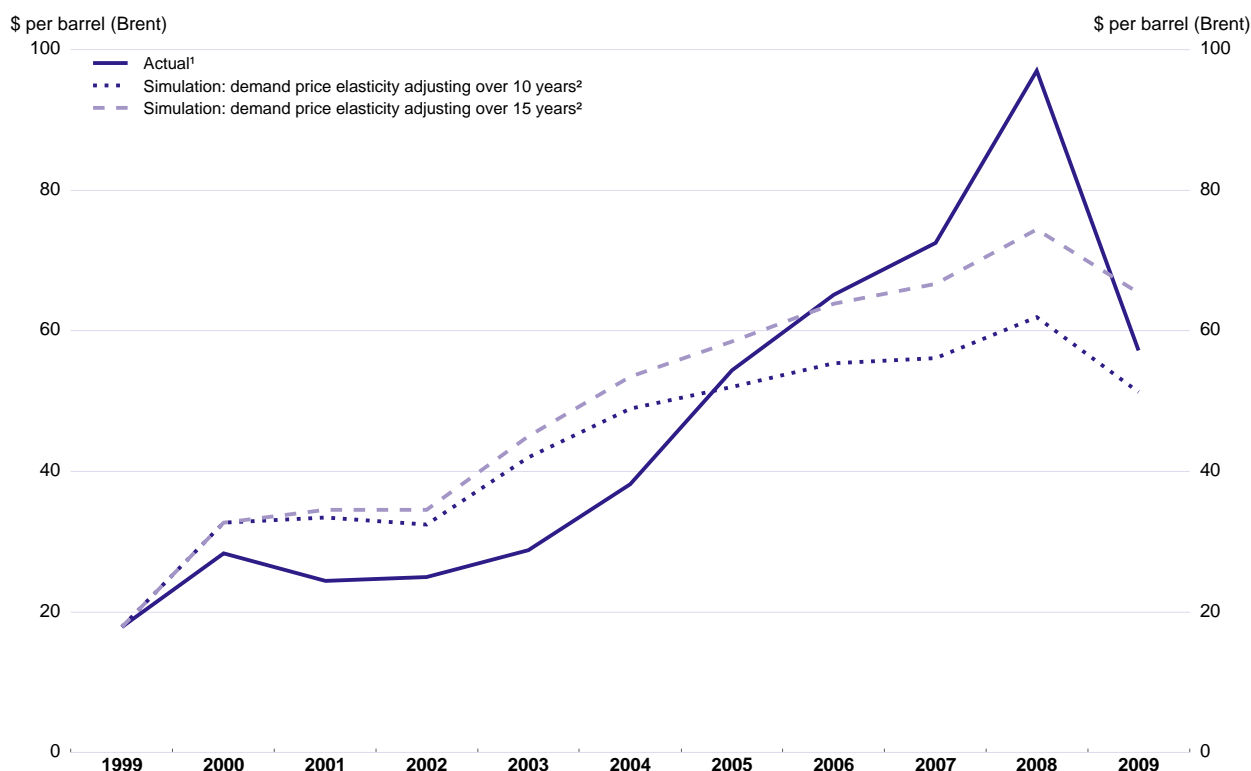
Figure 1. Oil prices have trended up



1. Brent price is back casted with West Texas Intermediate spot price.
2. Deflated by the personal consumption expenditures deflator of the United States (based in 2000).

Source: OECD Economic Outlook 85 database; OECD, Main Economic Indicator Database and IMF, Exchange Rates database.

Figure 2. Oil price: actual and simulated

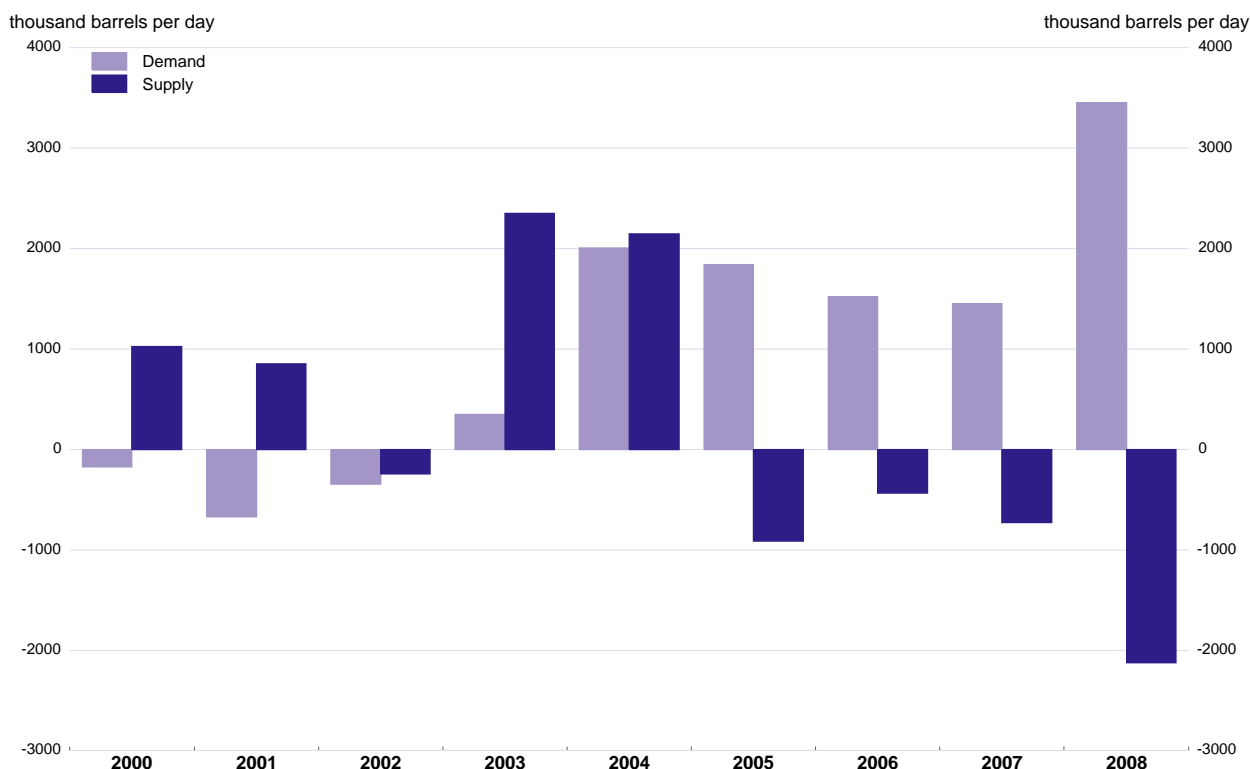


1. The value for 2009 corresponds to the average between January and September 2009.
2. Adjustment from short-term to long-term. Simulation for 2009 based on OECD and IMF growth projections as of Spring 2009; see the Appendix.

Source: IEA, World Energy Outlook 2006; IEA, Monthly Oil Data service; OECD Economic Outlook 85 database; IMF, World Economic Outlook, April 2009; and OECD calculations.

3. It should be noted that price projections, from a model such as this, are subject to large uncertainties due to difficulties in estimating price and income elasticities, shifts in economic structures and a lack of information about relevant variables such as capacity utilisation. For example, oil production decisions and car purchasing decisions (which affect oil consumption) will take many years to react to price movements. However while admittedly the model is simplistic, not least in view of the oligopolistic features of the oil market, it has the advantage of being able to analyse “fundamental” developments in both supply and demand.

4. Looking at year-to-year changes the model’s performance is less impressive. Indeed, price increases are substantially over-predicted through the first years of the decade and under-predicted for the more recent years until the oil price peak in 2008. To better understand what occurred over the past few years, demand and supply were predicted separately, using the ten-year lag version of the model, treating actual prices as given. This analysis suggests that the extent of the run-up in oil prices since 2003 was due to both much stronger than modeled oil demand growth and, from the middle of the decade onward, a weaker than implied oil supply response to rising prices (Figure 3).

Figure 3. Oil demand and supply: actual minus simulated¹

1. Actual minus simulated change in demand and supply, respectively. Predictions of demand and supply are generated by using the model's demand and supply equations, respectively, treating prices and income as given.

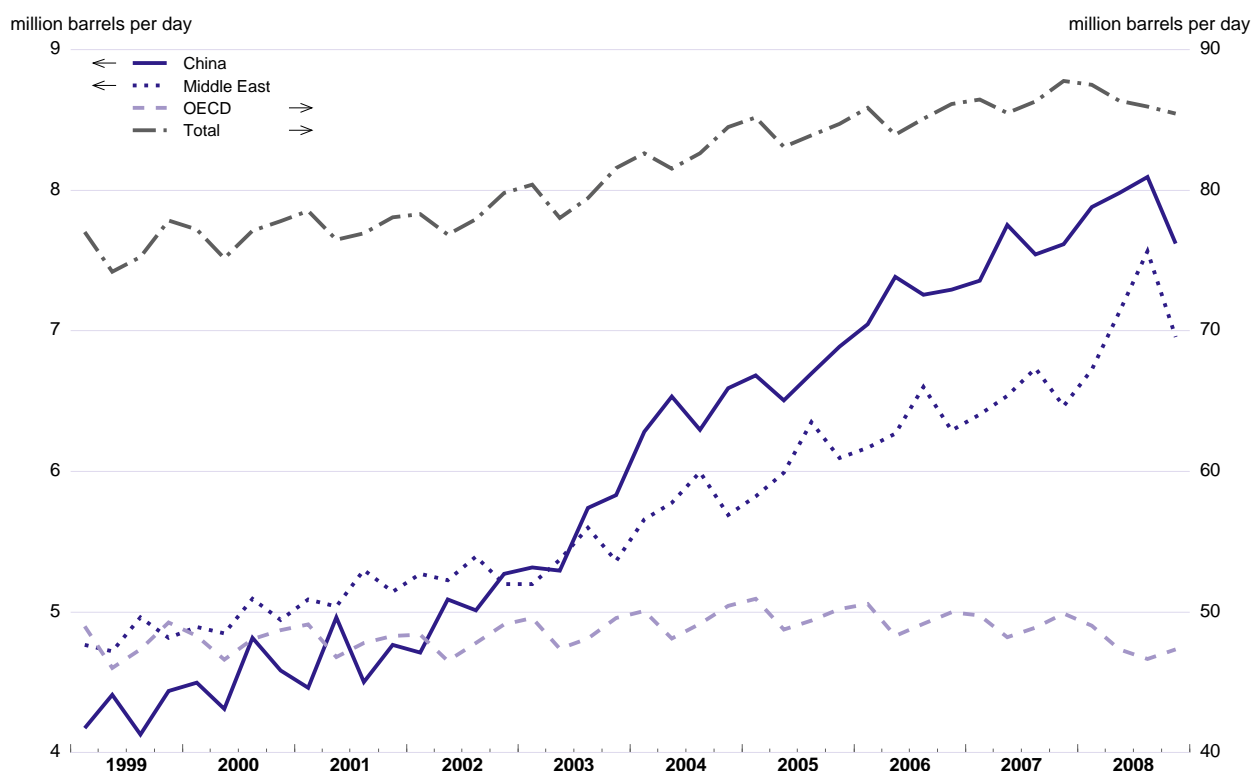
Source: IEA, World Energy Outlook 2006; IEA, Monthly Oil Data service; OECD Economic Outlook 85 database; IMF, World Economic Outlook, April 2009; and OECD calculations.

Global oil demand

5. The acceleration of world oil demand in the first part of the decade was largely driven by buoyant demand from emerging market economies, notably in Asia and the Middle East (Figure 4). China, the second largest oil consumer after the United States, contributed most to the upswing. Accelerating demand in Asian and Middle Eastern emerging markets has been reinforced by the relatively high energy intensity in power generation and industry in these economies as well as by the pervasiveness of capped retail prices that insulate consumers from hikes in world market prices.²

2. In emerging markets, fuel consumption is often subsidised or prices are regulated (as in China), which delays or prevents the pass through of higher crude oil prices to end-users.

Figure 4. Oil demand by region

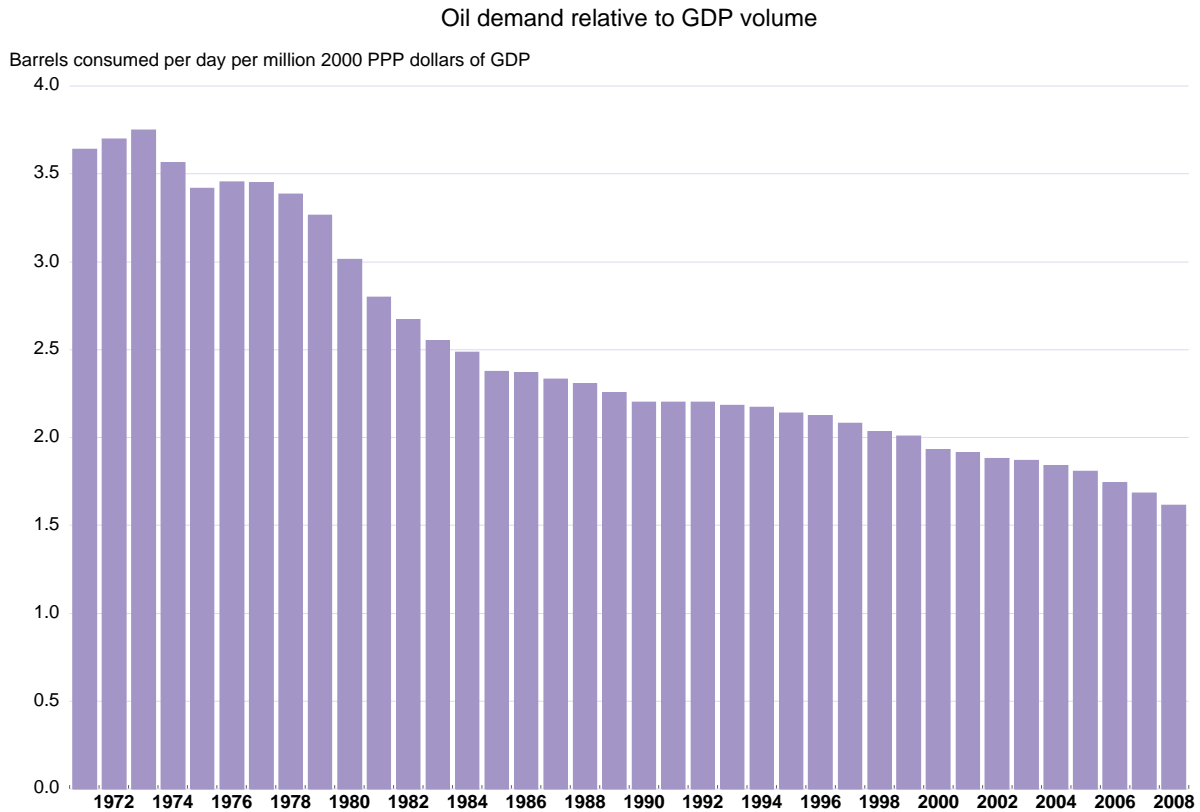


Source: IEA, Monthly Oil Data service.

6. In contrast to emerging markets, demand in the OECD area levelled off in the first half of the decade and even fell over 2006 to 2008. Correspondingly, oil intensity, which has been trending down in the OECD area since the 1970s, has fallen more rapidly in recent years (Figure 5). While mild weather conditions account for part of the demand slackening in the OECD area, the steep price increases witnessed since the early years of the decade also seem to have played a role.³ In particular, inter-fuel substitution has significantly contributed to the weakening in oil demand in the non-transport sector, notably by switching from oil to natural gas in electricity generation. While in the transport sector inter-fuel substitution is more limited, there is some evidence that high oil prices and the slackening of the economy are beginning to influence consumer behaviour with a reduction in discretionary driving and a switch to more efficient vehicles, notably in the United States.

3. Schurr (1983) finds that energy intensity of the US economy declined at a faster speed over the high-oil-price period between 1973 and 1983 than over any other period in the 20th century. For the period 1973-83, Rosenfeld (1990) finds accelerated efficiency gains in the heating and cooling of buildings. Analysis by Popp (2002) indicates a significant positive impact of high energy prices on the number of successful patent applications of energy saving technologies.

Figure 5. Oil intensity in the OECD area



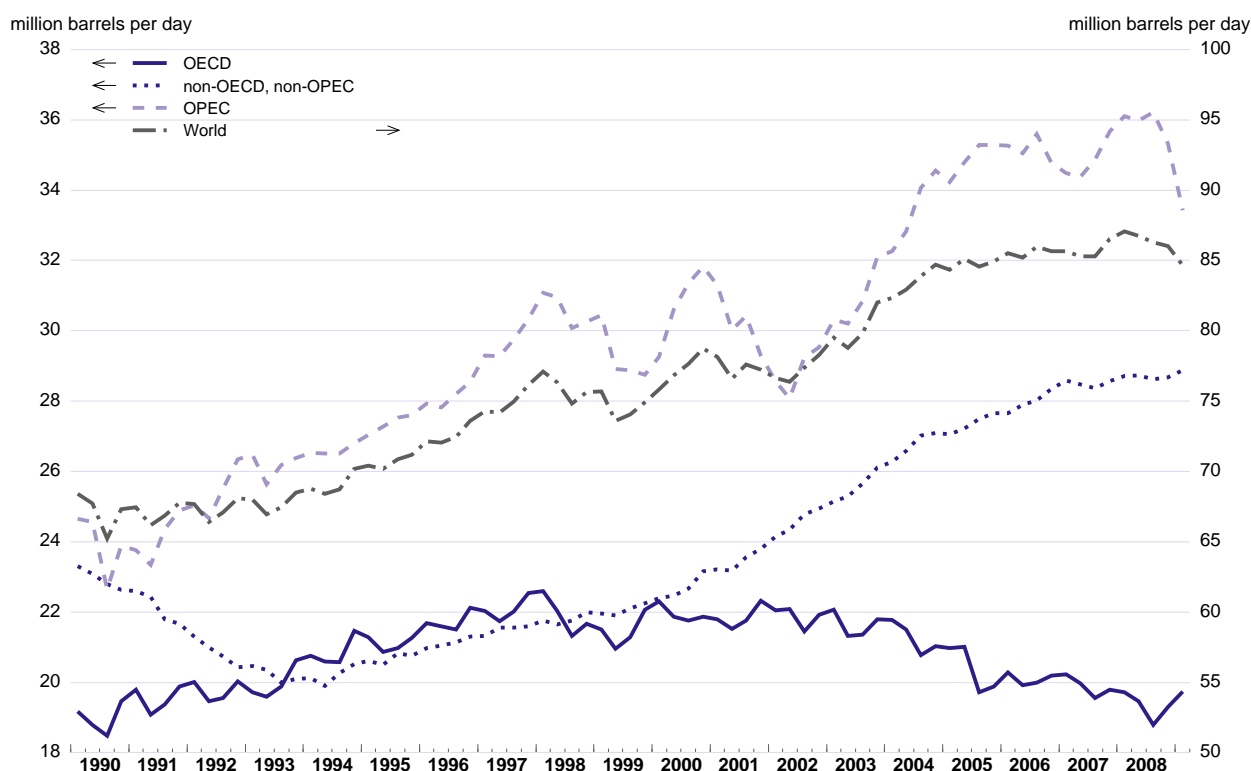
Source: IEA; and OECD Economic Outlook 85 database.

Global oil supply

7. While oil supply might have been expected to rise with the very large increase in price, it has been relatively flat after 2004 (Figure 6). There are several reasons. Investment in oil production, which had been relatively subdued in the OECD area when oil prices were low during the 1990s, was slow to resume when prices rose. The time lags between investment decisions and new production coming on stream are long, ranging between seven and ten years or even more, while the production from many conventional oil fields outside OPEC is declining. At the same time, project deadlines have been missed and budgets inflated beyond original estimates by an endemic shortage of qualified labour as well as drilling and engineering capacity, coupled with high costs for raw materials.⁴

4. See IEA (2008).

Figure 6. Oil supply by region



Source: IEA, Monthly Oil Data Service.

8. Climatic and geopolitical factors have also added to restraining supply, at least temporarily. A series of violent hurricanes severely damaged the US production and refinery infrastructure in autumn 2005, with repairs having extended over several years, and geopolitical tensions have caused production outages in recent years in major oil producing countries, notably Iraq, Nigeria and Venezuela. Cumulative production cuts by OPEC, first announced in November 2006, pushed OPEC crude oil supply in 2007 below the levels of the preceding year. Production cuts were relaxed in early summer 2008, when Saudi Arabia raised crude oil output, briefly before the financial crisis set in.

9. The effective depreciation of the dollar since the beginning of the decade and a long period of relatively low real interest rates are also likely to have contributed to the upward pressure on oil prices.⁵ With crude oil priced in US dollars, depreciation of the dollar reduces *ceteris paribus* the price of oil in other currencies, thereby increasing oil demand. There might also be a substitution by investors in favour of oil and at the expense of dollar denominated assets, as a US dollar depreciation reduces the returns on dollar denominated assets in terms of other currencies. Moreover, as the purchasing power of oil producers' revenues in terms of a currency basket declines with the dollar's depreciation, OPEC, exercising a certain degree of market power, has an incentive to compensate by letting oil prices rise. Lower interest rates tend to stimulate demand, including that of oil, while they make it less profitable for

5. See Breitenfellner and Cuaresma (2009) for a discussion of exchange rate effects on oil prices; see also Akram (2008).

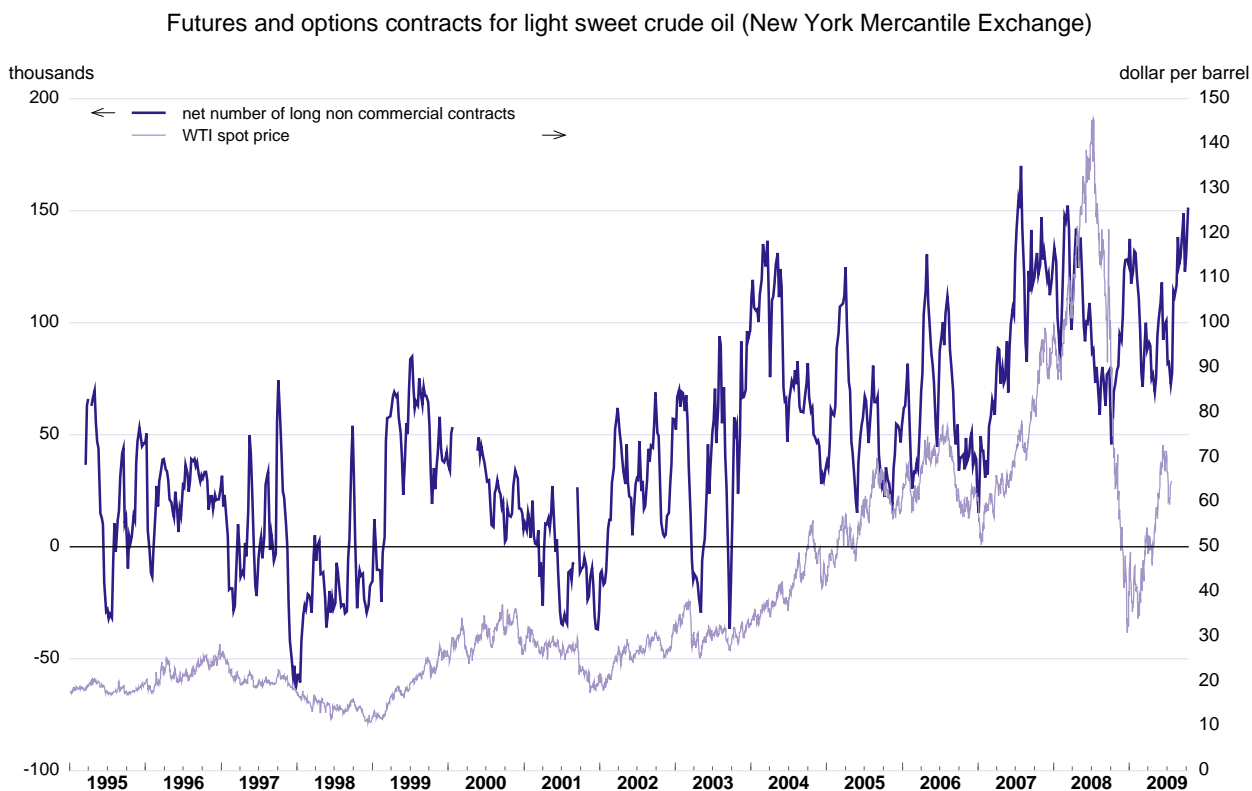
producers to extract oil and invest the proceeds on the bond market. The latter aspect might reduce the supply of oil putting upward pressure on the spot price.

10. The steep decline in oil prices in the second half of 2008 was mainly driven by falling oil demand, reflecting the dramatic downturn in current and prospective global economic activity in the wake of the financial crisis. By contrast, falling oil supply was a major factor behind the rebound in oil prices in the first half of 2009, with OPEC crude oil production in the first quarter of 2009 having recorded the largest quarterly fall in 20 years on the back of tightening OPEC production quotas. In late spring and summer 2009 market sentiment that the slump in economic activity might bottom out soon and stronger Chinese crude oil imports might also have played a role.

What role has speculation been playing?

11. In addition to the fundamentals mentioned above, concerns have been expressed that prices may have been pushed up by speculation. In recent years the number of non-commercial future and options positions in light sweet crude oil on the New York Mercantile Exchange has increased significantly (Figure 7). Between summer 2007 and spring 2008, the net long positions (*i.e.* current purchases for selling) held by non-commercial traders stood around record levels, indicating expectations of further rising oil prices.

Figure 7. Long positions by non commercial market participants



Source: U.S. Commodity Futures Trading Commission; and Datastream.

12. Special conditions would need to be met for speculation to drive spot oil prices. Speculators would have an incentive to build stocks if they expect prices to be higher in the future. In a similar vein, for speculation to be profitable it would be expected that the oil price futures curve would tend to slope upward (a situation referred to as “contango”). However there is no hard evidence of an abnormally high stock build-up during the period of rising prices up to the peak in summer 2008. By mid-2008, total OECD oil stocks stood at around their five-year average (Figure 8, upper panel). Some unobserved inventory build might nevertheless have taken place as data on oil inventories tend to be opaque or scarce for most non-OECD regions.

13. Also, over most of the period of rising spot prices up to mid 2008, futures prices were lower than spot prices (“backwardation”). In particular, this is true for the second half 2007 and the first half 2008 when oil prices nearly doubled within a few quarters (Figure 9). It is also worth noting that certain food commodities, for which organized futures markets do not exist, also experienced steep price increases up to around the middle of 2008, suggesting that economic fundamentals or other factors rather than financial market speculation were the main driver for a number of commodity prices.

14. During the most recent episode of rising crude oil prices, in spring and summer 2009, the futures curve sloped upward, suggesting that markets expected rising prices, and oil stocks were at elevated levels. In August 2009 OECD stocks were 3% above the levels of a year ago, amounting to 61 days in terms of forward demand. Crude oil stocks in China also increased. To a large degree, the rapid increase in oil inventories is likely to reflect the steep decline in oil consumption associated with the collapse of global economic activity witnessed since late 2008. However, the perception might also have been that once economic recovery gains ground re-accelerating oil demand might be confronted with significant supply-side restraint driving up prices. Indeed, the compliance rate of OPEC oil producers with OPEC’s announced supply restraint targets appears high by historical comparison.⁶ Moreover, as discussed in the next section, some fundamental factors appear to support elevated prices in the medium term.

15. Empirical investigations by the US Commodity Futures Trading Commission (CFTC) and others found no clear evidence for a systematic influence of trading in futures markets on oil price movements or price volatility. By contrast, speculative positions seem to follow oil price changes rather than causing them.⁷ However, empirical work on this issue is continuing, and might be accompanied by regulatory initiatives.⁸

16. Overall, while speculation might have played some role in short-term spot price movements, it is unlikely that it drives prices over the longer term above the levels that are determined by fundamental macroeconomic factors. Non-commercial traders (*e.g.* speculators) contribute to the efficiency of oil futures and options markets by providing liquidity. Hence, actions aimed at curbing their participation in these markets would likely incur costs in terms of market efficiency foregone.

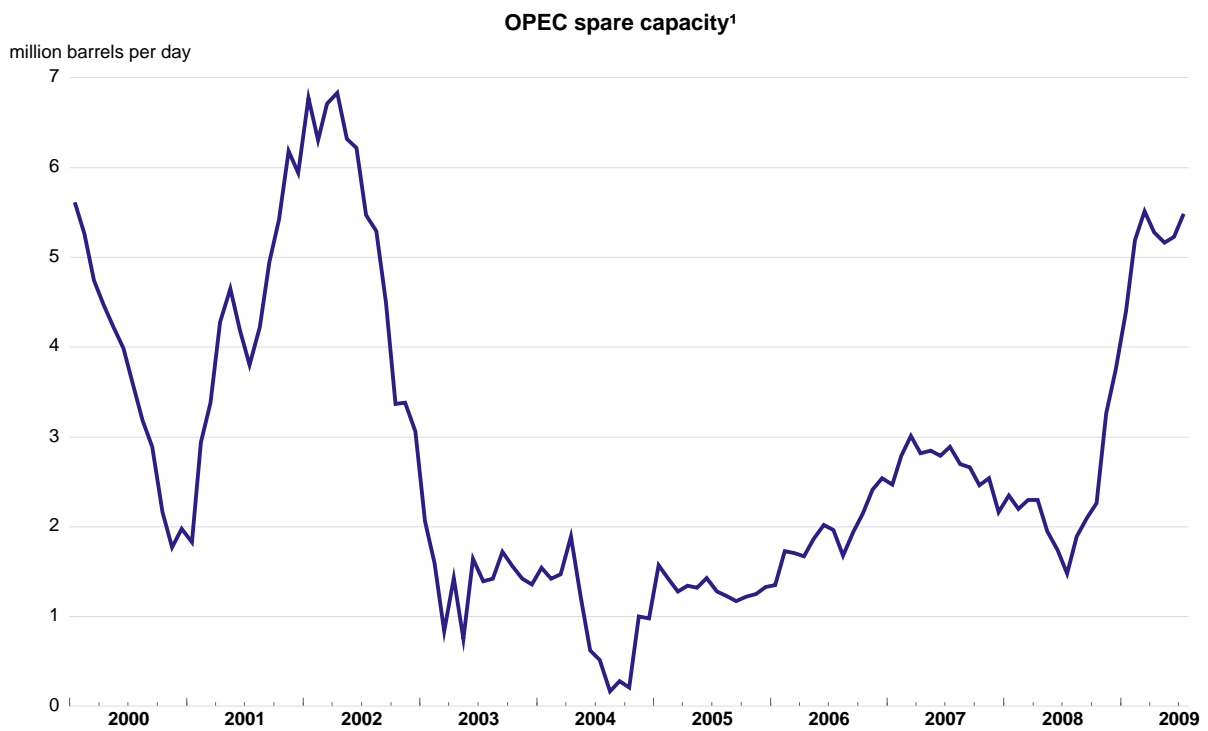
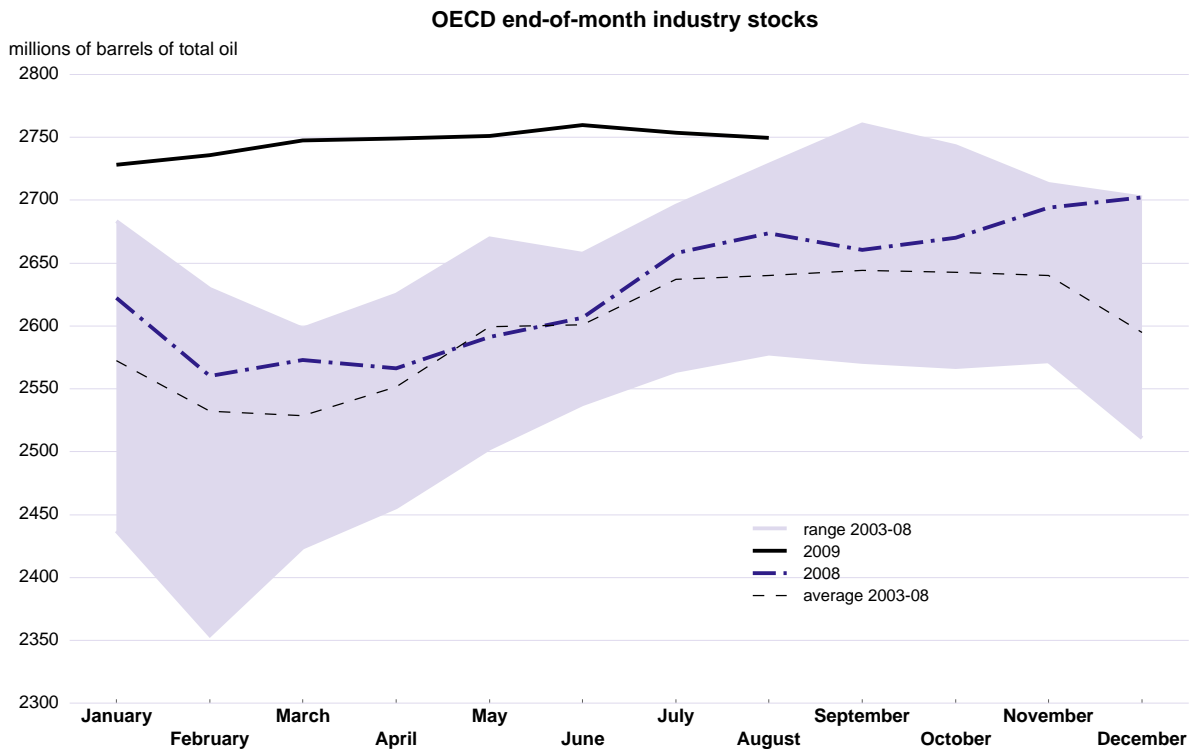
17. Still, inter-temporal considerations might be relevant. For instance, oil producers, notably OPEC, might trade off lower oil production at present -- leaving oil in the ground -- against higher oil production in the future, if they expect buoyant demand and price conditions to continue or, as noted above, if financial market returns are seen to be poor.

6. By March 2009 OPEC’s compliance rate with announced supply targets stood at 83% dropping to 74% in May 2009. See IEA (2009a, b).

7. See: Interagency Task Force on Commodity Markets (2008); IMF (2008).

8. For information on regulatory initiatives see the box “On speculation and regulation” in IEA (2009c).

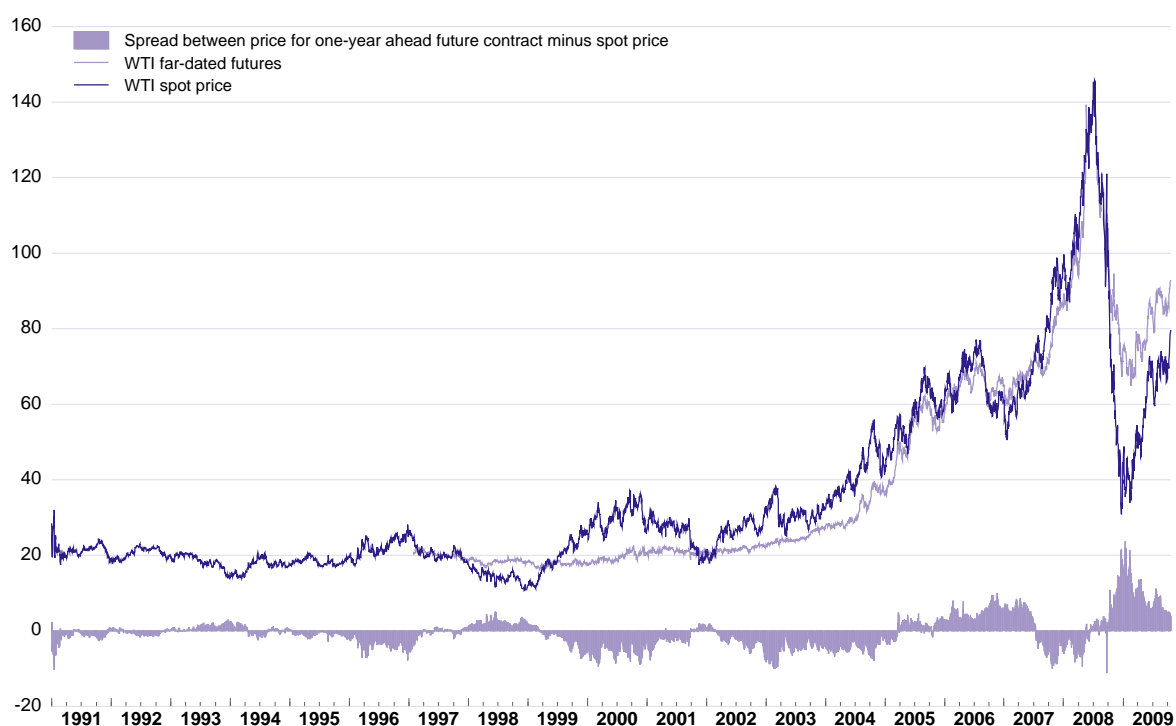
Figure 8. Stocks and spare capacity



1. Spare capacity includes only volumes that can be reached within 30 days and sustained for 90 days.

Source: IEA, Monthly Oil Data Service.

Figure 9. Oil spot and futures prices



Source: Datastream; and OECD calculations.

Will prices fall back to levels seen at the beginning of the decade?

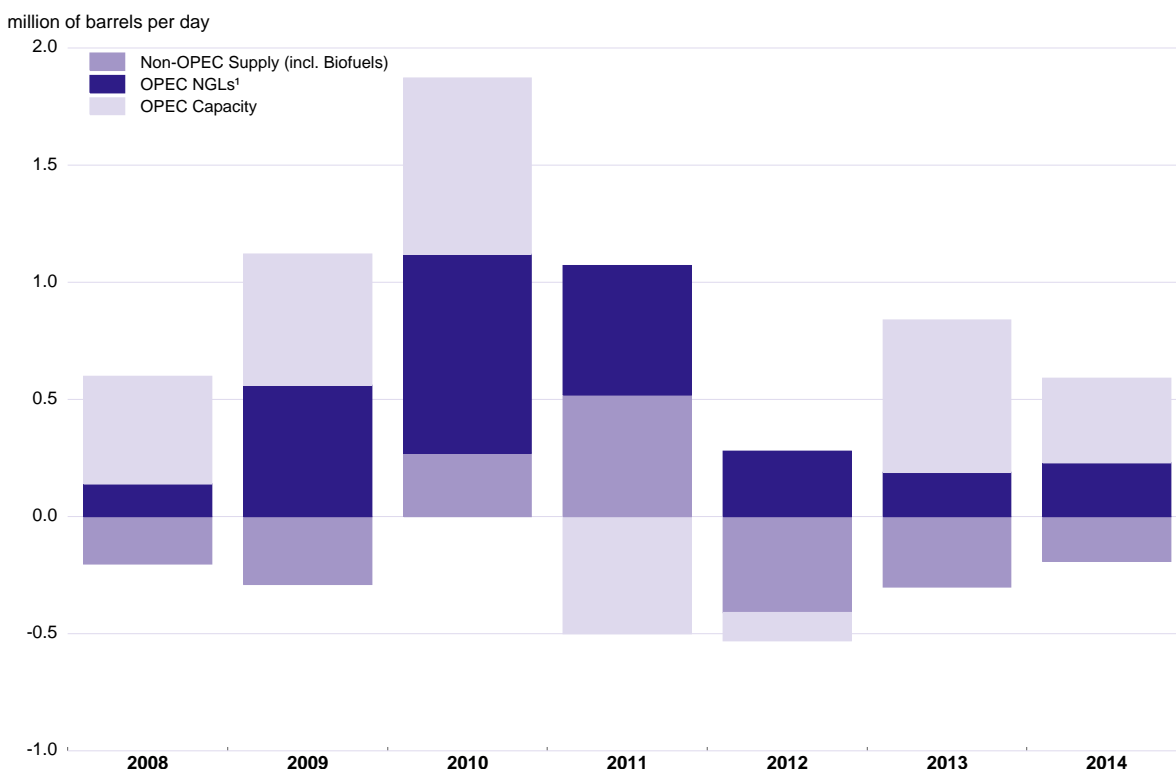
18. Fundamental conditions suggest that over the next quarters oil prices will remain significantly below the high levels witnessed in the recent past, as indicated by the illustrative model considered above. Weak world economic growth should damp oil demand, with relatively high present spare production capacity and oil inventories (Figure 8, lower panel) contributing temporarily to price moderation from the supply side.

19. However, barring macroeconomic surprises, crude prices are unlikely to fall back to levels seen in the first years of the decade either over the short or medium term. Buoyant trend growth in emerging markets, notably in areas where oil price increases are prevented from feeding into domestic energy prices, is likely to limit such price declines. Moreover, OPEC supply restraint is likely to act as a floor to prices above past lows and might put further upward pressure on prices when economic activity recovers from the recession.

20. Further out, strong energy demand growth in emerging markets could be reinforced by both household incomes in these countries rising towards thresholds where consumers are able to buy cars and appliances, and by investment in infrastructure. Potentially providing some offset would be a reduction in these economies' oil intensity, assuming more energy-efficient capital were to be put in place.

21. World oil capacity growth will slow significantly after 2010 (Figure 10). Recent evidence suggests that there have been substantial cut backs in capital spending and project delays as a result of lower oil prices and cash flow in the wake of the present financial crisis.⁹ Estimates of mature field decline rates imply that large additions to new production are needed each year just to hold world supply steady (Figure 11).¹⁰ Recent cuts in spending on existing fields risk pushing up field decline rates further. In addition, regulatory constraints on investment by foreign-owned companies in oil-rich countries have become increasingly more restrictive in the recent past, hampering the instalment of new production capacity in the medium term. This implies that future supplies of oil will have to rely more on non-conventional sources, such as deep water fields and oil sands, which are more costly to exploit than conventional fields.

Figure 10. World oil supply capacity growth

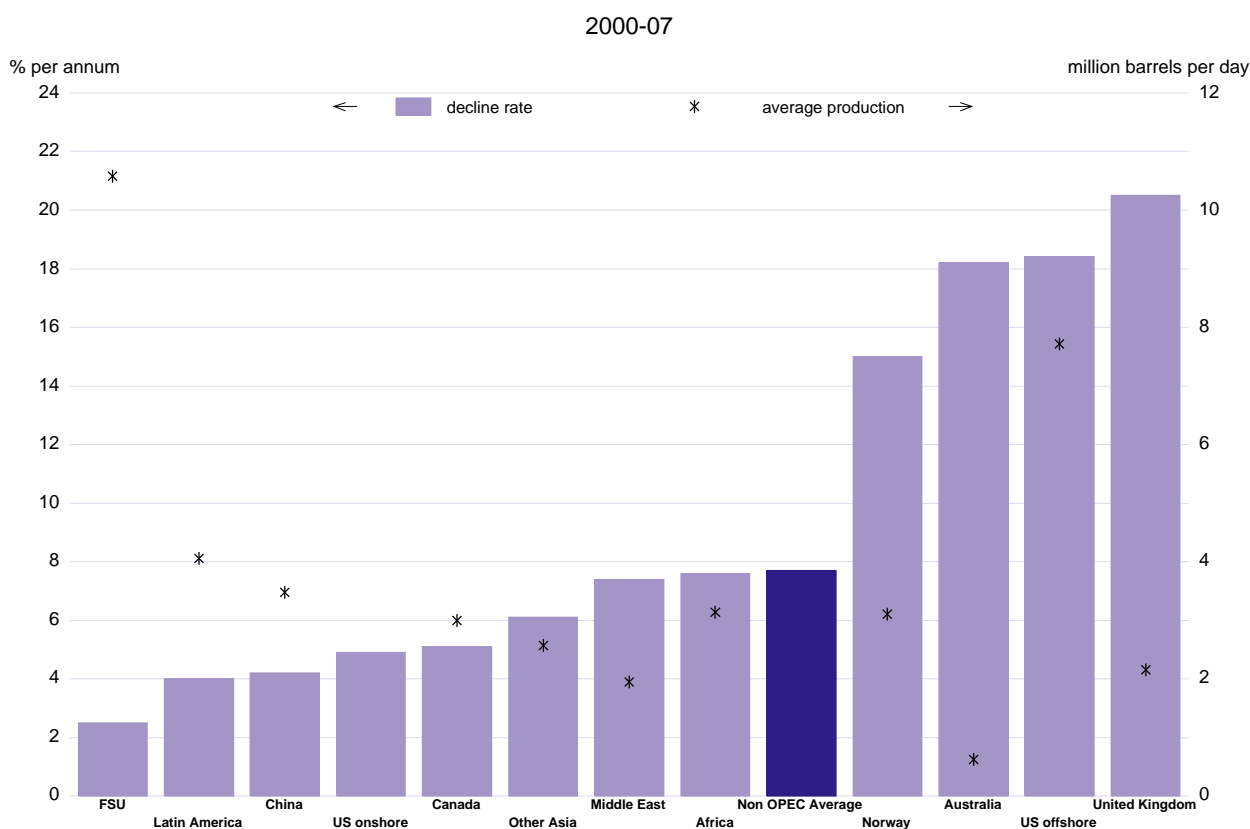


1. NGLs stands for natural gas liquids.

Source: IEA, Medium-Term Oil Market Report, 2009.

9. See IEA (2008) for an assessment of project delays prior to the financial crisis, and IEA (2009d) for the impact of the crisis on capital spending and project delays.

10. According to IEA estimates 3.5 million barrels per day of new production per year are needed to hold world oil supply constant (IEA, 2008). By comparison, since 2005 net annual additions to oil supply totalled 0.8 mb/d on average.

Figure 11. Observed average non-OPEC output decline rates¹

1. Included are mature oil and condensate fields showing sustained yearly output decline over periods of at least 12 to 18 months.

Note: the asterisks show average production over the period 2000-07. For the United States, this is offshore and onshore combined production.

Source: IEA, Medium-Term Oil Market Report, 2008.

22. Overall, there is a risk that in the medium term these factors combined may lead to another surge in oil prices to high levels in order for demand and supply to be matched.

What are the effects on the economy?

Exports and global payments imbalances

23. Increased external demand of oil exporters, boosted by high revenues, has become a significant force behind the growth of OECD area exports. Since 2002, exports of merchandised goods by the OECD area to the major oil exporters (here OPEC, Russia and Norway) have increased by some 230% in value terms (Figure 12, top panel). Of the OECD areas' additional payments for oil imports (accumulated between 2002 and 2008) about 40% has returned in the form of additional exports to these oil producers. This average figure, however, masks considerable differences in the strength of responding across countries, with Germany (at the high end) almost in balance between what it spent on oil compared to

what it gained in exports, while the United States and Japan experienced much smaller responding rates (Figure 12, middle panel).¹¹

24. Based on regression analysis, oil producers' responding behaviour on OECD area goods and services, after the large oil price rise, did not differ significantly from average responding patterns observed in the past.¹² Regarding the timing of responding, the largest part of the increase in oil exporters' demand for OECD area goods and services tends to materialise within the first year after a revenue hike (Figure 12, bottom panel).¹³

25. Nevertheless, oil producers have been running current account surpluses and their excess funds have been feeding into OECD financial markets, adding to upward pressure on asset valuations and contributing to holding bond yields low.¹⁴ This situation has been quite different from the 1970s where the oil price shocks led to higher inflation expectations and increased bond yields which tended to overwhelm any recycling effects on real activity. Higher credibility of monetary policy in comparison to the 1970s has contributed to this result.

26. Revenues by oil exporters have also contributed to finance the steep increase in the US current account deficit witnessed since the beginning of the decade until the economic slowdown in the wake of the financial crisis – the deficit increase itself partly reflecting higher oil imports. Oil producers' current account surpluses matched more than 90% of the US external deficit (2008). Asian economies, particularly China, have also posted significant current account surpluses, which combined are of a similar magnitude to those of the oil producers, likewise contributing to the financing of the US current account deficit (Figure 13).¹⁵ The US dollar remains the dominant currency for official foreign-exchange reserve

11. Despite these lower responding rates, for both countries the percentage increase over the period in exports to oil producers was roughly in line with the OECD average.

12. A regression of the following form was estimated:

$$\Delta \ln(m_t) = \alpha + \sum_{i=1}^{12} \beta_i \Delta \ln(m_{t-i}) + \delta \Delta \ln(x_t) + \gamma (\ln(m_{t-1}) - \ln(x_{t-1})) + \varepsilon_t$$

where m is oil producers' imports from the OECD and x are producers' exports to the OECD. The equation includes the first to twelfth lags of imports as the twelfth lag is significant. Using monthly data from 1993 to 2009, and testing whether a structural break occurred somewhere between July 1996 and December 2006, there was no statistical evidence of a structural break.

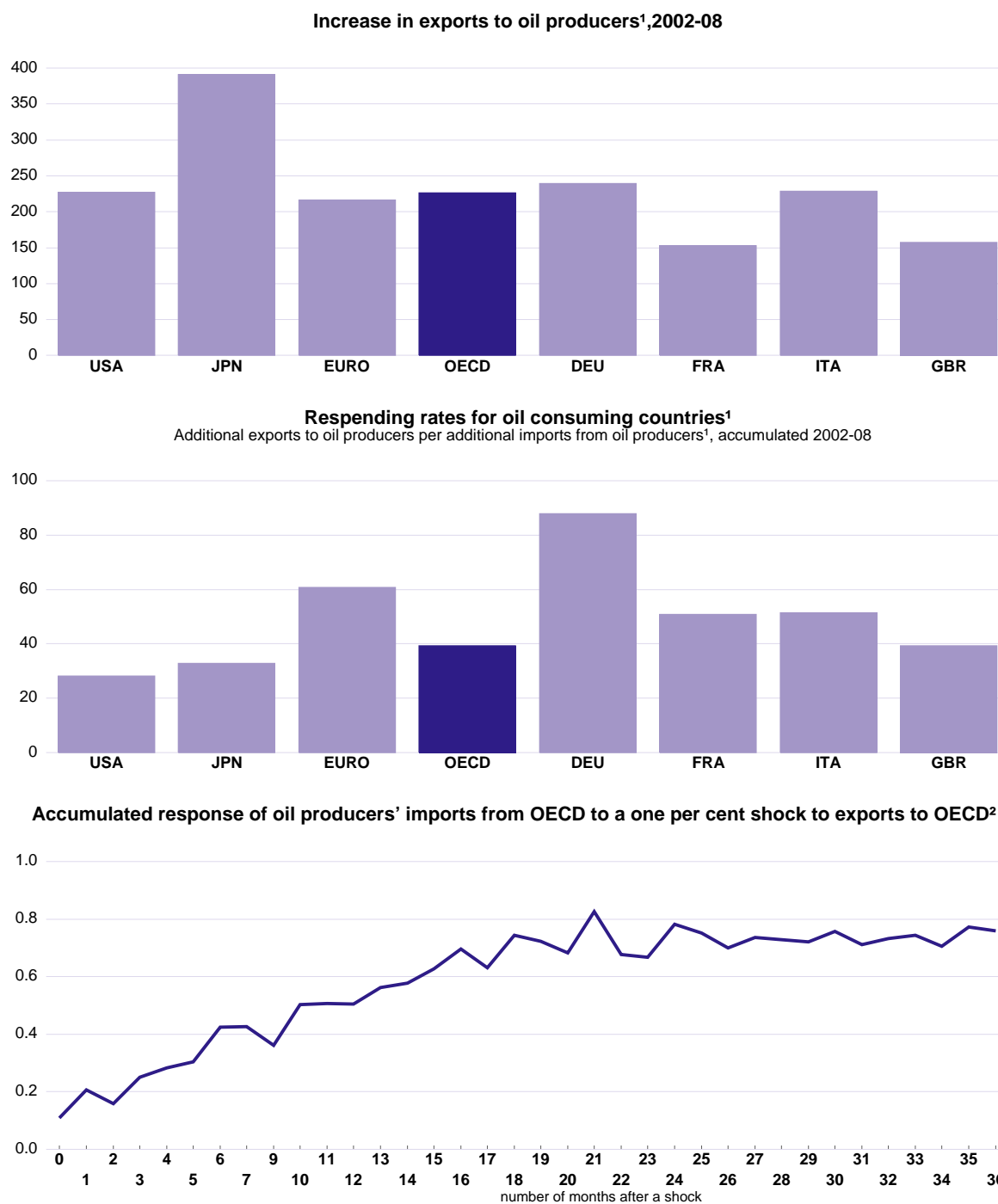
13. A bivariate VAR with 24 lags was estimated using monthly growth rates of oil producers' merchandise exports to and imports from the OECD from 1993 to mid-2008, roughly the end of the large run up in oil prices. So for imports

$$M_t = \alpha + \sum_{i=1}^{24} \beta_i M_{t-i} + \sum_{i=1}^{24} \delta_i X_{t-i} + \varepsilon_t$$

where M is the monthly growth rate of imports and X is the monthly growth rate of exports. A similar equation was estimated for exports. Broadly similar results were obtained using somewhat shorter lag lengths or including seasonal dummies, though models with shorter lag lengths showed greater signs of serial correlation problems in the residuals.

14. See OECD (2007) and Ahrend *et al.* (2006).

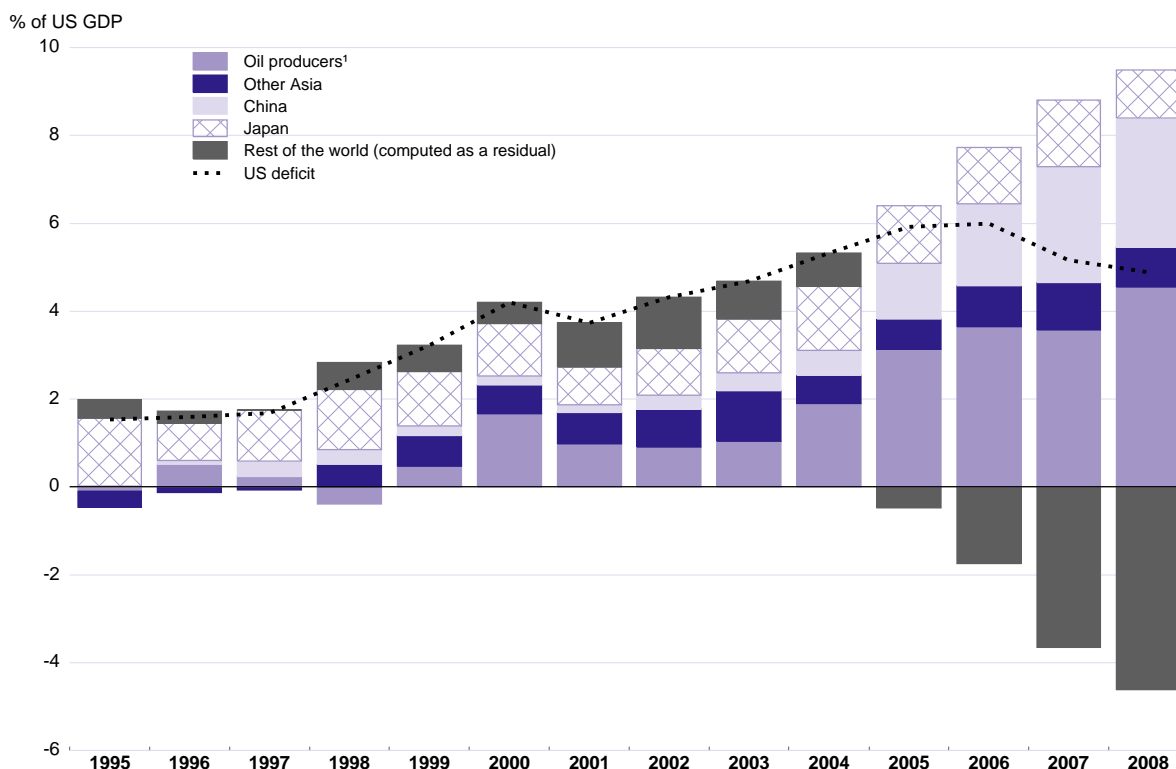
15. In 2008 the US current account deficit totalled about 5% of US GDP with the deficit in the trade balance for petroleum products accounting for roughly 3% of GDP.

Figure 12. Trade with oil producers in the period of rising oil prices

1. Oil producers: OPEC, Russia and Norway. Exports in value terms.

2. See footnote 13.

Source: OECD, Monthly Statistics of International Trade; and OECD calculations.

Figure 13. US current account deficit and its global counterparts

1. Oil producers: OPEC, Russia and Norway.

Source: OECD Economic Outlook 85 database; and OPEC, Annual Statistical Bulletin, 2008.

accumulation of oil producers, although some surplus countries have started to accumulate more of their exchange reserves in other currencies. Recently, investment by Sovereign Wealth Funds in the Middle East (whose funds are not accounted as official exchange reserves) have contributed to the recapitalisation of US banks that had been hit by financial turmoil.¹⁶

Inflation and activity

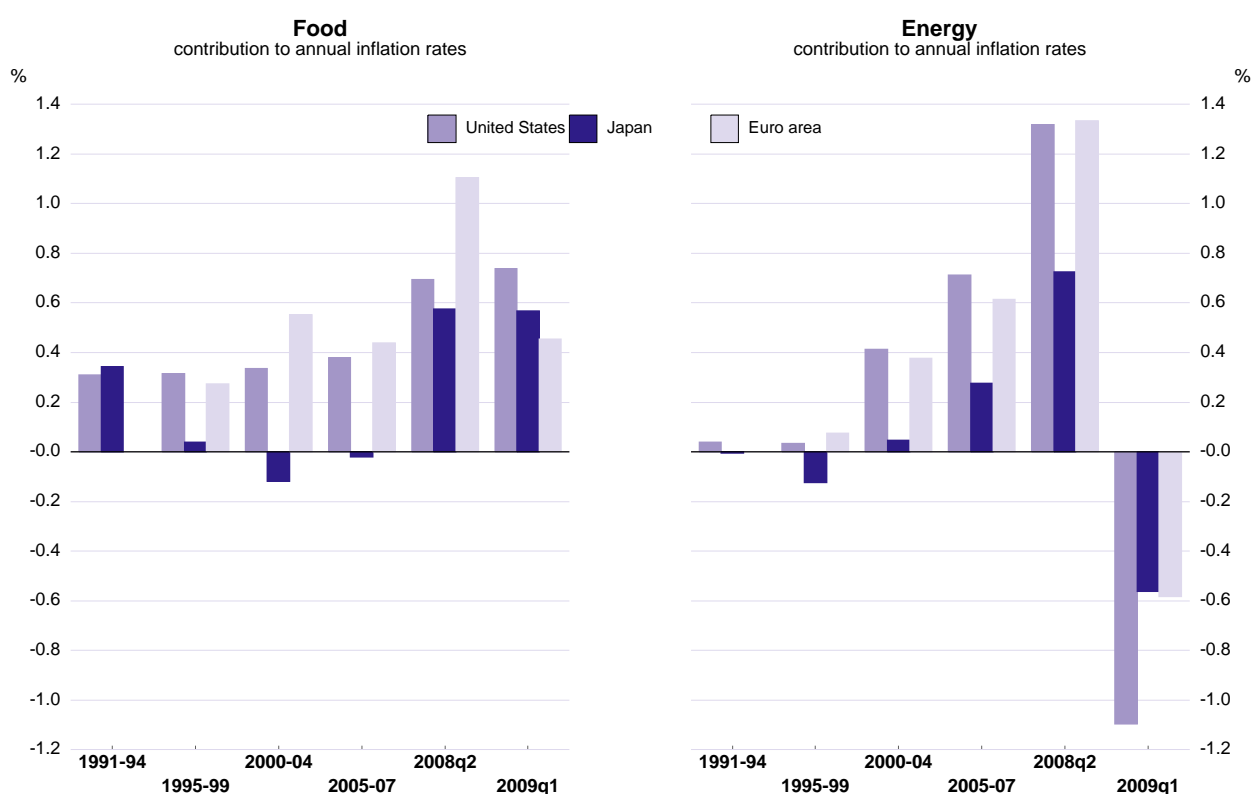
27. Rising oil prices put upward pressure on inflation through a number of channels. First of all, they drive up other fuel prices. This is notably the case for natural gas, as many power stations can switch between the two types of fuels in response to relative cost changes. Also, in several countries the price for natural gas is indexed to the oil price. Rising energy prices, in turn, put upward pressure on other commodity prices, like food, the production of which is generally energy intensive. In the second quarter

16. Available information indicates that the bulk of non-official financial flows into the United States originates in industrialised countries as opposed to emerging market economies. Also, despite elevated oil prices, non-official financial flows from oil exporters to the United States appear to be relatively low. However, for the oil exporters' financial investments to contribute to the financing of the US current account deficit, it is not necessary that direct flows to the United States take place. Rather, financing is indirect as the oil exporters' external surplus increases the global pool of funds that is available for investment in the United States.

of 2008, the impact effect of rising energy prices alone amounted to around a 1.3 percentage point increase in consumer price inflation in the United States and the euro area (Figure 14). But there were also second round effects; statistical measures of core or underlying inflation, such as trimmed means, which are designed to strip out impact effects, show that underlying inflationary pressures were increasing in most large OECD countries prior to the disinflationary effects of the present economic crisis. Since then, falls in prices for energy and food have been the main drivers of the marked deceleration in headline inflation in the second half of 2008 and into 2009.

28. Regarding real activity, there are a number of effects operating. Initially, deteriorating terms of trade associated with rising oil prices weigh on output in oil importing countries by reducing household purchasing power. While the deteriorating terms of trade transfer purchasing power to oil producers, they respond and recycle those funds, as noted above, and this helps to support activity. Based on the OECD's Global Model, which takes account of these various factors, a 10% increase in the price of oil could slow growth in the OECD area in the second year of the shock by two tenths of a percentage point, while inflation is pushed up by roughly two tenths of a percentage point in the first and another tenth in the second year.¹⁷

Figure 14. Energy and food prices and inflation



Source: Bureau of Economic Analysis; Eurostat; OECD, Main Economic Indicator database; and OECD Economic Outlook 85 database.

17. On the OECD's new model see "The Structure of the OECD's New Global Model", Appendix in Hervé *et al.* (2007). The simulations assume that non-OECD producers respond two-thirds of their additional revenues within two years and that exchange rates are fixed. Nominal short-term interest rates are held unchanged at the low levels prevailing in autumn 2009. Earlier simulations, made prior to the financial crisis, with the monetary authorities assumed to follow a Taylor rule yielded similar results.

29. However, these results might be subject to other factors that depend on economic conditions. For example, the normal offset from household saving to a fall in real income might be hampered if credit conditions are tight. Also, a sustained rise in energy prices (as well as food and other commodity prices) might provoke a larger inflationary response if labour markets in many countries are relatively tight. Moreover there are other channels by which oil price behaviour could affect real activity. In particular, increased oil price volatility might raise uncertainty about future oil prices causing delays in business investment reducing growth.¹⁸ In a similar vein, oil price changes might induce costly resource reallocations.

30. Over and above temporary effects, a sustained hike in real energy prices has a negative impact on potential output. At a basic level, a higher relative price of energy means greater intensity in the use of other inputs (labour and capital) which are available only in fixed or near-fixed supply, implying a fall in productive potential. As an illustration, the massive move in the real cost of oil in the second quarter of 2008 relative to its 20-year average could, if it were sustained, cut as much as 4% off steady-state potential output in the United States and 2% in the euro area in the long run.¹⁹ The difference arises because in the United States the share of oil and natural gas in production is about 50% larger than in the euro area and the oil price shock has been larger in the United States because of the weakening of the dollar. Adverse effects of high oil price volatility on fixed capital formation, which are not taken into account in the above, could also reduce potential output.

How should economic policy respond?

31. Many OECD countries have, over the last few decades, raised specific taxes on gasoline. While this increases the price of energy, it has also acted to reduce oil dependence, in part by encouraging the use of other energy sources. Policies that reduce oil intensity help, *ceteris paribus*, to buffer the adverse impact of a rise in the oil price on economic activity. At the same time, they limit the additional demand for oil in response to rising incomes, thereby diminishing the risk of demand-side induced oil price increases in the future.

32. While it might be considered attractive to smooth end-user prices by adjusting energy taxes downwards when crude oil prices rise -- as has been practiced by several European countries in response to episodes of rising prices -- such a policy is not without problems. *First*, it is very difficult *ex ante* to determine whether a change in the oil price is a temporary shock or a more permanent response to changes in market fundamentals. The recent episode of rising oil prices, which dates back to the end of the last century, stands as an example. While it largely reflects structural shifts in demand and supply conditions, consecutive price hikes have often been considered to be of short duration. Hence, lowering taxes would run the risk of simply impeding the effect that higher prices have on incentives to switch to alternative energy sources and increase the energy efficiency of the capital stock. Thus, lowering taxes in the end would raise medium-term oil dependence and put upward pressure on fuel prices. *Second*, if many countries adopted such a practice, then the "global" effect would be to reduce the price elasticity of demand, giving oil producers an incentive to cut supply or raise prices further. *Third*, the effectiveness of tax policy as a means of smoothing oil price movements may be compromised if tax reductions become permanent due to political economy considerations.

33. In emerging markets and developing countries, subsidies for fuel consumption are mainly motivated by social concerns, sometimes intended to serve as a substitute for income redistribution *via*

18. See Guo and Kliesen (2005) and Hamilton (2003).

19. See OECD (2008). The methodology is presented in greater detail in Cournède (2009).

social security systems, which are often underdeveloped. However, fuel subsidies tend to be poorly targeted and might turn out to be fiscally unsustainable in episodes of prolonged energy price increases. Indeed, rising budgetary costs recently led several governments in emerging market economies to increase price caps for fuel. A better response would be to address redistribution goals by improving or developing social security systems.

34. To the extent that the effect of oil price shocks on inflation is transitory and inflation expectations are well anchored, oil price hikes do not pose major problems for monetary policy makers. In determining whether or not this is the case, core inflation is typically regarded as a better measure of underlying inflationary pressures than headline inflation. However, with this decade's episode of rising oil prices largely driven by structural factors, upward pressure on the oil price has turned out to be quite persistent until the arrival of the economic slump and, as already noted, core measures (notably statistical ones) had been moving up, most prominently in the euro area. In response, and in conjunction with steeply rising food prices, short-term inflation expectations had also risen markedly in most large OECD economies. This illustrates the risk that in episodes of persistent oil price increases longer-term inflationary expectations might eventually drift upward as well. The challenge for the monetary authorities is to keep inflationary expectations well anchored and this could at times mean that policy would have to be tightened even if activity were to weaken.

35. Are high oil prices environmentally beneficial? Oil consumption has global negative environmental effects, and while rising oil prices have contributed to the increase in energy efficiency within and outside the OECD area, oil price hikes like those experienced over the past few years can be no substitute for effective environmental policies. Indeed, as highlighted above, the run-up in oil prices has largely been driven by rising oil consumption. In this context, improvements in energy efficiency can be characterised as "second round effects" that only damp the greenhouse gas emissions associated with buoyant energy demand. By contrast, effective environmental policies serve to reduce oil consumption -- and increase energy efficiency -- in the first place. Moreover, isolated oil price hikes induce inter-fuel substitutions in favour of other fuels that are also associated with high greenhouse gas emissions such as coal.²⁰ Hence, what is needed are time-consistent environmental policies that are comprehensive with respect to the main fuels, emitters and sectors and minimise the economic costs involved in reducing greenhouse gas emissions.

20 . See IEA (2007) and Duval (2008).

**APPENDIX:
A STYLISTED MODEL FOR OIL PRICES**

36. The stylised model is similar to the approach adopted in the baseline scenario of Brook *et al.* (2004). Oil demand of region *c* for the ten-year adjustment model is calculated using:

$$D_{c,t} = D_{c,1999} \left(1 + e_{Y,c} \left(\frac{Y_{c,t}}{Y_{c,1999}} - 1 \right) \right) \left(1 + e_{ST,c} \left(\frac{P_t}{P_{1999}} - 1 \right) + \frac{1}{8} (e_{LT,c} - e_{ST,c}) \left(\sum_{s=t-9}^{t-1} \left(\frac{P_s}{P_{1999}} - 1 \right) \right) \right) \frac{N_{c,t}}{N_{c,1999}}$$

where *c* and *t* are region and year identifiers, for *t* = 1999, ..., 2009; *Y* is a regional measure of real income *per capita*; *P* is the real price deflated by the US private consumption deflator; *N* is the population, *e_Y* is the income elasticity; *e_{ST}* is the short-term price elasticity; and *e_{LT}* is the long term price elasticity (and *P_s* is assumed equal to *P₁₉₉₉* for *s* before 1999). IEA (2006) estimates of the short-term and long-term price and long-term income *per capita* demand elasticities are used (table below). Data is based on IMF (2009a) for non-OECD (excluding China) GDP, OECD *Economic Outlook 85* for OECD and Chinese GDP and the US consumption deflator and IMF (2009b) for population. The forecasts for GDP are based on *Economic Outlook 85* projections for the OECD and China GDP and the US consumption deflator and IMF (2009a) forecasts for other economies' GDP. It is assumed the population grows at the same rate over 2008 and 2009 as in 2007 (or most recent available data). Total oil demand is computed by aggregating over nine regions covering the world, using the proxy measures of population and GDP from the above sources. For the 15 year model, an analogous equation is used with demand being influenced by prices as long as 14 (rather than nine) years earlier.

Table A.1. Demand elasticities of oil demand *per capita* by region

| | Price elasticity | | Income elasticity |
|--------------------|------------------|-----------|-------------------|
| | Short term | Long term | |
| OECD North America | -0.02 | -0.12 | 0.22 |
| OECD Europe | -0.03 | -0.11 | 0.49 |
| OECD Pacific | -0.05 | -0.25 | 0.39 |
| Developing Asia | -0.03 | -0.21 | 0.73 |
| Middle East | -0.01 | -0.07 | 0.67 |
| Latin America | -0.03 | -0.28 | 0.94 |
| Africa | -0.01 | -0.01 | 0.33 |

Note: The Developing Asia elasticities are used for both China and the rest of Asia and the OECD Europe elasticities are used for both OECD Europe and non-OECD Europe.

Source: IEA 2006.

37. On the supply side, it is assumed that the uniform supply real price elasticity is 0.04 (the short-term elasticity applied in Brook *et al.*, 2004). Supply is given by $S_t = S_{1999} (1 + e_{S,p}(P_t/P_{1999} - 1))$. The

oil price is set such that each year world demand plus changes in stocks and miscellaneous balancing items (which are assumed to be exogenous) equal supply. While actual changes in stocks data are used to 2008 (demand, supply and stocks data come from the IEA), for the assessment over 2009 it is assumed that the change in stocks will equal zero after the first quarter 2009. Given that before 2000 the oil price fluctuated for a decade or more around a reasonably steady mean, demand and supply might be considered as having reached a stationary state at the beginning of the episode considered in the main text.

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